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Examining Effects of Oil Price Shocks on Investment Behavior in Pakistan

by

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Examining Effects of Oil Price Shocks on Investment Behavior in Pakistan

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This thesis is dedicated to my parents and friends

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This is to certify that the research work presented in the thesis, entitled "**Examining Effects of Oil Price Shocks on Investment Behavior in Pakistan**" was conducted under the supervision of **Dr. Muhammad Ramzan Akhtar**. No part of this thesis has been submitted anywhere else for any other degree. This thesis is submitted to the **Department of Management Sciences, Capital University of Science and Technology** in partial fulfillment of the requirements for the degree of Doctor in Philosophy in the field of **Management Sciences.** The open defence of the thesis was conducted on **July 01, 2019.**

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List of Publications

It is certified that following publication(s) have been made out of the research work that has been carried out for this thesis:-

1. Khan, M., Tariq, Akhtar. M.. R., (2018). *Oil Price Shocks and its Implications for Stock Market in Pakistan.* Journal of Managerial Science, Volume XII, Number 01, pp. 21-36.

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Abstract

This study addresses the limitations of the previous studies and contributes to the literature through developing theoretical knowledge and examining the empirical framework on the consequences of the oil price uncertainty for the investment in financial and real assets. The study uses structural VAR to identify the oil supply, aggregate demand and oil specific demand shocks and to estimates, the impact of these identified shocks on the performance of stock market in Pakistan is analyzed. The results of impulse response functions and variance decomposition analysis confirm the significant role of oil supply shocks and aggregate demand shocks on the stock market whereas, oil specific demand shocks exert little influence on the changes in the stock market prices. Findings suggest that the impact of oil prices shocks is not the same; it differs and depends upon the underlying oil price shock.

This study further investigates using System GMM model how the corporate investment decisions in Pakistans developing and in a regulated oil price environment respond to international oil price uncertainty. The findings of this study reveal that international oil price uncertainty significantly affects the corporate investment decisions and also finds evidence in favour of compound options theory application in Pakistan. However, contrary to the existing studies, our findings imply that although the impacts of oil prices uncertainty in normal course are positive, corporate investment significantly decreases when the uncertainty increases at the exponential rate. These findings are in contrast with those found in US by (Henrique & Sadorsky, 2011). This difference is due to different economic conditions and structures of Pakistani and US economy.

In the decomposed oil price shocks and corporate investment phase, investigates the impacts of uncertainty of identified underlying oil price shocks on the corporate investment decisions by using GMM. Results show the positive effects of world oil supply uncertainty, whereas world oil demand and oil specific demand measures have significant negative effects on the corporate investment. These findings suggest that the impact of oil prices shocks on the corporate investment decisions is also not the same; it differs and depends upon the underlying oil price shock. Further findings from the analysis confirm the presence of both waiting options and the growth options in line with the empirical findings by (Henrique & Sadorsky, 2011). Finally finding from the oil intensity analysis suggest that in Pakistan volatility of different underlying oil price shocks affect significantly the corporate investment decisions in Pakistan for both the oil intensive and less oil intensive industries and there is not much difference between them. Results regarding the factor of size suggest that small firms are better in coping with the world oil supply side shock of oil price uncertainty, whereas the large size firms are better able to handle with the oil specific demand side shock of oil prices. Therefore effects of oil price shocks on investment is not the same for the large and small size firms and differ depending upon the underlying shock of oil price uncertainty also.

Findings imply that, the policy-making authorities, investors and managers must take care of the source of oil shocks, the difference, nature and intensity of effects according to their country environment before making the policies and decision about the investment plans.

Key words: Structural oil-price shocks, Real stock price, Real options, Corporate investment, Developing countries, Regulated oil price

JEL Classification Numbers: C32, G31, Q41, Q43.

Contents

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Abbreviations

AR	Auto Regressive
CF	Cash Flows
FOB	Free on Board
GARCH	Generalized Autoregressive Conditional Heteroskedasticity
GMM	Generalized Method of Moments
I	Investment
K	Total Assets
KSE	Karachi Stock Exchange
MPNR	Ministry of Petroleum and Natural Resources
OGRA	Oil and Gas Regulatory Authority
OLS	Ordinary least squares
OSD	Oil Specific Demand
Q	Tobin Q
REA	Global Real Economic Activity
ROP	Real Oil Price
SD	Standard Deviation
VAR	Vector Autoregressive
WOP	World Oil Production

Chapter 1

Introduction

1.1 Introduction and Background of the Study

Generally, most of developing countries are experiencing multifarious economic problems like high level of poverty, unemployment and macroeconomic imbalances. In order to cope with these problems accelerated and sustained investment and economic growth are necessarily required. In this context, efforts of expansion in investment and economic growth are seriously constrained mainly by the shortage of oil and energy resources. Oil being a major source of energy, significantly affects the economy. Its sustained and stable level of supply is essential for sustained growth in developing countries. The changes in price level of this important input affects the decision making behavior of consumers, investors and policy makers. Although all economic agents are affected by the changes in the level of oil prices, the case of investors is important. In general these countries are net importers of oil from the international market.

Oil price shock is a surprising change in the price of oil and is defined by Baumeister & Kilian (2016) as the difference between the realized and the expected oil prices. It is also defined as percent change in the real oil price by (Park & Ratti, 2008). On the other side oil price uncertainty is the chance of change in the price of oil expected in future time periods. It contains speculation of future changes in oil prices. Figure 1.1. and Figure 1.2. below show the graphic presentation of oil price history and oil price shocks from the year 2000-2016. Frequently rising oil prices increases cost of production and consequently reduces the profits of corporations. It also reduces customer demand as rise in oil prices leads to rise in inflation, resultantly this leaves less disposable amount available to customers for spending.

From the theoretical point of view different channels of affects of oil price changes on the investment in financial and real assets has been reported by the previous literature. Edelstein and Kilian (2007) point out that there are two channels by which energy price can affect firm investments. First, an increase in energy price drives up the marginal cost of production, as energy is an important input cost in the whole production cycle; even though some firms may not directly consume energy, such as crude oil, as part of the production process, they do nevertheless use energy as indirect costs, such as heating and transportation. Second, rising oil prices reduce consumer expenditures, which in turn reduce demand for the firms product.

Fluctuations in the price of energy introduce uncertainty about future energy prices, which results in firms postponing irreversible investments Pindyck (1991). Firms respond to energy uncertainty from both the supply and demand sides (Edelstein and Kilian, 2007). As a result, when energy prices go up, firms reduce investment because of declining sales and considerations over future cost expenditure. This negative effect is magnified by uncertainty, which reduces the incentive to invest. However when energy prices fall, higher investment spending triggered by increasing demand and falling costs is dampened by the increased uncertainty caused by the price fluctuation itself, reducing the incentive to invest.

This environment of increase in production costs, reduced profits and decreasing demand constrains the level of investment in the financial and real assets. Similarly sudden changes in oil prices, typically called as oil price shocks create uncertainty for investment leading to demand of higher rate of returns by investors, which becomes another independent factor inhibiting the level of financial and real investment at the stock market and corporate level. The discounted cash flow value model of share pricing implies that reduced profits and increased discounts rates results in decreased share prices. Tobin Q theory implies that decrease in

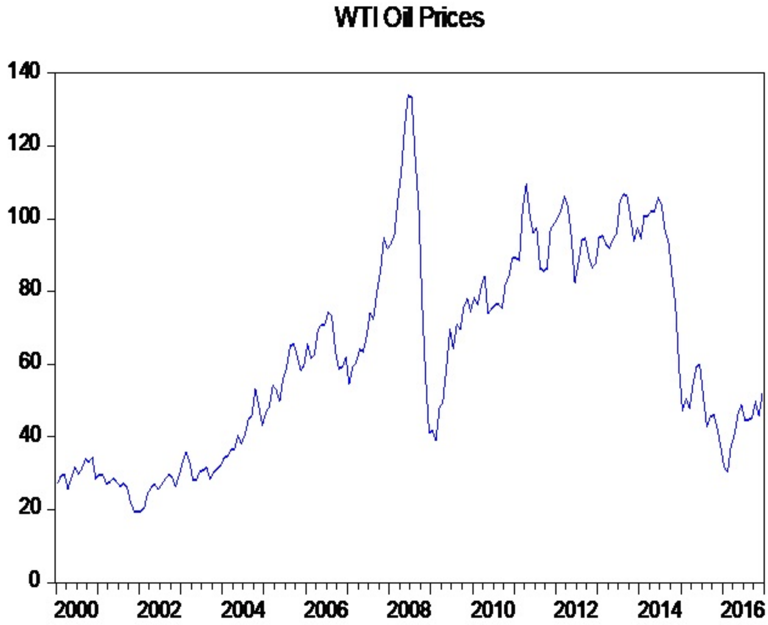

FIGURE 1.1: World Real Crude Oil Price. (U.S.$ per Barrel)

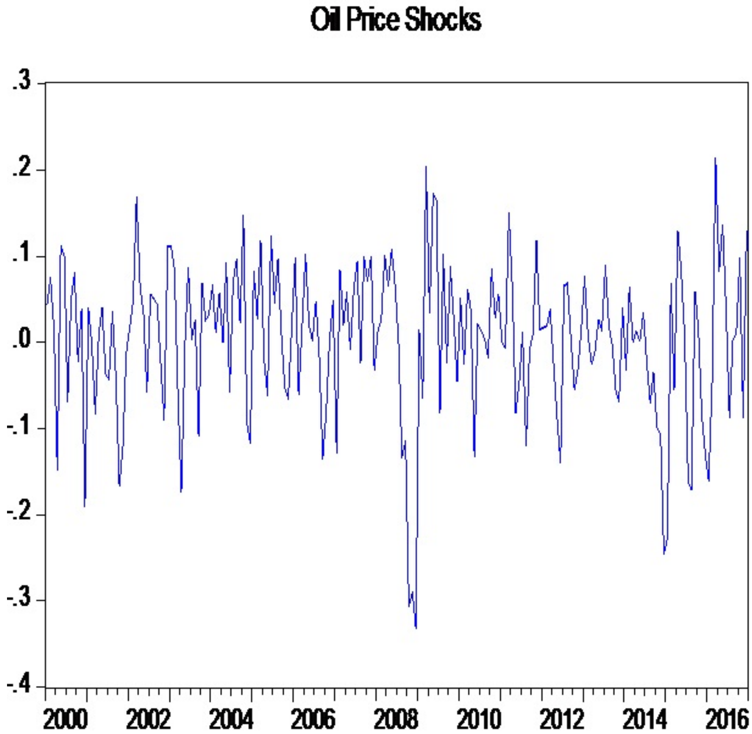

FIGURE 1.2: World Real Oil Price Shocks

share prices of firms inhibits managers investment incentives at the firms expansion projects. Therefore lower the share prices of firms lower will be the firm investment in physical assets. Consequently, changes in oil and investment decisions cause changes in both financial assets and physical assets at the micro and macroeconomic levels.

The existing research on the topic is quite scanty both for developing countries in general and Pakistan in particular. However there is substantial research available for the developed countries. The results of research conducted in developed countries are mixed. Most of the studies show negative relationship between changes in oil prices and the stock prices. Whereas some studies shows mixed results. The literature has widely discussed the implications of the oil price shocks and the view point that has emerged shows that rising oil prices discourage investment decisions and create recession in the economy. After the Second World War all the recessions in the USA except for one came after the rise in oil prices. Relevant past literature shows mixed results regarding the effects of oil-prices shocks on the stock markets returns. Chen et al. (1986) claim no effect of oil price changes on movement of share prices, whereas Jones and Kaul, (1996) show proof of a negative relationship. This negative effect, on the other hand, is not supported by (Huang et al., 1996) and (Wei, 2003).

Kilian (2009) criticized previous studies, for the reason that they took oil prices shocks as exogenous shocks. There are studies however, arguing that changes in the oil prices also respond to the same factors that affect the changes in the stock prices (Barsky and Kilian, 2002, 2004; Hamilton, 2003; Kilian 2009). As a result, average oil prices shocks must be decomposed into underlying structural sources which could reveal the endogenous characteristics of relevant oil price shock. Decomposing the oil price shocks can help eliminate, deficiency of past studies treating oil price shocks as exogenous shock. Additionally decomposition of the oil price shocks also help to analyze the respective effect and importance of each differentiated shock on stock prices, investment and other micro and macro economic variables. Kilian (2009) described following three underlying oil price shocks:

"shocks to the current physical availability of crude oil (oil supply shocks), shocks to the current demand for crude oil driven by fluctuations in the global business cycle (aggregate demand shocks); and shocks driven by shifts in the precautionary demand for oil (precautionary demand shocks). Precautionary demand arises from the uncertainty about shortfalls of expected supply relative to expected demand. It reflects the convenience yield from having access to inventory holdings of oil that can serve as insurance against an interruption of oil supplies (see Ron Alquist and Kilian (forthcoming) for a formal analysis). Such an interruption could arise because of concerns over unexpected growth of demand, over unexpected declines of supply, or over both. One can interpret precautionary demand shocks as arising from a shift in the conditional variance, as opposed to the conditional mean, of oil supply shortfalls. Such shifts in uncertainty may arise, even controlling for the global business cycle and the global supply of crude oil".

Existing studies in Pakistani case also produced mixed and inconclusive results Ansar and Asghar (2013) showed positive but not much strong relationship between the oil prices and KSE-100 index, where as Fatima and Bashir (2014) found evidence in favor of negative and asymmetric effect of oil price on these emerging stock markets. Naurin and Qayyum (2016) also show positive and asymmetric impact of oil price volatility on stock market index. These studies in Pakistan however treated oil price shocks as exogenous shock, and ignored the endogenous feature of oil prices. Macro economic variables like stock markets also affect the changes in oil prices as this approach is criticized by (Kilian, 2009). This study therefore follow Lutz Kilian decomposed model of oil price shocks which has never been applied on Pakistani data by any study before this.

The real investment part of this study investigates how oil price volatility affects the corporate investment decisions for a panel of Pakistani listed companies. As discussed above that demand for oil is increasing in Pakistan and doubled in a span of six years, and Pakistan has little crude oil reserve to support its growing economy and large population. So understanding oil price shocks and volatility is very important to Pakistani economy. However, to the best knowledge, there is no study available on the relationship between oil price volatility and corporate investment in Pakistan.

Additionally studies investigating the effects of oil price shocks on the corporate real investment in other parts of the world have also shown results which are not conclusive to help in better decision making like (Pindyck, 1991) reported that volatility of oil price introduces uncertainty about future energy prices, which make firms postpone their irreversible investment, whereas positive effect of oil price uncertainty on investment in the oil and gas companies has been shown by (Mohn and Misund, 2009). They also found negative effects of stock market uncertainty on investment in the oil and gas companies.

Henriques and Sadorsky (2011) examined the changes that oil price uncertainty brings to the strategic investment decisions in US. They used both real options and compound option theory to investigate how oil price volatility affects strategic investments. They conclude that effect of uncertain oil prices on the corporate real investments is U-shaped and is not a linear in nature.

Wang et al. (2017) investigated how Chinese corporations investment behaves in response to uncertainty originating from the international oil price? Their findings show significant discouraging effects of oil price uncertainty, which is more significant for non state owned companies than the state owned companies.

However these existing studies investigating the oil price uncertainty and corporate investment decisions have relied on using the single oil price measure and none of them has used the decomposed oil price shocks framework as pointed out by Kilian (2009) other studies mainly examining the oil price shocks and stock market and other macroeconomic variables. Kilian (2009) criticized the past studies, for the reason that researchers treated oil-price shocks as exogenous. Decomposing the oil price shocks helps eliminate deficiency of past research work which took oil prices as exogenous variable affecting the economy along with other variables. It also help address the weakness of past studies to articulate the differentiated impact of such underlying oil price shocks on the financial asset values.

At the industry level Fukunaga et al. (2010) followed the Kilian (2009) decomposed oil price components approach for estimation of changes in elements of oil price effects on the industrial production in the Japan and U.S. they used identified VAR for estimation of the models. They reported different effects of each underlying oil price element of shock and type of industry. They reported significant negative effects of oil supply disruptions for oil intensive industries coming through the supply side and for less oil intensive industries coming through the demand side.

For the U.S they found increasing effects of aggregate demand side oil price shock and oil specific demand component of oil price shocks causes negative effects on the supply side shocks of industrial production.

In this context Henriques and Sadorsky (2011) use a sample of U.S. firms for estimating the effects of oil price uncertainty on the firm level strategic investment in the USA by using the real and compound options theory. They investigation and found the presence of both the irreversible and growth options in the U.S. corporate investment decisions when faced with the oil price uncertainty. They reported evidence in favour of irreversible options theory however when uncertainty increases beyond certain point strategic growth option begins to work and further increase in uncertainty therefore cause increase in the corporate investment. Growth options works where new and existing potential competitors enter in the market to gain the market share and strategic advantage of the market conditions.

1.2 Gap Identification

This study focuses on theoretical and empirical gaps on the relationship between oil price fluctuations and investment decisions of investing in the financial assets and the real assets based upon the presented past literature in chapter 2. Therefore this contributes the existing body of knowledge. Present study fills following gaps in the previous available literature on the topic.

1.2.1 Decomposed Underlying Oil Price Uncertainty and Corporate Investment Decisions

First of all this study addresses the main limitation of past studies. Existing studies investigating the oil price uncertainty and corporate investment decisions have relied on using the single oil price measure and none of them has used the decomposed oil price shocks framework as pointed out by (Kilian, 2009). In this sense past studies on the topic suffers from limits of treating oil price shocks as exogenous shocks and their inability to explore distinguished effects of different underlying oil shocks.

Henriques and Sadorsky (2011) also raised points which imply that ideally there should be a framework that uses the different sources of oil price uncertainty which should be included in an investment and oil price uncertainty model. In this context different sources of oil price uncertainty were pointed out in argument by Henrique and Sadosky (2011) "Oil price uncertainty can arise from a number of different sources including global oil demand and supply conditions, the actions of institutional actors (OPEC), geopolitical issues (approximately 50% of the world's proven oil reserves are located in just four countries in the Middle East), and speculation in oil future markets (Sadorsky, 2004)". However they expressed their inability to model this decomposed oil price uncertainty sources approach and therefore used the traditional single oil price variable in their model estimation of the study. Therefore their study cannot explain the distinguished effects of each source of oil price uncertainty responsible for changes in firm level investment. This study therefore fills this gap by using this Kilian (2009) approach for the first time for estimation of oil price uncertainty and corporate investment. This study therefore fills this gap by using the decomposed oil price framework for investigating the distinct effects of underlying oil shocks on the corporate real investment behavior.

1.2.2 Oil Price Shocks and Stock Market in an Oil Price Regulated Environment in Pakistan

Secondly the recent mainstream literature on the topic has followed the Kilian (2009) demand and supply based decomposed oil shocks model and used World oil production, world aggregate demand shock and oil specific demand shocks in their framework as is evident from the studies like, (Apergis and Miller, 2008), (Ono, 2011), (Lippi and Nobili, 2012), (Baumeister and Peersman, 2013), (Gupta and Modise, 2013) , (Kilian and Murphy, 2014), (Degiannakis et al., 2013) , (Caporale and Ali, 2015) , (Kolodzeij and Kaufmann, 2014), (Chen, Hamori, and Kinkyo,

2014) , (Broadstock, & Filis, 2014), (Kang, Ronald & Kyung, 2015). However this existing research work using decomposed oil price shocks approach has mainly addressed the developed world and no previous study on the topic, could be found for developing countries like Pakistan.

Therefore, we do not know about the dimension and potency of the effects of underlying oil price shocks on the investment in financial assets like share prices in the developing economies like Pakistan. Keeping in mind the differences across the countries Crompton and Wu (2005) put forth that the impacts of shocks to the oil prices on the markets are likely to be different from nation to nation due to different industrial structures, energy structures, energy consumption intensities, imports dependence level and pricing mechanisms. Therefore present study fills this gap also by examining the implications of underlying oil price shocks for the stock market for the first time in Pakistan.

1.2.3 Oil Price Uncertainty and Corporate Investment in an Oil Price Regulated Environment

Thirdly Henrique and Sadosky (2011) tested the presence of both the irreversible and growth options in the U.S. corporate investment decisions when faced with the oil price uncertainty. In the U.S oil prices are settled comparatively in an open market, however in Pakistan government agency OGRA regulates the oil prices. Therefore it is not known how this oil price uncertainty and corporate investment decisions behave in an oil price regulated environment.

Pakistan is highly dependent on the import of oil and other energy sources. Pakistan spent \$14.77 billion on import of oil in 2014 which was about 1/3rd of its import bill. Decrease in international oil prices in 2016 has caused reduction of about 37 percent in the oil import bill of country which fell from \$12.166 to \$7.667 billion in FY15. Therefore, price variations in the global oil market and their components have become a vital issue for the economy of the country and this demands proper understanding of their potential effects on the stock market and corporate investment behavior. In this environment of heavy oil import dependence the government agency OGRA is regulating the oil prices in Pakistan and international oil prices are not as it is passed on to consumers instantly, this study aims at testing the presence of both the irreversibility option and the growth options for the first time in an oil price regulated environment by investigating the nature and extent of relationship between international oil price uncertainty and corporate investment decisions in Pakistan. Examining the impacts of fluctuation in the international price is necessary to investigate since Pakistan is mainly relying on imported oil to meet its needs. According to the Ministry of Petroleum and Natural Resources (MPNR), 82% of oil usage in Pakistan is met through imports while only 18% of it is met locally.

Therefore, changes in oil prices, decisions for investment in the financial and corporate real assets have an essential role in the macroeconomic and microeconomic changes in the short and the medium term. An appropriate understanding of the consequences of oil prices uncertainty on the financial and corporate real investment behavior is helpful for policy-makers, corporate managers, economists and market analysts. Results of this study are expected to be highly important for the stakeholders of stock market, investors and researchers in Pakistan.

1.3 Theoretical Background

The first part of study aims to identify the underlying causes of the shocks in the oil prices and examine their implications for the financial investment at the stock market in Pakistan. There is variety of literature available investigating the consequences of oil price shocks on investment in the financial assets of stock market. Equity pricing model can best explain its theoretical relationship. According to this model, current value of an equity share is equal to the present value of its future discounted cash flows. Discounted cash flow model of the stock price valuation imply that the shocks in the oil prices can be transmitted and affect the stock prices, through the two major channels.

First channel can be described as the supply side channel, as increase in oil prices can increase the cost of production and therefore decrease the profits of firms. This decrease in the earnings and cash flows of the firms can lead to falling share prices. Second channel can also be described as the demand side channel. Demand for oil and related products are nearly inelastic especially in the short term. Therefore rising oil prices can bring inflationary pressure which reduces the demand for firms products. This tendency of reduced the sales and profits of companies leads to reduction in the stock prices. As a consequence of these two channels of transmission of oil price fluctuations will affect the investment and share price levels in the stock markets.

This study also investigates the theoretical and empirical links between oil price uncertainty and corporate real investment decisions. The corporate investment decision is an important area of research. Its motivation is being driven by both theoretical and empirical concerns. This study explore examines the outcomes of oil price uncertainty for corporate investment spending in Pakistan by combining both the theory of investment and recent econometric techniques. This study uses recent panel data techniques for estimating of 468 PSX listed companies for the period from 2000-2016.

This approach is based upon the modern empirical research work in the field of uncertainty and investment relationship. Following this literature Tobin Q framework of investment is modeled and measures for oil price uncertainty and sources of oil price uncertainty are also included in this investment model. Mohn and Misund (2009) included the oil price volatility variable in their econometric model of investment. Their results showed highly significant coefficients which suggest results against the Tobin (1969) theory which imply that Q theory fully explain the investment model and incorporates all the information. Henrique and Sadosky (2011) tested the squared oil price volatility measures along with the oil price volatility measures. Their findings also this view point that Q model of investment is not sufficient for explaining the investment, therefore it is necessary to add more relevant variables in the investment model also.

Theory of corporate investment behavior has been developed through two main approaches. Previous literature advocates the real waiting options, and irreversible investment theory. Recently its relaxed by the research material on the real growth options, compound options and strategic investment. Increasing uncertainty about the future profits will increase the waiting option value and as a result defer the investment in the case of irreversible investments approach. Accordingly a negative association between the investment and uncertainty is suggested by this type of literature (Carruth et al., 2000; Bond et al., 2005). This study examines the investment decision in response to oil uncertainty, which involve the decision either to wait or expand.

However since compound real options theory implies both the waiting option decisions and the growth options decisions involved when faced with uncertainty, therefore following Mohn and Misund (2009) and Henrique and Sadosky (2011) investment behavior is focused in this study.

There are two channels by which oil price can effect firms investments. First, because oil is an important input cost of the whole production procedure, increasing oil price drives up the marginal production cost; even though some firms may not directly consume oil, such as crude oil, as part of the production process, they do nevertheless use oil for indirect costs, such as heating and transportation. Second, rising oil prices cause rise in inflation and resultant decreased disposable income, brings reduction in consumer expenditures, which in turn reduce demand for the firms product and vice versa.

Therefore corporate investment is affected by uncertainty in oil price from both the supply and demand sides. As a result, when oil prices go up, firms reduce investment because of declining sales and considerations over future cost expenditure. This negative effect is magnified by uncertainty, which reduces the incentive to invest. However, when oil prices fall, higher investment spending triggered by increasing demand and falling costs is dampened by the increased uncertainty caused by the price fluctuation itself, reducing the incentive to invest

Moreover theoretical insights from the literature shows that there is strong link between prices of the shares of a company trading at the stock markets and corporate real investment decisions (Tobin, 1969). Implied by this theoretical view, changes in share prices are expected to be reflected in real investment decisions at the corporate level also. Therefore it is also necessary to understand the behavior of corporate managers real investment decisions in response to oil prices uncertainty in Pakistan. Literature shows that the oil price volatility impact is mainly transmitted to the economy through firm level investment channel (Hamilton, 2008). Therefore in addition to macro level investigation of oil prices uncertainty impact on investors decision for investment in the financial assets, this study also investigates the micro level effects of oil prices uncertainty on the corporate real investment decision making behavior of the managers in Pakistan. In this way this study examines both the investors and managers investment behavior in response to oil price uncertainty.

1.4 Problem Statement

Developing and oil importing country like Pakistan can achieve the goals of stability and expansion of the growth and investment by having deep understating of implications of oil price changes for the investment behavior. Policy makers, investors and managers makers can use insights from this thesis, examining the outcomes of oil prices uncertainty for investment in the financial and assets at the aggregate and firm levels. The insights from this thesis can help the authorities in these developing countries in making policies to promoting the energy efficiency, achieving the goals of stable economic growth and expansion of investment.

Implications of oil price uncertainty for investment behavior have not been fully explored by previous academic research. Literature available on developing counties in particular and in developed general is extremely inadequate for making appropriate and correct policy decisions. A recent development in the relevant literature in the form of structural oil price model Kilian (2009) containing decomposed elements has scope for very important and appealing application on data from developing countries on the oil and investments in the financial and real assets at the stock market and corporate level.

A growing interest by the researchers on this topic is observed with increasing demand, dependence of world on the oil and growth of stock markets in the world. However, these past studies on the topic have mainly addressed the data and problems related to the developed countries. Kilian (2009) structural oil price model was mainly used in research attempts which focused the developed countries, hence this past available literature lack the necessary guidance required for decision making by the developing countries specially Pakistan.

In addition to above mentioned studies, there are only few studies which focused investigating the outcomes of oil price uncertainty on corporate investment, moreover these studies did not use Kilian (2009) decomposed oil price framework and used average oil prices as a measure of oil prices. Therefore they could not estimate the distinguished effects of different underlying sources of oil price uncertainty for corporate investment decisions. Also research on the consequences of oil price uncertainty in the emerging South Asian regional markets remains very scant. Additionally, past literature does not have consensus and lack forecasting guide lines regarding relationship between oil price uncertainty and financial and real investment behavior at the stock market and corporate level.

The case of Pakistan is different from developed countries and therefore studying the consequences of the oil price shocks on the investment behavior in Pakistan is important for several reasons. The domestic production of oil is considerably less than the demand for oil. The oil is used as an input for production, fuel for transportation, heating, electricity generation as well as for other sectors. Furthermore reserves of natural gas have been decreasing day by day and this is increasing reliance on oil imports. Additionally poor electricity and gas supply for industrial and other consumers has lead to more demand of oil. Import of oil by Pakistan nearly doubled in a span of 6 years from 113.7764 thousand barrels per day in 2004 to 227.0713 in 2010.

Pakistan is highly dependent on the import of oil and other energy sources. Pakistan spent \$14.77 billion on import of oil in 2014 which was about 1/3rd of its import bill. Decrease in international oil prices in 2016 has caused reduction of about 37 percent in the oil import bill of country which fell from $12.166 to $7.667 billion in FY15. Therefore, price variations in the global oil market have become a vital issue for the economy of the country and this demands proper understanding of their potential effects on the economy in general and corporate investment behavior in particular. In this environment of heavy oil import dependence the government agency OGRA is regulating the oil prices in Pakistan and international oil prices are not as it is passed on to consumers instantly, this study therefore aims at investigating the nature and extent of relationship between international oil price uncertainty and investment decisions including the investment in financial assets at the aggregate level and the real assets at the corporate level in Pakistan.

Pakistan has been compelled to rising oil imports due to the flat oil production and higher oil consumption levels in the country. Additionally, inadequate refining capability leads to heavy reliance on the import of petroleum products. Demand for petroleum products in Pakistan is approximately 16 million tons, 82% of which is met through imports while only 18% of it is met locally according to the Ministry of Petroleum and Natural Resources (MPNR). This much heavy reliance on import of oil lead Pakistani economy and markets, very much sensitive to the international oil price movements. Therefore it is essential to study the implications of oil price shock on the economy by focusing on the responses of investors and managers. In order to fully capture the effects of oil price shocks on the investment this study investigates the impact separately in terms of investment in the financial assets and corporate real investment decisions. The interest is to explain the nature of relationship between two variables but also the magnitude of effect.

Consequently, it's necessary to reconsider theoretical and empirical models and come up with more comprehensive model to develop better understanding and forecasting in oil prices uncertainty on financial and real investments behavior. In this situation, this study is bridging the gap and undertook three jobs: Firstly, to investigate the sources which influence the international oil price fluctuations, secondly, to determine and quantify which sources contribute most to the oil prices uncertainty and consequently financial and real investment behavior of the Pakistani investors and managers and thirdly, for the first time uses the decomposed sources model of international oil price uncertainty to explore the consequences of oil price uncertainty on the corporate real investment behavior.

1.5 Research Objectives

This study necessarily aims at developing theoretical knowledge and empirical framework on the consequences of the oil price uncertainty for the decisions of investment in financial and real assets. The results verify the extent to which oil price shocks contribute to the changes in stock market and corporate real investment volumes in Pakistan. Therefore this study intends to achieve following objectives:

1. To identify the underlying sources of the international oil price shocks.
2. To investigate the underlying oil price shocks effects on the stock market in Pakistan.
3. To examine the oil price uncertainty effects on the corporate real investment decisions in Pakistan.
4. To examine the decomposed oil prices uncertainty effects on the corporate investment decisions in Pakistan.
5. To ascertain whether the effects of decomposed oil price uncertainty on corporate investment decisions differ, depending upon the oil intensity of the firm in Pakistan?
6. To investigate whether the effects of decomposed oil price uncertainty on corporate investment decisions differ, depending upon the size of the firm in Pakistan?

1.6 Research Questions

Research Question # 1

What are the different underlying international oil price shocks?

Research Question # 2

How does the different underlying oil price shock affect the stock market in Pakistan?

Research Question # 3

How does the oil price uncertainty affect the corporate real investment decisions in Pakistan?

Research Question # 4

How does the decomposed oil prices uncertainty affect the corporate investment decisions in Pakistan?

Research Question # 5

Whether the decomposed oil price uncertainty effects on the corporate investment decisions differ depending upon the oil intensity of the firm in Pakistan?

Research Question # 6

Whether the impact of decomposed oil price uncertainty on corporate investment decisions differs between small and large firms in Pakistan?

1.7 Significance

In general developing countries are facing economic problems like high level of poverty, unemployment and macroeconomic imbalances (Todaro, 1977). Expanding the investment in financial and real assets can help in achieving the goals of economic growth, eliminating unemployment, poverty reduction and achieving prosperity. In this regard a good understanding oil price uncertainty is important since it is one of the major factors responsible for discouraging and destabilizing the financial and real investments decisions. For this purpose this study offers good understanding of sources and components of the oil price uncertainty and their resultant destabilizing effects contribution by proposing a comprehensive theoretical model.

This study uses the Kilian (2009) decomposed oil shocks framework for examining the effects of underlying sources of oil price uncertainty on the corporate investment decisions. Therefore this study adds to the exiting body of knowledge on oil shocks and investment decisions. Moreover since no previous study in Pakistan has examined the effects of oil price shocks on the stock markets by using the Kilian (2009) framework, this study performs this job and therefore offers better understanding of the oil price and stock market relationship. In addition this study also tests both the irreversible options and growth options theory of corporate investment when firms are faced with oil price uncertainty.

Using the decomposed oil price framework for investigating the implications of oil price shocks for corporate investment decisions offers better understanding of distinct effects of each underlying source of oil price shock. Supply side and demand side shocks affect differently, therefore this framework offers better understanding of oil price uncertainty and corporate investment relationship. Moreover using the Kilian (2009) framework can also help better understanding the consequences of the oil price shock for stock market in a developing oil importing country Pakistan.

The proposed comprehensive model is insightful for the corporate executives, investors, researchers and policy makers. The findings can be utilized in making decisions and strategies to achieve objectives like higher investment, economic growth, expansion, employment and poverty reduction etc.

The study is offering use of Kilian (2009) framework in the economic environment of the developing world corporate investment decisions for the first time, hence this study is a novel activity and is expected to be helpful for the researchers in this field because such framework on the developing world features is being made available for the first time that explain, the problem relevant to the larger part of human beings in the world as developing world constitute the larger population and area than the developed world.

For policy makers this study provides an opportunity to understand the sensitivity of investment to the oil price and guidelines to devise polices by facilitating the potentially new and existing financial and real investments. This can be done by introducing policies helping stable and lowest possible oil prices, raising the sectors contribution to the GDP which are non oil intensive or at least less oil price sensitive, taking measures which are feasible and reasonable to minimize the adverse outcomes of any oil price shock on the investment behavior. Further using measures like, increase in the strategic reserves of oil, improving the efficiency of energy usage and exploring and using the alternative fuels which are independent of oil prices can shield an oil-importing country from the worse consequences of oil supply shocks. Promoting multilateral cooperation by engaging in dialog with countries exporting the oil can also be helpful in minimizing the adverse consequence of oil prices shocks on the economy of developing oil importing country.

Investors and corporate managerial executives particularly can use the insights from the study to manage the risks of oil price changes in their portfolios and projects, by identifying stocks or projects offering the diversification means for the duration of large oil price swings. In the situation of rise in oil price expectations, the investment in shares and projects of companies and industrial sectors with the positive correlation are recommended. On the other side whenever there decreasing oil prices are expected, the investment in shares and projects of companies and industrial sectors with the negative correlation are considered as better option. Moreover diversification of portfolio risk can be achieved by portfolio managers by making the investments in stocks of sectors which respond differently to the oil price fluctuations.

Similarly once having better understanding of oil price changes managers at the firm can better manage this oil price risk involved their investment and expansion plans.

1.8 Contribution of the Study

It is important to point out that study will be contributing study on subject, is likely to lay down the fundamentals and framework for the future studies on the subject. This study contributes to the literature in three ways.

Firstly, present study is making important contribution in offering the analysis of effects of the uncertain decomposed oil price on the corporate real investment. No previous study so far has examined the decomposed oil price shocks effects on the corporate investment decisions though, there are studies which recognized the need for such decomposed framework and investigation (Henrique and Sadosky, 2011), (Elder and Serletis, 2010) and (Wang, 2012). Decomposed oil price shocks would be more informative and useful for corporate managers decision making, as it would distinguish responses of corporate investment to different underlying shocks like the case of Kilian and Park (2009) did for aggregate stock market in the US.

Secondly, Henrique and Sadosky (2011) tested both the growth and irreversible options of investment in response to oil price uncertainty in the U.S. But no previous study has specifically examined the implications of oil prices shocks on corporate real investment behavior in the oil price regulated environment especially of a developing country. Hence this study contribute to the existing stock of literature examining the linkages between oil prices uncertainty and corporate investment decision making in a developing oil importing country where oil price is regulated by the government.

Thirdly this study adds to the body of knowledge by examining the implications of sources of the oil price shocks for the stock market in Pakistan for the first time. Kilian (2009) decomposed framework which is widely used now in the literature on the topic, but no previous study could be found using this decomposed oil price shocks framework for investigation in an oil price regulated environment in Pakistan.

This study essentially examines the effects of oil price shocks on the investment in the financial and corporate real assets decisions in Pakistan. Sample period of the study is from Jan.1.2000-Dec.2016 and data sources include Pakistan Stock Exchange, State Bank of Pakistan, Federal Bureau of Statistics, Ministry of Petroleum, Finance Ministry, World Bank, IMF, EIA and annual reports of listed companies.

1.9 Study Scheme

Plan of the study is organized as follows. Section 2 reviews the literature on oil price uncertainty and financial and corporate investment from both the theoretical and empirical perspectives. Section 3 discusses data and methodology used in this study and discusses econometrics issues. Section 4 will be presenting results and discussion regarding causality between different oil price shocks and financial and corporate investment decision. Section 5 will derive conclusions and recommendations.

Chapter 2

Literature Review

There is vast literature available on the link between oil price shocks and the stock markets, where as very scant research material is available on the effects of shocks to the oil prices on the corporate real investment decision making behavior. Though there is vast literature available on the effects of shocks to the oil prices on the financial markets, still it has limited explanation potential. Early studies treated oil prices changes as exogenous shock and produced mixed results. Some studies arguing negative results and other reported positive effects of oil price shocks on the financial markets. There are studies reporting mixed results also. Kilian (2009) criticized this past research by arguing that shocks to oil prices are exogenous and are affected by the same forces having impact on the stock markets. He used sources of shocks to oil prices decomposed model for examining the impact of shocks to oil prices on the U.S stock markets. This model is now widely followed by studies on the topic and presents better explanation of shocks to oil prices impact. However scope of his decomposed model is limited to the developed world only, since it does not address this association in the developing countries. This study therefore fills this gap. In addition present study uses the decomposed model for examination of the effect of shocks to oil prices on the corporate real investment also for first time.

2.1 Oil and Stock Markets

This study first describes the theoretical linkage between shocks to oil prices and stock or asset prices and later it presents empirical literature on the subject in this section. Huang, Masulis and Stoll (1996) show the link between oil and stock price as per theoretical insight. Insights from the theory of the discounted cash flow method imply that stock prices are expected future cash flows discounted at a certain rate:

$$P = (E(CF))/(1+R_t)$$

Here P denotes the stock price, CF is the future flow, Rt denotes the discount rate, and E(.) is used for the expectation operator. Thus, stock returns are determined both by the expected cash flows and discount rates. We can use this model for understanding how the shocks to oil prices are transmitted to the stock prices. For example, shocks to oil prices have an impact on both expected cash flow and future discount rate. Mounting oil prices affect the cost of manufacturing, which in turn affects the firms cash flow. But whether this effect is a positive or negative, it depends on the individual type of industry, i.e., whether this industry belongs to an oil-producing industry or oil consuming industry. Further, oil price changes affect the rates of discount via changing in both the rate of inflation expected and the rates of interest expected. In the case of countries which depend upon import of oil for fulfilling their need like the U.S., rising prices of oil negatively affects the balances of payments, puts pressures on the exchange rates by depressing the U.S. dollar, and then eventually induces inflationary pressures, which may trigger rise in the interest rates by the regulatory central bank. Thus the expected return of the stock increases, which leads to adverse consequences for the stock returns. Overall, the effect of shocks to oil prices on stock markets are determined by the net effect of shocks to oil prices on changes in cash flows expected and the rate of discount expected.

Bernanke, Gertler and Watson (1997), for example, suggest that monetary policy makers tend to increase the rates of interest whenever they foresee the pressure of inflation due to the shocks to oil prices; a higher rate of interest then leads to demand of high returns and lower future cash flows eventually causes the falling prices of shares in the market. Hamilton (2003) observes that shocks to oil prices boost up uncertain situation regarding the oil futures market which eventually brings recession by postponing the investments and purchasing the goods that depends upon the energy. Jones et al. (2004) argued the expected earnings path transmitting the shocks to oil prices on the stock prices on the theoretical basis. Kilian (2010) put forth that oil is an important input used in the production of many goods, so higher energy costs lower usage of oil and lead to lower real output. Furthermore, higher oil prices brings down the purchase power of domestic households as consumers have lower discretionary income for other goods because of the increased cost of energy.

Theoretical point of view regarding the asset prices was put forth by Fisher (1930) and also by Williams (1938) imply that discounted future cash flows from owning an asset determine their prices. In this sense factors affecting the discounted future cash flows also significantly affect the prices of an asset. Consequently, increasing oil prices use to increase the manufacturing costs, restrain the earnings of firms. This reduction in earnings by firms is expected to give rise to conditions of falling stock prices (Filis et al., 2011). However for oil-exporting nation, an increase in oil rate has positive effect and plays direct role in increasing nations earnings. Consequently outflow and investment also increases which causes great production and less unemployment. Hence, response of stock markets will be positive (Jimenez-Rodriguez and Sanchez, 2005; Bjornland, 2009).

Unpredictability of change in prices might be an exact measure of informations flow rate in financial market, hence has a great impact on returns of stocks (Ross, 1989). Stock market is affected by shocks to oil prices because of uncertain conditions that the shocks to the oil prices may bring to the financial markets. They further put forth that these effects depend upon the source from it comes like the supply or the demand side. The change will be negative if it comes from the supply source and if shock comes from the demand side source then it will positively affect the stock prices (Filis et al., 2011).

Gupta and Modise (2013) pointed out that fluctuations in world oil prices seriously affect the South Africa. Increase in the world crude oil prices affect the economy of South Africa through many ways, for example; money flow from South Africa to the oil-exporting nations, increase in manufacturing costs, rising inflations and so uncertainty in the stock markets.

Literature evidence shows that the research activity addressing the oil price and share prices relationship has been growing since last decade. However mostly this research has been done on the developed countries data, and few investigated the developing countries data dynamics. Participants at the markets and policy makers desire a comprehensive model explaining the effect of shocks to oil prices on the share prices in the stock markets. The literature in this context includes the following studies.

Kaul and Seyhun (1990) together with Sadorsky (1999) put forth that oil price changes negatively affect the share prices. Ferson and Harvey (1995) reported significant effect of oil prices risk, but in different dimensions on data of the 18 different equity markets they studied. Kaneko and Lee (1995), shows oil prices affecting the share prices in Japan. Jones and Kaul (1996) examined the international developed countries data of five countries and found that oil prices volatility do affect the stock markets. Using the quarterly data they also found this change in stock prices comes through changes in expected cash flow earnings. For measuring the oil prices they used the Producer Price Index for Fuels. Their findings imply link between prices of oil and the returns on shares in the market. Daily data was used by Huang et al. (1996) to examine the association between oil futures prices and U.S. stock prices. They used VAR model and found that oil futures prices though lead some oil company stock prices at individual level but this not the case at aggregate level stock markets like the S&P 500. Sadorsky (1999) used the VAR model in monthly data of USA and found that changes in oil prices and volatility affect the stock returns and economy significantly, but asymmetrically. They also reported change in oil price behavior as it explains stock price movements more than the interest rates since 1986.

Oil price risk was reported as an important as market risk factor for the equity returns of industries in the Australian stock market by (Faff and Brailsford, 2000). They used monthly data and found that oil price have positive effect on the Oil and Gas industries and a negative effect on the industries like Papers and Package industry and Transport. Sadorsky (2001), used multifactor model considering the numerous risk premiums for the returns on stocks in the sector of oil and gas. His findings show that rates of exchange, rates of interest and oil price risk factors as the main determinants of returns on stocks in the sector of oil and gas. His findings also show positive association between oil prices and stock prices of the firms in the oil and gas industry.

Small literature is available focusing the oil price effect on prices of shares in the developing countries as compared with developed countries. Using the VAR model Papapetrou (2001) examined the relationship between prices of oil, prices of shares, rates of interest and the real economy in Greece. He reported influence of oil price changes on the real economic conditions and the level of employment. Hong et al. (2002) identified adverse link between the prices of oil and shares market. Pollet (2002) and Driesprong et al. (2003) found that oil prices explain the world stock market prices. Hammoudeh and Eleisa (2004) explored the interaction between the prices of oil and the stock markets prices in five GCC countries. They used daily data and only the Saudi Arabian stock market was found to have a bi-directional association between the oil and stock prices.

Bittlingmayer (2005) reported that changes in the oil prices have association with the war risk and impact the share prices asymmetrically. El-Sharif et al. (2005) investigated the association between the prices of oil and stock price returns in different sectors of the London Stock Exchange. They found a positive link between the returns of stocks and prices of oil of oil sector, nevertheless, potency of this relationship vary across the sectors. Sawyer and Nandha (2006) on the other hand, found no role of changes in the prices of oil in returns of shares market at the aggregate level; however they found proof of oil prices impact at the industry level.

Gogineni (2007) reported that prices of oil are positively related with the stock prices if oil price volatility is caused by changes in the aggregate demand, however it has negative impact on stock prices, if oil price changes are motivated by the changes in supply. This point of view also got support from and (Yurtsever and Zahor, 2007). In addition, oil prices effect on stock prices is asymmetric, as higher oil prices resulted in lower stock prices, whereas lower price of oil do not necessarily cause higher prices of stocks. Negative impact of shocks to oil prices especially on output and profitability of an oil intensive firm was argued by (Nandha and Faff, 2008). However they failed to provide empirical support for such impact on certain industries. On the other side, O'Neil et al. (2008) reported negative impact of shocks to oil prices on stock prices in a larger sample comprising 13 developed stock markets. This finding also got support from (Park and Ratti, 2008).

Bjornland (2008) found the price of oil effect the prices of shares, but this effect comes through the changes in the monetary policy. On the other side, Cong et al. (2008) did not in favor such relationship for the most of the Chinese stocks prices, with the exception of manufacturing sector. Driesprong et al. (2008) examined the prices of oil changes affecting the aggregate stock market indices. They used monthly data of 48 developing and developed nations and their findings shows significantly negative association developed and developing countries, but they also found that the bulk of the associations however as insignificant on the statistical grounds.

Recently, on the other hand, researchers came up with view point that oil price changes are resulted by macroeconomic variable. This approach leads to the decomposing the changes in the prices of oil price into the structural shocks (Lutz Kilian, 2009; Kilian and Park, 2009). Oil price decomposition approach implies that, various underlying oil price change sources may involve different impact on the relevant economic variables. Past literature generated mix views on the subject of the impact of shocks to the oil prices on the stock market prices and returns. Chen et al. (1986) found that changes in the prices of oil have no effect on the tendency of stock price movement, whereas Jones and Kaul (1996) found the negative link evidence. However Huang et al. (1996) and Wei (2003) do not the negative association, viewpoint.

Kilian (2009) criticized the past studies, for the reason that researchers treated oil-price shocks as exogenous. There are also studies like Barsky and Kilian (2002, 2004) which argued that changes in the prices of oil also react to the same causes which also affect the prices of shares market. This point of view also got support from (Hamilton, 2005) and (Kilian, 2008).

In this context aggregate shocks to oil prices must be decomposed into the underlying structural shocks reflecting the endogenous features of such shocks to oil prices. Decomposing the shocks to oil prices helps eliminate deficiency of past research work which took oil prices as exogenous variable affecting the economy along with other variables. It also help address the weakness of past studies to articulate the differentiated impact of such underlying shocks to oil prices on the financial asset values. In this context Kilian (2008) examined the separate effects of just exogenous oil supply shocks on the U.S economy and reported temporary declining impact contribution of oil disruptions on GDP. He found evidence of positive effect of oil price increases driven by the aggregate demand shock in the short run. This is because advantage of increase in the aggregate demands for all industrial products will dominate the disadvantage caused by increase in the oil price in the short run, however this positive effect erodes with the time. He also reported that increase in oil prices driven by the oil specific demand shock adversely affects the GDP in U.S. economy. Kilian and Park (2009) while investigating the impacts of decomposed oil price shocks on the U.S. stock market reported adverse effects on only when increase in the oil prices are caused by oil specific demand shock. They reported no significant negative effects of oil price shocks driven by the oil supply side changes. They found positive impacts of oil price increases which are driven mainly by the world aggregate demand shocks for a period of one year.

Apergis and Miller (2008) reported that shocks to oil prices do not much affect the stock prices in the world, however underlying structural shocks to oil prices has significant part in changing stock prices. Fang (2010) while investigating the effect of structural shocks to oil prices characterizing the endogenous feature of shocks to oil prices on the returns of share prices in India, Russia, Brazil and China found that both the global demand and oil specific demand shocks positively affect the stock prices while in India different underlying shocks to oil prices do not significantly impact the stock prices.

Ono (2011) analyzed the effects of shocks to oil prices on in BRIC countries shares markets and reported that this shock positively affect the Indian and Russian stock markets returns, where as no effect of oil prices shocks was found for the Brazilian and Chinese stock markets. Cong et al. (2008) investigated and reported evidence against any significant effect of oil supply shocks in the Indian, Russian, and Chinese stock markets.

Filis et al. (2011) explored this link between price of oil and the shares market of nations which are exporting and importing the oil on a time varying basis from the 1997 2009 through the DCC-GARCH model. They found negative impact of prices of oil changes on the shares market values, except for the year 2008.

Masih, Peters & Mello (2011) investigated the effect of changes in oil prices and volatility on the equity markets for the years 1998-2005. They used VEC model. They provide evidence that shocks to oil prices negatively affect the profitability of firms in two different ways. Firstly, it increases the cost of production and hence results in decreased profitability of firms. Secondly, seeing the decline in the profitability discourages the investors investments in share, which negatively affect the investment trends and stock markets.

Arouri et al. (2011) investigated the relationship between prices of oil and shares markets in the nations of GCC. They used the model of VAR-GARCH to test the data from the year 2005 to 2010. Their findings show that the then crisis period increased the volatility of oil market transmission to the shares market in the GCC countries.

Lippi and Nobili (2012) explored the outcomes of underlying shocks to oil prices on the macroeconomic variables. They used the shock from demand and supply sides and further categorized the underlying supply shocks as global and domestic.

They found that the global supply shocks affect the shocks to oil prices and these effects are four times greater than the domestic oil supply shocks. In addition they reported that the impacts of shocks to the oil prices on the US economic activity depends upon the type of underlying shock.

Arouri (2012) assessed the link between the shocks to oil prices and the shares markets in the Europe on the sectoral basis and found that this relationship vary greatly depending upon the sectors. Li, Zhu & Yu. (2012) assessed the sector level association between the level of oil prices and the shares markets in the China and their findings reported the structural breaks.

Basher et al. (2012) investigated the link between the changes in the prices of oil, exchange rate changes and the emerging stock markets. They reported that shocks to the prices of oil result in decreased share prices and the exchange rates in the short run. Sadorsky (2012) investigated the spillover of the volatility between the prices of oil and the shares price levels of the clean energy sector and the technology sector. His findings show greater impact of stock prices of technology on the clean energy firms than the oil prices.

Baumeister and Peersman (2013) investigated the changing impact of oil supply shocks on the U.S. economy over the time. They found that after the mid eighties there is a significant declining trend in the price elasticity of oil demand in the shorter periods. Mollick and Assefa (2013) investigated the link between prices of oil markets and the returns of shares in the US by using the model of GARCH. They reported negative effects of prices of oil market before the financial crisis, however positive effect 2009 afterwards. Awartani and Maghyereh (2013) also investigated the link between prices of oil and the equity in the GCC. For this they used the multivariate GARCH framework found evidence of bi-directional, but asymmetric transmission of the volatility and return.

Gupta and Modise (2013) found greater contribution of oil supply shocks in South Africa an oil importing country. Ciner (2013) assessed the link between changes in the prices of oil markets and the returns of the shares markets. He used the frequency domain method and reported time varying effect of oil price changes. His results shown that oil prices shocks with less than a year frequency negatively affect the stock returns, whereas shocks which continue from 1year to 3 years have positive effect on the stock returns.

Kilian and Murphy (2013) in their investigation used the structural oil price model, which contained the speculative demand component also, besides the demand flow and supply flow shocks. They found the significant role of speculative demand shocks in major oil price shock like 1979, 1986 and 1990.

Degiannakis et al. (2013) examined by using the time varying approach the link between the prices of oil markets and returns on the shares of the 10 different industrial sectors in the Europe, after taking into consideration the origin of the oil price shock. They found changing behavior of oil prices and stock prices relationship over time. They also found that both the type of industry and the underlying cause of the oil price shock play significant role in the link between oil prices stock returns.

Narayan and Sharma (2014) assessed the contribution of oil price to the volatility of stock return. They used data of 560 companies listed on the NYSE. They reported important role of prices of the oil market in forecasting the variances of firm returns. Mohanty et al (2014) studied the role of risk of changes in the prices of oil market for the industry of U.S. Travel and Leisure by using the frameworks of FamaFrenchCarhart's (1997) four-factor asset pricing model by augmenting with the factor of risk in the prices of oil market. They found significant negative impact of oil prices, which vary greatly over the time and across the different sectors.

Caporale, Ali, & Spagnolo (2015) examined the effect of shocks to oil prices on the stock prices in China on a time-varying basis. They used weekly data of ten sectors for their analysis. Their analysis show positive effect of oil price uncertainty during periods of demand-side originated shocks. However precautionary demand shocks were found to have insignificant impact.

Kolodzeij and Kaufmann (2014) reconsidered the Kilian (2009) view point regarding the important role of oil demand shocks and the less important role of supply shocks. Their findings show the difference of criterias by OPEC and non OPEC nations regarding the output levels. They found that its OPEC output level determines the oil price level. Their analysis also show that the positive link between the dry cargo freight costs and oil prices is because of impact of higher oil prices on transportation costs.

Chen,Hamori and Kinkyo (2014) made an extension to the Kilian (2009) model by identifying an exogenous underlying shock to the oil prices, which arises from fluctuations in the international conditions of the financial market and examined the resultant outcomes of changes in the prices of oil market on the macroeconomic variables. Their results confirmed the important role of financial shock in determining the oil prices and consequently on macroeconomic changes.

Broadstock and Filis (2014) investigated the relationship between underlying different shocks to oil prices and the aggregate and sectoral based stock markets in the China and the US on the time varying basis. They found that link between prices of the oil market and the shares markets vary greatly depending upon the time and different sectors. They also found that impact of different underlying shocks on the shares markets vary substantially depending upon the source of shock. Furthermore they found China more capable of bearing the oil prices shocks than the US.

Kang, Ronald and Kyung (2015) examined the effect shocks to oil prices on the covariance of returns of the share market and the volatility in the US. They found negative effect of aggregate demand side shocks and the shocks coming from the oil-market specific demand on the covariance of return and volatility. Whereas the oil supply shocks are found to have positive effects and therefore increases the variance and volatility of stock market returns.

Phan, Sharma and Narayan (2015) while investigating the oil price ability to predict the stock returns found that this ability of forecasting depends upon the data frequency, estimator and sectors of economy. Phan et al. (2015) shows positive impact of shocks to oil prices on the oil producers stock returns whereas negative impact on the stock returns of the oil consumers sectors.

In the Pakistani context following are few studies which examine the association between shocks to oil prices and Stock price index is concerned.

Ansar and Asghar (2013) analyzed the impact of prices of the oil market on the CPI and shares market by using the multi regression and data from January 2007 to August 2012. Their results showed weak positive link among the prices of oil market, CPI and KSE-100 index. Siddique (2014) examined the impact of oil price fluctuation on the stock market performance in Pakistan by using annual data from 2003 to 2012. Study reported significant association between oil price and stock market changes in Pakistan.

Fatima and Bashir (2014) explored the link between oil prices volatility and stock market changes in Pakistan and China. They used monthly data from 1998 to 2013. They found evidence in favor of negative and asymmetric effects of changes in the prices of oil market on these emerging shares markets. Naurin and Qayyum (2016) uses Bivariate EGARCH model and shows positive and asymmetric effects of volatility in the prices of oil market on the index of shares market.

These studies in Pakistan however treated shocks to oil prices as exogenous shock, which is criticized by Kilian (2009) as mentioned earlier in detail and main stream literature on the subject after has seconded the view point of Kilian (2009), as there exist reverse casualty between oil shocks and macro economic variables like stock markets. This study therefore follow Lutz Kilian decomposed model of shocks to oil prices which has never been applied in Pakistani case.

Lutz Kilian framework however has mainly been used by studies focusing the developed countries. Developing countries are mostly depends on import of oil for their energy and other uses. Despite this fact only few studies have so far attempted the investigation of oil and stock market relationship in the developing countries. Further past studies also suffer from limitation of using the oil prices as exogenous variable as criticized by (Kilian, 2009). This study addresses this limitation by using this Kilian (2009) decomposed framework of underlying oil price shock for investigating the implications of shocks to oil prices.

Therefore present study undertakes to examine the impact of oil price uncertainty on stock prices at the Pakistan Stock Exchange in Pakistan. This investigation first modify the Kilian (2009) framework by employing the vector autoregressive model for decomposing the oil price underlying shocks into three sources namely oil-supply shock, aggregate-demand shock and oil specific demand shock. This study thereafter apply a structural vector autoregressive method to find out the implications of these underlying structural shocks to oil prices on the stock market in Pakistan.

2.2 Oil Price Uncertainty and Corporate Investment

Theoretical and empirical research has addressed the link between the uncertainty and corporate investment for many years. Theoretical efforts in the early eighties like Cukierman (1980), Bernanke (1983), and McDonald and Siegel (1986) motivated the research work in this field. These researchers investigated the consequences of waiting options and the irreversibility for the corporate investment decisions. Irreversibility of investment leads to a real option for the firm to postpone the investment. Value of the waiting option is increased by rise in uncertainty about future profits which imply the adverse effect of uncertainty on the investment.

On association of investment and uncertainty, significant amount of work has been done but their results and findings cannot reach to a conclusion helpful for making decisions because of various theories focusing different ways. Particularly association between uncertain situations and investment decisions cannot be established due to Economic theory. It is critical to separate the firm in confinement from firm saw in connection to different firms (Leahy and Whited, 1996). In the previous one, we have to think about the change in companys condition, for example; difference in daily stock prices and in this case uncertainty directly influences investment. While in last case, as we focus on association of different firms together, hence we consider covariance of a firm changes from other projects also and uncertainty in this case only affects when it disturbs covariance of various projects. In view of these two cases, there are three famous models from alternate points of view to describe the investment and uncertainty link. First model is about covariance.

The capital asset pricing model (CAPM) is about connection of assets risk and return. Risk of assets is estimated by the covariance of its returns and market portfolios. Along these lines, more covariance implies more risk to investment which thus increases the returns rate required by the potential investors. Higher returns rate demand on investment by the investors brings down the investment and the stock of capital. Hence, negative link between investment and the uncertainty is predicted by CAPM.

The other two models focus on the variances of shocks firms face in the individual capacity. Regarding investments Leahy and Whited (1996) anticipate distinctive impact of uncertain situations relying on the marginal revenues curvature shape.

Hartman (1972), for example, uses the relative flexibility of labour and capital to produce the convex return. His model is based on two assumptions. First, firms can choose only the capital input prior to knowing the labour cost and output price. Second, firms can choose the labour after observing wage and output prices. So, under a linearly homogeneous production function, the marginal product of both capital and labour is a function of the labour-capital ratio. If the labour and capital ratio can be changed to adjust to fluctuation of output price, the change in marginal revenue product of capital will be more than the changes in output price. Thus, increased output price uncertainty increases the incentive to invest.

Abel (1983) finds that no matter what curvature the marginal product of capital has, higher uncertainty leads to higher investment given current product price. However, this curvature is important in explaining the relationship between the expected growth rate of investment and the expected growth rate of the marginal product of capital. When the function of the marginal product of capital is convex, the expected growth rate of investment is less than the expected growth rate of marginal product of capital, multiplied by the elasticity of investment uncertainty, and vice versa.

The principle class of models centers on the part of irreversibility of firm investment resolutions and predict a sunken negligible income result of capital. Mostly, in any case, investments are in any event halfway irreversible. They generally include a sunk cost that can't be recouped if the market ends up being more regrettable than anticipated. Though, firms are responsible for the planning of their investments. They can simply put off the venture choice and hold up until the point when new favorable situation arrives. Until arrival of new evidences, investment pronouncement can be delayed. Consequently, if a venture is irreversible and can be postponed, they turn out to be extremely touchy to vulnerability over future settlements.

Irreversibility can emerge from numerous parts of business. Once investment is made it becomes difficult for the firms to disinvest and redeem their investment money, since investment expenditures made to buy machinery and plants and install them are hard to recover back due to valuation and resale problems with respect to these items. Further regulations by the Governments can likewise influence irreversibility and can restrict it. For instance, capital controls measures by governments can it difficult to convert the currency on to another currency after sale of business assets.

Investment project which is irreversible can be described and has similarity with the call options used in finance. An agreement is made between the two parties in a financial call option. In this agreement the party purchasing the option posses the right of buying an asset in future at certain agreed price in an agreed future time period. The value or price of real option is made in general is based upon the value assets underlying at present time in the market plus the future expected volatility. In the wake of practicing the alternative, the purchaser can't recover the cost, despite the fact that the purchaser could trade the asset through sale to another person.

A firm with venture openings of investing can use the choices available, that is, spend the cash currently on investment ventures, or do as such later on to seek after another opportunity in the future times. This activity is likewise irreversible. Correspondingly, this venture opportunity could be an asset or a task that can be exchanged to alternative firm. In the event that a firm uses the option of investing today, it loses the chance to use this money or the asset from allocating to some project or elsewhere while opting to wait and see for another profitable opportunity. Changes in economic situations that can influence the flow of cash flows in the future periods can significantly affect firm plans about the investment (Dixit and Pindyck, 1994).

Investment level changes and business circle are being explained via irreversibility by (Bernanke, 1983). He contends that on account of the irreversibility of invested assets and the unavailability of choice of allocating these resources into another profitable opportunity available in the future time periods the ultimate decision usually investors make is to go far delaying this investment plan until the point when new favorable situation of investment comes. Pindyck (1991) states that net present value rule are made invalid by irreversibility. That is, the estimation of a unit capital must equivalent the total of the cost of a unit and loosing the choice of making investment in the future.

There are about two ways in which irreversible investment is affected by the uncertainty. One way through which its impact are transmitted to firm is by affecting the marginal revenues of additional investment and second path through which effects are transmitted is through its competing rivals expected way of marginal revenues from additionally invested capital (Caballero, 1991).

The recent literature on real options focuses on the compound option theory. Basically, compound option theory suggests that there are two options when firms make their investments: the option to wait and the option to grow. The first option tends to discourage investment while waiting for new information to make a better decision. The other option encourages early investment to take advantage in terms of market share and opportunities for growth.

Kulatilaka and Perotti (1998) investigate decision making with respect to irreversible investment under imperfect competition and uncertainty. They point out that there are two assumptions in the literature: first, firms are assumed to have monopoly over investment opportunities. That is, the investment opportunity is secured and there is only a small impact on the market. Second, the product market is assumed to be perfectly competitive. However, these two assumptions do not always hold in the real world. For example, while firms wait for new information, other firms may take this opportunity to gain market share or grow their business.

In this sense, when facing uncertainty in an imperfect market, firms are affected by two options: the option to wait for new information and the option to grow the business. Rising uncertainty increases the value of the option to wait to invest, which results in delayed investments. However, this effect does not hold permanently. After a certain point, uncertainty eventually leads to an increase in investments, due to the increased option value of taking market share or business expansion. They also point out that rise in the uncertainty, raises the value of option of the growth more than the value of the waiting option of investment.

Nevertheless, negative uncertainty and investment relationship view point is now softened by the latest literature on the real options and the strategic investments. Smit and Trigeorgis (2004) pointed out this development in the uncertainty and investment literature by stating that investment decisions involve the future development options also besides the sacrificing waiting option.

Recent evidence shows that the value of both the waiting and growth options is increased by the rise in uncertainty (Kulatilaka and Perotti, 1998) and (Sarkar, 2000). All together, strategic investment and imperfect competition erode the worth of waiting option (Grenadier 2002, Akdogu and MacKay2008). In order to find out the sign oil price uncertainty and investment association empirical investigation is needed. Carruth, Dickerson and Henley (2000) reported that past empirical evidence, especially for the micro level data; support the negative link between the uncertainties and investments. A majority of the studies empirically examining this link and inspired by the fresh panel data analysis also support the view point of negative effects of uncertainties on the corporate investment decisions.

There is no consensus regarding the use of proxy for uncertainty and variety of uncertainty indicators has been used in the literature. Business sentiment surveys perception of managers at the companies in the Belgium was used as the proxy for the price and demand uncertainty by (Fuss and (Vermeulen, 2004). Guiso and

Parigi (1999) used the measure of demand side uncertainties based upon the views of business leaders in Italy. Analysts earnings forecast spread was used by (Bond et al., 2005) as proxy for the uncertainty.

Ferderer (1993) used interest rates and options prices etc as measures for uncertainty indicators. ARCH and GARCH models are also frequently used to forecast the volatility in empirical literature regarding the uncertainty and investment (Price, 1996). ARCH and GARCH model generated indicator explicitly express the expected volatility. On the other hand, this model involves two stages. In addition, this method is not as good in case of high frequency data as it normally contain a low persistence of shocks.

Recent studies mostly used the historical data uncertainty indicators (e.g. Bond et al, 2005 and Bloom et al, 2007). Present study uses the observed measure of uncertainty, but this study does not rely on single measure only, like stock price volatility.

Literature evidence show that only few attempts in past have addressed the implications of uncertainties in the oil and gas sector, but they produces mixed results. Favero, Pesaran and Sharma (1992) studied the oil and gas sector in the UK. Their results show that uncertainties significantly affect in the determination of the investment. Hurn and Wright (1994) in contrast found no evidence of any effect of oil price uncertainty on the oil and gas fields investment decisions in the UK.

Mohn and Misund (2009) investigated the impact of oil price uncertainty along with stock market uncertainty on the investment behavior of oil and gas companies. They found negative effect of stock market uncertainty, while positive impact of uncertain prices of oil market on corporate investment. Casassus, Collin-Dufresne, & Routledge (2018) in their study also assumed that investment in reserves of oil as irreversible.

Elder and Serletis (2010) studied the impact of uncertain oil prices on aggregate investment and the U.S economic growth. They used bi variate GARCH model and reported that increase in oil price volatility reduces the investment and economic growth. Elder and Serletis (2009) in a similar study found similar results for Canada.

Yoon and Ratti (2011) examined the outcomes of uncertain energy price levels on the investment in the U.S and reported negative effect on investment coming through reduced sales growth. Ratti, Seoul and Yoon (2011) investigated the effects of changes in the energy prices on investment in Europe for different industries. They reported negative effect energy price uncertainty on the corporate real investment. They also reported more significant negative impact for manufacturing firms as compared with the other non financial companies.

Henrique and Sadosky (2011) assessed the implications of uncertain prices of oil market for the firm level strategic investment in the USA by using the real and compound options theory. They reported results which are against the linear relationship assumptions and found U shaped association between oil price uncertainty and investment.

Wang et al. (2017) examined Chinese corporations investment behavior in response to uncertainty originating from the international oil price. They reported significant discouraging effects of uncertain oil prices are more serious for the firms which are not owned by state than the state owned companies.

The model utilized as a part of this investigation expects decreasing revenues from additional investment in the face of uncertainty and spotlights on the part of irreversibility of firm speculation. Since Bernanke (1983) contends that on account of the irreversibility of invested assets and the unavailability of choice of allocating these resources into another profitable opportunity available in the future time periods the ultimate decision usually investors make is to go far delaying this investment plan until the point when new favorable situation of investment comes, therefore this model predicts a negative impact of uncertain situations on the corporate investment decisions. In addition this study includes the point of view argued by the recent literature about the presence of theory of the compound options. This theory proposes that firms making investment have two choices. One option (choice) involves the waiting for good time to come and then go for investment and other is to go for gaining the strategic growth by investing now.

Kulatilaka and Perotti (1998) put forth from their findings about that investment and uncertainty association does not remain same over the time. In the start value of waiting option is increased with increasing uncertainty, which consequently encourage delaying the investment plans. When uncertainty increases beyond a certain point then g value of options for growth surpass the option of waiting, this therefore result in rising investment levels.

Henrique and Sadosky (2011) empirically examined the data of U.S. organizations and reported the presence of both the waiting and the growth options theoretical evidence. They reported the U-shaped curvature of the investment when faced with the uncertain oil prices. Accordingly, since Pakistan completely relies upon imports for its oil utilization, this study therefore expect to see uncertain oil prices more significantly and negatively affecting investment by the firms in Pakistan. Also, in light of the fact that two choices interfere with each other in view of compound option theory, this study further use the second hypothesis of investigation that there is a U-shaped instead of direct linear link between uncertain oil prices and Pakistani firm-level investment decisions.

Element of size of the firm was included in the model by (Ratti, Seoul and Yoon, 2011). They tested the firm size influence on the link between investment and the uncertain energy prices. They reported the less significant negative impact of expanded energy costs on firm level investment for huge firms. These outcomes recommend that substantially larger firms are adaptable when confronting increasing energy prices and have better capacity to shield from the rising prices of the energy than the small size firms.

Along these lines, it is hypothesized that effects of uncertain oil price on the small size firms are more seriously negative than the large size firms.

In addition to size this study also explores the difference of oil price shocks effects based upon oil intensity of the firms. (Lee and Ni, 2002) in this context examined the effects of oil price shocks on the supply and demand of goods and services by various industries. They found evidence in favor of reduced supply for oil intensive industries like chemicals industries and those engaged in refining petroleum products. In comparison to this they found demand reduction effects of oil price shocks for other industries particularly for auto sector.

2.3 Decomposed Underlying Oil Price Shocks and Corporate Investment

Traditional point of view of treating shocks to oil prices as exogenous variable and assuming same and similar effects of oil price shocks has been questioned and opposed by recent research work on the oil price literature. Recent researchers on the other hand, came up with view point that oil price changes are resulted by macroeconomic variable also. This approach leads to the decomposing the oil price changes into the structural shocks (Kilian, 2009; Kilian and Park, 2009). This approach of oil price decomposition implies that, various underlying oil price change sources may involve different impact on the relevant economic variables. Past literature generated mix views on the subject of the impact of oil-price shocks on the stock market prices and returns. Chen et al. (1986) found that oil prices changes have no effect on the tendency of stock price movement, whereas Jones and Kaul (1996) show negative relationship evidence. However Huang et al. (1996) and Wei (2003) do not the negative association, viewpoint.

Kilian (2009) criticized the past studies, for the reason that researchers treated oil-price shocks as exogenous. There are studies on the other hand, which argued that oil price changes also react to the same causes which also affect stock market prices (Barsky and Kilian, 2002, 2004; Hamilton, 2005; Kilian, 2008). Therefore aggregate shocks to oil prices must be decomposed into the underlying structural shocks reflecting the endogenous features of such shocks to oil prices. Decomposing the shocks to oil prices helps eliminate deficiency of past research work which took oil prices as exogenous variable affecting the economy along with other variables. It also help address the weakness of past studies to articulate the differentiated impact of such underlying shocks to oil prices on the financial asset values.

At the industry level Fukunaga et al. (2010) followed the Kilian (2009) decomposed oil price components approach for estimation of changes in elements of oil price effects on the industrial production in the Japan and U.S. they used identified VAR for estimation of the models. They reported different effects of each underlying oil price element of shock and type of industry. They reported significant negative effects of oil supply disruptions for oil intensive industries coming through the supply side and for less oil intensive industries coming through the demand side. For the U.S they found increasing effects of aggregate demand side oil price shock and oil specific demand component of shocks to oil prices causes negative effects on the supply side shocks of industrial production.

In this context Henrique and Sadosky (2011) use a sample of U.S. firms for estimating the effects of oil price uncertainty on the firm level strategic investment in the USA by using the real and compound options theory. Henrique and Sadosky (2011) raised points which imply that ideally there should be a framework that uses the different sources of oil price uncertainty which should be included in an investment and oil price uncertainty model. They argued that uncertainty of oil prices can results from number of conditions like the global supply and demand and other reasons. However they expressed their inability to model this decomposed oil price uncertainty sources approach and therefore used the traditional oil price variable in their model and estimation of the study. Therefore their study cannot explain the distinguished effects of each source of oil price uncertainty responsible for changes in firm level investment. Present study therefore fills this gap by using the Kilian (2009) approach for the first time for estimation of oil price uncertainty and corporate investment.

This present study therefore fills following gaps in the previous literature available on the topic. First and main limitation of past studies is that they used average oil price and did not use the decomposed shocks to oil prices framework for examining its effects on the corporate real investment decisions. In this sense these studies suffers from limits of treating shocks to oil prices as exogenous shocks and their inability to explore distinguished effects of different underlying oil shocks. This study therefore for the first time uses the decomposed model for investigating the distinct effects of underlying oil shocks on the corporate real investment behavior. Additionally although there are several studies on the impact of oil prices on the financial and economic variables at the aggregate level, there is limited empirical work at firm level.

Secondly the recent mainstream literature on the topic has followed the Kilian (2009) demand and supply based decomposed oil shocks model. Such studies used World oil production, world aggregate demand shock and oil specific demand shocks in their framework, ass is evident from the studies like, (Apergis and Miller, 2008), (Ono, 2011), (Lippi and Nobili, 2012), (Baumeister and Peersman, 2013), (Gupta and Modise, 2013) , (Kilian and Murphy, 2013), (Degiannakis et al, 2013), (Caporale and Ali, 2015), (Kolodzeij and Kaufmann, 2014), (Chen, Hamori, and Kinkyo, 2014) , (Broadstock, & Filis, 2014), (Kang, Ronald and Kyung, 2015). However this existing research work using decomposed shocks to oil prices approach has mainly addressed the developed world and no previous study on the topic, could be found for developing countries like Pakistan. Therefore, we do not know about the dimension and potency of the effects of underlying shocks to oil prices on the investment in financial assets like share prices and corporate investment in the developing economies like Pakistan.

Keeping in mind the differences across the countries Crompton and Wu (2005) put forth that the impacts of shocks to the oil prices on the markets are likely to be different from nation to nation due to different industrial structures, energy structures, energy consumption intensities, imports dependence level and pricing mechanisms. Pakistan is highly dependent on the import of oil and other energy sources. Pakistan spent \$14.77 billion on import of oil in 2014 which was about 1/3rd of its import bill. Decrease in international oil prices in 2016 has caused reduction of about 37 percent in the oil import bill of country which fell from \$12.166 to \$7.667 billion in FY15. Therefore, price variations in the global oil market and their components have become a vital issue for the economy of the country and this demands proper understanding of their potential effects on the stock market and corporate investment behavior. In this environment of heavy oil import dependence the government agency OGRA is regulating the oil prices in Pakistan and international oil prices are not as it is passed on to consumers instantly, this study aims at investigating the nature and extent of relationship between oil price uncertainty and corporate investment decisions in Pakistan, besides investigating the implication of shocks to oil prices for stock market in Pakistan.

2.4 Research Hypothesis:

In the light of foregoing literature review hypothesis for this study are suggested here in this section.

Based upon Kilian (2009) that there are different sources of oil price shocks and they are not the same and are different from each other. Literature following Kilian & Park (2009) support the viewpoint that affects of different underlying sources of oil price shocks on the stock market is not the same and are different from each other, therefore the first hypothesis of the study is:

H1: Effect of different underlying world oil price supply and oil specific demand shocks are negative, whereas of world aggregate demand shock is positive on the stock market in Pakistan.

Based upon literature recent evidence especially from Wang et al. (2017), Mohn and Misund (2009) and Henrique and Sadosky (2011) second hypothesis of the study for an oil price regulated environment is:

H2: Higher the oil price uncertainty lowers the corporate real investment, however overall has U shaped relationship.

Since main stream recent literature focusing the topic has followed the Kilian (2009) demand and supply based decomposed oil shocks model. They have argued logically in favor of the decomposed oil shocks methodology and provided evidence of effects of oil shocks in different directions and potency therefore present study uses this methodology for investigation the oil price uncertainty effects of the corporate investment decisions for the first time. Therefore third hypothesis for this investigation is:

H3: Effect of different underlying oil price shocks on the corporate investment is not the same.

Based upon literature evidence in the past, affects of oil price uncertainty are more likely to be severe for oil intensive firms than the less oil intensive firms. Fukunaga et al. (2010) found supported evidence of more severe effects for oil intensive industries in Japan. Lee and Ni (2002) also in this context found evidence in favor of reduced supply effect for oil intensive industries like chemicals industries and those engaged in refining petroleum products. In comparison to this they found demand reduction effects of oil price shocks for other industries particularly for auto sector. Therefore fourth hypothesis of the study is:

H4: Higher the oil price uncertainty, the lower the corporate investment, for oil intensive firms than the less oil intensive firms.

Ratti, Seoul and Yoon (2011) included and tested the firm size influence on the link between investment and the uncertain energy prices. They reported the less significant negative impact of expanded energy costs on firm level investment for huge firms. These outcomes recommend that substantially larger firms are adaptable when confronting increasing energy prices and have better capacity to shield from the rising prices of the energy than the small size firms. Therefore in this study, it is hypothesized that effects of uncertain oil price on the small size firms are more seriously negative than the large size firms:

H5: Higher the oil price uncertainty, the lower the corporate investment, for small firms than the large size firms.

Chapter 3

Data and Methodology

In this chapter empirical methodology techniques and data of the study are discussed. Empirical techniques and data presented below in this chapter to investigate the implications of oil price shocks for the stock market in Pakistan and the effects of oil price uncertainty on the corporate investment decisions. This study also discuss the data and methodology to estimate the effects of underlying oil price uncertainty on the corporate investment decisions in Pakistan.

3.1 Oil and Stock Market

Empirical methodology and data regarding the implications of oil price shocks for the stock market are presented in this section. . Empirical methodology discussed below includes the Structural VAR model, Impulse responses and variance decomposition variance decomposition analysis of the SVAR model. Lastly data and sources of the data are presented.

3.1.1 Structural VAR Model

In this study structural VAR model is estimated to identify sources of oil price shocks and to examine their consequences for the stock market in Pakistan. The structural oil shocks include global oil supply shock, an aggregate demand shock and an oil-specific demand shock. The structural VAR model represented as following:

$$A_0 y_t = \alpha = \sum_{i=1}^{p} A_i y_{t-1} + \varepsilon_t$$

Here yt represent a (4 1) vector that contains world crude oil production (WOP), world real economic activity (REA) real oil prices (ROP) and real stock price (STP). A0 denotes coefficient matrix, symbolizes constant term vector, and t represent a vector of structural shocks which are serially and mutually uncorrelated. After applying the reasonable restrictions to identify, reduced-form errors estimated obtained from equation given below can help recover the structural shocks:

$$e_t = A_0^{-1} \varepsilon_t$$

where et denotes the reduced-form errors

Following Kilian (2009), a VAR is estimated to identify oil shocks in first step of analysis. In the second step, this study analyzed the effects of these identified shocks on the stock market index.

Since oil prices are regulated by Government in Pakistan and oil contacts are made by Government 45 days in advance. Therefore delayed effect is expected in Pakistan. In this case oil price of past lag 45 days shall be used by study for current month price to adjust for 45 days advance purchase agreements. However in annual data effect is included in annual oil prices. Moreover, oil price set today in market also includes the effects of future movement also.

Therefore delayed effect is expected in Pakistan. In this scenario oil price effect will be late with delay of 45 days. Govt. cannot delay passing on effect of oil price shock for unlimited time. In line with the approach taken by Kilian (2009), a VAR will be estimated by using 24 lags of each variable. This can help assessing the likely implications of oil prices over the longer time periods also.

Identification of structural oil price shocks is done by using the structural VAR method. However Choleski decomposition method is used for the exogeniety order of variables in the structural VAR model. Insight from the literature shows that the order of variables according to the exogeneity of variables is WOP, REA, ROP and STP. Order in this sequence implies that a shock to a variable higher in the order has contemporary impacts on the variables in the lower order but not vice versa. Past studies including the Kilian (2009) imply that a World oil production (WOP) has the least response to other variables due to higher cost of adjustment. This order becomes REA, ROP and STP in terms of exogeneity.

Therefore, the VAR in the reduced-form is hereby formed after multiplying both the sides of Eq. (1) by $A0^{-1}$, and it is represented below in a recursive structure:

$$\begin{pmatrix} u1_t \\ u2_t \\ u3_t \\ u4_t \end{pmatrix} = \begin{bmatrix} 1 & 0 & 0 & 0 \\ a21 & 1 & 0 & 0 \\ a31 & a32 & 1 & 0 \\ a41 & a42 & a43 & 1 \end{bmatrix} \mathrm{X} \begin{pmatrix} \varepsilon_{oil\ supply\ shock} \\ \varepsilon_{aggregate\ demand\ shock} \\ \varepsilon_{oil\ specific\ demand\ shock} \\ \varepsilon_{Stock\ Price\ shock} \end{pmatrix}$$

3.1.2 Impulse Response to Structural Shocks

Impulse responses are used to elaborate the respective importance of each of the structural shock identified in as a source of oil price changes and stock prices, the of real oil prices (ROP) and other related variables to a shock of one standard deviation are performed.

3.1.3 Variance Decomposition

In this section, in addition to impulse response analysis variance decomposition is estimated to investigate how much different structural shocks contribute to the changes in other variables included in the VAR model.

3.1.4 Data

A brief description on the data used in the oil and stock market empirical analysis is presented in this section.

This study uses the monthly data from July 1997 to June 2017. Since objective of the present study is the investigation of the impacts of changes in oil prices on the aggregate stock prices of the market, therefore Pakistan Stock Exchange in Pakistan index is used as a measure of stock market. Since individual stock price has undiversifiable risk associated with the individual entity and industry it belongs to so different industries have different degrees of oil dependence. Some use crude oil as a raw input while others may only use it for transportation and heating. Thus, the individual stock price may show a biased response when facing oil price fluctuations. The real stock returns are calculated by deducting the inflation rate CPI from the returns in the logs of Pakistani stock price index (KSE 100).

This study uses three different underlying of oil price uncertainty as the measures to calculate the oil price uncertainty. Kilian (2009) discussed three underlying of oil price changes which are oil supply shocks, aggregate demand shocks and oil specific demand shocks. Kilian (2009) has defined these in following manner:

"shocks to the current physical availability of crude oil (oil supply shocks), shocks to the current demand for crude oil driven by fluctuations in the global business cycle (aggregate demand shocks); and shocks driven by shifts in the precautionary demand for oil (precautionary demand shocks). Precautionary demand arises from the uncertainty about shortfalls of expected supply relative to expected demand. It reflects the convenience yield from having access to inventory holdings of oil that can serve as insurance against an interruption of oil supplies (see Ron Alquist and Kilian (forthcoming) for a formal analysis). Such an interruption could arise because of concerns over unexpected growth of demand, over unexpected declines of supply, or over both. One can interpret precautionary demand shocks as arising from a shift in the conditional variance, as opposed to the conditional mean, of oil supply shortfalls. Such shifts in uncertainty may arise, even controlling for the global business cycle and the global supply of crude oil".

Present study uses the global oil production (WOP) to represent the world oil supply, which reflects both the OPEC and non OPEC countries political uncertainties and cartel activities. This data is collected from the Energy Information Administration (EIA). To represent the global aggregate demand, this study follows Kilian (2009) which used dry cargo freight rates as an indicator of world real economic activity.

To represent the oil specific demand shock real oil Price (ROP) is used. It is measured by using the Cushing, OK WTI Spot Price FOB (Dollars per Barrel). Free-on-Board (FOB) importing price of crude oil was by following Kolodzeij and Kaufmann (2014). Monthly data of WTI Spot Price FOB oil prices is available from https://www.eia.gov/dnav/pet/hist/LeafHandler.ashx?n=PET&s=RWTC&f=M. a link of the US E.I.A. Free on board oil price measure is used since other measures like US West Texas Intermediate prices contain the effects of freight charges also. Finally real oil price is obtained after deflating the oil prices by the US inflation rate. The US CPI data is available from the IMFs International Financial Statistics.

3.2 Oil and Corporate Investment

3.2.1 Tobin Q Theoretical Model

Q ratio which is widely used model of modern empirical research in the field of investment was introduced by (Tobin, 1969). It is commonly known as Tobin Q and simple and intuitive. In this model investment is related to Q ratio. Tobin q is the ratio between the market and replacement value of an asset or a firm. It presume that valuing the stock market can help measure the maximum value of a firm under the certain assumptions perfect competition and constant returns. Additionally theory implies that Tobin Q ratio sufficiently explains the investment. Therefore Q ratio should be providing comprehensive picture of profit prospects and the investment behavior. Extra information like cash flows could not have a say in explaining the investment trends.

Tobin q is equal to 1 where the market value and the book value of a firm are equal. Where the market value of a firm is greater than the book value of its assets, its Tobin q ratio shall be greater than the 1. This situation imply over valued stock of the firm and making more investments is beneficial for the firm, since the real cost of capital is less than what the firm can get by issuing shares. In a situation where the Tobin q ratio is less than the 1, it shows that the firm value is undervalued in the market and that the book value of firm is more the value of its shares in the market. In this situation it is better for the firm not to replace its capital. According to the Tobin q model of investment value of a firm is the driving force behind investment spending. Tobin's q model has been the most popular model among all models that capture the dynamics of investment.

Anyway as the Dixit and Pindyck investigation proposes, firms may postpone extension or constriction for quite a while and may just do as such if q remains fundamentally above or beneath unity. The Efficient Markets Hypothesis (EMH) recommends that stock price and market value of an organization portray all the information about the future expectations and its scenarios. In this way, market value of a share contains information about business essentials, for example, income, profits, future dividends, administrative execution, economic situations and the market's desire for the future patterns in such factors. Theoretically, it is arbitrage procedure to precisely mirror the inborn estimation of organizations. Whenever the value of share prices goes above the fundamental price of it, then agents in the market will start selling these shares, which as a consequence will drive the price back to its original position.

Therefore in this sense, the q's numerator gives a right clue of the present worth and possible scenarios for the future of the company. In the event that a firm faces a q less than 1, at that point this is an indication that it should purchase extra capital in light of the fact that the present estimation of its profits forecast for the future from such capital will be higher than their costs. Obviously, when a firm grows its capital stock it will confront decreasing returns, due to decreasing product of additional of capital. This will tend to make q ration return to unity. In any case, if the EMH is right, prices and values of the shares will furnish true information about the firm's present position and likely future chances so that potential investors and agents can decide in a better way about their buy or sell decisions. In case that the business sectors in the market values a firm is very well, at that point q will rise and the company should expand its capital stock. This can be accomplished by either obtaining capital or by assuming control over the assets of different firms.

Assembling these pieces, expanded interest for physical capital by portfolio holders increases value of share prices which bring down the cost of capital. Whenever the cost of capital becomes low, the management of business is induced to invest more. This channel of transmission from the stock market valuation of share prices to the investment decisions by the firms works via NPV net present value (NPV) figuring by the managers. Management use the criteria of NPV to make investment in the projects. Projects having positive NPV induce the managers to invest.

Therefore, as per Brainard and Tobin (1968, 1977), the announcement that supervisors just embrace venture with positive net present value is constrained to the limit that management just go for investment in projects where a q value is higher than one. Higher share prices and stock markets both are considered as symptom of good conditions according to a point of view of the Brainard and Tobin (1968, 1977). Stock market forum facilitate the investors in communicating their desire for investment in the physical assets. Firms react and accumulate the desired money.

Whenever stock prices are high, this boost the investment in projects and formation of capital, as increase in the value of stock prices help in bringing down firms' cost of capital. q is an especially helpful pointer since it is a "composite" flexible that considers both the "cost of capital" and marginal efficiency of investment. The cost of equity reflects both the future profit expectations and their readiness to acquire capital by the potential investors, since these components are embodied in the share prices. Subsequently q contains both the financial and the real values that need to be considered before making the investment decisions and it is this composite character that suggests q for empirical estimation of investment model.

Assumptions are made to simplify many aspects. First assumption is that the objective of the firm is maximization of the value of the equity owned by all shareholders, who are assumed to be risk-neutral. So this research study does not consider the effect of risk on the firm's required rate of return. Second, this firm pays no taxes and issues no debt, so financial policy is also outside consideration of this study. Third, the market is perfectly competitive and investors can access all information about prices and products at zero cost.

3.2.2 Empirical Model Specification

Following Bond and Reenen (2007), following Q model relating the investment to the q ratio is used under the standard neoclassical assumptions regarding the behavior stated above. Complete derivation of the Eq. (1) is given in Appendix A.

$$\frac{I_t}{K_t} = a + \frac{1}{b} Q_t + e_t \tag{1}$$

In this Eq. (1), I_t is the gross investment of the firm, K_t is the fixed capital stock of the firm, Q_t represent the marginal q (Q=q1) and e_t is a random error term. The Eq. (1) is the base for the most of the empirically testing papers of q theory (i.e Summers, 1981; Hayashi, 1982; Fazzari et al., 1988; Blundell et al., 1992; Hubbard, 1998).

The benefit of q model is that the current investment decision is explicitly modeled, and the parameter in the model is from the adjustment cost function, which should be invariant to structural changes. On the other hand, q model may be seriously misspecified since Q theory has been criticized for the reasons that empirical conditions under which Tobin Q is tested differs from the theoretical conditions assumed for the deriving the Q model. For example, Blanchard, Rhee and Summers (1993) find that fundamentals are more useful in predicting investment of

U.S. firms than Tobin's q from 1920s to 1990s. Others reasons of criticisms includes grounds like, because the adjustment cost function may not be symmetric and quadratic as specified above. This relationship can be asymmetric or even non-linear. Perfect competition and constant returns to scale may not be realistic for any firm.

However, much literature challenges this interpretation. A general equilibrium model having dynamic features, with financial frictions was developed by (Gomes, 2001) and tested it with simulated data. He finds that Tobin's q has good explanatory power for the variability in Investment, and that cash flow does not provide any additional power. Bond et al. (2004) answered this criticism in following manner.

"The well-known Q model of investment relates investment to the firm's stock market valuation, which is meant to reflect the present discounted value of expected future profits. For the special case of perfectly competitive markets and constant returns to scale technology, (Hayashi, 1982) showed that average Q the ratio of the maximized value of the firm to the replacement cost of its existing capital stock would be a sufficient statistic for investment rates. The usual empirical measure, which we call Tobin's Q, further assumes that the maximized value of the firm can be measured by its stock market valuation. Under these assumptions, the stock market valuation would capture all relevant information about expected future profitability, and significant coefficients on cash-flow variables after controlling for Tobin's Q could not be attributed to additional information about current expectations. However if the Hayashi conditions are not satisfied, or if stock market valuations are influenced by 'bubbles' or any factors other than the present discounted value of expected future profits; then Tobin's Q would not capture all relevant information about the expected future profitability of current investment. In this case additional explanatory variables like current or lagged sales or cash-flow terms could proxy for the missing information about expected future conditions. (Cooper and Ejarque, 2001) provide a recent illustration of this mechanism, using simulated data from a model in which firms have market power and average Q is not a sufficient statistic for investment rates."

The attractiveness of q model has at least two advantages. First, it is simple and has an intuitive relationship between investment and book to market ratio. Second, q represents a sufficient statistic for investment based on neoclassical economic theory and is tested extensively in the empirical applications. The center of attention of the present study is investigating the part of oil price uncertainty in the investment behavior of Pakistani firms, thus the q model is a good starting point for my theoretical model.

Eq.1 implies that Q_t should be an endogenous variable in this model. In addition, Eq.1 is usually augmented with other explanatory variables of interest. Fazzari, Hubbard and Petersen (1988), added the cash flows variable into the model, which relates the investment to Tobin.s q and was followed by many studies. Agency theory also justifies Using the cash flow to explain the strategic investments. An agency problem regarding the strategic investments can arise due to asymmetric information and incompatibilities of the incentives (Jensen and Meckling, 1976).

Managers involved in the decision making of strategic investments normally have extra information's regarding the expected net present value of the investments than the owners, shareholders and upper level managers and managers are strongly induced to invest in projects serving their private interests more than the social benefit of organization on the whole. Consequently, there is possibility of over investment at the firm level. This likely hood of agency problems discourages the financial capital lending agencies from lending the money for strategic investment projects of the companies, making debt and equity financing costly and difficult for firms. (Fazzari et al., 1988; Stulz, 1990). These financial constraints can stop firms from investing in investment opportunities having good profitability. Therefore firms are more inclined to invest when they have their own cash flows available.

Past studies have used different types of uncertainties indicators like profitability, sales, exchange rate and stock prices to model the uncertainty for examining the link between uncertainty and investments. Present study focuses investigating the association between one particular category of macroeconomic uncertainty which is oil prices uncertainty and corporate investment.

This study follow the Henrique and Sadosky (2011) procedure by, including cash flows, oil price volatility, and squared oil price volatility into model. Squared term is used for Exponential growth rate. Exponential growth rate is used when something grows quickly, or grows faster and faster. It's involves a non-linear relationship. In statistical models such type of techniques are known as semi-parametric empirical technique. Study uses GARCH to measure oil shocks. Alternatively Oil Price Volatility is also measured by using the historical estimates of the variances of the sample period. Data of daily oil prices of WTI free on board is available from the U.S. Energy Information Agency.

$$\frac{I_t}{K_t} = a + \frac{1}{b}Q_t + \mathrm{cf}_t + \mathrm{O}_t + \mathrm{O}^2{}_t + \mathrm{e}_t \qquad (2)$$

Moreover, since firms may not have similar investment rates due to technology shocks, and there may be common trends affecting all firms in the same way (e.g., business cycles), Eq.2 is further enlarged with fixed effects for individual firms η_i and time period effect μ_t, where i is for individual firms and t is for different time periods

$$\frac{I_{it}}{K_{it}} = a + \frac{1}{b}Q_{it} + cf_{it} + \mathrm{O}_{it} + \mathrm{O}^2{}_{it} + \ + \eta_i + \upsilon_t + \mathrm{e}_{it} \quad (3)$$

There is no compelling reason to believe e_t is serially uncorrelated, following Mohn and Misund (2009), Study assume that e_t follows an AR(1) process

$$e_{it} = \rho\, \mathrm{e}_{it-1} + \varsigma \mathrm{e}_{it} \qquad (4)$$

Substituting Eq.3 into Eq.4 yields

$$\frac{I_{it}}{K_{it}} = a(1-\rho) + \rho\frac{I_{it-1}}{K_{it-1}} + \frac{1}{b}Q_{it} - \frac{\rho}{b}Q_{it-1} + \gamma_1 cf_{it} - \rho\gamma_1 cf_{it-1} + \gamma_2 \mathrm{O}_{it} - \rho\gamma_2 \mathrm{O}_{it-1} + \gamma_3 \mathrm{O}^2{}_{it}$$
$$- \rho\gamma_3 \mathrm{O}^2{}_{it-1} + (1-\rho)\eta_i + \upsilon_t - \rho\upsilon_{t-1} + \mathrm{e}_{it} \qquad (5)$$

For econometrics purposes, Eq.5 can be rewritten as

where e_{it} is the white noise and serially uncorrelated. β_6 to $\beta_9$quantify the instantaneous effects of sources of oil prices volatility and their lags on investment.

$$\frac{I_{it}}{K_{it}} = \beta_0 + \beta_1 \frac{I_{it-1}}{K_{it-1}} + \beta_2 Q_{it} + \beta_3 Q_{it-1} + \beta_4 cf_{it} + \beta_5 cf_{it-1} + \beta_6 O_{it} + \beta_7 O_{it-1} + \beta_8 O^2{}_{it} + \beta_9 O^2{}_{it-1} + (1-\rho)\eta_i + \upsilon_t - \rho\upsilon_{t-1} + e_{it} \quad (6)$$

3.2.3 Econometric Methods of Estimation

The empirical framework uses one period lag while relating the investment to the capital ratio to itself, Tobin Q, cash flow, oil price volatility and squared oil price volatility measures. This model estimates and tests a panel data set of about 17 years regarding the over 468 non-financial Pakistani companies from year 2000-2016. The study uses the panel regression for estimating, by using the generalized method of moments (GMM) techniques while taking into account the fixed effects for individual firms, fixed time effect, and potential endogeneity features between the variables.

Generalized Method of Moments (GMM) is outlined by Arellano and Bond (1991) to adapt to the circumstances where there are number of periods are small, but cross sections are large. What's more, GMM does not require perfect information about the dispersion of the data series. However for estimation of the GMM model it need on just specific moments obtained from the model that underlie. A remarkable component of GMM lies in that in models for which the parameters in a model are less than the moment conditions; its estimation gives a direct method to test the determination of the proposed model. Lagged values of the dependent variable are pointed out by Arellano and Bond (1991) as the preferred instrument matrix for estimation of the GMM.

This model in Eq (6) is the case of dynamic linear panel framework, containing the overlooked panel data effect η_i which can be fixed or random either. By the structure of the model, the unnoticed panel-level effects η_i has correlation with the I_{it}/K_{it} and the lag of the exploratory variable resulting which may result in biased estimating approach (Arellano and Bond, 1991). They developed the generalized method of moments (GMM) estimation technique having ability of providing the consistent parameter estimations this type of models. They removed the unnoticed firm specific η_i heterogeneity by using the first difference transformations. The technique introduced by Arellano and Bond (1991) designed for conditions of large quantity of cross sectional and a small quantity of time period series of data and this approach can perform poorly in the situations having too large autoregressive parameters or where the variation of the pane data effect to the variation of the particular error is too large. Blundell and Bond (1998) developed a system GMM estimator addressing these limits by including the level instruments for the level of the equation.

Bond (2002) provides a good overview and comparison of these approaches. Bond (2002) points out that two-step weight matrix can improve efficiency in large samples. However, in small samples, the two-step GMM estimator has severe downward bias. Windmeijer (2005) proposes a solution for the biased two-step estimator in small samples and takes the fact into consideration that the common asymptote type standard errors normally do not consider the additional variance generated by the parameters estimated in while building the capable weighting matrix. He finds that using a bias correction could gain a more accurate approximation in a finite sample even though the correction effects are decreasing with sample size. Thus, in this study, all the estimations are performed with two-step and bias-corrected estimators for the covariance matrix.

3.2.4 Diagnostics Tests for Validity

This study uses the diagnostic tests to make sure that results obtained are valid and robust. Weak instruments could lead to finite sample bias when using first-differenced GMM estimators, in a highly persistent series. Bond (2002), pointed out that first-difference GMM estimator, introduced by Arellano and Bond (1991), require the autoregressive parameters to be significantly less than 1. Therefore this study, before estimating the dynamic q model, attempts to decide whether the dynamic properties of these variables are suitable to be used in GMM. A simple AR(1) regression with and without fixed effects can be used for this purpose. If the coefficients of lagged value come below 1, it would suggest that the first-difference of all the variables is suitable as instruments for the dynamic model. Arellano and

Bond (1991) introduce a test for zero autocorrelation in the first-differenced errors of GMM.

Following the Roodman (2006) this study uses the Hansen J test for testing the soundness of the over identification assumption for the instrument matrix. Compared with Hansen J, the Sargan test, which also tests over identification, is not robust and varies greatly depending upon the autocorrelation and heteroscedasticity and has the tendency of over-rejecting the hypothesis. Thus, Hansen J is used in this study for the over-identification test. Further Wald X Square is used to test the joint significance of all model parameters.

Estimation of the system GMM is performed by treating the Q, cash flow, and lag of investments each as endogenous, while oil price volatility and squared oil price volatility measures, time effects and their lags as exogenous variables. Oil price uncertainty and squared oil price uncertainty measures are used in this model for the reason that compound option theory suggests that the option to wait and the option to grow interact with each other when firms face investment decisions. Testing both volatilities help assessing the non-linear association between the oil price uncertainty and the corporate investment behavior in this study

3.2.5 Firm-Level Data

This study uses secondary data of 468 non-financial companies listed on Pakistan Stock Exchange in Pakistan. The sources of this company level data are various Balance Sheet Analysis (BSA) reports provided by State Bank of Pakistan (SBP), the annual reports issued by the companies, and website of the Business Recorder. This is unbalanced panel data set which covers the 17 years period from January 2000 to December 2016.

This study uses the data items capital expenditures on acquisition of fixed assets, market value capital of capital, long term debts and total assets denoted in millions Pak rupees. Following the Whited (2006) changes in capital expenditure on property, plant and equipment incurred by a company are used as measure for the company investment (I_{it}) divided by capital stock (K_{it}). Following the Mohn and

Misund (2009) the total assets are used as a measure for the capital stock. Tobin's q is calculated by following Chuang and Pruitt (1994) and using company items as, (market value of the company equity + preferred stock value + long-term debt + current liabilities - current asset)/total asset in year t-1.

Consistent with previous literature, the Tobin's q is calculated following (Chuang and Pruitt, 1994).

$$Tobin's\ q = \frac{(CE + PS + LD + CL - CA)_t}{TA_{t-1}} \quad (7)$$

where CE denotes the market value of the company equity, PS represent the preferred stock value of company, LD shows the long-term debt of company, CL denotes the current liabilities, CA represent the current asset of the company and TA shows the total asset owned by the company.

Following Chuang and Pruitt (1994) this study relates the market value of a firm's capital stock to the lag value of total assets i.e. installed capital. It is used to measure the change in market value of firm capital stock installed. Tobin's q depends on current and future expected benefits from installed capital. If MPK exceeds the real cost of capital, firms are able to make profits on installed capital. As a result rental firms become desirous of owning capital. This will raise the market value of stocks of the profit-making firms and corporate investment. The converse is true for firms incurring losses on their installed capital. For such firms since MPK is less than the cost of capital, the market value of installed capital is low, implying a low value of q, too.

Study relates the market value of a firm's existing shares capital to the lag value of total assets, to measure the change in market value of firm capital stock and the Tobin Q value since Tobin's theory implies that investment is made when the change in the firm's market value exceeds its cost. The change in market value relative to capital cost is called 'marginal q. Following the Whited (2006) changes in capital expenditure on property, plant and equipment incurred by a company are used as measure for the company investment. Following the Mohn and Misund

(2009) the total assets are used as a measure for the capital stock. Therefore the investment over the total asset is as follows:

$$\frac{I_t}{K_t} = \frac{PPE_t}{TA_t} \tag{8}$$

Where PPE is the change in expenditure on property, plant and equipment and TA is the total asset. Therefore current investment in current year used not to date.

The control variable, cash flow, is measured as

$$CF_t = \frac{(NI + DDA)_t}{TA_t} \tag{9}$$

where NI indicates the net income, DDA denotes the depreciation, depletion and amortization, TA is the total asset.

Whited (2006) points out that it is important to remove the outliers when working with firm panel data. So for Tobin's q, $\frac{I_t}{K_t}$, CF$_t$, any observations lying outside the 99% confidence intervals are removed as outliers. In addition, compared with other developed countries, mergers and acquisitions are less frequent in Pakistan, so study does not loose other data in samples.

3.2.6 Oil Price Volatility

Pakistan like many other oil importing countries and US, is importing oil from international oil market at the prices of international oil market. Present study is basically aimed at examining the effects of "International" Oil Price on Investment behavior in Pakistan and therefore in line with existing literature on the topic, used International oil prices indicator. In literature past studies Wang, Xiang, Ruan and Hu (2017) in a study published in the Energy Economics examined the oil prices effects on investment Chinese context and put forth that "Daily closing oil prices are measured using the nearest contract to maturity of the WTI light crude oil price contract. The daily oil price data are from the US Energy Information

Agency." Similarly Mohn and Misund (2009) in their paper published in the Energy Economics, even for non U.S companies used International price of Brent Blend Oil. They stated "Based on daily price data for the brent blend quality for each of the last 14 years" Moreover data for local oil prices for the entire period of study on consistent basis is currently not available.

Pakistan is highly dependent on the import of oil and other energy sources. According to the Ministry of Petroleum and Natural Resources (MPNR), 82% of oil usage in Pakistan is met through imports while only 18% of it is met locally. Pakistan spent $14.77 billion on import of oil in 2014 which was about 1/3rd of its import bill. Decrease in international oil prices in 2016 has caused reduction of about 37 percent in the oil import bill of country which fell from $12.166 to $7.667 billion in FY15. Therefore, price variations in the global oil market and their components have become a vital issue for the economy of the country.Therefore for measuring Real Oil Price (ROP) a measure widely used in the international oil market Cushing, OK WTI Spot Price FOB (Dollars per Barrel) is used by this study.

For measuring the oil price uncertainty in general there are two measures used by the literature. One is the standard deviation method which is commonly used by the past literature measuring the uncertainty and other is the GARCH (1, 1) method suggested by (Baum et al., 2008). The GARCH-type models allow the conditional variance to be dependent upon their own previous lag and can explore the grouping characteristics changes in the oil prices and therefore preferred over the standard deviation method. This study therefore uses GARCH (1, 1) to obtain the conditional variances and estimate the oil price uncertainty using monthly data of international oil prices for the period from 2000 to 2016. Diagnostic tests applied for GARCH (1, 1) show that this model is specified well (to conserve space GARCH (1, 1) model results are not reported here). Monthly frequency is annualized by taking average of the 12 months of conditional variance.

However standard deviation method is also used for testing the robustness of results for different proxies of measuring the uncertainty. For this purpose monthly frequency is annualized by taking average of the 12 months of standard deviations.

The monthly data of WTI free on board prices is obtained from the Energy Information Agency. Annualized average returns of oil prices are used for measuring the oil price volatility.

Following previous literature, Tobin's q, $\frac{I_it}{K_it}$, CF_{it} variables in ratio form are winsorized at the 5th 95th percent levels. Negative values for investment, Q, total assets and cash flows were considered as missing. In addition, since compared with other developed countries, mergers and acquisitions are less frequent in Pakistan, so study does not loose other data in samples.

3.3 Decomposed Oil Price Uncertainty and Corporate Investment

This model of the study uses the extended decomposed oil price shocks model of Kilian (2009), to estimate the response of corporate real investment to different underlying sources of oil price shocks. There are different sources responsible for causing the oil price uncertainty. Oil price uncertainty can be from both the supply side and the demand side, such as oil supply disruptions caused by cartel action or unrest in the Middle East, world economic expansion, or precautionary demand from speculators (Kilian, 2009). Since Oil and oil products are used as direct input for producing many of the goods and services, hence uncertainties of oil prices like the uncertainties regarding the other essential inputs of production process also affect the future profit prospects and investments of companies.

Henrique and Sadosky (2011) used oil price volatility, and squared oil price volatility for estimation of the investment model. Treating oil price as exogenous shock was questioned by Kilian (2009) on ground that different sources of oil prices are not alike and cause different outcomes. To address this issue of oil shocks this study therefore here uses the Kilian (2009) decomposed oil price shocks model to assess the impact of underlying oil shocks on oil price volatility, and consequently on corporate investment.

In first step following Kilian (2009) structural VAR technique is used to identify three different sources of oil price shocks. These sources of oil price shocks identified through structural VAR method are oil supply OS_t, oil demand OD_t and oil specific demand OSD_t. Then volatility from residual shocks of these three underlying sources is calculated through the standard deviation method. Standard deviation method is commonly used in the finance literature for calculation of volatility and uncertainty.

3.3.1 Model Specification

The Q ratio is widely used model for empirical estimation of investment. It was introduced by (Tobin, 1969). It is commonly known as Tobin Q and is simple and intuitive. In this model investment is related to Q ratio. Tobin q is the ratio between the market and replacement value of an asset or a firm. Q theory implies that Tobin Q ratio sufficiently explains the future prospects about the profits and hence the investment behavior of firms. Tobin q is equal to 1 where the market value and the book value of a firm are equal. Where the market value of a firm is greater than the book value of its assets, its Tobin q ratio shall be greater than the 1. This scenario imply over valued stock of the firm and making more investments is beneficial for the firm, since the real cost of capital is less than what the firm can get by issuing shares.

In a situation where the Tobin q ratio is less than the 1, it shows that the firm value is undervalued in the market and that the book value of firm is more the value of its shares in the market. In this situation it is better for the firm not to replace its capital. According to the Tobin q model, the value of a firm is the driving force behind investment spending. Tobin's q model has been the most popular model among all models that capture the dynamics of investment. Following Bond and Van Reenen (2007), the Tobin's q model can be derived as shown in Appendix A.

Following Bond and Reenen (2007), following Q model relating the investment to the q ratio is used under the standard neoclassical assumptions regarding the behavior stated above. Complete derivation of the Eq. (1) is given in Appendix A.

$$\frac{I_t}{K_t} = a + \frac{1}{b} Q_t + e_t \tag{1}$$

In this Eq. (1), I_t is the gross investment of the firm, K_t is the fixed capital stock of the firm,Q_t represent the marginal q (Q=q1) and e_t is a random error term. The Eq. (1) is the base for the most of the empirically testing papers of q theory (i.e Summers, 1981; Hayashi, 1982; Fazzari et al., 1988; Blundell et al., 1992; Hubbard, 1998).

The benefit of Q model is that the current investment decision is explicitly modeled, and the parameter in the model is from the adjustment cost function, which should be invariant to structural changes. The Q theory has been criticized due to unrealistic assumptions of perfect competition and constant returns which may not be found for any firm.

In addition, q model may be seriously misspecified since for the reasons that empirical conditions under which Tobin Q is tested differs from the theoretical conditions assumed for the deriving the Q model. For example, Blanchard, Rhee and Summers (1993) found that fundamentals are more useful in predicting investment of U.S. firms than Tobin's q from 1920s to 1990s.

Therefore Eq.1 is usually augmented with other explanatory variables of interest. Agency theory justifies using the cash flow to explain the investment decisions. An agency problem regarding the investment decisions can arise due to asymmetric information's and clash of interest regarding incentives (Jensen and Meckling, 1976). Managers involved in the decision making of strategic investments normally have extra information's regarding the expected net present value of the investments than the owners, shareholders and upper level managers. Managers are also strongly induced to invest in projects serving their private interests more than the social benefit of organization on the whole. Consequently, there is possibility of over investment at the firm level. This likelihood of agency problems discourages the financial capital lending agencies from lending the money for investment projects of the companies, making debt and equity financing costly and difficult for firms (Fazzari et al., 1988; Stulz, 1990). These financial constraints can keep firms away from investing in investment opportunities having good profitability. Therefore firms with greater internal cash flows are more inclined to go for investment expansion projects.

Sudden changes in oil prices and oil price uncertainty can affect the profitability and investment decisions of firms, since it is an important input for most of products. Frequently rising oil prices increases cost of production and consequently reduces the profits of corporations. It also reduces customer demand as rise in oil prices leads to rise in inflation, resultantly less disposable amount available to customers for spending. Fluctuations in the price of energy introduce uncertainty about future energy prices, which results in firms postponing irreversible investments (Pindyck, 1991). Present study focuses on investigating the association between uncertainty of underlying sources of oil prices and corporate investment.

This study modify the Henrique and Sadosky (2011), model by adding sources of oil price volatility to the model which includes oil supply OS_t, oil demand OD_t and oil specific demand OSD_t volatilities and their squared volatilities, instead of using the just oil price volatility, and squared oil price volatility. This decomposed oil price shocks model can help analyze the distinct contribution of each underlying shock of oil price to the variation in corporate investment in Pakistan.

$$\frac{I_t}{K_t} = a + \frac{1}{b}Q_t + \mathrm{cf}_t + \mathrm{OS}\hat{}_t + \mathrm{OS}\hat{}^2{}_t + \mathrm{OD}\hat{}_t + \mathrm{OD}\hat{}^2{}_t + \mathrm{OSD}\hat{}_t + \mathrm{OSD}\hat{}^2{}_t + \mathrm{e}_t \quad (2)$$

Moreover, since firms may not have similar investment rates due to technology shocks, and there may be common trends affecting all firms in the same way (e.g., business cycles), Eq.2 is further enlarged with fixed effects for individual firms η_i and time period effect μ_t, where i is for individual firms and t is for different time periods

$$\frac{I_{it}}{K_{it}} = a + \frac{1}{b}Q_{it} + cf_{it} + \mathrm{OS\^{}}_t + \mathrm{OS\^{}}^2{}_t + \mathrm{OD\^{}}_t + \mathrm{OD\^{}}^2{}_t + \mathrm{OSD\^{}}_t + \mathrm{OSD\^{}}^2{}_t + \eta_i + \upsilon_t + e_{it} \quad (3)$$

There is no compelling reason to believe e_t is serially uncorrelated, following Mohn and Misund (2009), I assume that e_t follows an AR(1) process

$$e_{it} = \rho e_{it-1} + \varsigma e_{it} \quad (4)$$

Substituting Eq.3 into Eq.4 yields

$$\frac{I_{it}}{K_{it}} = a(1-\rho) + \rho\frac{I_{it-1}}{K_{it-1}} + \frac{1}{b}Q_{it} - \frac{\rho}{b}Q_{it-1} + \beta_1 cf_{it} - \rho\beta_1 cf_{it-1} + \beta_2 \mathrm{OS\^{}}_{it} - \rho\beta_2 \mathrm{OS\^{}}_{it-1} + \beta_3 \mathrm{OS\^{}}^2{}_{it} - \rho\beta_3 \mathrm{OS\^{}}^2{}_{it-1} + \beta_4 \mathrm{OD\^{}}_{it} - \rho\beta_4 \mathrm{OD\^{}}_{it-1} + \beta_5 \mathrm{OD\^{}}^2{}_{it} - \rho\beta_5 \mathrm{OD\^{}}^2{}_{it-1} + \beta_6 \mathrm{OSD}_{\^{}it} - \rho\beta_6 \mathrm{OSD\^{}}_{it-1} + \beta_7 \mathrm{OSD\^{}}^2{}_{it} - \rho\beta_7 \mathrm{OSD\^{}}^2{}_{it-1} + (1-\rho)\eta_i + \upsilon_t - \rho\upsilon_{t-1} + e_{it} \quad (5)$$

For econometrics purposes, Eq.5 can be rewritten as

$$\frac{I_{it}}{K_{it}} = \beta_0 + \beta_1\frac{I_{it-1}}{K_{it-1}} + \beta_2 Q_{it} + \beta_3 Q_{it-1} + \beta_4 cf_{it} + \beta_5 cf_{it-1} + \beta_6 \mathrm{OS\^{}}_{it} + \beta_7 \mathrm{OS}_{\^{}it-1} + \beta_8 \mathrm{OS\^{}}^2{}_{it} + \beta_9 \mathrm{OS\^{}}^2{}_{it-1} + \beta_{10} \mathrm{OD\^{}}_{it} + \beta_{11} \mathrm{OD\^{}}_{it-1} + \beta_{12} \mathrm{OD\^{}}^2{}_{it} + \beta_{13} \mathrm{OD\^{}}^2{}_{it-1} + \beta_{14} \mathrm{OSD\^{}}_{it} + \beta_{15} \mathrm{OSD\^{}}_{it-1} + \beta_{16} \mathrm{OSD\^{}}^2{}_{it} + \beta_{17} \mathrm{OSD\^{}}^2{}_{it-1} + (1-\rho)\eta_i + \upsilon_t - \rho\upsilon_{t-1} \quad (6)$$

where e_{it} is the white noise and serially uncorrelated. β_6 to β_{17} quantify the instantaneous effects of sources of oil prices volatility and their lags on investment.

The decomposition approach has the benefit of its ability in obtaining the distinct impact of each underlying source of oil price shock to the corporate real investment.

3.3.2 Estimation of the Model

The empirical framework uses one period lag while relating the investment to the capital ratio to itself, Tobin Q, cash flow, oil supply OS_t, oil demand $OD_t$and oil specific demandOSD_t volatilities and their squared volatilities each. For estimation of this panel model, this study uses the generalized method of moments

(GMM) technique, which takes into account, the fixed effects for individual firms, fixed time effect, and addresses the potential of endogeneity problem between the variables.

Generalized Method of Moments (GMM) is outlined by Arellano and Bond (1991) to adapt to the circumstances where there are number of periods are small, but cross sections are large. What's more, GMM does not require perfect information about the dispersion of the data series. However for estimation of the GMM model it need on just specific moments obtained from the model that underlie. A remarkable component of GMM lies in that in models for which the parameters in a model are less than the moment conditions; its estimation gives a direct method to test the determination of the proposed model. Lagged values of the dependent variable are pointed out by Arellano and Bond (1991) as the preferred instrument matrix for estimation of the GMM.

Eq (6) is the case of dynamic linear panel framework, containing the overlooked panel data effect η_i which can be fixed or random either. By the structure of the model, the unnoticed panel-level effects η_i has correlation with the I_{it}/K_{it} and the lag of the exploratory variable resulting which may result in biased estimating approach (Arellano and Bond, 1991). They developed the generalized method of moments (GMM) estimation technique having ability of providing the consistent parameter estimations this type of models. They removed the unnoticed firm specific η_i heterogeneity by using the first difference transformations. The technique introduced by Arellano and Bond (1991) designed for conditions of large quantity of cross sectional and a small quantity of time period series of data and this approach can perform poorly in the situations having too large autoregressive parameters or where the variation of the pane data effect to the variation of the particular error is too large. Blundell and Bond (1998) developed a system GMM estimator addressing these limits by including the level instruments for the level of the equation.

Bond (2002) provides a good overview and comparison of these approaches. Following Bond (2002) suggestion that two-step weight matrix can improve efficiency in large samples, in this study all the estimations are performed with two-step and bias-corrected estimators for the covariance matrix. Bond (2002) also pointed out that first-difference GMM estimator, introduced by Arellano and Bond (1991) requires the autoregressive parameters to be significantly less than 1. Thus, a simple AR (1) regression for dynamic Q model of investment is estimated, with and without fixed effects for deciding whether the dynamic properties of these variables are suitable to be used in GMM. If the coefficients of lagged value come below 1, it would suggest that the first-difference of all the variables is suitable as instruments for the dynamic model.

Diagnostic tests were performed to ensure the robustness and validity of estimates. Following the Roodman (2006) the Hansen J test for testing the soundness of the over identification assumption for the instrument matrix is used. Compared with Hansen J, the Sargan test, which also tests over identification, is not robust and varies greatly depending upon the autocorrelation and heteroskedasticity and has the tendency of over-rejecting the hypothesis. Additionally the Arellano and Bond (1991) introduced AR (2) test is used, to assess the presence of the higher-order autocorrelation. The Wald X Square is used to test the joint significance of all model parameters.

For the system GMM technique, Q, cash flow, and lag of investments are each taken as endogenous, while oil supply OS_t, oil demand OD_t and oil specific demand OSD_t volatilities and their squared volatilities, time effects and their lags are treated as exogenous. oil supply OS_t, oil demand OD_t and oil specific demand OSD_t volatilities and their squared volatilities measures both are used in this model for the reason that compound option theory suggests that the option to wait and the option to grow both can perform when firms face investment decisions under the uncertain conditions. Testing squared oil price volatility also help assessing the non-linear association between the oil price uncertainty and the corporate investment behavior in this study.

3.3.3 Firm Level Data

This study uses secondary data of 468 non-financial companies listed on Pakistan Stock Exchange in Pakistan. The sources of this company level data are various Balance Sheet Analysis (BSA) reports provided by State Bank of Pakistan (SBP), the annual reports issued by the companies, and website of the Business Recorder. This is unbalanced panel data set which covers the 17 years period from January 2000 to December 2016.

This study uses the data items capital expenditures on acquisition of fixed assets, market value capital of capital, long term debts and total assets denoted in millions Pak rupees. Following the Whited (2006) changes in capital expenditure on property, plant and equipment incurred by a company are used as measure for the company investment (I_{it}) divided by capital stock (K_{it}). Following the Mohn and Misund (2009) the total assets are used as a measure for the capital stock. Tobin's q is calculated by following Chuang and Pruitt (1994) and using company items as, (market value of the company equity + preferred stock value + long-term debt + current liabilities - current asset)/total asset in year t-1. The control variable, cash flow, is measured as, (Net income + depreciation, depletion and amortization)/ total asset. Cash flows, depreciation, depletion and amortization and total assets are denoted by CF_{it} , DDA_{it} and TA_{it} respectively.

3.3.4 Underlying Oil Price Shocks and Data

This study uses three different underlying of oil price uncertainty as the measures to calculate the oil price uncertainty. Kilian (2009) discussed three underlying of oil price changes which are oil supply shocks, aggregate demand shocks and oil specific demand shocks. Kilian (2009) has defined them as: "shocks to the current physical availability of crude oil (oil supply shocks), shocks to the current demand for crude oil driven by fluctuations in the global business cycle (aggregate demand shocks); and shocks driven by shifts in the precautionary demand for oil (precautionary demand shocks)." Following Kilian (2009) structural VAR method is used to identify these three sources of oil price uncertainty. Residual shocks of these

SVAR identified three oil price shocks are further used to calculate uncertainty by using SD and GARCH method.

To represent the world oil supply, global oil production (WOP) is used to reflect both the OPEC and non OPEC countries political uncertainties and cartel activities. This data is collected from the Energy Information Administration (EIA). To represent the global aggregate demand, this study follows Kilian (2009) which used dry cargo freight rates as an indicator of world real economic activity.

Real Oil Price (ROP) is used as a measure for oil specific demand and is measured by using the Cushing, OK WTI Spot Price FOB (Dollars per Barrel). Free-on-Board (FOB) importing price of crude oil was by following (Kolodzeij and Kaufmann, 2014). Monthly data of WTI Spot Price FOB oil prices is available from US EIA. Free on board oil price measure is used since other measures like US West Texas Intermediate prices contain the effects of freight charges also. Finally real oil price is obtained after deflating the oil prices by the US inflation rate. The US CPI data is available from the IMFs International Financial Statistics.

In this study structural VAR model is estimated for identifying the sources of oil price shocks and to examine their consequences for the corporate investment in Pakistan. The structural oil shocks include global oil supply shock, an aggregate demand shock and an oil-specific demand shock. The structural VAR model represented as following:

$$A_0 y_t = \alpha = \sum_{i=1}^{p} A_i y_{t-1} + \varepsilon_t$$

Here yt represent a (4 1) vector that contains world crude oil production (WOP), world real economic activity (REA) real oil prices (ROP) and real stock price (STP). A0 denotes coefficient matrix, symbolizes constant term vector, and t represent a vector of structural shocks which are serially and mutually uncorrelated. After applying the reasonable restrictions to identify, reduced-form errors estimated obtained from equation given below can help recover the structural shocks:

where et denotes the reduced-form errors

$$e_t = A_0^{-1}\varepsilon_t$$

Following the Kilian and Park (2009) a structural VAR model with lags of 24 is used, to identify oil shocks and analyze the impacts of these shocks on the performance of stock market. This lag criterion of 24 months can well capture the delayed effect also and can help in estimating the possible long-run impacts of these variables. Structural shocks are arranged according to the exogeneity of variables which shows that the order of variables is WOP, REA and ROP. Order in this sequence implies that a shock to a variable higher in the order has contemporary impacts on the variables in the lower order but not vice versa. Past studies including the Kilian (2009) imply that a World oil production (WOP) has the least response to other variables due to higher cost of adjustment. Using this implicit effects pattern this study assumes that order of structural shocks of oil prices follow the implication running in order from WOP, REA and ROP respectively.

Therefore, the VAR in the reduced-form is hereby formed after multiplying both the sides of Eq. (1) by $A0^{-1}$, and it is represented below in a recursive structure:

$$\begin{pmatrix} u1_t \\ u2_t \\ u3_t \end{pmatrix} = \begin{bmatrix} 1 & 0 & 0 \\ a21 & 1 & 0 \\ a31 & a32 & 1 \end{bmatrix} \mathrm{X} \begin{pmatrix} \varepsilon_{oil\ supply\ shock} \\ \varepsilon_{aggregate\ demand\ shock} \\ \varepsilon_{oil\ specific\ demand\ shock} \end{pmatrix}$$

Volatility is commonly calculated by standard deviation in the finance literature and is discussed in the next section.

3.3.5 Uncertainty of the Underlying Oil Price Shocks

For measuring the uncertainty in general there are two measures used by the literature. One is the standard deviation method which is commonly used by the past literature measuring the uncertainty and other is the GARCH (1, 1) method suggested by (Baum et al., 2008). The standard deviation method is commonly used in the finance literature to measure uncertainty. This study therefore uses standard deviation method to measure the uncertainty for underlying sources of oil prices. Monthly frequency is annualized by taking average of the 12 months of standard deviations. The monthly data of WTI free on board prices is obtained from the Energy Information Agency. Annualized average returns of oil prices are used for measuring the oil price volatility.

Volatility of three underlying sources oil supply; aggregate demandând oil specific demandŝhocks can be measured in following way:

$$O_t = \sqrt{\frac{1}{N-1}\sum_{t=1}^{n}\left(r_t^o - E\left(r_t^o\right)\right)^2}$$

wherer_t^o denotes the monthly oil price sources returns, which is calculated as $=r_t^o = 100Ln(p_t/p_(t-1))$. N is the number of months each year, which is 12 for monthly values .

Following previous literature, Tobin's q,I_{it}/K_{it} , CF_{it} variables in ratio form are winsorized at the 5th 95th percent levels. Negative values for investment, Q, total assets and cash flows were considered as missing. In addition, since compared with other developed countries, mergers and acquisitions are less frequent in Pakistan, so study does not loose other data in samples.

3.4 Subsamples

3.4.1 Oil-Intensive Industries and Less Oil-Intensive Industries

Following the Fukunaga, Hirakata and Sudo (2010) the industry classification used in Pakistan divided into two subsamples, oil intensive industries and less oil intensive industries. They used the cost share of oil in each industry as the criterion to decide whether a particular industry is oil-intensive. They reported oil intensity is high in Oil and Coal Products, Glass and Ceramic Products, Non-ferrous Metals, Iron and Steel, and Chemicals. On the other hand, Pulp and Paper, Metal Products, Rubber Products, Machinery, Precision Instruments, Transportation Equipment and Electric Appliances are classified as less oil-intensive industries. This Fukunaga, Hirakata and Sudo (2010) the industry classification approximately seem reasonable in the context of Pakistan based upon a 2017-17 report from Oil & Gas Regulatory Authority (OGRA).

According to this report during the year 2016-17 90% of POL energy products ware consumed by transport and power sectors of which transport sector consumed 57% and power consumed 33%. From rest 8% was used by other industrial sectors. This situation shows that major 90% POL consumption is made by only two sectors transport and power. Other sectors all inclusive consume only 8%. Therefore transport and power sectors consume major part and are included in oil intensive industries and rest all sectors do not matter much and therefore using Fukunaga, Hirakata and Sudo (2010) the industry classification in Pakistan is reasonable. All the data regarding the industries is available from BSA report provided on the website of state bank of Pakistan.

3.4.2 Large and Small Size Firms

Literature has also reported that energy price shocks effects on corporate investment differ depending upon the size of the companies. In such manner Ratti, Seoul and Yoon (2011) bring the size of the firm into the baseline model to test if size of the firm influences the connection between oil price shocks and the corporate investments. They reported evidence of the less negative impact of energy prices increases on the for huge firms investment plans. These outcomes propose that huge firms are adaptable when confronting energy cost increments and have better assets to shield from the high energy costs than little firms. Along these lines, hypothesis with respect to the part of firm size in this investigation is that negative impact is more noteworthy for little firms.

This study therefore divides the main sample into the sub samples of the study by using the average value of size of firms measured by total assets of firms. Firms having size value greater than the average value are categorized as the large size firms and equal to or less than the average value of size are included in the small size firms samples for analysis.

For robustness sake, this study in addition to sub samples of Large and Small size firms, further investigates the effects of oil price uncertainty for the Top 20% firms and the Low 20% firms in terms of size. This study further examines the effects of underlying oil price uncertainty sources and the corporate investment decisions of Top 20% firms and the Low 20% firms. For this purpose this study constructed Top 20% firms in size and Low 20% firms in size samples.

Chapter 4

Results and Discussion

In this section empirical findings of the study are reported. Empirical finding presented below in this chapter includes the implications of oil price shocks for the stock market in Pakistan, effects of oil price uncertainty and underlying sources of oil price uncertainty for the corporate investment decisions in Pakistan.

4.1 Oil Price Shocks and Stock Market

This section presents the empirical results regarding the implications of oil price shocks for the stock market in Pakistan. Results from the analysis are described in two steps. First part presents results regarding the identification of the sources of oil prices shocks through impulse responses and variance decomposition analysis of the SVAR model.

TABLE 4.1: Descriptive Statistics

	WOP	REA	OP	KSE
Mean	73017.29	3.425	56.55	12697.9
Median	73529.33	0.507	50.98	9635.99
Maximum	82296.94	66.778	133.88	50591.57
Minimum	64307.1	-133.127	11.35	841.7
Std. Dev.	4489.759	32.541	29.957	12445.02
Skewness	0.036	-0.282	0.366	1.288
Kurtosis	2.146	3.569	2.01	3.804
Jarque-Bera	7.343	6.432	15.156	72.826
Probability	0.025	0.04	0.001	0.001

Figure 4.1: Time Series graphs of WOP, REA, OP and KSE

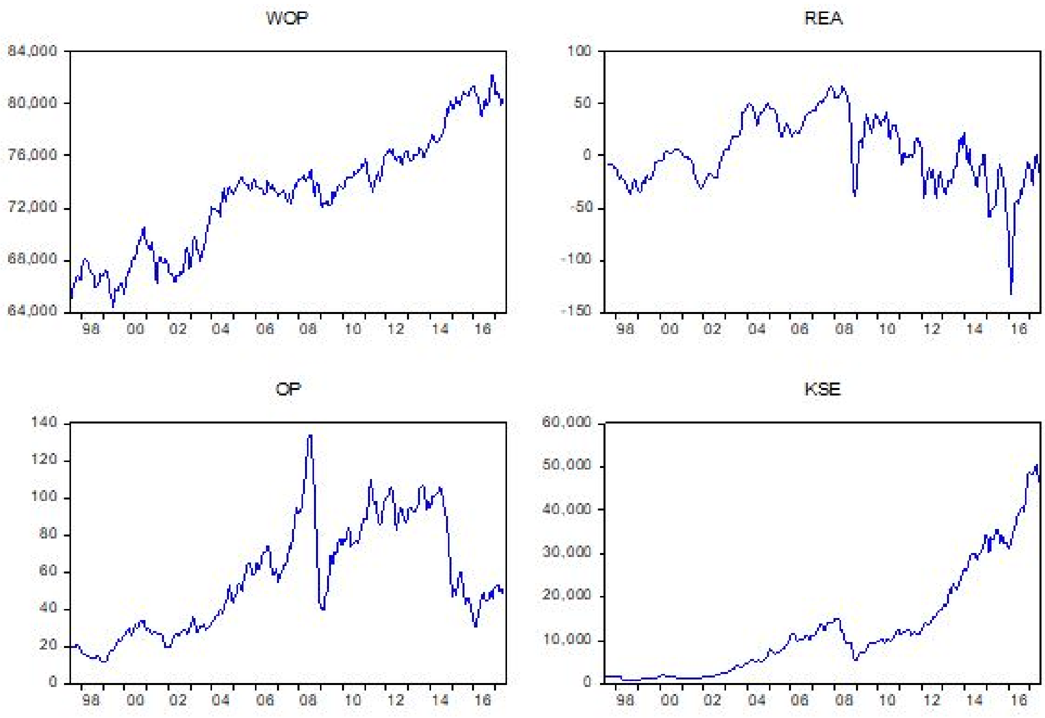

FIGURE 4.1: Time Series Graphs of WOP, REA, OP and KSE

Note: Time series graphs of World oil supply shocks is indicated by (WOP), world aggregate demand for all industrial commodities which is (Kilian, 2009) real economic activity index is denoted by (REA), oil specific demand shock is represented by (OP) and finally Karachi stock exchange index is denoted by (KSE)

Table 4.2: Descriptive Statistics of Structural Oil Price Residuals Series

	WOPˆ	REAˆ	OPˆ
Mean	0.0002	0.2074	0.002
Median	0.0005	0.613	0.0101
Maximum	0.0228	32.3504	0.2365
Minimum	-0.0263	-35.9993	-0.2492
Std. Dev.	0.0075	9.6015	0.0807
Skewness	-0.1672	-0.4717	-0.4084
Kurtosis	3.7672	5.5148	3.1147
Jarque-Bera	5.954	61.3225	5.7821
Probability	0.0509	0.001	0.0555

Second part presents the finding from the structural VAR analyzing the impacts of identified shocks on the stock market index. Preliminary summary of data in the form of descriptive statistics in the Table 4.1 and Figure 4.1 presents graph of variables used is provided to have basic understanding of the data and variables. In addition descriptive statistics summary of residual shocks arrived through estimation of structural VAR analysis is also presented in Table 4.2 to provide basic understanding of the shocks also.

World oil supply shocks is indicated by (WOP), world aggregate demand for all industrial commodities which is (Kilian, 2009) real economic activity index is denoted by (REA), oil specific demand shock is represented by (OP) and finally Karachi stock exchange index is denoted by (KSE). Further real values of international oil prices WTI and Karachi stock exchange index were derived by deflating these values with inflation rates for the US and Pakistan respectively.

From preliminary graphs of oil price variables world oil supply, world aggregate demand and oil specific demand it is evident that all three variables do not have similar pattern of movement and therefore are different from each other in their pattern of movement. Therefore they apparently seem to endorse the (Kilian, 2009) view point that all the oil price shocks are not same alike.

4.1.1 Identifying the Oil Price Shocks

First of all this study following (Kilian, 2009) methodology attempts to identify the various underlying oil price shocks. For this purpose structural VAR analysis were used. Impulse responses of oil prices to various shocks and variance decompositions analysis were also used to for this purpose. Their results are described in following sections.

4.1.2 Impulse Response of Oil Prices to Structural Shocks

Fig. 4.2 shows the impulse responses of real oil prices and other variables to a shock of one standard deviation. Two standard error bands are shown by dotted lines. Similarly Fig. 4.3 shows the cumulative impulse responses of real oil prices and other variables to a shock of one standard deviation. The results show that changes in aggregate demand shock (REA) causes significant and stable increase in real oil prices. This significant change lasts about six months. A shock coming from oil specific demand causes an immediate, large, stable and significant positive effect on oil prices in the international oil market. However a very small and insignificant effect of oil supply shock is observed. The similar findings were also reported by (Kilian, 2009) and (Chen et al., 2014).

4.1.3 Variance Decomposition of Oil Shocks

In addition to impulse response functions, the relative role of different structural shocks in VAR in causing oil price changes is also explored by estimating the variance decomposition. Results of variance decomposition comprising the part played by structural variables like oil supply shocks, oil aggregate demand shocks and oil specific demand shocks in causing changes in oil prices are shown by Table 4.3

Response to structural one standard deviation shocks with two standard error confidence bands

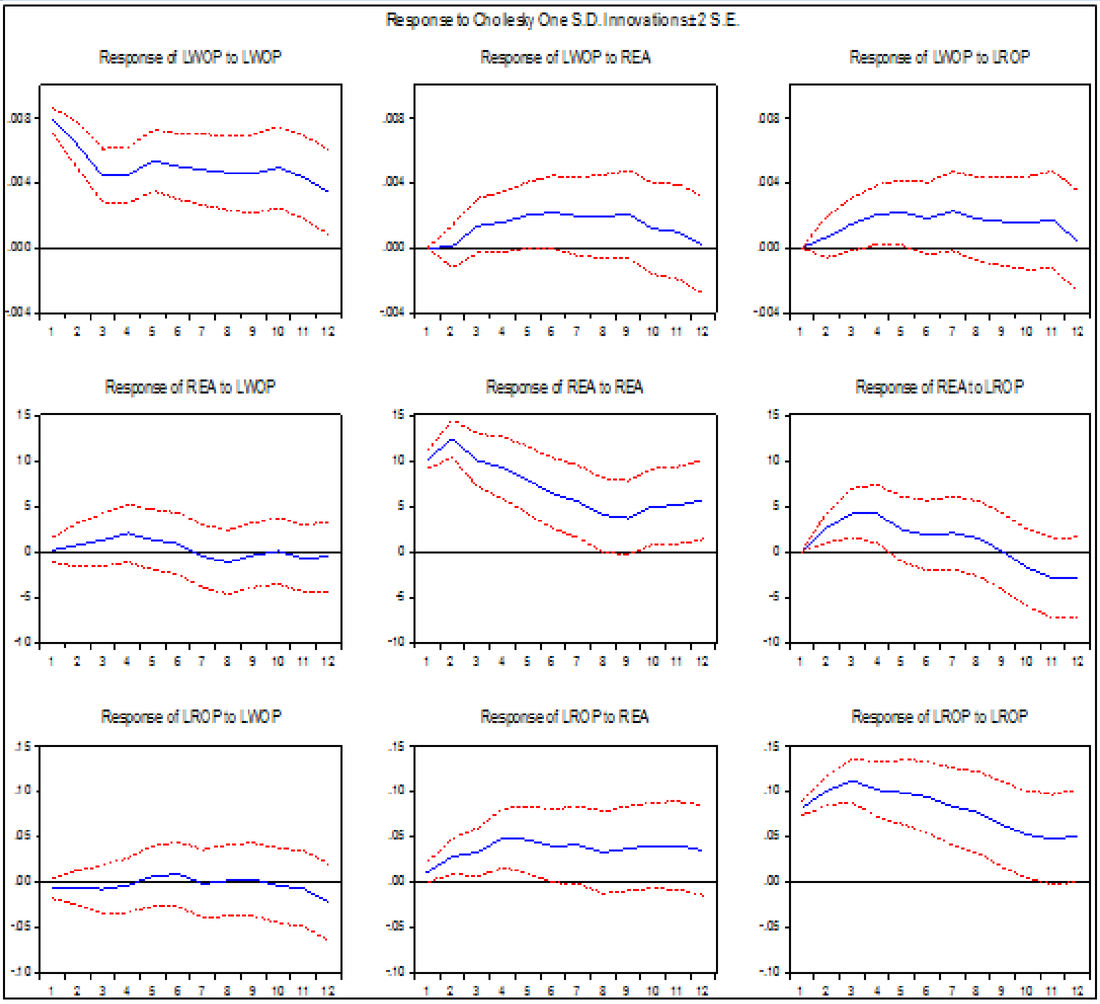

FIGURE 4.2: Structural VAR Impulse Responses

Note:

The LWOP denotes the log of world oil production; rea is the world real economic activity and rop is the log value of real oil prices.

Cumulative response to structural one standard deviation shocks with two standard error confidence bands

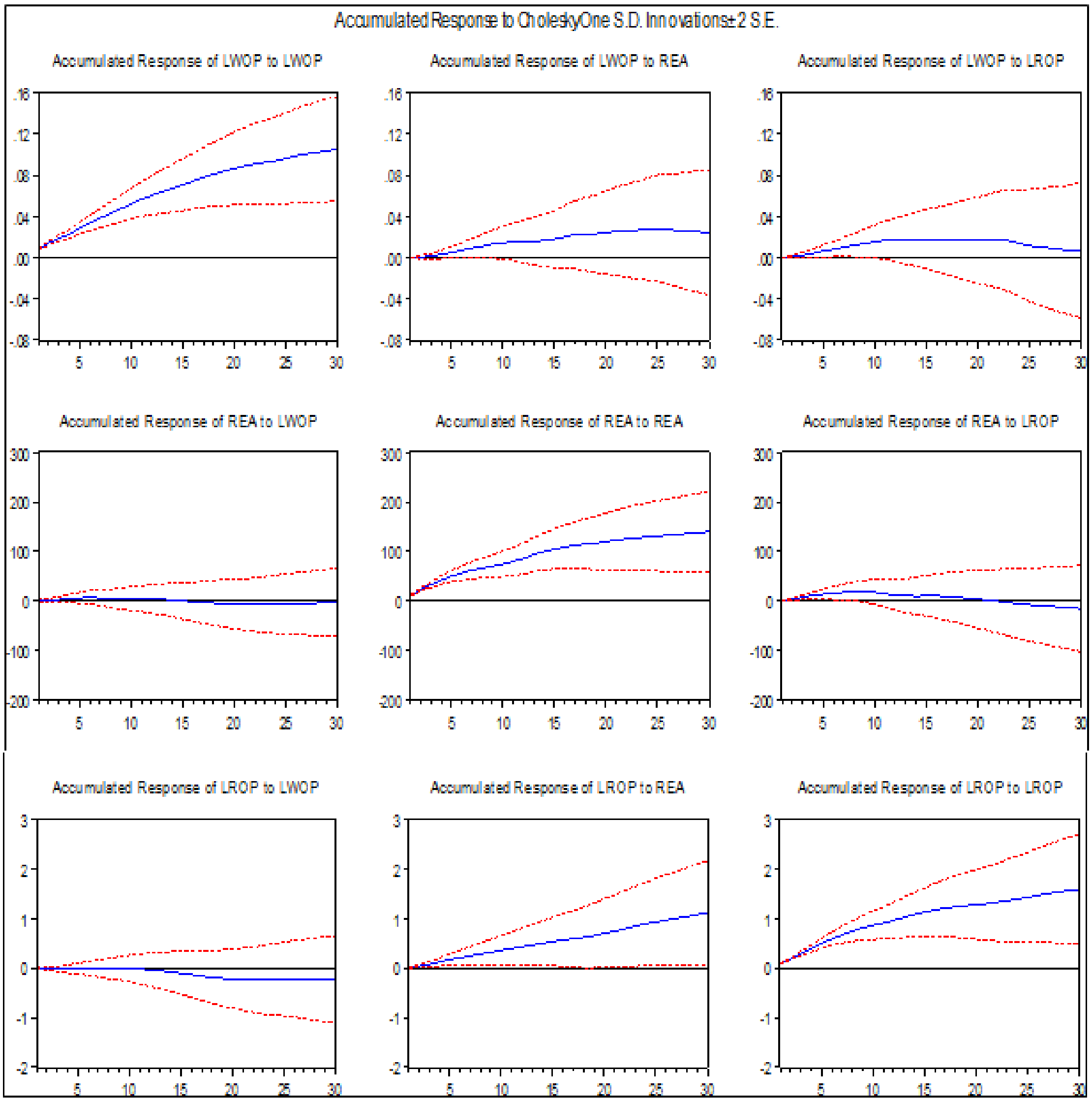

FIGURE 4.3: Cumulative Impulse Responses of Oil Prices to Structural Oil Shocks for 30 Months Horizon

Note:

The LWOP denotes the log value of world oil production; rea is the world real economic activity and rop is the log value of real oil prices

Table 4.3: Variance Decomposition of Oil Price Shocks

Period	Oil Supply shock		Aggregate demand shock		Oil specific demand shock	
1	0.76	(1.35)	1.715	(1.88)	97.52	(2.23)
5	0.37	(1.74)	11.49	(7.21)	88.13	(7.28)
10	0.33	(2.88)	14.9	(10.22)	84.75	(10.3)
15	2.04	(4.64)	17.59	(11.88)	80.35	(12.1)
20	4.09	(6.52)	20.22	(13.19)	75.67	(13.58)

Standard Errors: Monte Carlo (1000 repetitions)

The biggest contributing element in oil price changes is oil specific demand shocks itself. However, part played by this shock decreases gradually with passage of time, but still it is major contributor by causing 75% changes in oil price shocks after 20 months. in contrast with this, the shocks from the supply side of oil market just explain the 4% variation in the oil price fluctuations. This shows the less significant part of in explaining the prices of oil market. These findings mainly verify the findings reported in for in the impulse responses analysis section presented above.

4.1.4 Structural Oil Price Shocks and Stock Prices

After identifying the various sources of oil price shocks by following the Kilian (2009) methodology present study used the SVAR methodology by following Kilian & Park (2009) to estimate the effects of identified oil price shocks on the stock market in Pakistan. For this purpose structural VAR analysis were further estimated and impulse responses of stock market to various oil price shocks identified, namely world oil supply, world oil demand and oil specific demand shocks were also calculated. Variance decompositions analyses were also used to for this purpose. Their results are described in following sections.

4.1.5 Impulse Response of Stock Market to Structural Oil Shocks

The impulse responses were estimated for analyzing the responses of stock market prices to the structural oil price shocks are presented in Fig. 4.4. The lines in dots show the standard errors. These standard error bands determine the statistical significance of one standard deviation shock to a variable concerned. Similarly Fig. 4.5 shows the cumulated or accumulated impulse responses of real oil prices and other variables to a shock of one standard deviation. According to the results shown by Fig. 4.4 an increase in oil supply shocks is associated with the increasing stock prices in Pakistan. This increase in stock prices remained significant during the 3rd to 6th month approximately. These results are consistent with the study by (Chen et al., 2014). An increase in aggregate demand shocks increases stocks prices which remains significant for first three months. After 3 months a gradually decreasing but insignificant trend of stock prices is observed.

These results are nearly consistent with the findings of (Kilian, 2009). An increase in oil specific demand shocks have a decreasing effect on stock prices in Pakistan, however this decrease is not significant. These results are consistent with findings of Degiannakis et al. (2013); studying the response of European industries stock returns and found no significant effect of oil specific demand shocks on the stock prices. Similar results were also reported by (Basher et al., 2012) and (Chen et al., 2014).

Response of KSE index to structural one standard deviation shocks with two standard error confidence bands

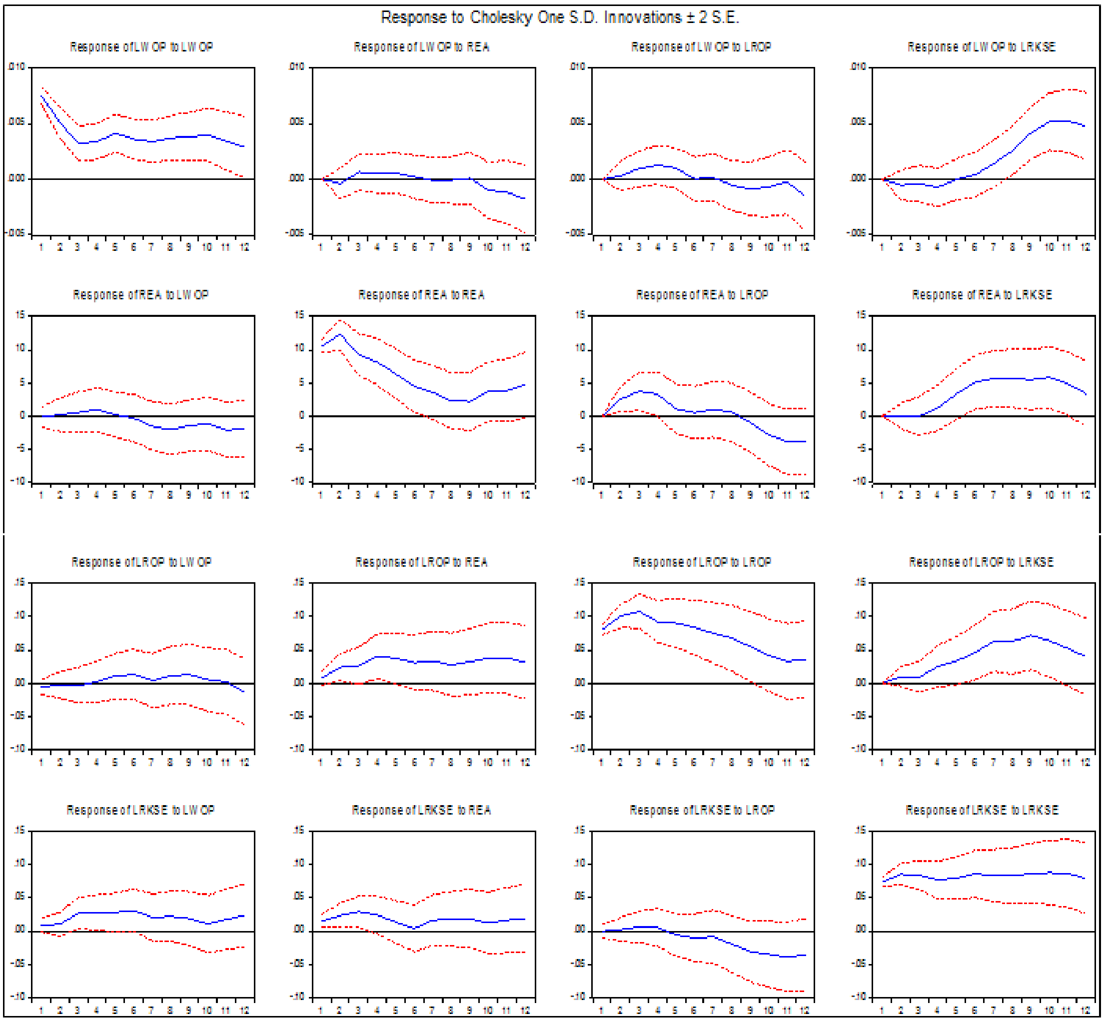

FIGURE 4.4: Structural VAR Impulse Responses of Stock Market to Oil Shocks

Note: The LWOP denotes the log value of world oil production; rea is the world real economic activity; rop is the log value of real oil prices and logged value of Karachi stock exchange index is denoted by LKSE

Cumulative response to structural one standard deviation shocks with two standard error confidence bands

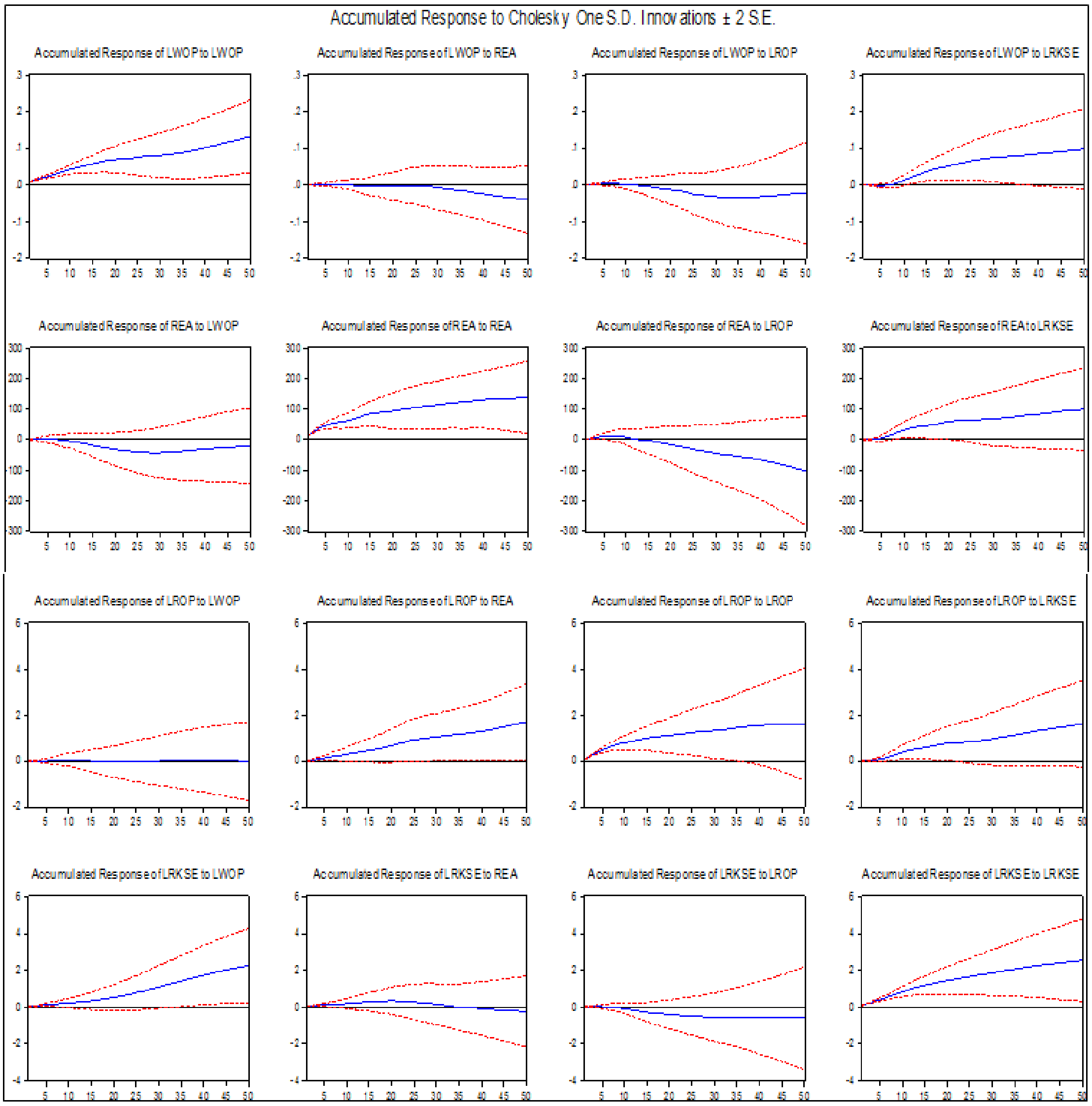

FIGURE 4.5: Cumulative Structural VAR Impulse Responses of Stock Market to Oil Shocks

Note:

The LWOP denotes the log value of world oil production; rea is the world real economic activity; rop is the log value of real oil prices and logged value of Karachi stock exchange index is denoted by LKSE

4.1.6 Variance Decomposition of Structural Stock Market Shocks

Table 4.3 shows the variance decomposition analysis results. It uncovers the role of structural oil shocks identified in the SVAR model discussed above in relation with the asset prices like stock prices of KSE 100. Three structural oil markets shocks together account for 30% innovations in stocks prices in 24 months period. These results are close to Kang & Ratti (2013) which reported oil price shocks accounting for about 33% variation in U.S stock market. Oil supply shocks though exert little influence on changes in oil prices, but they have significant influential role in changing the stock prices in Pakistan by accounting for about 16% variation. While aggregate demand and oil specific demand shocks have minor role in stock price innovations in Pakistan.

Table 4.4: Variance Decomposition of Oil and Stock Market Shocks

Period	Oil Supply shock		Aggregate demand shock		Oil specific demand shock		KSE	
1	1.36	(1.57)	3.92	(2.52)	0	(0.61)	94.71	(2.99)
6	7.52	(6.2)	5.21	(5.17)	0.47	(2.7)	86.78	(7.92)
12	5.78	(6.86)	4.15	(6.47)	5.82	(7.78)	84.24	(11.11)
18	8.8	(9.66)	4.43	(8.09)	9.29	(11.11)	77.46	(14.46)
24	15.65	(12.48)	4.39	(8.52)	9.1	(11.75)	70.84	(15.63)

Standard Errors: Monte Carlo (1000 repetitions)

Results of this second step show that oil supply shocks and aggregate demand shocks have significant effect on the stock prices, whereas oil specific demand shocks have little effect on the stock market prices in Pakistan. Additionally cumulative impulse response analysis imply more stable effect of oil supply shocks however, effects of aggregate demand for oil changes over the time. These results are also in line with the (Chen et al., 2014) findings. The results of this study imply that impact of oil price shocks on stock markets vary greatly depending upon the nature and source of the shock and each shock has affected the stock market in different directions with different potencies. Therefore, policy makers, investors and managers must take care of sources of underlying oil price shocks in making their decisions regarding this oil price risks and investments.

4.2 Oil Price Uncertainty and Corporate Investment

In this section empirical finding regarding the effects of oil price uncertainty on corporate investment decisions in Pakistan are presented. In the beginning preliminary analysis of the study are provided. These analyses include the time series plot of monthly oil prices from 2000-2016 the descriptive statics regarding the oil price uncertainty and investment related variables. Further analyses regarding the correlations AR (1) characteristics are also reported. Then empirical results after estimation of model for oil price uncertainty and corporate investment decisions are presented. Results regarding robustness of the results for alternate measure of oil price uncertainty are also provided. Finally for better understanding of effects over the long term and short term, analyses regarding the long and short term effects of oil price uncertainty on corporate investment are also presented.

4.2.1 Preliminary Tests Correlations and AR (1) Estimates

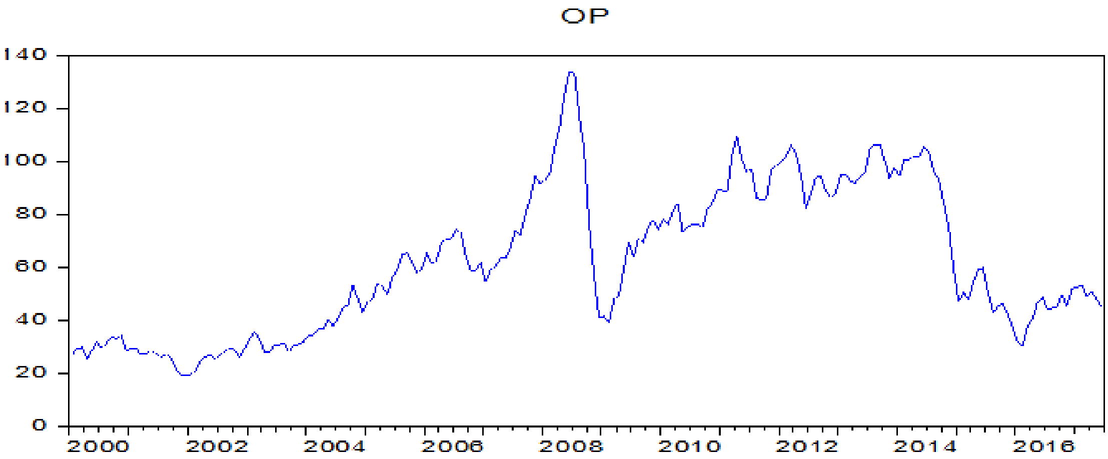

Figure 4.6: Oil Prices WTI FOB 2000-2016 Monthly Data Graphed

Fig.4.6 shows that oil price has gone through large fluctuations in the period from 2000 to 2016. A high level of oil prices and then a sudden large collapse can be observed in year 2008. Similarly a period of high prices remained from 2010 to 2014 and then a significant drop was observed. From 2014 international oil prices fell down significantly, economies of oil exporting countries like KSA, Russian federation and others faced serious economic problems in this phase. On the other side oil importing countries benefited from substantial increase in their import bills. Decrease in international oil prices in 2016 has caused reduction of about 37 percent in the oil import bill of Pakistan which fell from \$12.166 to \$7.667 billion in FY15

Statistical summary of variables used by the study in the form of mean values, standard deviations, minimum and maximum values are provided in Table 4.5 Mean value of sample shows that corporate investment growth rate which is represented by I/K on average is 10% which is reasonable amount of investment, on the other side cash flows represented by CF/K growth rate is also about 10%. Q $= q_{-1}$ratio on average is 3.8 which shows that market value of companies is greater than the book value of assets OilvolG is the annualized oil price volatility obtained through GARCH (1, 1) method. OilvolGsq is the squared value of OilvolG. For robustness check of oil price volatility variable, OilvolSD and OilvolSDsq calculated by the standard deviation method are also used.

Table 4.5: Descriptive Statistics Oil Price Uncertainty and Corporate Investment

Variable	Obs	Mean	Std.Dev.	Min	Max
IK	5106	0.104	0.09	0.011	0.351
Q	4808	3.793	4.114	0.344	15.821
CFK	5734	0.097	0.107	-0.071	0.348
OilvolG	6437	0.007	0.002	0.005	0.015
OilvolSD	6437	0.084	0.027	0.047	0.164
OilvolGsq	6437	6.00E-05	5.00E-05	2.00E-05	2.00E-04
OilvolSDsq	6437	0.008	0.006	0.002	0.027

Table 4.6 presents the level of correlations among the main variables of this research. Investment has positive correlation with its lag value, which validate the opinion that investment process involves the inheritance. Investment is also positively associated with Q and Cash flow, which is as per expectations.

TABLE 4.6: Matrix of Correlations Oil Price Uncertainty and Corporate Investment

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)
(1) IK	1						
(2) Q	0.021	1					
(3) CFK	0.071	0.53	1				
(4) OilvolG	-0.008	-0.035	-0.015	1			
(5) OilvolGsq	-0.018	-0.032	-0.027	0.989	1		
(6) OilvolSD	0.002	-0.001	-0.006	0.582	0.5	1	
(7) OvolSDsq	-0.003	0.003	-0.016	0.509	0.429	0.983	1

Investment has negative link with the variable of oil price volatility (OilvolG) and the oil price volatility squared (OilvolGsq), but has positive correlation with the market volatility (MarvolG). (Bond, 2002) pointed out that using weak instrument in a highly persistent series for first difference GMM estimations can cause a finite sample bias.

TABLE 4.7: AR(1) Estimates of the Variables in the Model

Estimator	I/K	Q	CF/K	OilvolG	OilvolSD
OLS	0.221***	0.836***	0.688***	0.123***	0.184***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
FE	0.033**	0.514***	0.381***		
	(0.029)	(0.000)	(0.000)		

Note: using OLS and fixed effect (FE) estimation techniques this table presents estimated coefficients and their p-values for regressing variables on their lagged dependent variables for estimating the AR(1) process of equation:

$y_t = py_{t-1} + u_t$

Significance levels *** p<0.01, ** p<0.05, * p<0.1

First difference estimation technique introduced by Arellano and Bond (1991) needs parameters of auto regression to be less than 1. Therefore before estimating the dynamic Q model of investment through GMM, AR (1) process is estimated with simple OLS and fixed effect models. In Table 4.7 all the coefficients of lagged variables have values below 1, which implies that first difference of these all variables can be used as instruments with valuable information.

4.2.2 Estimation of Oil Price Uncertainty and Corporate Investment Decisions

Table 4.8 presents the estimated results of the effects of oil price uncertainty on companies' investment decisions. Results presented in the Table 4.8, include two types of models estimation, Model 1 is simple Q model without cash flow and Model 2 is Q model with cash flows. The system GMM technique is estimated with the robust and two step methods. The advantage of using system GMM methodology of estimation is that it considers the unobserved panel effects and also controls for the endogeneity. For estimation purposes this study follows the empirical studies by treating Investment (I/K), cash flows (C/FK), Tobins q (Q) as endogenous variables. To control for the business cycles effects time period year dummies are used and fixed effects of firm specific effects are used.

The lagged value of investment has positive coefficients of 0.139 and 0.227 in Model 1 and Model 2 respectively. Both are significant at the 1% and 10% level of significance. This implies that current year investment is influenced by the investment in previous year and therefore follows a persistent pattern. This result is consistent with the theoretical suggestions and findings by Baum et al. (2008) and others, which imply positive association between current and previous period investment levels, follow an inherent dynamic process. Results from the Q ratio show positive significant contribution in explaining the rate of investment. These results of Q ratio comply with the Q theory of investment; however one period lagged value of Q does not significantly influence the investment decisions.

Table 4.8: Oil Price Uncertainty and Corporate Investment

	Model 1			Model 2		
IK	Coef.		St.Err	Coef.		St.Err
L.IK	0.139	*	(0.083)	0.227	***	(0.08)
Q	0.004	**	(0.002)	0.004	**	(0.001)
L.Q	-0.0004		(0.002)	-0.001		(0.002)
CFK				-0.043		(0.076)
L.CFK				0.001		(0.063)
OilvolG	12.068	***	(4.365)	13.16	***	(4.447)
L.OilvolG	21.395	***	(5.641)	17.675	***	(5.832)
OilvolGsq	-715.995	***	(228.623)	-766.181	***	(235.597)
L.OilvolGsq	-1156.736	***	(279.294)	-956.129	***	(293.019)
_cons	-0.063	**	(0.032)	(0.055)	*	(0.031)
Diognostic tests			p-value			p-value
Wald chi$\hat{2}$	59.82		(0.000)	61.38		(0.000)
AR(1)	-5.89	***	(0.000)	-6.56	***	(0.000)
AR(2)	0.67		(0.500)	1.37		(0.171)
Hansen test	164.35		(0.130)	249.92		(0.226)
Number of obs	3520			3520		
*** p<0.01,** p<0.05, * p<0.1						

Notes: The coefficient are statistically significant at: 10*, 5** and 1*** percents levels respectively

Table 4.8 presents the results of the models bases upon two-step robust standard errors given in parenthesis.

For the system GMM technique, Q, cash flow, and lag of investments are each taken as endogenous.

Oil price volatility squared volatility, time effects and their lags are treated as exogenous.

Lags of 3 to 6 are used in for system GMM estimated results presented.

All explanatory variables are used as standard instruments.

For instruments validity J test of over identification introduced by Hansen is used.

Arellano and Bond (1991) AR (2) test for testing presence of autocorrelation is used.

The coefficients of time period dummy variables estimated are not reported here.

From the cash flow results shown by Model 2 part of Table 4.8, it is observed that internal cash flows of companies do not have any significant effect on investment decisions of firms. This result is in contrast with the US companies findings analyzed by (Henriques and Sadorsky, 2011) which show a positive association between cash flows and investment. This implies that companies in Pakistan can raise their capital from external sources like stocks and debts for financing their investment projects and are less dependent upon internally generated funds for financing investment projects. In addition accumulation of enough internal cash flows take time, hence companies rely on external sources for financing investments.

GMM estimates for the effects of oil price volatility show positive signs of coefficients for both Model 1 and Model 2. Estimated current and lagged measures of GARCH oil price volatility increasing effects, however coefficients of squared oil price volatility measures show significant negative effects and therefore suggest reducing effects of oil price volatility, when this volatility increases at exponential rates beyond a certain point. These results however are different from those reported by Henrique and Sadosky (2011) for US companies implying U shaped relationship with negative effect initially and later positive impacts once oil price volatility increases with exponential rates. The apparent reason for initial positive effect on Pakistani companies investment seems that, government regulates and provides subsidies in Pakistan on oil prices and government subsidies and regulating behavior has restrained the negative effects initially.

However once international oil prices and uncertainty go beyond certain points than government is unable to absorb the shocks by providing unlimited subsidies, therefore passes this burden to consumers which leads to more negative and adverse consequences for investment decisions of companies. This negative effect is also found for lagged squared oil price volatility measure which suggests that this negative effect is robust and stable over the period. Findings from Wang et al. (2017) also support this point, which imply lesser impacts of oil price shocks, for time periods, when there is state regulation in place and greater impacts for time periods when there was minimum state intervention in place in regulating oil prices. In addition Wang et al. (2017) findings also imply that for state owned companies effects of oil prices were restrained and remained positive, due to support by government. Both these viewpoints support the difference of results in the case Pakistani companies investment behavior than that from the US companies behavior.

It is necessary to discuss diagnostics tests because strength of system GMM results depends whether the instruments used are valid or not. Therefore following diagnostic tests are discussed here. Hansen J test guides about using the over-identifying restrictions and follow the distribution of x^2 with null hypothesis that there is no over identification problem and instruments used are exogenous instruments and not correlated with residual distribution. The weakness of Hansen J test is that when null hypothesis is rejected, it cannot guide about which source of over identification is responsible for failure of the model. The AR(1) and AR(2) are Arellano - Bond tests for first and second serial correlation in residuals. It has null hypothesis of no serial correlation problem in residuals. Mohn and Misund (2009) put forth that first order serial correlation is not a source of problem but second order serial correlation can breach the assumptions of the model. For testing whether the overall parameters of the model are significant Wald x^2 is used.

Both the Model 1 and Model 2 specifications comply with the requirements of specification tests and have generally exhibited satisfactorily. Wald x^2tests of overall significance of the variables are highly significant and justify including the time dummy variables also in both the models. Hansen J test stats show that p value of J test is greater than 0.10 levels and therefore there is no problem of any over identification in both Model 1 and Model 2. Arellano bond tests of serial correlation in residuals shows that AR (1) has problem of serial correlation which is not a problem as pointed out by Mohn and Misund (2009), but p value for AR (2) is greater than 0.10 to show that at 10% level of significance there is no problem of serial correlation in Model 1 and Model 2.

4.2.3 Robustness of Results

To check the consistency of the results in Model 1 and Model 2, across the different techniques of measuring the uncertainty both the models are estimated again by using the alternate volatility measure of oil prices. This alternate volatility proxy for oil prices is calculated through the standard deviation of annualized returns. The results of robustness test are presented in Table 4.9.

The results of robustness tests confirm the consistency of main findings across the different alternate measures of oil price volatility and in general are quite similar with those in Table 4.8.

It is noticed that size of coefficients of oil volatility measures has decreased and is are significant at 5% level now as compared with 1% significance level in the main model, but signs direction is still the same. In robustness analysis reported in Table 4.9, the lag value of oil volatility and lags value of squared oil volatility are still greater than their level values, which is also consistent with the coefficients of the main results reported in Table 4.8.

TABLE 4.9: Robustness Check Oil Price Uncertainty and Corporate Investment

	Model 1			Model 2		
IK	Coef.		St.Err	Coef.		St.Err
L.IK	0.085		(0.066)	0.172	***	(0.059)
Q	0.002	**	(0.001)	0.002	*	(0.001)
L.Q	0.001		(0.001)	0.001		(0.001)
CFK				-0.089		(0.063)
L.CFK				0.049		(0.053)
OilvolSD	0.607	**	(0.280)	0.595	**	(0.293)
L.OilvolSD	0.633	**	(0.278)	0.683	**	(0.323)
OilvolSDsq	-2.908	**	(1.335)	-2.896	**	(1.425)
L.OilvolSDsq	-3.351	**	(1.321)	-3.687	**	(1.518)
_cons	0.021		(0.020)	0.022		(0.020)
Diognostic tests			p-value			p-value
Wald chi$\hat{2}$	38.076	***	(0.000)	34.373	***	(0.000)
AR(1)	-6.5	***	(0.000)	-7.42	***	(0.000)
AR(2)	0.24		(0.81)	1.11		(0.265)
Hansen test	296.39		(0.179)	373.36		(0.628)
Number of obs	3520			3520		

*** p<0.01 ** p<0.05 * p<0.1

Notes: The coefficient are statistically significant at: 10*, 5** and 1*** percents levels respectively.

Table 4.9 presents the results of the models bases upon two-step robust standard errors given in parenthesis.

For the system GMM technique, Q, cash flow, and lag of investments are each taken as endogenous.

Oil price volatility squared volatility, time effects and their lags are treated as exogenous.

Lags of 3 and deeper are used in for system GMM estimated results presented.

All explanatory variables are used as standard instruments.

For instruments validity J test of over identification introduced by Hansen is used.

Arellano and Bond (1991) AR (2) test for testing presence of autocorrelation is used

The coefficients of time period dummy variables estimated are not reported here.

4.2.4 Long and Short Terms Effects of Oil Price Uncertainty on the Investment

The summary of results comprising the long and short term effects of linear and exponential oil price uncertainty on the corporate investment is presented in the Table 4.10. In the short term effects of oil price volatility on the investment are positive. It is shown by positive coefficients of contemporaneous and lagged effects which are 13.160 and 17.675 respectively. Linear oil price volatility is calculated by the GARCH method. Its long run effect is also indicated positive by coefficient of 39.890. These results are different from Mohn and Misund (2009), which imply instant negative effects and positive effects in the long term. However when oil price volatility increases in the exponential form than oil price volatility cause significant reduction in the corporate investment level in both the short and long terms, which is obvious from the results of oil volatility squared results.

In the short term both the contemporaneous and lagged coefficients of investment are -766.181 and -956.129 are negative and significant which imply negative effect of squared oil price volatility in the short term.

Table 4.10: Long and Short Terms Effects of Oil Price Uncertainty and Corporate Investment

	OilvolG		OilvolGsq	
	Coefficient	P value	Coefficients	P value
Contemporaneous effect	13.160***	(0.000)	-766.181***	(0.000)
lagged effect	17.675***	(0.000)	-956.129***	(0.000)
Cumulative effect	30.835***	(0.000)	-1722.310***	(0.000)
long-term effect	39.890***	(0.000)	-2228.085***	(0.000)

Note: This Table 4.10. reports the summary of estimated coefficients in the form of instant and lagged effects based on coefficients of oil volatility measures in Model 2 of Table 4.9. These instant and lagged oil volatility coefficients are used for calculating the cumulated and long run impacts of oil price uncertainty on the investment.

Sum of contemporaneous and lagged effects is used for calculation of cumulative effects. Based on model 2 in Table 4.9 long run effects are calculated ass (5+6)/(11), while non-linear test procedure is used for attaining the p-values

*p<0.1, **p<0.05, ***p< 0.01 respectively are significance levels

Same is the case in the long run, where significant negative coefficients of investment levels in response to squared oil price volatility are observed in Pakistani companies. To summarize this point it is observed that initially oil price uncertainty in Pakistan does not have adverse effects on investment by the companies, however when uncertainty go beyond and increases exponentially that it seriously discourages the investment decisions of companies and hence discourages the investment.

Since Pakistan mainly depends on import of oil for its energy needs, it seems appropriate reason for such depressing effects when oil price volatility increases exponentially. The apparent reason for initial positive effect on Pakistani companies investment seems that, government regulates and provides subsidies in Pakistan on oil prices and government subsidies and regulating behavior has restrained the negative effects initially. However once international oil prices and uncertainty go beyond certain points than government is unable to absorb the shocks by providing unlimited subsidies, therefore passes this burden to consumers which leads to more negative and adverse consequences for investment decisions of companies.

4.3 Decomposed Oil Price Uncertainty and Corporate Investment

This section reports the empirical finding regarding the effects of decomposed oil price uncertainty on corporate investment decisions in Pakistan. This section starts with the preliminary analysis of the study. These analyses include the time series plot of monthly decomposed underlying measures of oil prices changes containing the world oil production (WOP) representing the world oil supply, Kilian (2009) real economic activity index (REA) used as proxy for world aggregate demand and oil specific demand indicated by the WTI free on board oil prices from 2000-2016. The descriptive statics regarding these underlying sources of oil price uncertainty and investment related variables are also provided. Further analyses regarding the correlations matrix between the decomposed oil price uncertainty measures and investment related variables and AR (1) characteristics of decomposed oil price uncertainty measures are also reported. Then empirical results after estimation of main model for effects of decomposed oil price uncertainty on the corporate investment decisions are presented. To test the robustness of results and difference of effects across samples based upon oil intensity of the firms are also presented. For this purpose this study divides the data into subsamples containing the oil intensive and less oil intensive samples and presents the estimated results for respective sub samples. Finally for better understanding of effects over the large and small size firms this study further split the main samples into large and small size samples and presents the estimated results for the large and small size sub samples separately.

Kilian (2009) imply that effects of different sources of oil price shocks differ depending upon the underlying source of oil price shock. This study therefore for the first time attempts to unfold whether the effects of different oil price uncertainty sources for corporate investment decisions also differ depending upon the source of oil price uncertainty?

Figure 4.7. World Oil Production World Oil Supply (WOP), World Real Economic Activity Aggregate Demand (REA) and Oil Specific Demand.

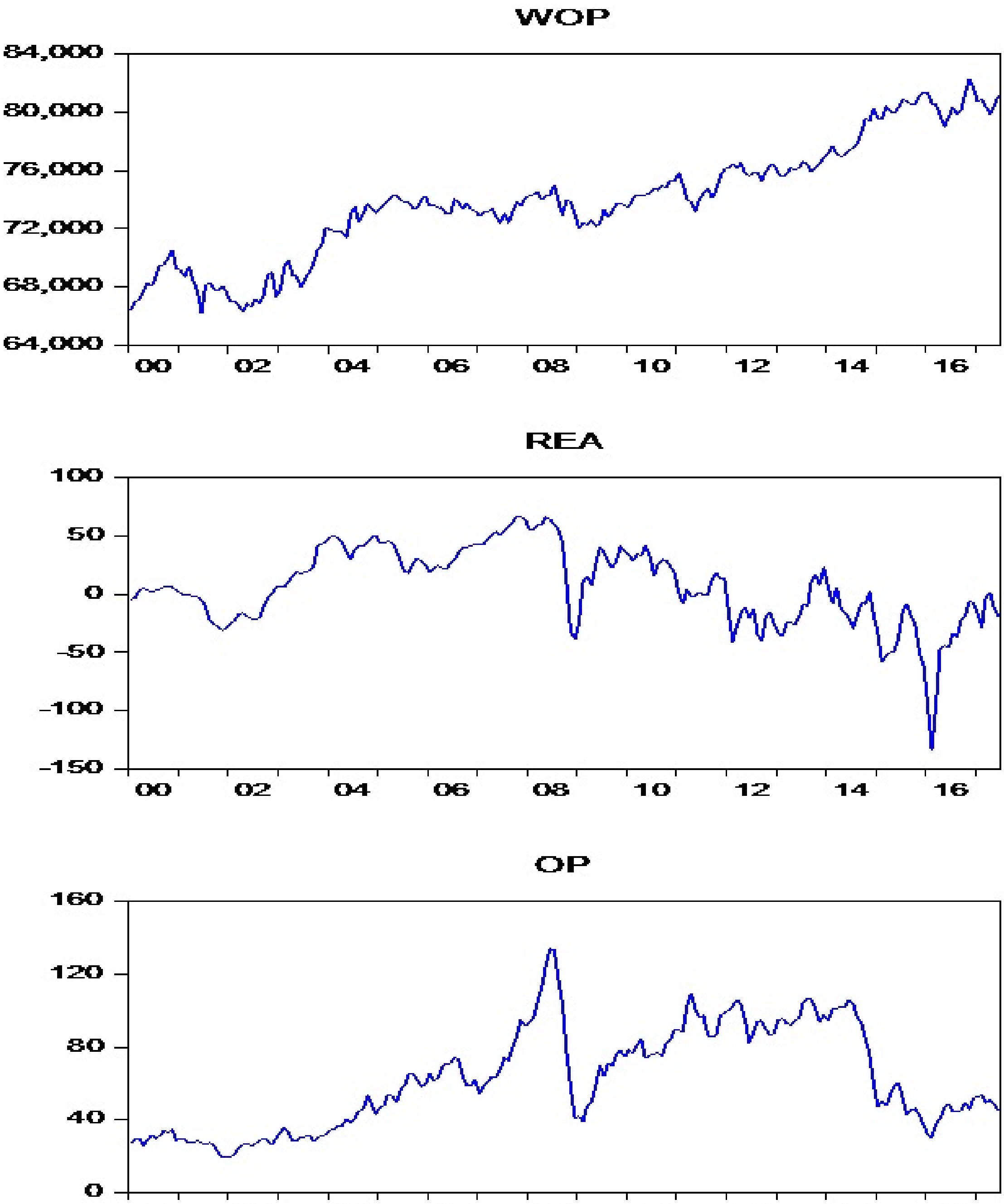

FIGURE 4.7: Underlying Shocks of Oil Prices Uncertainty 2000-2016 Monthly Data Graphed

Henrique and Sadosky (2011) pointed out the need for modeling the decomposed oil price uncertainty approach but expressed their inability to model this. In addition to average oil price shocks effects for corporate investment decisions as discussed in previous section, this study therefore, also models and empirically investigate the effects of different sources of oil price shocks introduced by Kilian (2009) on the corporate investment. These sources of oil price include the world oil supply, world aggregate demand and oil specific demand.

4.3.1 Preliminary Tests Correlations and AR (1) Estimates

Preliminary examination of Fig.4.7 shows that different causes of oil price changes have not followed the same pattern of movements at the same time. This figure display that world aggregate demand (REA) started decreasing before 2013 up to start of 2015, but world oil supply was continuously increasing in this same period. Kilian (2009) imply that different sources of oil price shock have not the same and similar effects and therefore have different effects on macroeconomic variables. This paper therefore examines the effects of decomposed underlying sources of oil price uncertainty on corporate investment decisions. This study expects their different effects on firm level micro economic investment variables also.

Oil price levels have gone through large fluctuations in the period from 2000 to 2016. A high level of oil prices and then a sudden large collapse can be observed in year 2008. Similarly a period of high prices remained from 2010 to 2014 and then a significant drop was observed. From 2014 international oil prices fell down significantly, economies of oil exporting countries like KSA, Russian federation and other oil exporting countries faced serious economic problems in this phase. On the other side oil importing countries benefitted from substantial decrease in their import bills. Decrease in international oil prices in 2016 has caused reduction of about 37 percent in the oil import bill of Pakistan which fell from $12.166 to $7.667 billion in FY15.

Table 4.11: Descriptive Statistics Decomposed Oil Price Uncertainty and Corporate Investment

Variable	Obs	Mean	Std.Dev.	Min	Max
I/K	5106	0.104	0.09	0.011	0.351
Q	4808	3.793	4.114	0.344	15.821
CF/K	5734	0.097	0.107	-0.071	0.348
sdu_wop	6437	0.006	0.002	0.003	0.01
sdu_rea	6437	7.694	3.343	3.886	14.467
sdu_osd	6437	0.067	0.017	0.042	0.104
sdu_wopsq	6437	4E-05	0.00002	1E-05	0.0001
sdu_reasq	6437	70.372	57.82	15.105	209.31
sdu_osdsq	6437	0.005	0.002	0.002	0.011

Note: This table presents the summary of descriptive statistics for the firm-specific variables.

Investment (I) is defined as the purchasing property, plant and equipment also known as fixed tangible assets.

Q is used to denote the Tobin Q, which is the ratio between the market and replacement value of an asset or a firm.

Cash flows (CF) are equal to net income + accumulated depreciation generated by firm in year.

Investment (I) and cash flows (CF) are normalized by firms total assets.

SD is the standard deviation of obtained residuals series from SVAR tests. World oil production (sdu_wop) world aggregate demand (sdu_rea) and oil specific demand (sdu_osd) respectively

Sq are squared values of these three underlying sources of oil price uncertainty respectively

Statistical summary of variables used by the study in the shape of mean values, standard deviations, minimum and maximum values are provided in Table 4.11. Mean value of sample shows that corporate investment growth rate which is represented by I/K on average is 10% which is reasonable amount of investment, on the other side cash flows represented by CF/K growth rate is also about 10%. Q = $q_(-1)$ ratio on average is 3.8 which shows that market value of companies is greater than the book value of assets. Standard deviations measured by, sdu_wop, sdu_rea and sdu_osd represent the decomposed oil price uncertainty variables namely world oil supply, world aggregate oil demand and oil specific demand respectively.

Summary statics in the Table 4.11. show the least volatility of world oil supply variable which is 0.002, whereas sdu_rea 3.343 imply the greater world aggregate demand oil price volatility variable. Oil specific demand however has standard deviation of 0.017 which is greater than the oil supply shock, however lower than the aggregate demand shock. All these monthly oil price volatility measures are annualized and obtained through standard deviation method, which is commonly used in finance literature. Since this study also attempts to investigate the presence of and nature of growth and compound options theory, besides the irreversibility of investment, therefore squared values of all the three sources of oil price uncertainty variables are also included for analysis. Therefore sdu_wopsq, sdu_reasq and sdu_osdsq represent the squared values of underlying oil price shocks. The mean and standard deviations values of all these three squared variables are different from one and other.

Correlation between the main variables of this study is reported in Table 4.12. These correlation results show that investment has positive correlation with its lag value, which validate the opinion that investment process involves the inheritance. Investment is also positively associated with Q and Cash flow, which is as per expectations. Decomposed oil price uncertainty source variables, however are differently linked with the investment, as world oil supply is positively associated whereas world aggregate oil demand and oil specific demand shocks are negatively correlated with the corporate investment variables.

Table 4.12: Matrix of Correlations Decomposed Oil Price Uncertainty and Corporate Investment

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
(1) I/K	1								
(2) Q	0.02	1							
(3) CF/K	0.07	0.53	1						
(4) sdu_wop	0.05	-0.02	0.02	1					
(5) sdu_rea	-0.13	-0.09	-0.01	-0.36	1				
(6) sdu_osd	-0.05	0.01	-0.01	0.15	0.23	1			
(7) sdu_wopsq	0.05	-0.03	0.03	0.99	-0.36	0.12	1		
(8) sdu_reasq	-0.12	-0.10	0.01	-0.40	0.99	0.20	-0.39	1	
(9) sdu_osdsq	-0.04	0.02	-0.01	0.17	0.23	0.99	0.14	0.20	1

To make sure that series is not persistent, as (Bond, 2002) pointed out that using weak instrument in a highly persistent series for first difference GMM estimations can cause a finite sample bias, oil price decomposed variables are also regressed with AR(1) process in this section and reported in Table 4.13. Since first difference estimation technique introduced by Arellano and Bond (1991) needs parameters of auto regression to be less than 1. Therefore before estimating the dynamic Q model of investment through GMM, AR (1) process is estimated with simple OLS models. Statistics reported in Table 4.13. show that all the coefficients of lagged variables have values below 1, which implies that first difference of these all variables can be used as instruments with valuable information.

Table 4.13: AR(1) Estimates of the Variables in the Model

Estimator	sdu_wop	sdu_rea	sdu_osd	sdu_wopsq	sdu_reasq	sdu_osdsq
OLS	0.426***	0.745***	0.186***	0.442***	0.819***	0.122***
P value	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)

Note: using OLS and fixed effect (FE) estimation techniques this table presents estimated coefficients and their p-values for regressing variables on their lagged dependent variables for estimating the AR(1) process of equation:

$y_t = py_{t-1} + u_t$

Significance levels *** p<0.01, ** p<0.05, * p<0.1

4.3.2 Estimation of Decomposed Oil Price Uncertainty and Corporate Investment Decisions

This section presents the estimated results of the effects of decomposed oil price uncertainty sources on the corporate investment decisions. Results presented in this section are categorized in three models. Model 1 is simple Q model augmented with decomposed oil shocks, but without cash flows, Model 2 is Q model augmented with cash flows and decomposed oil shocks, whereas in Model 3 investment Model 2 is augmented with the squared oil price variables also to test the presence of compound options theory. For estimation purpose the system GMM technique is used with the two step methods. The advantage of using system GMM methodology of estimation is that it considers the unobserved panel effects and also controls for the endogeneity.

For estimation purposes this paper following the Henrique and Sadosky (2011) and other empirical studies by treating Investment (I/K), cash flows (C/FK), Tobin's q (Q) as endogenous variables. To control for the business cycles effects time period year dummies are used and fixed effects of firm specific effects are used. Empirical results from all the three models in the Table 4.14, 4.15 and 4.16. Tables 4.14, 4.15 and 4.16 imply that previous year investment has positive and significant coefficients at the 5% significance levels in the model 1, and at the 1% level each in the model 2 and model 3 respectively. This implies that current year investment is influenced by the investment in previous year and therefore follows a persistent pattern. This result is consistent with the theoretical suggestions and findings by Baum et al. (2008) and others, which imply positive association between current and previous period investment levels, follow an inherent dynamic process. Results from the Q ratio show positive significant contribution of lagged value of Q ration in explaining the rate of investment. These results of Q ratio comply with the Q theory of investment; however level value of Q does not show stable significant influence on the investment decisions. Therefore this implies that Tobin Q has significant role in explaining investment, but with a delay of lagged one year.

Table 4.14: Model 1 Decomposed Oil Price Uncertainty and Corporate Investment

I/K	Coef.	St.Err	t-value	p-value	Sig.
L.I/K	0.064	0.028	2.310	0.021	**
Q	-0.001	0.001	-2.040	0.042	**
L.Q	0.004	0.001	6.700	0.000	***
sdu_wop	0.949	0.652	1.460	0.145	
L.sdu_wop	3.380	0.690	4.900	0.000	***
sdu_rea	-0.001	0.000	-1.770	0.076	*
L.sdu_rea	-0.003	0.001	-5.290	0.000	***
sdu_osd	-0.190	0.072	-2.640	0.008	***
L.sdu_osd	-0.167	0.079	-2.100	0.036	**
_cons	0.102	0.010	9.950	0.000	***
Diognostic Tests:					
AR(2)	0.200			0.843	
J-Stat	163.130			0.144	
Mean dependent var	0.101				
SD dependent var	0.086				
Number of obs	3520.000				
Chi-square	270.617				

*** p<0.01,** p<0.05, * p<0.1

Notes: The coefficient are statistically significant at: 10*, 5** and 1*** percents levels respectively.

Table 4.14 presents the results of the model estimated using the two-step system generalized methods of movements.

For the system GMM technique, Q, cash flow, and lag of investments are each taken as endogenous.

Lags of 3 to 6 are used in for system GMM estimated results presented.

All explanatory variables are used as standard instruments.

For instruments validity J test of over identification introduced by Hansen is used.

Arellano and Bond (1991) AR (2) test for testing presence of autocorrelation is used

The coefficients of time period dummy variables estimated are not reported here.

TABLE 4.15: Model 2 Decomposed Oil Price Uncertainty and Corporate Investment

I/K	Coef.	St.Err	t-value	p-value	Sig.
L.I/K	0.181	0.025	7.160	0.000	***
Q	-0.002	0.000	-3.580	0.000	***
L.Q	0.004	0.001	7.310	0.000	***
CF/K	-0.062	0.030	-2.100	0.036	**
L.CF/K	-0.006	0.029	-0.190	0.847	
sdu_wop	0.497	0.694	0.710	0.474	
L.sdu_wop	3.055	0.562	5.440	0.000	***
sdu_rea	-0.001	0.000	-1.620	0.105	*
L.sdu_rea	-0.002	0.000	-5.950	0.000	***
sdu_osd	-0.202	0.066	-3.060	0.002	***
L.sdu_osd	-0.246	0.064	-3.840	0.000	***
_cons	0.105	0.009	12.320	0.000	***
Diognostic Tests:					
AR(2)	1.630			0.103	
J-Stat	220.350			0.166	
Mean dependent var	0.101				
SD dependent var	0.086				
Number of obs	3520.000				
Chi-square	437.855				

*** $p<0.01$,** $p<0.05$, * $p<0.1$

Notes: The coefficient are statistically significant at: 10*, 5** and 1*** percents levels respectively.

Table 4.15 presents the results of the model estimated using the two-step system generalized methods of movements.

For the system GMM technique, Q, cash flow, and lag of investments are each taken as endogenous.

Lags of 3 to 5 are used in for system GMM estimated results presented.

All explanatory variables are used as standard instruments.

For instruments validity J test of over identification introduced by Hansen is used.

Arellano and Bond (1991) AR (2) test for testing presence of autocorrelation is used

The coefficients of time period dummy variables estimated are not reported here.

Table 4.16: Model 3 Decomposed Oil Price Uncertainty and Corporate Investment

I/K	Coef.	St.Err	t-value	p-value	Sig.
L.I/K	0.103	0.026	4.020	0.000	***
Q	-0.001	0.001	-0.900	0.366	
L.Q	0.001	0.001	2.200	0.028	**
CF/K	-0.060	0.031	-1.910	0.056	*
L.CF/K	0.027	0.027	0.980	0.329	
sdu_wop	-13.139	4.954	-2.650	0.008	***
L.sdu_wop	6.323	4.830	1.310	0.190	
sdu_rea	-0.008	0.003	-3.160	0.002	***
L.sdu_rea	-0.010	0.003	-3.190	0.001	***
sdu_osd	-1.614	0.569	-2.840	0.005	***
L.sdu_osd	-3.435	0.679	-5.050	0.000	***
sdu_wopsq	1061.106	363.982	2.920	0.004	***
L.sdu_wopsq	-272.348	385.595	-0.710	0.480	
sdu_reasq	0.000	0.000	3.950	0.000	***
L.sdu_reasq	0.000	0.000	2.410	0.016	**
sdu_osdsq	10.882	3.842	2.830	0.005	***
L.sdu_osdsq	20.736	4.338	4.780	0.000	***
_cons	0.357	0.048	7.380	0.000	***
Diognostic Tests:					
AR(2)	0.710			0.478	
J-Stat	218.760			0.186	
Mean dependent var	0.101				
SD dependent var	0.086				
Number of obs	3520.000				
Chi-square	456.568				

*** $p<0.01$,** $p<0.05$, * $p<0.1$

Notes: The coefficient are statistically significant at: 10*, 5** and 1*** percents levels respectively.

Table 4.16 presents the results of the model estimated using the two-step system generalized methods of movements.

For the system GMM technique, Q, cash flow, and lag of investments are each taken as endogenous.

Lags of 3 to 5 are used in for system GMM estimated results presented.

All explanatory variables are used as standard instruments.

For instruments validity J test of over identification introduced by Hansen is used.

Arellano and Bond (1991) AR (2) test for testing presence of autocorrelation is used

The coefficients of time period dummy variables estimated are not reported here.

It is observed from the cash flow results that internal cash flows of companies do not have any significant effect on investment decisions of firms. This finding is in contrast with the US companies finding analyzed by Henrique and Sadosky (2011) which show positive association between the cash flows and the investment rates. This imply that companies in Pakistan can raise their capital from external sources like stocks and debts for financing their investment projects and are less dependent upon internally generated funds for financing investment projects. In addition accumulation of enough internal cash flows take time, hence companies rely on external sources for financing investments.

Effects of underlying oil price volatility measures, which is the main focus of this study has produced very different and interesting results from the GMM estimates. In contrast with the assumptions of same effect by oil price sources in the previous literature and same positive effects of average oil price volatility on investment presented in the previous models of this present study, results from all the decomposed models reported in Table 4.14, 4.15 and 4.16 shows that different oil price shocks have different effects on the corporate investment. Results in all the three Tables 4.14, 4.15 and 4.16 shows that world oil supply uncertainty indicated by the sdu_wop has positive effect, whereas world oil demand and oil specific demand measured by sdu_rea and sdu_osd respectively has significant negative effects on the corporate investment decisions in Pakistan. These results imply different effects of different world oil price uncertainty measure including the oil supply, aggregate demand and oil specific demand. Therefore these findings are in contrast with the Wang et al. (2017), Henrique and Sadosky (2011), Mohn and Misund (2009) and other relevant previous studies, which assume the same effect of oil price uncertainty measures. Henrique and Sadosky (2011) reported negative effects of average oil price uncertainty measure for US companies.

Further introducing exponential measures for the three underlying oil price uncertainty measures, by including the squared terms however shows positive effects for nearly all the three underlying oil price volatility measures. The coefficients estimated for world oil supply squared (sdu_wopsq), world oil demand (sdu_reasq) and oil specific demand (sdu_osdsq) carry positive and significant signs. These findings with the negative effects for the three underlying oil price uncertainty measures and positive effects of their squared terms imply evidence of U shaped link between the underlying oil price volatility measures and the corporate investment. These findings are consistent with the forecasts of theoretical literature from the strategic growth options. It is also in line with the empirical findings by Henrique and Sadosky (2011), which reported evidence of U shaped link between oil price uncertainty and strategic investment of US companies. This U shaped relation remains stable as it is also found for lagged values of underlying oil price uncertainty measures, except for the world oil supply squared (sdu_wopsq) measure, which is insignificant and has negative sign.

Since the strength of system GMM results depends whether the instruments used are valid or not, therefore diagnostics tests were also used and are discussed here. To make sure that instruments used are not over identified Hansen J test is used for this purpose. Hansen J test stats show that p value of J test is greater than 0.10 levels and therefore there is no problem of any over identification in the model 1, model 2 and model 3 reported in the Table 4.14 Table 4.15 and Table 4.16 respectively. Another test the AR (2) is an Arellano - Bond tests for second order serial correlation in residuals. It has null hypothesis of no serial correlation problem in residuals. Mohn and Misund (2009) put forth that first order serial correlation is not a source of problem but second order serial correlation can breach the assumptions of the model. Arellano bond tests of serial correlation in residuals show that p value for AR (2) is greater than 0.10 to show that at 10% level of significance there is no problem of serial correlation in the model 1, model 2 and model 3 reported in the Tables 4.14, 4.15 and 4.16 respectively.

For testing whether the overall parameters of the model are significant Wald x^2 is used. All the specifications of model 1, model 2 and model 3 reported in the Table 4.14, Table 4.15 and Table 4.16 respectively comply with the requirements of specification tests and have generally exhibited satisfactorily. Wald x^2tests of overall significance of the variables are highly significant and justify including the time dummy variables also in both the models.

4.3.3 More Oil Intensive and Less Oil Intensive Firms

To investigate the role of intensity or proportion of crude oil and related products usage as an input cost in production process, this study further examines the effects of underlying oil price uncertainty sources and the corporate investment decisions. For this purpose two sub samples into energy intensive industries and less energy intensive industries in formed. Oil intensive industries use greater share of oil and related products as an input than the less oil intensive industries.

TABLE 4.17: Descriptive Statistics Oil Intensive and Less Oil Intensive Firms

Panel A
Oil Intensive Industries

Variable	Obs	Mean	Std.Dev.	Min	Max
I/K	1201	0.101	0.094	0.011	0.351
Q	1210	5.069	4.649	0.344	15.82
CF/K	1346	0.113	0.116	-0.07	0.348

Panel B
Less Intensive Industries

Variable	Obs	Mean	Std.Dev.	Min	Max
I/K	3905	0.106	0.089	0.011	0.351
Q	3598	3.363	3.823	0.344	15.82
CF/K	4388	0.092	0.104	-0.07	0.348

Notes: This table presents the summary of descriptive statistics for the firm-specific variables. Investment (I) is defined as the purchasing property, plant and equipments also known as fixed tangible assets. Q is used to denote the Tobin Q, which is the ratio between the market and replacement value of an asset or a firm Cash flows (CF) are equal to net income + accumulated depreciation generated by firm in year. Investment (I) and cash flows (CF) are normalized by firms total assets.

Table 4.18 and Table 4.19 report the results for estimation of oil intensive and less oil intensive industries respectively. On the whole the results reported for the investment (I/K), cash flows (CF/K) and Tobin Q for oil intensive firms and less the less oil intensive firms are nearly similar with the results presented in the full sample.

Oil Intensive Firms

TABLE 4.18: System GMM Estimates of Decomposed Oil Price Uncertainty and Oil Intensive Firms Investment

I/K	Coef.	St.Err	t-value	p-value	Sig.
L.I/K	0.106	0.009	11.260	0.000	***
Q	0.000	0.000	0.890	0.373	
L.Q	0.003	0.000	10.960	0.000	***
CF/K	-0.158	0.015	-10.680	0.000	***
L.CF/K	0.103	0.017	5.990	0.000	***
sdu_wop	0.101	0.446	0.230	0.821	
L.sdu_wop	1.975	0.240	8.240	0.000	***
sdu_rea	-0.003	0.000	-11.000	0.000	***
L.sdu_rea	-0.001	0.000	-4.540	0.000	***
sdu_osd	-0.051	0.045	-1.140	0.255	
L.sdu_osd	-0.013	0.028	-0.470	0.637	
_cons	0.101	0.006	18.360	0.000	***
Diognostic Tests:					
AR(2)	0.600			0.550	
J-Stat	89.800			1.000	
Mean dependent var	0.098				
SD dependent var	0.090				
Number of obs	902.000				
Chi-square	6902.957				

*** p<0.01,** p<0.05, * p<0.1

Notes: The coefficient are statistically significant at: 10*, 5** and 1*** percents levels respectively.

Table 4.18 presents the results of the model estimated using the two-step system generalized methods of movements.

For the system GMM technique, Q, cash flow, and lag of investments are each taken as endogenous.

Lags of 2 to 4 are used in for system GMM estimated results presented.

All explanatory variables are used as standard instruments.

For instruments validity J test of over identification introduced by Hansen is used.

Arellano and Bond (1991) AR (2) test for testing presence of autocorrelation is used

The coefficients of time period dummy variables estimated are not reported here.

For oil intensive industries the positive coefficient of oil supply side uncertainty at the lagged oil supply shock, is similar with the full sample results. On the other side negative effects of aggregate oil demand side shocks are reported for the investment decisions of oil intensive firms, where as no significant effects can be seen for the oil specific demand side uncertainty. For the less oil intensive industries the reported results reported are not very much different from the oil intensive firms, except for few differences.

One difference is that significantly negative effects is reported for oil intensive industries whereas, for less oil intensive firms aggregate demand side uncertainty has negative effects significant only at the lagged period. Other difference is that for less oil intensive firm's oil specific demand shock is also found to be significantly affecting the investment in a negative direction, whereas no significant role can be observed for oil intensive firms. On the whole both the oil intensive and less oil intensive industries are affected significantly by the underlying oil price uncertainty sources and not much difference of effects is found for oil intensive and less oil intensive firms, except few differences. Less oil intensive industries which are not much dependent on using oil and related products as an input cost in the production process are also significantly affected by the underlying oil price shocks.

Theoretically oil price affect the investment from both the supply side and the demand side. As put forth by Edelstein and Kilian (2007) that firms respond to energy uncertainty from both the supply and demand sides. As a result, when energy prices go up, firms reduce investment because of declining sales and considerations over future cost expenditure. This negative effect is magnified by uncertainty, which reduces the incentive to invest. The possible explanation of this therefore seems that it is not the supply side effects, but the demand side effects and oil price uncertainty are dominating the role in Pakistan. Therefore for both the oil intensive and less oil intensive industries the different sources of underlying oil price volatility depress significantly the corporate investment decisions in Pakistan.

Less Oil Intensive Firms

Table 4.19: System GMM Estimates of Decomposed Oil Price Uncertainty and Less Oil Intensive Firms Investment

I/K	Coef.	St.Err	t-value	p-value	Sig.
L.I/K	0.126	0.011	11.480	0.000	***
Q	-0.003	0.000	-9.760	0.000	***
L.Q	0.004	0.000	17.380	0.000	***
CF/K	0.040	0.011	3.770	0.000	***
L.CF/K	-0.001	0.009	-0.150	0.878	
sdu_wop	-0.278	0.269	-1.030	0.300	
L.sdu_wop	3.774	0.254	14.880	0.000	***
sdu_rea	0.000	0.000	1.060	0.288	
L.sdu_rea	-0.003	0.000	-12.640	0.000	***
sdu_osd	-0.186	0.037	-5.010	0.000	***
L.sdu_osd	-0.393	0.028	-14.070	0.000	***
_cons	0.114	0.003	33.820	0.000	***
Diognostic Tests:					
AR(2)	0.830			0.407	
J-Stat	231.370			0.336	
Mean dependent var	0.103				
SD dependent var	0.085				
Number of obs	2618.000				
Chi-square	1660.068				

*** $p<0.01$,** $p<0.05$, * $p<0.1$

Notes: The coefficient are statistically significant at: 10*, 5** and 1*** percents levels respectively.

Table 4.19 presents the results of the model estimated using the two-step system generalized methods of movements.

For the system GMM technique, Q, cash flow, and lag of investments are each taken as endogenous.

Lags of 2 to 4 are used in for system GMM estimated results presented.

All explanatory variables are used as standard instruments.

For instruments validity J test of over identification introduced by Hansen is used.

Arellano and Bond (1991) AR (2) test for testing presence of autocorrelation is used

The coefficients of time period dummy variables estimated are not reported here.

Edelstein and Kilian (2007) point out that there are two channels by which energy price can affect firm investments. First, an increase in energy price drives up the marginal cost of production, as energy is an important input cost in the whole production cycle; even though some firms may not directly consume energy, such as crude oil, as part of the production process, they do nevertheless use energy as indirect costs, such as heating and transportation. Second, rising oil prices reduce consumer expenditures, which in turn reduce demand for the firms product. Fluctuations in the price of energy introduce uncertainty about future energy prices, which results in firms postponing irreversible investments (Pindyck, 1991). Edelstein and Kilian (2007) also show that firms respond to energy uncertainty from both the supply and demand sides. As a result, when energy prices go up, firms reduce investment because of declining sales and considerations over future cost expenditure. This negative effect is magnified by uncertainty, which reduces the incentive to invest. However when energy prices fall, higher investment spending triggered by increasing demand and falling costs is dampened by the increased uncertainty caused by the price fluctuation itself, reducing the incentive to invest.

4.3.4 Effects on the Large and Small Size Firms

To investigate whether the effects of oil price uncertainty differ depending upon the size of the firm, this study further examines the effects of underlying oil price uncertainty sources and the corporate investment decisions of firms of different sizes. For this purpose this study constructed large size and small size samples by using the mean value of total assets size as a benchmark criterion. Firms greater than the average value of total assets are categorized as large size firms and remaining as the small size firms.

In this context Sadorsky (2008) provides a summary of previous research, while discussing oil prices and the stock prices association. He has categorized the previous work in three main categories. The first point of view put forth by Caves and Barton (1990) argues small firms lack in capabilities, resources to change their inputs mix and economies of scale, as compared with the large scale firms to save themselves from the rising energy prices.

Contrary to this Aigniger and Tichy (1991) opined that quick decision making and lesser complexity of management structure can enable give rise to quick decision making process in small firms. Therefore innovation can be easy in small firms and they can efficiently deal with the increasing energy prices. Third type of evidence provided by Nguyen and Lee (2002) rejects the role of either large or small sized firms in achieving energy efficiency and therefore handling the rising energy prices. They found for US firms in manufacturing sector that large and small firms are equal in efficiency to deal with the energy price changes.

Table 4.20: Descriptive Statistics Large and Small Size Firms

Panel A
Large Size Industries

Variable	Obs	Mean	Std.Dev.	Min	Max
I/K	2445	0.106	0.091	0.011	0.351
Q	2501	4.153	4.375	0.344	15.821
CF/K	2674	0.112	0.107	-0.071	0.348

Panel B
Small Size Industries

Variable	Obs	Mean	Std.Dev.	Min	Max
I/K	2661	0.103	0.089	0.011	0.351
Q	2307	3.402	3.773	0.344	15.821
CF/K	3060	0.085	0.105	-0.071	0.348

Notes: This table 4.20 presents the summary of descriptive statistics for the firm-specific variables. Investment (I) is defined as the purchasing property, plant and equipments also known as fixed tangible assets. Q is used to denote the Tobin Q, which is the ratio between the market and replacement value of an asset or a firm Cash flows (CF) are equal to net income + accumulated depreciation generated by firm in year. Investment (I) and cash flows (CF) are normalized by firms total assets.

Table 4.20 reports the summary statistics of these two large and small size sub-samples. It is evident from the summary statistics that on average the values of investment (I/K), cash flows (CF/K) and Tobin Q for large size firms are greater than the values for the small size firms.

For large size firms and the small size firms the estimated GMM results are reported in the Table 4.21. and 4.22 respectively.

On the whole the results reported for the investment (I/K), cash flows (CF/K) and Tobin Q for large size firms and the small firms are nearly similar with the results presented in the full sample, except few minor differences. In both the large and small size firms all the variables are significant, except Q and lagged cash flows which are insignificant for the small size firms. Cash flows at level however show significantly positive effects for small firms. This finding is in line with Bond et al. (2004), which imply for small firms in the bubble conditions of stock prices cash flows have an important role in explaining share prices. In addition Vogt (1994) put forth that those firms also depends upon cash flows for financing their investments, which have low Q ratios.

Oil price volatility coming from the world oil supply side initially has negative effects on the large size firms, but lagged effects are significantly positive. While world oil supply side uncertainty has significantly positive effects on the corporate investment decisions of the small size firms. In addition similar with the main sample results oil price uncertainty coming from world aggregate demand side significantly reduce the investment of both the large and the small size firms. Therefore there is no difference of effects for large and the small size firms can be found for world aggregate demand side uncertainty on the corporate investment decisions.

Large Size Firms

Table 4.21: System GMM Estimates of Decomposed Oil Price Uncertainty and Large Size Firm Investment

I/K	Coef.	St.Err	t-value	p-value	Sig.
L.I/K	0.135	0.007	18.260	0.000	***
Q	-0.001	0.000	-4.030	0.000	***
L.Q	0.003	0.000	16.460	0.000	***
CF/K	-0.195	0.007	-28.370	0.000	***
L.CF/K	0.118	0.009	13.070	0.000	***
sdu_wop	-2.479	0.270	-9.200	0.000	***
L.sdu_wop	2.348	0.212	11.050	0.000	***
sdu_rea	-0.001	0.000	-7.300	0.000	***
L.sdu_rea	-0.002	0.000	-9.120	0.000	***
sdu_osd	-0.067	0.031	-2.160	0.031	**
L.sdu_osd	-0.180	0.027	-6.690	0.000	***
_cons	0.121	0.004	31.770	0.000	***
Diognostic Tests:					
AR(2)	1.540			0.125	
J-Stat	186.610			0.432	
Mean dependent var	0.096				
SD dependent var	0.081				
Number of obs	1857.000				
Chi-square	2701.919				

*** $p<0.01$,** $p<0.05$, * $p<0.1$

Table 4.21 presents the results of the model estimated using the two-step system generalized methods of movements.

For the system GMM technique, Q, cash flow, and lag of investments are each taken as endogenous.

Lags of 3 to 4 are used in for system GMM estimated results presented.

All explanatory variables are used as standard instruments.

For instruments validity J test of over identification introduced by Hansen is used.

Arellano and Bond (1991) AR (2) test for testing presence of autocorrelation is used

The coefficients of time period dummy variables estimated are not reported here.

Small Size Firms

TABLE 4.22: System GMM Estimates of Decomposed Oil Price Uncertainty and Small Size Firm Investment

I/K	Coef.	St.Err	t-value	p-value	Sig.
L.I/K	0.023	0.009	2.490	0.013	**
Q	0.000	0.000	0.270	0.790	
L.Q	0.001	0.000	10.240	0.000	***
CF/K	0.061	0.006	10.110	0.000	***
L.CF/K	-0.006	0.008	-0.840	0.400	
sdu_wop	1.240	0.219	5.660	0.000	***
L.sdu_wop	3.439	0.262	13.110	0.000	***
sdu_rea	-0.001	0.000	-8.350	0.000	***
L.sdu_rea	-0.002	0.000	-10.810	0.000	***
sdu_osd	-0.130	0.029	-4.450	0.000	***
L.sdu_osd	-0.236	0.027	-8.860	0.000	***
_cons	0.105	0.004	23.490	0.000	***
Diognostic Tests:					
AR(2)	-0.950			0.341	
J-Stat	170.040			0.633	
Mean dependent var	0.101				
SD dependent var	0.086				
Number of obs	1496.000				
Chi-square	2165.646				

*** $p<0.01$,** $p<0.05$, * $p<0.1$

Notes: The coefficients are statistically significant at: 10*, 5** and 1*** percent levels respectively.

Table 4.22 presents the results of the model estimated using the two-step system generalized methods of movements.

For instruments validity J test of over identification introduced by Hansen is used.

(Arellano and Bond, 1991) AR (2) test for testing presence of autocorrelation is used.

The coefficients of time period dummy variables estimated are not reported here.

Lags of 3 to 4 are used in for system GMM estimated results presented.

Oil specific demand source of oil price uncertainty is also found to have significantly depressing effects for investment both in the large and the small size firms, however lower coefficients of this particular source of uncertainty for large firms than the small firms imply that large firms have resources and are better able to handle with the oil specific demand side source of oil price uncertainty. This result is in line with the finding by (Ratti, Seol and Yoon, 2011). They used total assets to measure the size of the firm and reported less negative effects of increasing energy prices for the large firms.

In addition to Large and Small size firms, for robustness sake, this study further investigate the effects of oil price uncertainty differ between the Top 20% firms and the Low 20% firms in terms of size. This study further examines the effects of underlying oil price uncertainty sources and the corporate investment decisions of Top 20% firms and the Low 20% firms. For this purpose this study constructed Top 20% firms in size and Low 20% firms in size samples.

Table 4.23 and 4.24 respectively report the estimated GMM results for Top 20% and Low 20% firms in terms of size. In this case it is observed that Low 20% firms suffer more than the Top 20% firms from the oil price shocks. Corporate investment was adversely affected by all three types of underlying oil prices shocks, whether it is from the world oil supply side, world demand side or the oil specific demand side uncertainty. Compared with the Low 20% the Large 20% of the firms were faced with less severe effects of oil price shocks, as oil specific demand shocks and world oil supply side immediately did not have adverse effects on the corporate investment. However oil price uncertainty originated from the world demand side have negative consequences for the Top 20% firms also.

Top 20% Firms

Table 4.23: System GMM Estimates of Decomposed Oil Price Uncertainty and Top 20% Corporate Investment

I/K	Coef.	St.Err	t-value	p-value	Sig.
L.I/K	0.001	0.006	0.260	0.798	
Q	0.001	0.000	16.010	0.000	***
L.Q	-0.001	0.000	-8.250	0.000	***
CF/K	-0.012	0.006	-2.090	0.036	**
L.CF/K	-0.006	0.006	-1.070	0.285	
sdu_wop	1.373	0.325	4.230	0.000	***
L.sdu_wop	-1.018	0.172	-5.930	0.000	***
sdu_rea	-0.002	0.000	-13.150	0.000	***
L.sdu_rea	-0.001	0.000	-9.550	0.000	***
sdu_osd	0.135	0.013	10.180	0.000	***
L.sdu_osd	0.381	0.037	10.430	0.000	***
_cons	0.087	0.004	19.370	0.000	***
Diognostic Tests:					
AR(2)	1.510			0.132	
J-Stat	92.860			1.000	
Mean dependent var	0.091				
SD dependent var	0.079				
Number of obs	786.000				
Chi-square	3225095.694				

*** p<0.01,** p<0.05, * p<0.1

Notes:

The coefficients are statistically significant at: 10*, 5** and 1*** percent levels respectively

Table 4.23 presents the results of the model estimated using the two-step system generalized methods of movements.

For instruments validity J test of over identification introduced by Hansen is used.

Arellano and Bond (1991) AR (2) test for testing presence of autocorrelation is used.

The coefficients of time period dummy variables estimated are not reported here.

Lags of 4 is used in for system GMM estimated results presented

Low 20% Firms

Table 4.24: System GMM Estimates of Decomposed Oil Price Uncertainty and Low 20% Corporate Investment

I/K	Coef.	St.Err	t-value	p-value	Sig.
L.I/K	-0.196	0.004	-54.630	0.000	***
Q	-0.005	0.000	-24.950	0.000	***
L.Q	-0.003	0.000	-27.450	0.000	***
CF/K	0.144	0.008	18.810	0.000	***
L.CF/K	0.154	0.006	26.590	0.000	***
sdu_wop	-1.149	0.193	-5.950	0.000	***
L.sdu_wop	5.328	0.204	26.090	0.000	***
sdu_rea	-0.001	0.000	-3.650	0.000	***
L.sdu_rea	-0.004	0.000	-18.490	0.000	***
sdu_osd	-0.174	0.025	-6.890	0.000	***
L.sdu_osd	-0.506	0.022	-22.940	0.000	***
_cons	0.155	0.003	59.060	0.000	***
Diognostic Tests:					
AR(2)	-1.440			0.150	
J-Stat	68.900			1.000	
Mean dependent var	0.081				
SD dependent var	0.082				
Number of obs	400.000				
Chi-square	340874.942				

*** $p<0.01$,** $p<0.05$, * $p<0.1$

Notes:

The coefficients are statistically significant at: 10*, 5** and 1*** percent levels respectively

Table 4.24 presents the results of the model estimated using the two-step system generalized methods of movements.

For instruments validity J test of over identification introduced by Hansen is used.

Arellano and Bond (1991) AR (2) test for testing presence of autocorrelation is used

The coefficients of time period dummy variables estimated are not reported here.

Lags of 3 to 4 are used in for system GMM estimated results presented

This imply that Top 20% firms have more resources and are better able to handle with the oil specific demand side source of oil price uncertainty and also from world oil supply side. These results are also consistent with the finding by (Ratti, Seol and Yoon, 2011). In this context Caves and Barton (1991), argues small firms lack in capabilities and necessary resources to change their inputs mix and economies of scale, as compared with the large scale firms to save themselves from the rising energy prices. This seems the reason for less severe effects of oil price shocks for large size firms as compared with the small size firms.

To summarize the discussion it is argued that small firms are better in coping with the world oil supply side source of oil price uncertainty, whereas the large size firms are better able to handle with the oil specific demand side source of oil prices. Therefore effects of oil price shocks on investment is not the same for the large and small size firms and differ depending upon the underlying source of oil price uncertainty also.

Chapter 5

Summary, Conclusion and Recommendations

This chapter presents the outcomes of investment in the financial and real assets in response to oil price shocks in Pakistan. This study first presents the conclusions keeping in view the hypothesis of the study. Further it presents the contribution that this study makes to the existing body of knowledge and implications of this study for investors, managers and policymakers. In the end of this chapter future study directions are presented.

Efforts of economic growth are seriously constrained mainly by the shortage of oil and energy resources. Oil being a major source of energy, crucially affects the economy (Ebohon, 1996). Its sustained and stable level of supply is essential for sustained growth in developing countries like Pakistan for increasing job opportunities and reducing poverty. The changes in price level of this important input affects the decision making behavior of consumers, investors and policy makers. Although all economic agents are affected by the changes in the level of oil prices, the case of investors is important. In general these countries are net importers of oil from the international market. In this context there is vast literature available on the topic; however it suffers from following limitations.

First and main limitation of past studies is that they used single average oil price measure and did not use the decomposed oil price shocks framework for examining its effects on the corporate real investment decisions. In this sense these studies suffers from limits of treating oil price shocks as exogenous shocks and their inability to explore distinguished effects of different underlying oil shocks. In this context Henrique and Sadosky (2011) pointed out different sources of oil price uncertainty affecting the corporate investment decisions. However they have shown their inability to model these underlying sources of oil price uncertainty and strategic investment decisions by the U.S. firms in their studies and therefore used the traditional single oil price variable in their model estimation of the study.

Therefore their study cannot explain the distinguished effects of each source of oil price uncertainty responsible for changes in firm level investment. This study therefore fills this gap by using this Kilian (2009) approach for the first time for estimation of oil price uncertainty and corporate investment. This study therefore fills this gap by using the decomposed oil price framework for investigating the distinct effects of underlying oil shocks on the corporate real investment behavior.

Moreover recent literature focusing especially relation between oil price shocks and stock markets has mainly followed the Kilian (2009) demand and supply based decomposed oil shocks model. Researcher in this field used World oil production, world aggregate demand shock and oil specific demand shocks in their framework following the (Kilian, 2009). However this existing research work using decomposed oil price shocks approach has mainly addressed the developed world and no previous study on the topic, could be found for developing countries like Pakistan. Therefore, we do not know about the dimension and potency of the effects of underlying oil price shocks on the investment in financial assets like share prices in the developing economies like Pakistan. Keeping in mind the differences across the countries Crompton and Wu (2005) put forth that the impacts of shocks to the oil prices on the markets are likely to be different from nation to nation due to different industrial structures, energy structures, energy consumption intensities, imports dependence level and pricing mechanisms. Therefore present study fills this gap also by examining the implications of underlying oil price shocks for the stock market for the first time in Pakistan.

In addition presence of both the irreversible and growth options in the U.S. corporate investment decisions when faced with the oil price uncertainty were examined by (Henriques and Sadorsky, 2011). In Pakistan government agency OGRA regulates the oil prices, whereas in the U.S oil prices are settled comparatively in an open market. Therefore how this oil price uncertainty and corporate investment decisions behave in an oil price regulated environment is still unknown. Therefore, price variations in the global oil market and their components have become a vital issue for the economy of the country and this demands proper understanding of their potential effects on the stock market and corporate investment behavior. In this environment of heavy oil import dependence the government agency OGRA is regulating the oil prices in Pakistan and international oil prices are not as it is passed on to consumers instantly.

In this context purpose of present study is to examine the implications of oil price fluctuations for the investment in the stock market aggregate level and corporate real assets at the firms level. This study also aims at testing the presence of both the irreversibility option and the growth options for the first time in an oil price regulated environment by investigating the nature and extent of relationship between oil price uncertainty and corporate investment decisions in Pakistan. Changes in oil prices, decisions for investment in the financial and corporate real assets have an essential role in the macroeconomic and microeconomic changes in the short and the medium term. An appropriate understanding of the consequences of oil prices uncertainty on the financial and corporate real investment behavior is helpful for policy-makers, corporate managers, economists and market analysts. Results of this study are expected to be highly important for the stakeholders of stock market, investors and researchers in Pakistan.

5.1 Conclusions

Realizing the heavy reliance and sensitivity of Pakistani economy to the imported oil and sudden changes in recent international oil prices, this study undertakes investigating the oil price shocks and its implications for the stock prices in Pakistan at the aggregate market level. For this purpose this study for the first time uses the Kilian (2009) structural VAR decomposed oil price shocks methodology for analysis in Pakistan. This approach distinguishes this research effort from past few studies in Pakistan. Using this approach is important since it addresses the caveat of traditional methodology of treating oil price shocks as exogenous variable. Additionally it also allows for analyzing the distinguished effects of underlying sources of oil price variation.

This study investigated the different underlying international oil price shocks and how does and to what extent different underlying oil price shocks affect the stock market in Pakistan. Analysis of this study proceeds in two steps. In first step sources of oil price shocks were identified namely aggregate oil supply shock, aggregate demand shocks and oil specific shocks. Impulse response and variance decompositions results show that oil specific demand and aggregate demand for oil shocks have important bearing on the oil price shocks while oil supply shocks have little role.

In the second step implications of these identified underlying oil price shocks for the aggregate stock market prices were analyzed by following the SVAR framework used by (Kilian & Park, 2009). Results of this second step show that oil supply shocks and aggregate demand shocks have significant effect on the stock prices, whereas oil specific demand shocks have little effect on the stock market prices in Pakistan. Additionally cumulative impulse response analysis imply more stable effect of oil supply shocks however, effects of aggregate demand for oil changes over the time. These results are also in line with the (Chen et al., 2014) findings.

The results of this study imply that impact of oil price shocks on stock markets vary greatly depending upon the nature and source of the shock and each shock has affected the stock market in different directions with different potencies. Therefore, policy makers, investors and managers must take care of sources of underlying oil price shocks in making their decisions regarding this oil price risks and investments.

The most essential decision made by companies is the investment expenditure, since it involves business growth and achieving the advantage over the other competing companies in the market. Uncertainty regarding the price levels of an important input crude oil, which has been very much volatile during the recent past, makes this investment decisions difficult for managers, investors and policy makers. This study uses the real options theory for empirical examination of the relation between the oil price uncertainty and the corporate investment decisions in Pakistan.

Contrary to the previous studies which investigated this issue in the developed countries, this study investigates this relationship in an environment of a regulated oil pricing in a developing country which is highly dependent on imported oil for its needs over the seventeen years period from 2000-2016. This study contributes the existing body of knowledge as, compound options theory for investment involving both the waiting options and the growth options in the face of oil price uncertainty has never been explored previously in such an environment.

The main findings from the estimations imply that higher oil price uncertainty significantly lowers the corporate investment. However this relationship is not linear and involves both the growth options and the waiting options. This finding is consistent with the compound options theory and empirical results reported by the (Henriques and Sadorsky, 2011). However results of this study are different from those for US reported by Henrique and Sadosky (2011), in the sense that for US they reported initially waiting options evidence due to negative effect of oil price volatility and then growth options favored by positive and stimulating effects on the investment decisions of squared oil price volatility capturing the exponential case of oil price volatility.

Whereas results of present study focusing the Pakistani data found initial growth options evidence as there is positive effect. However it goes significantly negative and therefore supports the waiting options presence thereby discouraging for investment environment once it goes exponential. The appropriate reason for this difference seems the environment of Pakistan where oil prices are regulated by OGRA and rely heavily on imported oil for its needs. All this influence the productions costs and the demands for the products and causes doubts about the outcomes of investment decisions with resulting depressed investment.

Therefore before making policy decisions regarding regulation of oil prices and seeking alternate sources of energy, policy makers should consider this fact that availability of environment with minimized oil price uncertainty, is conducive for achieving the goals of investment expansion.

This study also attempts to identify the sources of oil price uncertainty and examine their implications for the corporate investment decisions in Pakistan. Further this study also examined the presence of both the waiting and growth options in the face of oil price uncertainty in Pakistan. This study contributes to the existing body of knowledge by addressing the main limitation of past studies that they used single average oil price measure and did not use the decomposed oil price shocks framework for examining its effects on the corporate real investment decisions. This study therefore fills this gap by using the decomposed oil price framework for investigating the distinct effects of underlying oil shocks on the corporate real investment behavior.

For this purpose this study for the first time uses the Kilian (2009) structural VAR decomposed oil price shocks methodology for investigating the effects of oil price uncertainty sources on the corporate investment decisions. This approach distinguishes this research effort from past studies on the topic. Using this approach is important since it addresses the caveat of traditional methodology of treating oil price shocks as exogenous variable. Additionally it also allows for analyzing the distinguished effects of underlying sources of oil price variation.

Analysis of this study proceeds in three steps. In first step following Kilian (2009) sources of oil price shocks were identified namely aggregate oil supply shock, aggregate demand shocks and oil specific shocks by using the structural VAR method. In the second step following the most of finance and economics literature volatility of these measures was calculated by using the standard deviation method. In third and final step in line with main stream literature on the topic, the effects of decomposed oil price uncertainty sources on the corporate investment decisions were estimated by using the common method generalized methods of movement. Further sub samples were made estimated to examine the effects of oil price uncertainty sources on the corporate investment decisions in oil intensive and less oil intensive industries. Moreover these effects were also examined for the firms of large and small size.

Results from all the decomposed models show that effects of different oil price shocks are not the same and similar. They have different effects on the corporate investment in terms of direction and potency. Finding from the results shows the positive effects of world oil supply uncertainty, whereas world oil demand and oil specific demand measures have significant negative effects on the corporate investment decisions in Pakistan. These results imply different effects of different world oil price uncertainty measure including the oil supply, aggregate demand and oil specific demand. Therefore these findings are in contrast with the Wang et al. (2017), Henrique and Sadosky (2011), Mohn and Misund (2009) and other relevant previous studies, which assume the same effect of oil price uncertainty measures. Henrique and Sadosky (2011) reported negative effects of average oil price uncertainty measure for US companies.

In addition introducing exponential measures for the three underlying oil price uncertainty measures, by including the squared terms however shows positive effects for nearly all the three underlying oil price volatility measures. These findings with the negative effects for the three underlying oil price uncertainty measures and positive effects of their squared terms imply evidence of U shaped link between the underlying oil price volatility measures and the corporate investment. These findings are consistent with the forecasts of theoretical literature from the strategic growth options. It is also in line with the empirical findings by Henrique and Sadosky (2011), which reported evidence of U shaped link between oil price uncertainty and strategic investment of US companies. Except for the world oil supply squared measure, which is insignificant and has negative sign, this U shaped relation remains stable as it is also found for lagged values of underlying oil price uncertainty measures.

The results of this decomposed underlying sources of price shocks on corporate investment decisions show that corporate investment vary greatly depending upon the nature and source of the shock and each shock is responded by corporate investment in a different way. Therefore, policy makers, investors and managers must take care of sources of underlying oil price shocks in making their decisions regarding this oil price risks and investments.

This study further examines the effects of underlying oil price uncertainty sources and the corporate investment decisions by focusing the role of intensity or proportion of crude oil and related products usage as an input cost in production process. For this purpose two sub samples into energy intensive industries and less energy intensive industries in formed. Oil intensive industries use greater share of oil and related products as an input than the less oil intensive industries.

Summary statistics for these two sub samples show that on average the values of investment (I/K), cash flows (CF/K) and Tobin Q for oil intensive firms are greater than the less oil intensive firms. On the whole the results reported for the investment (I/K), cash flows (CF/K) and Tobin Q for oil intensive firms and less the less oil intensive firms are nearly similar with the results presented in the full sample.

For oil intensive industries the positive coefficient of oil supply side uncertainty at the lagged oil supply shock, is similar with the full sample results. On the other side negative effects of aggregate oil demand side shocks are reported for the investment decisions of oil intensive firms, where as no significant effects can be seen for the oil specific demand side uncertainty. For the less oil intensive industries the results reported are not very much different from the oil intensive firms, except for few differences. One difference is that significantly negative effects is reported for oil intensive industries whereas, for less oil intensive firms aggregate demand side uncertainty has negative effects significant only at the lagged period.

Other difference is that for less oil intensive firms oil specific demand shock is also found to be significantly affecting the investment in a negative direction, whereas no significant role can be observed for oil intensive firms. On the whole both the oil intensive and less oil intensive industries are affected significantly by the underlying oil price uncertainty sources and not much difference of effects is found for oil intensive and less oil intensive firms, except few differences. Less oil intensive industries which are not much dependent on using oil and related products as an input cost in the production process are also significantly affected by the underlying oil price shocks. The possible explanation of this therefore seems that it is not the supply side effects, but the demand side effects are dominating the role. Therefore for both the oil intensive and less oil intensive industries the different sources of underlying oil price volatility affect significantly the corporate investment decisions in Pakistan.

To investigate whether the effects of oil price uncertainty differ depending upon the size of the firm, this study further examines the effects of underlying oil price uncertainty sources and the corporate investment decisions of firms of different sizes. For this purpose this study constructed large size and small size samples by using the mean value of total assets size as a benchmark criterion. Firms greater than the average value of total assets are categorized as large size firms and remaining as the small size firms.

It is evident from the summary statistics that on average the values of investment (I/K), cash flows (CF/K) and Tobin Q for large size firms are greater than the values for the small size firms. On the whole the results reported for the investment (I/K), cash flows (CF/K) and Tobin Q for large size firms and the small firms are nearly similar with the results presented in the full sample, except few minor differences. In both the large and small size firms all the variables are significant, except Q and lagged cash flows which are insignificant for the small size firms. Cash flows at level however show significantly positive effects for small firms. This finding is in line with (Bond et al., 2004), which imply for small firms in the bubble conditions of stock prices cash flows have an important role in explaining share prices. In addition (Vogt, 1994) put forth that those firms also depends upon cash flows for financing their investments, which have low Q ratios.

Oil price volatility coming from the world oil demand side have significant discouraging consequences for investment by both the Large and small size firms. However, according to the estimated GMM results for Top 20% and Low 20%

firms in terms of size, it is observed that Low 20% firms suffer more than the Top 20% firms from the oil price shocks. Corporate investment was adversely affected by all three types of underlying oil prices shocks, whether it is from the world oil supply side, world demand side or the oil specific demand side uncertainty. Compared with the Low 20% the Large 20% of the firms were faced with less severe effects of oil price shocks, as oil specific demand shocks and world oil supply side immediately did not have adverse effects on the corporate investment. However oil price uncertainty originated from the world demand side have negative consequences for the Top 20% firms also.

This result is in line with the finding by (Ratti, Seol and Yoon, 2011). They used total assets to measure the size of the firm and reported less negative effects of increasing energy prices for the large firms. In this context Caves and Barton (1991), argues small firms lack in capabilities and necessary resources to change their inputs mix and economies of scale, as compared with the large scale firms to save themselves from the rising energy prices. This seems the reason for less severe effects of oil price shocks for large size firms as compared with the small size firms. Therefore effects of oil price shocks on investment is not the same for the large and small size firms and differ depending upon the underlying source of oil price uncertainty also.

5.2 Implications

A good understanding oil price uncertainty is important since it is one of the major factors responsible for discouraging and destabilizing the financial and real investments decisions. For this purpose this study offers good understanding of sources and components of the oil price uncertainty and their resultant destabilizing effects contribution by proposing a comprehensive theoretical model. The findings from this study are insightful for the corporate executives, investors, researchers and policy makers. The findings can be utilized in making decisions and strategies to achieve objectives like higher investment, economic growth, expansion, employment and poverty reduction etc.

The results of this study imply that impact of oil price shocks on stock markets vary greatly depending upon the nature and source of the shock and each shock is responded by stock markets in a different way. Further these impacts differ with the country specific environment like oil price regulation, energy usage structure and energy efficiency patterns etc. Therefore findings in one country especially in developed countries cannot be properly applied to others for making decisions. In this context, policy makers, investors and managers must take care of sources of underlying oil price shocks and respective country specific characteristics in making their decisions regarding this oil price risks and investments.

Further findings from this study imply and suggest that before making policy decisions regarding regulation of oil prices and seeking alternate sources of energy, policy makers should consider this fact that availability of environment with minimized oil price uncertainty is conducive for achieving the goals of investment expansion.

Moreover the results of this decomposed underlying sources of price shocks on corporate investment decisions show that corporate investment also vary greatly depending upon the source of the oil price uncertainty and each source uncertainty is responded by corporate investment in a different way. Therefore, care of sources of underlying oil price shocks in making their decisions regarding this oil price risks and investments must also be taken by policy makers, investors and managers.

The study offers the use of Kilian (2009) framework in the economic environment of the developing world corporate investment decisions for the first time, hence this study is a novel activity and is helpful for the researchers in this field because such framework on the developing world features is being made available for the first time.

For policy makers this study implies the destabilizing effects of oil price shocks for investment in the financial and real assets. They can introduce policies and measures to manages this risk and minimize these effects. This can be done by introducing policies helping stable and lowest possible oil prices, raising the sectors contribution to the GDP which are non oil intensive or at least less oil price sensitive, taking measures which are feasible and reasonable to minimize the adverse outcomes of any oil price shock on the investment behavior. Further using measures like, increase in the strategic reserves of oil, improving the efficiency of energy usage and exploring and using the alternative fuels which are independent of oil prices can shield an oil-importing country from the worse consequences of oil supply shocks. Promoting multilateral cooperation by engaging in dialog with countries exporting the oil can also be helpful in minimizing the adverse consequence of oil prices shocks on the economy of developing oil importing country.

Finding from this study can be used by investors and their corporate managers in managing the risk inherent in their portfolios and projects by identifying stocks or projects offering the diversification means for the duration of large oil price swings. Stocks of industries or specific companies which are positively correlated to oil prices are recommended rise in oil prices is expected. On the other hand, stocks with negative sensitivity are considered better investments in times of declining oil price forecasts. Also, portfolio managers can benefit by rebalancing portfolios with stocks from different sectors if these stocks react differently to changes in oil prices. This will allow for risk diversification opportunities to be achieved through investing in stocks across sectors.

This study also imply that corporate managers to design their investment and expansion plans by going for projects having positive relationship with oil prices and not opting irreversible investments projects when oil prices are expected to rise. In particular, investors and their corporate managers can use these findings in managing the risk inherent in their portfolios and projects by identifying sectors offering means of diversification for the duration of big swing in the oil price. This will enable risk diversification opportunities to be achieved through investing in expansionary projects across sectors rather than within a sector.

5.3 Future Research

This study is faced with the limitation of data relevant to the Pakistan only and others constraints. Therefore for future research this study recommends the more investigations of the topic especially in the followings:

- Future study may investigate this association between structural oil price shocks and stock market by using time varying and sign restrictions approach.
- A study investigating the structural oil price shocks effects on stock market at the various sectors level can also help better understanding the differences of effects across different sectors. Further investigating the difference of oil price effects for the state owned and non state owned companies can also help better understanding of effects of oil price shocks on the stock markets level. For future research suggestions splitting this work in oil intensive and less oil intensive companies' analysis can produce useful information. In addition, separate analysis of the large size and small size firms
- An investigation of link between structural oil price shocks and stock market at the firm level is also needed to gain the micro level understanding of the this link and how the shocks to the oil prices affects the Pakistani firms stock prices.
- Investigating the difference of oil price effects for the state owned and non state owned companies can also help better understanding of effects of oil price uncertainty on the corporate investment decisions. Further division on the basis of financial position like financial constrained and unconstrained firm may be examined. Moreover splitting firms on the basis of firms making investments in R&D and not investing on R&D can also offer useful findings.
- Since this study is limited to the Pakistan only, therefore a comparative study using this decomposed framework with rich data sets of other oil importing developing countries of the region is required as well, to see the differences and similarities of effects and sensitivities of their respective corporate investment decisions and stock markets to the structural oil price shocks.

- Investigation which introduces the structural breaks by taking into consideration the periods of recessions and turmoil can offer useful understanding of structural oil shocks effects on investment in financial and real assets.

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Appendix-A

Following Bond and Van Reenen (2007), the Tobin's q model can be derived as follows. There are three types of factors to be considered for production. Capital assets include both tangible and intangible assets, which are durable. Labour inputs are the people hired by the firm each year. The last factor is current inputs, which are purchased by the firm but will not be fully consumed in a particular period. Based on the neoclassical assumptions above, the dynamic optimization problem for the firm can be characterized as

$$V_t = [\max \prod_t(K_t, I_t, L_t, M_t) + \beta_{1+t} E_t(V_{1+t})]$$
$$= \max [\sum_{i=d}^{\infty} \beta_{i+1} \prod_t(K_{t+i}, I_{t+i}, L_{t+i}, M_{t+i})] \quad (1)$$

where V_t is the firm value with output price pt, $\prod_t$ is the firm's net revenue function, K_t is the fixed capital inputs, I_t is the gross investment with price p_t^K , L_t is the labour inputs with wage w_t, M_t is the different types of current inputs with price p_t^M. β_{t+i} is the firm's discount rate equal to $(1 + \rho_{t+i})^{-1}$ where ρ_{t+i} denotes the risk free rate between period t + i - 1 and period t + i and $\rho_t = 0$. E(.) indicate the value expected conditional to information offered in period t.

Due to capital accumulation, capital inputs can be expressed as

$$K_t = (1 - \delta)K_{t-1} + I_t \quad (2)$$

here δ denotes the depreciation rate of capital. Based on this equation, the net revenue function is given by

$$\prod_t(K_t, I_t, L_t, M_t) = p_t F(K_t, L_t, M_t) - p_t^K I_t - w_t L_t - p_t^M M_t \quad (3)$$

where p_t denotes the price of product and $F(K_t, L_t, M_t)$ is the neoclassical production function. To solve the Eq.1, the first-order conditions are

$$\frac{\partial \Pi_t}{\partial I_t} = -\lambda_t \quad (4)$$

$$\frac{\partial \Pi_t}{\partial K_t} = \lambda_t - (1-\delta)\beta_{t+1}E_t(\lambda_{t+1}) \quad (5)$$

$$\frac{\partial \Pi_t}{\partial L_t} = 0 \quad (6)$$

$$\frac{\partial \Pi_t}{\partial M_t} = 0 \quad (7)$$

where $\lambda_t = \frac{1}{1-\delta}\left(\frac{\partial V_t}{\partial K_{t-1}}\right)$ is shadow value related to capital accumulation. Eq.4 sets the additional cost of capital equal to the shadow value. Eq.5 describes the evolution path of shadow values and capital stock. Eq.6 and Eq.7 are standard first-order conditions for non-durable goods.

The linear homogeneity of the revenue function yields

$$\Pi_t(K_t, I_t, L_t, M_t) = K_t\frac{\partial \Pi_t}{\partial K_t} + I_t\frac{\partial \Pi_t}{\partial I_t} \quad (8)$$

Put Eq.4 and Eq.5 into Eq.8

$$\Pi_t(K_t, I_t, L_t, M_t) = K_t\left(\lambda_t - (1-\delta)\beta_{t+1}E_t(\lambda_{t+1})\right) + I_t(-\lambda_t) \quad (9)$$

Combine Eq.9 and Eq.2

$$\Pi_t(K_t, I_t, L_t, M_t) = -K_t(1-\delta)\beta_{t+1}E_t(\lambda_{t+1}) + \lambda_t(1-\delta)K_{t-1} \quad (10)$$

Re-arrange Eq.10

$$\lambda_t(1-\delta)K_{t-1} = \prod_t(K_t, I_t, L_t, M_t) + K_t(1-\delta)\beta_{t+1}E_t(\lambda_{t+1}) \qquad (11)$$

Solving forward by repeated substitution gives

$$\lambda_t(1-\delta)K_{t-1} = E_t\sum_{s=0}^{\infty}\beta_{t+s}\prod_s(K_{t+s}, I_{t+s}, L_{t+s}, M_{t+s}) = V_t \qquad (12)$$

Because λ_t is a forward-looking measure of current and future marginal revenue product of capital, Tobin q, which measures ratio of the maximized value of firm to the replacement cost, can be expressed as

$$q_t = \frac{\lambda_t}{p_t^K} = \frac{V_t}{(1-\delta)K_{t-1}p_t^K} \qquad (13)$$

Tobin q model supposes the firm's only quasi-fixed input is homogeneous capital goods. To obtain an empirical investment model, the function of marginal adjustment cost must be defined. Followed by Summers (1981) and consistent with mainstream research in q theory, the function can be specified in asymmetric and quadratic form as follows:

$$G(I_t, K_t)\frac{b}{2}\left[\frac{I_t}{K_t} - a\right]^2 K_t \qquad (14)$$

The basic q model requires function $G(I_t, K_t)$ to be homogeneous of degree one in (I_t, K_t), which is constant return to scale. Then Eq.3 can be rewritten as

$$\prod_t(K_t, I_t, L_t, M_t) = p_t[F(K_t, L_t, M_t) - G(I_t, K_t)] - p_t^K I_t - w_t L_t - p_t^M M_t \qquad (15)$$

Assuming the market is perfectly competitive,

$$G(I_t, K_t)\frac{b}{2}\left[\frac{I_t}{K_t} - a\right]^2 K_t \qquad (14)$$

The basic q model requires function $G(I_t, K_t)$ to be homogeneous of degree one in (I_t, K_t), which is constant return to scale. Then Eq.3 can be rewritten as

$$\prod_t(K_t, I_t, L_t, M_t) = p_t[F(K_t, L_t, M_t) - G(I_t, K_t)] - p_t^K I_t - w_t L_t - p_t^M M_t \quad (15)$$

Finally, combining Eq.17, Eq.18, and Eq.13

$$\frac{\partial \prod_t}{\partial I_t} = -p_t \frac{\partial G_t}{\partial I_t} - p_t^K \qquad (16)$$

Combined with Eq.4

$$\frac{\partial G_t}{\partial I_t} = \left(\frac{\lambda_t}{p_t^K} - 1\right)\frac{p_t^K}{p_t} \qquad (17)$$

Meanwhile, the first-order condition of Eq.14 is

$$\frac{\partial G_t}{\partial I_t} = b\left(\frac{K_t}{I_t} - a\right) \qquad (18)$$

where $Q_t = q_{t-1}$and a and b are parameters of adjustment cost function. Equation 19 provides the base for empirical model of the study.

Appendix-B 1

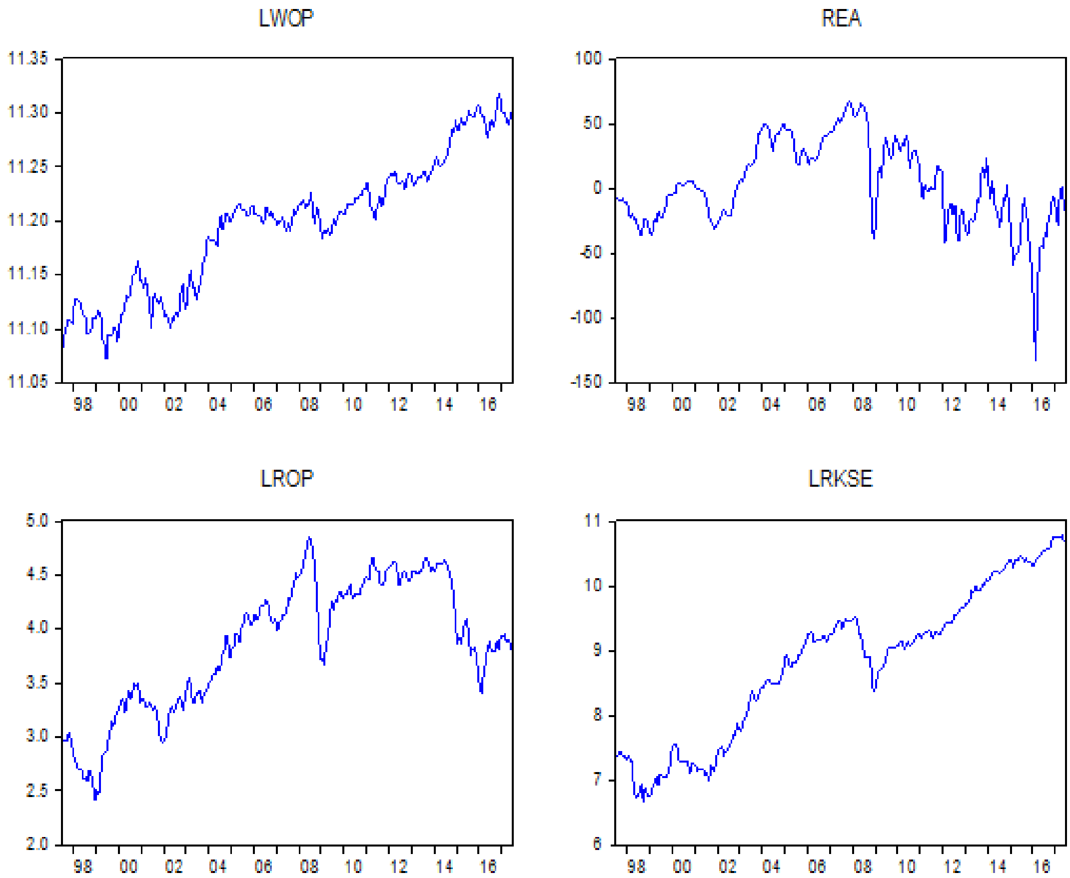

Figure B1: Time series graphs of World oil supply shocks is indicated by (LWOP), world aggregate demand for all industrial commodities which is (Kilian, 2009) real economic activity index is denoted by (REA), oil specific demand shock is represented by (OSD) and finally Karachi stock exchange index is denoted by (LKSE)

Appendix-B 2

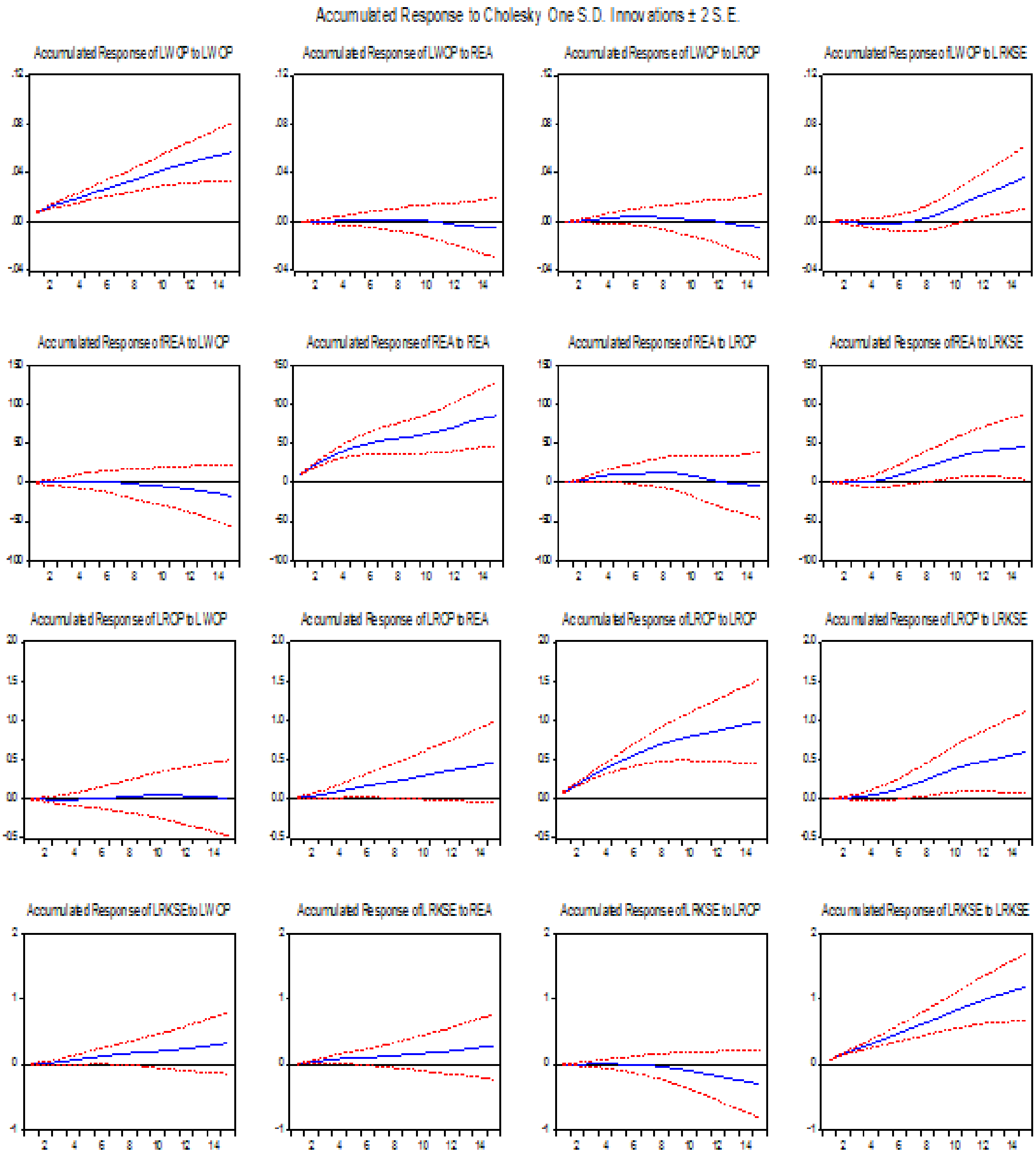

Figure B2: Cumulative impulse responses of oil prices to structural oil shocks for 14 months horizon.
Note: the LWOP denotes the log value of world oil production; rea is the world real economic activity and rop is the log value of real oil prices

Appendix-B 3

Cumulative response to structural one standard deviation shocks with two standard error confidence bands

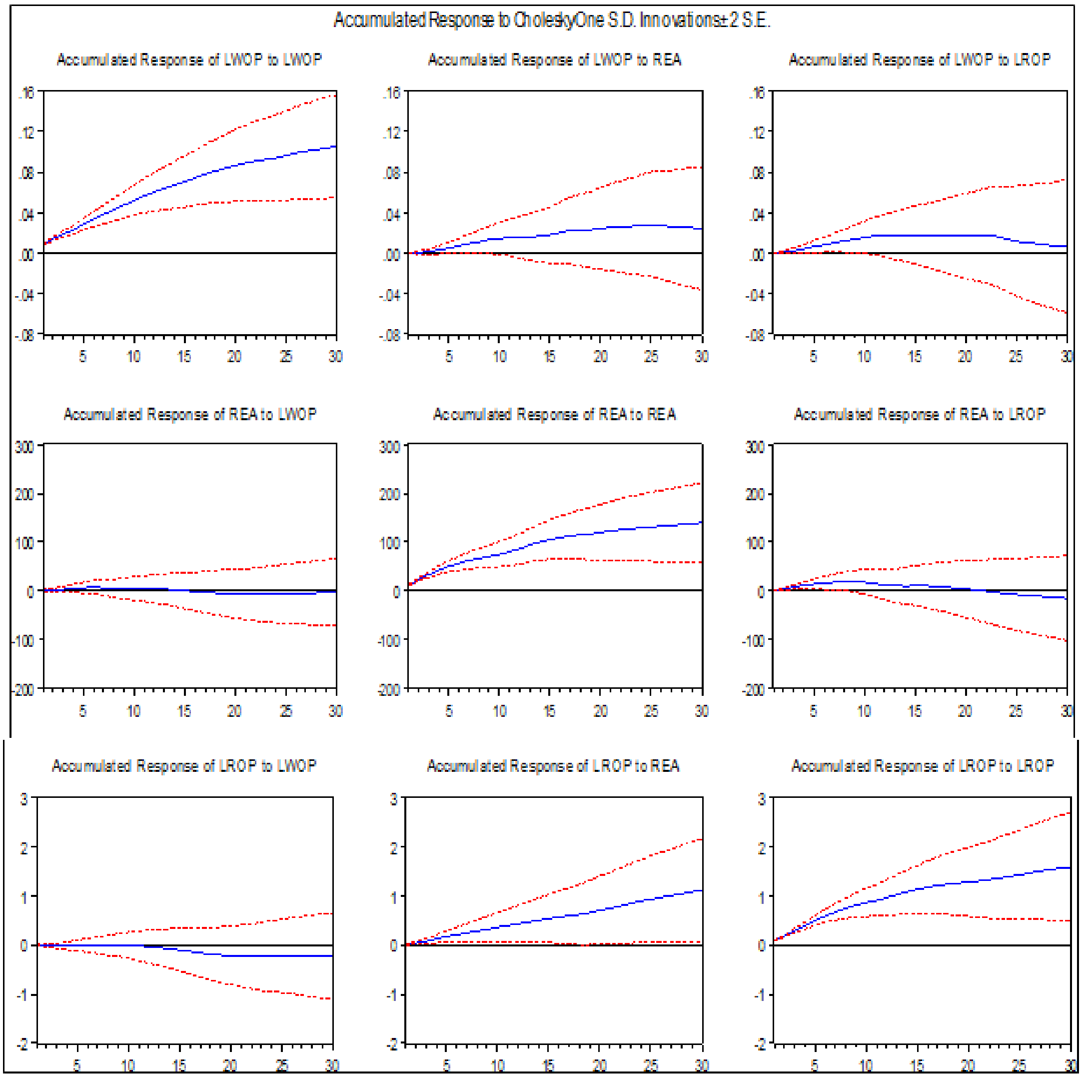

Fig B3: Cumulative impulse responses of oil prices to structural oil shocks for 30 months horizon
Note: the LWOP denotes the log value of world oil production; rea is the world real economic activity and rop is the log value of real oil prices

Appendix-B 4

Cumulative response to structural one standard deviation shocks with two standard error confidence bands

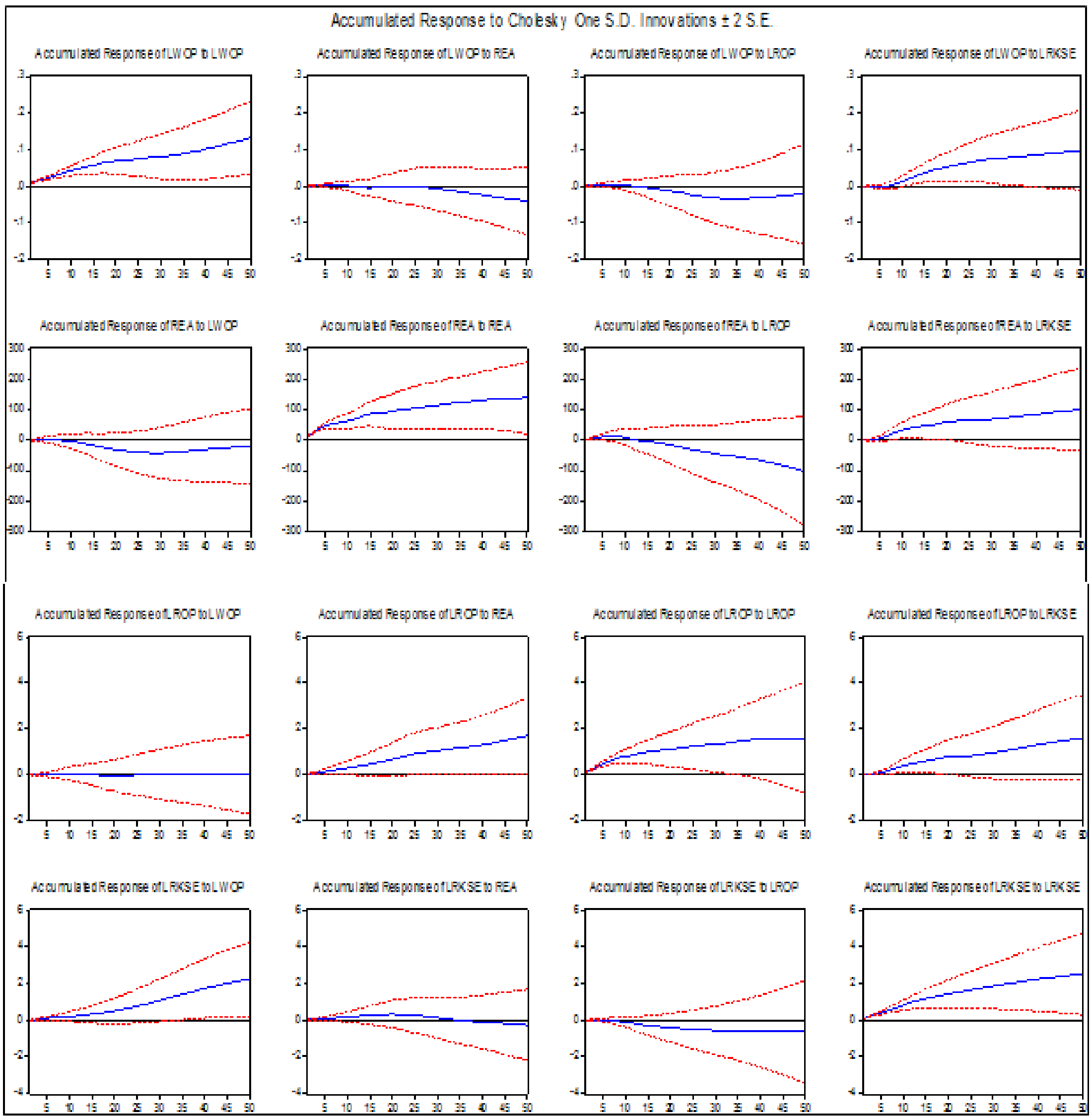

Fig. B4: Cumulative impulse responses of stock prices to structural oil shocks for 50 months horizon Note: the LWOP denotes the log value of world oil production; rea is the world real economic activity; rop is the log value of real oil prices and logged value of Karachi stock exchange index is denoted by LKSE