HOW IS VOLATILITY IN COMMODITY MARKET LINKED TO OIL PRICE SHOCKS IN CASE OF PAKISTAN?

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CERTIFICATE

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A Dissertation Submitted to the Department of Economics and Finance, PIDE, in partial fulfillment of the Requirement of the degree of Master of Philosophy in Economics and Finance

بسم الله الرحمن الرحيم

In the name of Allah,
the Most Beneficent,
the Most Merciful

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ABSTRACT

Oil price increase has major micro and macro-economic effects on the economy as a whole. Unpredictability of oil prices can have serious consequences as it assumes an imperative part in the development of a nation. Oil price increase has a significant effect on oil importing countries as compared to oil exporting countries. Oil prices are thought to have direct effect on agriculture and metal commodities prices as oil is used as an input in production so change in oil prices can significantly affect the prices of these commodities.

This study examines the relationship between oil, agriculture and metals commodity prices. we have used monthly data for the period of 2001:M7 to 2017:M4.at the first stage GARCH Model is applied to measure the volatility associated with the returns of all commodities .Beaulieu and Miron (1992) seasonal unit root test has been applied to test the time series properties. Oil, silver and gold prices are stationary at first difference, while the rest of the variables are stationary at level (wheat, sugar, tea, cooking oil). In order to measure the impacts of oil prices on agriculture and metal commodity prices, we have applied SVAR Model. Impulse response and variance decomposition are applied to measure the impact of oil prices on agriculture and metal commodity prices. The results of Impulse response function indicate that oil prices do not have Significant impact on wheat and tea prices whereas there is a slight increase in sugar and cooking oil prices following the oil price changes. In case of metals there is a slight increase in gold and silver prices following the oil price shocks. . Variance decomposition analysis also supports the findings based on impulse response functions. However the effects of oil price changes on various commodities is different.

Chapter 1

INTRODUCTION

1.1 Introduction:

Oil has become a paramount resource for the development of a nation as agricultural and industrial sector is mainly dependent on this sector. Due to external reliance on oil, fluctuations in oil prices will affect pertinent industries as Pakistan is an oil importing country. The importance of oil can't be ignored as industrial and agriculture sector is dependent on it. Various economic and geopolitical factors could affect the oil prices.

There are a number of factors which can increase supply or decreased demand. The decreased in demand is due to moderate economic growth in Japan, China, Russia, and economic downturn in Europe and expanded energy efficiency in US and Europe .Increased supply is because of sharp increment in Canadian and US oil production and capacity of producers such as Libya and Iraq to keep up yield despite their political turmoil .Thus, the supply of oil is dependent on geological discovery, cost of extraction, etc. Globally oil is traded at a single price so a major change in oil supply or demand in one part of the World change oil prices around the globe .Declining oil prices could have a huge impact for a country like Pakistan which is heavily dependent on oil imports.so a fall in oil prices would help to narrow the current account deficit and increases foreign exchange savings.it can also benefit consumers and economy as a whole.

There is a close association between agriculture commodity market prices, and oil price unpredictability. Many studies in the past endeavored to investigate the connection between oil price unpredictability and agriculture commodity prices. Crude oil and agriculture commodity experienced a severe rise during the period from 2006 to mid-2008.The main reason for this the substitution between bio fuels and fossil fuels. Oil price increase causes people to develop alternative energy .As oil price Raises the expenses for biofuels, as biofuels are produced using corn and other agriculture products so demand for these alternative fuel expands that's why crop prices increase. This also rose concerned for the countries that are heavily depend on food imports.

There are also many explanations for the connection between agriculture and oil prices. As oil costs raises, the cost of agricultural commodities also raises, because of increments in transportation expenses and price of fertilizers. (Yuan 2008 and Tyner 2010). Now days, agriculture system utilizes oil products to transport inputs to the farm, to fuel farm machinery and to transport farm yield to end consumer. So prices of agriculture commodities increased. The increased economic activity increases the oil prices which in turn would increase the demand for food, so the costs of various agriculture commodities also increased so there is a worry that high and insecure costs of crude oil may cause sustenance costs to continue expanding (Hochman et al 2012, Beaumister and Killian 2013) Oil is frequently used as a contribution to agriculture chemicals. So there is a worry that high and precarious costs of raw petroleum may cause food prices to keep on expanding. (Bloomberg 2011).

There is a close association between food and oil price. Current global food system is highly dependent on fuel and transport system. Oil is likewise utilized as contribution to farming chemicals. As oil price increase commercial food price also increases. Rising transport costs add to the rising prices of food imports making them more expensive. High food and fuel price has worst effect on the general population of the developing country as compared to developed countries. Crude oil is the critical contribution for production of agricultural commodities because agriculture is an energy exhaustive sector. Mostly the developing countries and underdeveloped countries will be mostly affected by rise of agriculture commodity prices. High energy costs can impact the World agricultural markets through cost of processing, handling and transporting these commodities.

Almost for all economies, oil and agriculture prices matter. Similarly if oil prices increase, it will cause a sharp increment in agriculture commodity prices which has an adverse influence on every single monetary condition. According to authors Martin and Ivanic (2008) McCalla (2009) an unexpected increase in food price could grow destitution, which would create economic problems and political turmoil. In such conditions, population may encounter malnutrition in the long run. And relying on the degree of increase in agricultural commodity prices, it will further aggravate farmer production and marketing costs and thus this situation is become more pervasive for poor net importing nations, for example, Pakistan.

1.2. Background of study:

Oil is considered as lifeblood for the development of an economy for over hundred years. According to institute for energy Research, Oil is directly accountable for about 2.5% of World GDP. Oil is vital economic input as it can generate heat, fuel vehicles; drive machinery etc. oil price volatility could affect price levels, production levels and economic growth of a country. Oil is as important in the developed world as agriculture. Crude oil is the most important resource for the industrialized nations.

Oil price increase has major micro and macro-economic effects on the economy as a whole. Unpredictability of oil prices can have serious consequences as it assumes an imperative part in the development of a nation. Oil importing countries are significantly affected by oil price increase as compared to oil exporting countries. At the micro level it can affect family and businesses: production costs expand, transportation cost also increases as oil is a vital input. Production becomes more costly for businesses because of higher oil prices. Oil price increase will cause increment in production costs causing commodity price increase. Higher commodity prices would contribute to lower demand for goods and services. In this manner, aggregate employment and output level would shrink. (Hunt, Laxton, Isard 2001).

At the macro level, oil price increase can cause inflation and reduce economic growth. It can cause inflation directly by influencing the costs of goods which are made up of petroleum products. Oil price increase can indirectly affect manufacturing and transportation costs which thusly will influence the prices of various goods and services. Oil price shock affects macro-economic performance through various channels i.e. higher oil prices brings income from oil importing countries to oil exporting countries. It builds inflation through higher expenses of imported merchandise and oil based items. (jamali et al 2011)

Pakistan has a semi-industrialized economy which is mainly in textiles, chemicals, agriculture etc. Pakistan imports oil from Middle East and it totally depends on oil imports to run its Economic activity. Falling oil prices can be beneficial for a country like Pakistan. It saves foreign exchange reserves. A major impact of decline in oil prices will be reflected in CPI inflation. A decrease in inflation would further reduce interest rates increasing credit availability so more money would be available for investment. As Pakistan is an agricultural country so falling oil prices will be beneficial for farmers.

1.3 Research gap:

The effect of changes in oil costs on commodity market prices can have serious impacts on the nation as it rely on whether the country is a net importer or exporter. Pakistan is an oil importing country so oil prices changes could have a significant impact on its economy. We have added to the literature by measuring the volatility of different commodities, by infusing GARCH specifications and furthermore contributed to the literature by researching the impacts of oil price changes on commodity prices in Pakistan by using SVAR approach. According to the best of my insight, this is the first study which has attempted to explore the relationship between oil price changes and agriculture and metal commodity prices in case of Pakistan. The main goal of this paper is to discover the impacts of oil price shocks on unpredictability of various commodities. We tried to explore the impacts of oil price changes on the volatility of agriculture and metal commodities. This topic is extensively explored in case of developed countries and regions but not in case of Pakistan.

1.4 Objectives of study:

Following are the goals of this research:

The first goal of this study is to gauge the volatility of all commodities, which can be described by using appropriate GARCH specifications.

The second goal of this study is to discover the impact of oil price changes on commodity prices by using SVAR approach. in case of Pakistan. Regardless of whether global oil price shocks affect Pakistan agricultural and metal commodities price unfavorably or not? Whether oil price decrease has any positive effect on commodity prices?

1.5 Organization of the study:

Chapter 1 is the introductory chapter while the remaining study consists of the four chapters. Chapter 2 gives the relevant Literature Review. Chapter 3 provides Data and methodology that has been used to achieve the objectives of the study. Chapter 4 contains empirical results and discussions .Chapter 5 concludes the whole discussions and gives conclusion and some policy recommendations.

Chapter 2

LITERATURE REVIEW

As far as various studies are concerned, different authors used different methods to discover the relationship between oil and commodity market prices. Larger part of studies concentrates on a number of different factors to grasp the reason of escalating agricultural commodity prices. However, there is a close connection between agriculture and energy markets as agriculture sector is highly dependent upon oil sector. As an expansion in the oil prices increase the input costs which cause an increase in agricultural commodity prices (Hanson et al 1993) .Another explanation behind this increase is because of expanded economic activity rather than increase in oil prices Byrne et al (2013).According to Hamilton and kilian (2009) increased demand by rising Asian economies are in charge of persistent increment in crude oil prices for the span from 2003-2008. Another connection between agricultural and oil prices is through the exchange rate as indicated by Harri et al (2009). Some researchers have mixed outcomes regarding oil-agriculture commodity price relationship. Findings of some studies also show that agriculture commodity prices are not influenced by crude oil prices and aid the neutrality hypothesis. Here is a short review of the existing literature from previous studies.

Literature review regarding oil prices and agriculture commodity market prices:

Among the papers, that paid attention on agriculture-oil market relation i.e. Yudong et al (2014) study the impacts of oil price shock on agriculture commodity price changes. By utilizing SVAR analysis they have divided oil price changes into 3 components i.e. aggregate demand shock, oil specific demand shock. And oil supply shock By Using the data from 1980-2012 they have Divided into sub samples in order to analyze the impact of 2006-2008 food crises. Their findings indicate that the impact of oil price shock on agricultural markets differ greatly relying on the fact that whether the changes in oil prices are due to supply or demand shock. Authors of this study inferred that in period before crisis, oil price shock can explain a smaller portion of variations but after the crisis this situation is different, oil specific contribute to variations in agriculture commodity prices. To investigate the impacts of oil price shocks on US agriculture market Hanson et al (1990) utilized Compatible general equilibrium model. There results demonstrate that oil prices affect agriculture sector not only through input costs but other factors like exchange rate and foreign borrowings are also responsible. To investigate the connection between oil and energy prices, Alanoud et al (2015) used a bivariate GARCH for exploring the mean and volatility spillover between energy ethanol and oil and four selected food items (corns, soybean, sugar, wheat) and examined the effect of four recent events by including dummy variables in both variance and conditional mean equations. There results indicate that food and energy prices are deeply inter correlated. Yu et al (2006) explored the relationship between notable traded oil prices (soya beans, palm oil, and rapeseed, sunflower) and World crude oil prices by utilizing Johansen cointegration approach and directed acyclic causality approach to deal with weekly data from M1- 1990 to M4- 2006.There outcomes indicate that shocks in crude oil prices do not have any phenomenal variation of edible oil prices. Eric et al (2013) study the impact on food market by presenting biofuel as a substitute for fossil fuels in the energy market. They have shown how rivalry for the finite land resources which happens between biofuel and food production defines a relationship between food and energy price. They report that cost of sustenance will be developing insofar as oil stock is being depleted whether population is increasing or not. They have investigated the effect of efficiency of land use in either biofuel or food sector. Ahmadi et al (2015) broke down the impacts of oil price shock on volatility of agriculture and metal commodity prices for the span of 1983 to 2014 and have separated oil price shock into 3 components i.e. supply, demand and speculative demand shock. They had used SVAR approach, by portioning data into two sub samples. Results indicate that responses of volatility of every item to an oil price shock differ remarkably relying upon the type of shock in both periods. Zhong and Reed (2008) analyzed the impacts of World crude oil prices on china market using soy meal, pork prices, and corn by applying VARMA model, variance decomposition, impulse response and cointegration analysis for the period of M1- 2000 to M10-2007 and inferred that World oil prices are not major considerations responsible for escalating agriculture prices of China. Gray Gozgar et al (2014) analyze the links between 27 agricultural commodities and World oil prices prices for the period from 1990 to 2013 for monthly data. Their findings indicate that there is a unidirectional causality running from oil price to agriculture commodity prices. So high oil costs essentially raises all agriculture commodity prices. Gardebroek and Hernandez (2013) examined the volatility mediation between ethanol, corn prices and oil in US from 1997 - 2011. They follow MGARCH approach to inspect the reliance and volatility between oil, corn and ethanol markets. Authors find volatility spillover from corn to ethanol prices yet not from oil to corn markets. To investigate the effects of energy price shocks on US agriculture commodity prices and productivity growth, Wang and Mcphail (2014) utilize SVAR model for the period of 1948 to 2011, their results indicate that in short run, energy price shock negatively effects productivity growth.

Rosa and Vasciaveo (2012) analyzed the volatility and interactions among prices of agriculture commodities in Italy and US utilizing the time series analysis. They have used spot prices of wheat, corn, soya bean in US and Italy and crude oil prices for the span of 2002 to 2010.There outcomes indicate that oil prices effects wheat, soya beans and corn prices in US, But not in Italy. Zibin Zhang et al (2009) look at the connections among agriculture commodity prices and fuel by prices on fuels (gasoline, oil and ethanol) and agriculture commodities (rice, soya bean, sugar, corn and wheat) for the period from 1989 to 2008. Keeping in mind to investigate the long and short run relationship among fuel and agriculture commodity prices, a vector error correction model is evaluated. There results imply that there is no immediate long run price connection between agricultural commodity prices and fuel. But as far as short run price movements are concerned, sugar prices are affecting all other commodity prices with the exception of rice. As sugar is utilized as an input in ethanol production so enhanced ethanol production is affecting short run agriculture commodity prices. Wixson and Katchova (2011) find the linkage between energy and commodity prices by using asymmetric price transmission model. They have used monthly price data from 1995 to 2010 for testing causality and asymmetric price transmission for the prices of wheat, soya bean, corn, oil and ethanol. Authors find the asymmetric relationship between agriculture commodity prices and oil prices. Qiang and Fan (2011) examined the volatility spillover effects between metal market, agriculture market, crude oil market and entire non energy commodity market by constructing a bivariate EGARCH model. There empirical findings indicate that crude oil market has remarkable volatility spillover effects on non-energy commodity markets. The volatility of crude oil prices dependently influences other commodity prices. Hudson et al (2010) analyzed the effects of oil price shocks on cotton prices by plotting reaction of cotton prices in US concerning variations in the World oil prices. They have utilized monthly data from M1- 1975 to M2- 2008, by using Structural vector autoregressive model; the authors presume that oil prices clarify only 3% of the fluctuations in cotton prices in long run. So we can conclude that an increase in cotton prices in US can't only be credited to oil price shocks. Nazliogu (2011) broke down the relationship between agriculture commodity prices and World oil prices. He examined the nonlinear and direct connections between world oil and three agriculture commodities prices (corns, soya bean and wheat). The linear causality shows that oil prices and agriculture commodity prices do not influence each other. These relationships are determined by using weekly data for 3 agriculture commodities from 1994 to 2010. The nonlinear causality demonstrates that there are nonlinear relationships between oil and agriculture commodity prices. Sharri et al (2013) analyzed the impact of oil price shock in economic sectors of Malaysia. They dissected the impact of oil price shock on different sectors i.e. agriculture, construction, manufacturing, and transportation sectors. Quarterly data from 2000-2011 were used in this study. They had applied the Johnson co integration technique to observe the long run relationship and had found that oil price shocks affect agriculture and construction sector relies on oil prices. Arshad and Ayaz (2011) employed SVAR methodology to investigate the impacts of oil and food price for selected macroeconomic variables including inflation, output and money balances, interest rate and real effective exchange rate for Pakistan form 1990M1 to 2017M7. Generalized impulse response functions and generalized forecast variance decompositions are employed to analyze the impact of oil and food price shocks to Pakistan’s economy. There results implied that oil and food price shocks significantly affect output, short-term interest rate, inflation rate and real effective exchange rate. However, among all, real effective exchange rate has seen a dominant source of variations in Pakistan.

Abdul and Saqib (2015) analyze the impacts of oil price shocks on Pakistan economy by incorporating variables such as gross domestic product, the wholesale price index, and large scale manufacturing index. This study uses SVAR approach for the period of 1983-2013.they find out that price volatility has a negative impact on GDP and the LSMI, and a positive relationship with the WPI. Muhammad Abubakar (2008) explores the impacts of oil prices on daily used goods. According to the author the volatility in oil price has an impact on macroeconomic variables. The increment in the oil price passed on to petroleum commodities and directly hits the industry, consumer household and the Government. They have used a quantitative research based on a combination of primary and secondary monthly data for the period of M1-2008 to M12-2012 of oil prices as a dependent variable and CPI, SPI and WPI as independent variables to measure its correlation. This study shows strong relationship between oil prices and CPI, SPI and WPI. Whenever oil prices increases it also increases inflation so the price of daily used commodities increases.

Chuanguo and Xuqin (2015) examined the effect of World oil price shock on China agricultural commodities i.e. wheat, corn, pulp cotton, soybean and natural rubber. They have applied ARJI-GARCH and ARMA GARCH model. With the specific end goal to break down the effects of oil price shocks on China agricultural commodities, they divided global oil price fluctuations into two parts: one is smooth fluctuations and the other one is jump behavior caused by crisis. They concluded that oil price shock had different impacts on agricultural commodities and find out that oil price shocks on most commodities is asymmetric. Chen et al (2010) investigates the connection between wheat, soya bean, corn, and crude oil prices. There empirical findings show that change in each grain price is significantly influenced by the changes in crude oil prices and other grain prices. Their findings suggest that grain commodities are rivaling with the derived demand for biofuels by utilizing soya beans or corns to produce ethanol during the phase of higher crude oil prices in recent years. Chang and Su (2010) utilize a bivariate EGARCH and find substitutive effect of biofuels on fossil fuels in times of lower and higher crude oil prices. There empirical results indicate that substitutive effect was occurred during the higher crude oil prices period because of remarkable price spillover effects from crude oil future to soybeans futures and corn, suggesting that the increase in food prices can be ascribed to more consumption of biofuels. Clement et al (2014) explore causality between prices of agriculture commodities and oil prices in South Africa. They had used daily data for oil prices and prices of wheat, sun flower, soybeans, and corn and used the Granger causality test in restrictive quintiles. There results indicate that the impacts of oil prices on agriculture commodity prices vary over the distinctive quintiles of the conditional distribution. In short there results imply that because of nonlinear reliance between oil prices and agricultural commodity prices, regular granger causality implied ambigoious results. Gohin and Chanlret (2009) explored the macroeconomic relationship between agricultural markets and energy prices. They explored the long run connection among energy and food products utilizing general equilibrium model. And also demonstrate that price of energy and food may even go in reverse direction when macroeconomic linkages are considered. Juan C. Reboredo (2012) study whether there is relationship between food and oil markets by studying dependence structure and comovment through copulas. They have used weekly data for the period of 1998-2011.empirical results indicate neutrality between changes in oil prices and food prices. Oil prices had no causal effect on agriculture price spikes.

Nazliogu and Soytas (2011) inspected the effects of short and long run association between World oil prices, individual commodity prices, and lira dollar exchange rate in Turkey. By utilizing Toda-yamanoto approach and impulse response approach for the period of 1994 to 2010.Their outcomes imply that there is no effect on agricultural commodity market both in short and long term to oil price changes. Soytas et al (2009) explored the long and short run transmission between Turkish interest rate, and Turkish lira US dollar exchange rate, World oil prices and a domestic spot gold and silver prices. They had used daily time series data for the span of 2003-2007. There long run results demonstrate that Turkish Spot precious metal markets, interest rate market, as well as exchange rate do not provide valuable information that would help enhance the forecasts of World oil prices. Kwan and Koo (2009) examined the long run causal links between food prices, exchange rates and energy prices by utilizing granger causality tests for the span of M1- 1998 to M7- 2008. The study concludes that energy prices and energy prices affect food prices through different channels. Mitchell (2008) also features the role of oil prices and the estimation of US dollar on rising food prices. He scrutinizes that links between food prices and oil prices turn out to be more viable due to biofuel generation.

Literature review regarding oil prices and metal commodity market prices:

Among the contributions on metals oil market linkage, Znag and Xiaohua (2015) examined the impact of oil price shocks on china metal market particularly broke down the effects on two sorts of metals i.e. copper and aluminum. They have used ARJI and GARCH method to access the jump behavior and volatility process in the global oil market. Thus, by separating the oil price shock into positive and negative shock so that they can inspect whether oil price volatility had asymmetric impacts or symmetric impacts. This study concludes that oil price shock has significant impact on china metal market and impacts were consistent. Copper is more easily influenced by oil price shock when contrasted with aluminum. Ramzan et al (2009) investigates the relationship between oil prices and US/dollar /Euro exchange rates and spot prices of precious metals. Four valuable metals include platinum, silver, gold, and palladium. They have used daily data for the period from 1999 to 2007 and have employed generalized impulse response functions and variance decomposition. They conclude that spot prices of exchange rate and valuable metals may be closely linked in short run but not in long run.

Chen et al (2016) broke down the impact of oil price shocks on bilateral exchange rate of US dollar .They follow SVAR to broke the oil price changes into oil supply and other oil specific shocks and oil demand shocks and inferred that responses of dollar exchange rate to oil price shock differs significantly depended upon whether changes in oil prices are caused by aggregate demand or supply. Scholten and Yurtsever (2012) explored the impacts of oil price shocks on European industries. They had explored 38 different industries in Europe for the period of 1983-2007 and had used dynamic VAR and multivariate regressions to examine how different industries reciprocate to oil price shocks. Authors deduced that the impact of oil price shocks on different industries is different.

Chuanguo and Xiaoqing et al (2014) analyzed the effects of oil price shocks on fundamental industries and mass commodity markets in China. The industries include petrochemicals, oil fats and grains and metals. They separated the oil price volatility into unexpected, expected and negatively expected classifications. They had employed the EGARCH and ARJI to look at the impacts of oil price shock on commodity markets for the span of 2001-2011. Empirical results indicate that both expected and unexpected oil price volatilities influence commodity markets. Similarly, metals and grains indices did not altogether react to the expected volatility in oil prices.

Methodological framework used by various studies:

In terms of methodology various models and methods were used by different authors. the impacts of oil price shocks by using general equilibrium models is analyzed by Hanson et al (1993). Alanoud et al (2015) used bivariate GARCH for researching the mean and volatility spillover between energy and food items. Ahamadi et al (2015) used SVAR, variance decomposition and impulse response for analyzing the impacts of oil price changes on unpredictability of metal commodity prices and agriculture. Zhang and Reed (2008) applied VARMA model for breaking down the impacts of World crude oil prices on agriculture commodity prices. Zibin Zhang et al (2009) used VECM for analyzing the relationship between agriculture commodity prices and fuel. Qjang and Fan (2011) analyzed the volatility spillover effects between agriculture market, crude oil markets, metal markets and non-energy market by developing a bivariate EGARCH model.

From the above literature, we can conclude that most of studies focused on different techniques for investigating the relationship between commodity market price oil prices. Some studies conclude there is positive relationship between oil prices and commodity prices while other support the neutrality hypothesis i.e. implying that there is no relationship between oil and commodity market prices. As mentioned above volatility of oil prices can have serious consequences for an economy like Pakistan that is dependent on oil imports. This research focuses on the how volatility in commodity market is affected by oil price changes.

CHAPTER 3

DATA AND METHODOLOGY

3.1 Introduction:

In this chapter section 3.2 discusses data sources and its time span. We have used monthly data for the period from 2001-M6 to 2017-M4. Section 3.3 gives details about key descriptive statistics. The next section 3.4 deals with methodological framework. In this study we have used both the techniques of financial and economic time series econometrics. We have used GARCH model for measuring the conditional volatility of each commodity returns, Section 3.4.deals with ARCH/GARCH Model to measure volatility. We have used monthly data; in order to check stationary of data we have applied Beulieu and Mirron (1992) seasonal unit root test, so section 3.4.2 deals with unit root tests. Further to explore the relationship between agriculture metal commodity markets prices and oil prices, we have applied SVAR. Section 3.5 deals with SVAR Methodology and section 3.5.1 deals with impulse response function.

3.2 Data sources:

We have used monthly prices for oil, metals, and agricultural commodities from 2001-M7 to 2017-M4. Four agricultural commodities (wheat, sugar, cooking oil, tea) and two metals (gold, silver) have been used in this study. Agricultural and metal commodity prices data has been collected from FBS (Federal bureau of statistics). Whereas oil price data has been collected from World Bank commodity price data (the pink sheet).which represents the price of oil dollar per barrel.

3.3 Descriptive statistics:

For analyzing the behavior of data set, we have used three different measures of descriptive analysis i.e. Standard deviation, mean and stability ratio. For descriptive statistics we have divided the data into different periods. We will use the monthly time series data from July 2001 to April 2017.By dividing the data into various groups e.g. 2001:M7 to 2004:M12, 2005:M1 to 2008:M12 and so on. And by calculating standard deviation, mean and stability ratio we can analyze how distinctively variables behaved during various periods. A stability ratio represents the volatility during each period and a high value of stability ratio is an indicator of more unpredictability. For calculating volatility we can utilize standard deviation and stability ratio. In any case, the issue with the standard deviation is that it's not a decent measure of volatility as stability ratio incorporates the mean and standard deviation and gives us valuable information regarding which sample has higher standard deviation in contrast to the mean.

For checking the normality of the data series we have employed Jacque bera test .Jacque bera is a test statistic for measuring normality in a data. It's a combination of both skewness and kurtosis, and tests whether the series is normally distributed or not. This test statistic is the combination of skewness and kurtosis and compares it with the normal distribution.

For volatility clustering we have kurtosis. Volatility clustering implies that "*large changes tend to be followed by large changes and small changes tend to be followed by small changes according to (Mandelbrot 1963)"*.Similarly, ACFs and PACFs are used to examine whether time series has cyclical patterns. For this we have Box pierce Q-statistic and Ljung Box Q-statistics the null hypothesis of both series is the series is white noise i.e. it does not have a persistent behavior over time. If we reject the null hypothesis then it means series does not contain white noise and hence possibly follow cyclical patterns.

3.4 Methodological Framework:

The aim of this paper is to explore how unpredictability in commodity market is linked to oil price shocks. The first goal of this study is to investigate the conditional volatility of each commodity returns by utilizing GARCH Models. The second target of this research is to evaluate the effects of oil price changes on volatility of commodity returns by utilizing SVAR technique.

3.4.1 Using ARCH/GARCH Models for measuring volatility:

Different studies have used different methods for measuring volatility of variables. Mostly used methods for measuring volatility are ARCH (Autoregressive conditional hetroskedasticity) and GARCH (Generalized Autoregressive conditional hetroskedasticity). In order to measure the volatility of different commodities we have used GARCH Model that is developed by Bollerslev (1986).Usually the variance of the error term remains constant with the passage of time (homoscedastic assumption) but mostly financial and some econometric time series show volatility clustering i.e. "*the periods of large changes are followed by further periods of large changes in opposite direction and periods of small changes are followed by further periods of small changes in opposite direction*".so there is volatility clustering the variance of u_t depends on history. We have used time series data so there is possibility that ARCH effect may be present. So we have check for ARCH effect first. As ARCH effect is present in all series of returns so we have applied GARCH Model. In order to identify ARCH effect the best identification tool may be ACFs and PACFs plots of the series. To gauge the ARCH effect Engle (1982) introduced autoregressive conditional hetroskesdascity ARCH (q) model in which a time series exhibiting conditional hetroskedasticity or auto correlation in the squared series. It's a Lagrange multiplier test to quantify the significance of ARCH effect, which assumes conditional variance as a linear function of past squared values of process

$$\sigma_t^2 = \alpha_o + \sum_i^q \alpha_i \varepsilon_{t-i}^2$$

If ARCH effect is present in the price series of agriculture and metal commodities Then we will go for GARCH (p ,q) model. Bollerslev Introduced generalized ARCH model i.e. GARCH (p, q) model.in (1986). A GARCH Model utilizes the Past squared variances and past changes to show the fluctuation at time. GARCH equation is

$$\sigma_t^2 = \alpha_o + \sum_i^q \alpha_i \varepsilon_{t-i}^2 + \sum_j^p \beta_j \sigma_{t-j}^2$$

Afterwards, we will estimate the volatility of the price series of agriculture and metal commodities with the GARCH (p ,q) model developed by Bollerslev (1986). We have choosen the suitable model in the light of Arch test, autocorrelation test and the aikaike information criteria.

3.4.2: Unit root tests:

Unit root tests are used for checking the time series properties of the variables of interest. By and large most of the variables which are used for research purposes are usually non-stationary. For reliable results the non-stationary data should be transformed into stationary data. For checking stationary we have PP tests (Phillips and Perron, 1988) and KPSS tests (Kwiatkowski, Phillips, Schmidt and Shinn, 1992) .But the extent of our study is concerned, we are utilizing monthly data so there is probability of seasonal unit root in the data. The seasonal unit root test makes it possible to determine the nature of the deterministic and stochastic seasonal fluctuations. We have utilized Beaulieu and Miron (1992) seasonal unit root test which is the expansion of HEGY test (1990).

3.4.2.1: Beulieu and Miron (1992) seasonal unit root test:

Beulieu and Miron (1992) led the investigation of seasonal and non-seasonal unit roots (unit roots at zero, semiannual, and yearly frequency) in monthly time series data by broadening the Approach of HEGY (Hylleberg, Engel,Granger and Yoo, 1990). The auxiliary regression model to perform the monthly unit root test is given by the following equation:

$$y_{13t} = \alpha + \beta t + \sum_{i=1}^{11} \gamma_i S_i + \sum_{j=1}^{12} \pi_j Y_{jt-1} + \varepsilon_t$$

The auxiliary variables are defined as follows:

$$y_{1t} = (1 + A + A^2 + A^3 + A^4 + ... + A^{11}) y_t$$

$$y_{2t} = -(1 - A + A^2 - A^3 + ... - A^{11}) y_t$$

$$y_{3t} = -(A - A^3 + A^5 - A^7 + A^9 - A^{11}) y_t$$

$$y_{4t} = -(1 - A^2 + A^4 - A^6 + A^8 - A^{10}) y_t$$

$$y_{5t} = -\frac{1}{2}(1 + A - 2A^2 + A^3 + A^4 - 2A^5 + A^6 + A^7 - 2A^8 + A^9 + A^{10} - 2A^{11}) y_t$$

$$y_{6t} = \frac{\sqrt{3}}{2}(1 - A + A^3 - A^4 + A^6 - A^7 + A^9 - A^{10}) y_t$$

$$y_{7t} = \frac{1}{2}(1 - A - 2A^2 - A^3 + A^4 + 2A^5 + A^6 - A^7 - 2A^8 - A^9 + A^{10} + 2A^{11}) y_t$$

$$y_{8t} = -\frac{\sqrt{3}}{2}(1 + A - A^3 - A^4 + A^6 + A^7 - A^9 - A^{10}) y_t$$

$$y_{9t} = -\frac{1}{2}(\sqrt{3} - A + A^3 - \sqrt{3}A^4 + 2A^5 - \sqrt{3}A^6 + A^7 - A^9 + \sqrt{3}A^{10} - 2A^{11}) y_t$$

$$y_{10t} = \frac{1}{2}(1 - \sqrt{3}A + 2A^2 - \sqrt{3}A^3 + A^4 - A^6 + \sqrt{3}A^7 - 2A^8 + \sqrt{3}A^9 - A^{10}) y_t$$

$$y_{11t} = \frac{1}{2}(\sqrt{3} + A - A^3 - \sqrt{3}A^4 - 2A^5 - \sqrt{3}A^6 - A^7 + A^9 + \sqrt{3}A^{10} + 2A^{11}) y_t$$

$$y_{12t} = -\frac{1}{2}(1 + \sqrt{3}A + 2A^2 + \sqrt{3}A^3 + A^4 - A^6 - \sqrt{3}A^7 - 2A^8 - \sqrt{3}A^9 - A^{10}) y_t$$

$$y_{13t} = (1 - A^{12}) y_t$$

The estimated equation includes a constant, trend, eleven seasonal dummies and lags of the dependent variables. The series of the variables can be generated as follows.

$$y_{1t} = (1 + A + A^2 + A^3 + ... A^{11}) y^t$$

$$y_{2t} = -(1 + A + A^2 - A^3 + A^4 - A^5 + A^6 - A^7 + A^8 - A^9 + A^{10} - A^{11}) y^t$$

$$y_{3t} = -(A - A^3 + A^5 - A^7 + A^9 - A^{11}) y_t$$

$$y_{4t} = -(1 - A^2 + A^4 - A^6 + A^8 - A^{10}) y_t$$

$$y_{5t} = -1/2(1 + A - 2A^2 + A^3 + A^4 - 2A^5 + A^6 + A^7 - 2A^8 + A^9 + A^{10} - 2A^{11}\ \ ) y_t$$

$$y_{6t} = \sqrt{3}/2\,(1 - A + A^3 - A^4 + A^6 - A^7 - A^9 - A^{10}) y_t$$

$$y_{7t} = \frac{1}{2}(1 - A - 2A^2 - A^3 + A^4 + 2A^5 + A^6 - A^7 - 2A^8 - A^9 + A^{10} + 2A^{11}) y_t$$

$$y_{8t} = -\frac{\sqrt{3}}{2}(1 + A - A^3 - A^4 + A^6 + A^7 - A^9 - A^{10}) y_t$$

$$y_{9t} = -\frac{1}{2}(\sqrt{3} - A + A^3 - \sqrt{3}A^4 + 2A^5 - \sqrt{3}A^6 + A^7 - A^9 + \sqrt{3}A^{10} - 2A^{11}) y_t$$

$$y_{10t} = \frac{1}{2}(1 - \sqrt{3}A + 2A^2 - \sqrt{3}A^3 + A^4 - A^6 + \sqrt{3}A^7 - 2A^8 + \sqrt{3}A^9 - A^{10}) y_t$$

$$y_{11t} = \frac{1}{2}(\sqrt{3} + A - A^3 - \sqrt{3}A^4 - 2A^5 - \sqrt{3}A^6 - A^7 + A^9 + \sqrt{3}A^{10} + 2A^{11}) y_t$$

$$y_{12t} = -\frac{1}{2}(1 + \sqrt{3}A + 2A^2 + \sqrt{3}A^3 + A^4 - A^6 - \sqrt{3}A^7 - 2A^8 - \sqrt{3}A^9 - A^{10}) y_t$$

$$y_{13t} = (1 - A^{12}) y_t$$

After the generation of series, the next step is the estimation of model which is done by OLS (Ordinary least square). So we can write the model as:

$$\varphi(A) y_{13t} = \mu_t \pi_{1,}\ y_{1,t-1} \ldots\ldots\ldots \pi_{12,} y_{12,t-12} + \varepsilon_t$$

Where $\varphi(A)$ represents the remainder with roots that lie outside the unit circle and μ_t represents the trend and seasonality which is further equal to

$$\mu_t = D_t + D_S = \delta + A_t + \sum \alpha_s D_{s,t}$$

The next step is to check the white noise of the residuals at 1st and 12th lag. So we have applied serial correlation LM test. If there is problem of autocorrelation then we have to add the lags of dependent variables until the residuals are white noised. After this process we have tested different hypothesis. First two hypotheses are usually tested individually while the rest of the hypothesis is tested jointly by applying Wald test. The null hypothesis is as under:

$$H_0^A: \pi_1 = 0$$

$$H_0^B: \pi_2 = 0$$

$$H_0^C: \pi_3 = \pi_4 = 0$$

$$H_0^D: \pi_5 = \pi_6 = 0$$

$$H_0^E: \pi_7 = \pi_8 = 0$$

$$H_0^F: \pi_9 = \pi_{10} = 0$$

$$H_0^G: \pi_{11} = \pi_{12} = 0$$

By using T-statistics, zero frequency unit root and semi -annual frequency unit root are tested. Similarly, While F-statistics.is used for testing other complex unit roots. In case of T-statistics, if our calculated value of t-statistics is less than the critical values then we reject the null hypothesis and deduce that there is no unit root but in other case we have to apply the stationary filters in order to make data stationary. In case of F- statistics we accept the null hypothesis if the calculated value is less than the critical value.

3.5 SVAR Methodology:

Our goal is to estimate the impacts of oil price shocks on commodity market, so we have applied the SVAR (Structural Vector Autoregressive) methodology. A VAR (Vector Autoregressive) Model is utilized for Multivariate time series arrangement. A VAR Model is a system where each variable is a linear function of past lags of it and lags of other variables. So each equation in the VAR contains the same set of determining variables. A SVAR Model is used to dissect the impacts of oil price shocks on metals and agriculture commodity prices.

Backing Breitunget et al. (2004), we begin with the following structural VAR (s) system

$$XY_t = X_1 Y_{t-1} + X_2 Y_{t-2} + ... X_s Y_{t-s} + A\varepsilon_t \text{ .... (1)}$$

Where Y_t is a (n*1) vector of endogenous variables. ($S^C, S^t, S^S, S^C, S^S, S^g$) A_i invertible (n*n) matrices which catches the impact the dynamic innovations between k variables in the model. And ε_t is a (n*1) vectors of structural error terms. "S" is the number of lag. Thus is a (n*1) vector of structural shocks assumed normally distributed with zero mean. Therefore system (1) can be expressed as

$$XY_t = X_1 Y_{t-1} + X_2 Y_{t-2} + ...X_s Y_{T-S} + A\varepsilon_t \text{ .... (2)}$$

The structural model represented by system (2) ought to be true objective of the end goal of policy analysis and must be given portrayal according to (Leepret et al 1996). The model represented in system (2) can be obtained by pre multiplying model (2) with A^{-1} as written below

$$Y_t = X_1^* Y_{t-1} + X_2^* Y_{t-2} + ...X_s^* Y_{t-s} + \mu_t \text{ .... (3)}$$

Where $X_1^* = X^{-1} X_i, \mu$ denotes reduced form VAR residuals which are uncorrelated with variables and normally, autonomously distributed with variance covariance matrix

So we have $\Omega = E(\mu_t \mu_t^{/})$

$$Xu_t = B\varepsilon_t = \mu_t = X^{-1} B\varepsilon_t \text{..(4)}$$

We can identify the structural coefficients represented in equation (2) from reduced form equation (3).Using relation (4) we can identify basis structural parameters, so it is important to impose restrictions as in our case we have 7 variables so we have imposed 21 additional restrictions to Determine model.

3.5.1 Impulse response function:

Impulse response functions are used to describe what is the reaction of economy to exogenous shocks or impulses? Impulse response functions portray the response of endogenous macroeconomic variables such as output, yield, and consumption, investment at the time of shocks and over consequent point in time.

The second goal of this study is to find out the effects of oil price shocks on agriculture and metal commodity prices. An impulse response function allows us to understand the vigorous effect of oil price shocks on commodity prices. It follows over time the normal responses of present and future estimations of each of factor to a shock.

CHAPTER 4

EMPIRICAL RESULTS AND DISCUSSIONS

4.1 Introduction:

The estimated results and their discussions are presented in this chapter. The results have been presented from estimation techniques employed in the study namely the GARCH Models, SVAR Model. First of all the results of descriptive statistics are mentioned in section 4.2.and results of bivariate analysis are presented in 4.2.1. Section 4.3 contains data description and results. Similarly section 4.3.2 represents GARCH results. The results of Impulse response Analysis and Variance decomposition are mentioned in section 4.5 and 4.6.

4.2 Descriptive Statistics:

For examining the descriptive analysis of the variables of interest, we have divided the complete sample period for all the variables into different subsamples i.e. 2001:M7-2004:M12, 2005:M1-2008:M12, and so on. The average oil price for complete sample period from 2001:M7-2017:M4 is 68.437 and standard deviation is 45.78. While stability ratio is 45.78%,. But the standard deviation and stability ratio of the complete sample period show higher volatility as compared to the other subsamples of different commodities.so we can say that complete sample period is most volatile for all the seven variables. Different subsamples have different values of stability ratio standard deviation. Similarly higher value is an indication of more volatility. If we use standard deviation as a measure of volatility the subsamples of 2005s and 2013 have the higher standard deviation.

Table 1: (Descriptive statistics)

VARIABLES	PERIOD	MEAN	STD	SR
OIL	2001:M7-2017-M4	68.4372	31.33346	45.78426
	2001:M7-2004M12	29.50628	6.997277	23.71453
	2005:M1-2008M12	72.53954	22.35545	30.8183
	2009:M1-2012M12	91.10083	22.81652	25.04535
	2013-M1-2017M4	75.17434	29.09765	38.7069
SUGAR	2001:M7-2017-M4	43.78811	18.37226	41.9572
	2001:M7-2004M12	21.00075	1.910752	9.098494
	2005:M1-2008M12	30.52248	11.26544	36.90865
	2009:M1-2012M12	60.22313	11.26544	18.70617
	2013-M1-2017M4	59.26769	5.438534	9.176221
COOKING OIL	2001:M7-2017-M4	356.1723	134.3158	37.71091
	2001:M7-2004M12	196.7835	14.8348	7.538642
	2005:M1-2008M12	261.885	71.26939	27.214
	2009:M1-2012M12	435.3665	72.91384	16.74769
	2013-M1-2017M4	498.8413	35.70729	7.158045
WHEAT	2001:M7-2017-M4	218.1834	101.9215	46.71368
	2001:M7-2004M12	94.88664	13.40224	14.12448
	2005:M1-2008M12	144.9892	43.30124	29.86514
	2009:M1-2012M12	262.5292	14.75721	5.621171
	2013-M1-2017M4	346.8296	19.94493	5.750642
TEA	2001:M7-2017-M4	104.9315	40.91991	38.99678
	2001:M7-2004M12	66.39144	7.398349	11.14353
	2005:M1-2008M12	67.52741	9.261611	13.71534
	2009:M1-2012M12	119.4783	16.43893	13.75892
	2013-M1-2017M4	157.159	18.19657	11.57844
GOLD	2001:M7-2017-M4	26271.88	16444.86	62.59491
	2001:M7-2004M12	6727.688	844.5044	12.55267
	2005:M1-2008M12	13486.07	4115.679	30.518
	2009:M1-2012M12	38064.22	10107.75	26.55445
	2013-M1-2017M4	42974.63	3292.135	7.660647
SILVER	2001:M7-2017-M4	459.4502	305.7845	66.55444
	2001:M7-2004M12	110.2591	13.87016	12.57961
	2005:M1-2008M12	250.001	87.31581	34.92619
	2009:M1-2012M12	716.1783	271.6756	409.2028
	2013-M1-2017M4	697.8471	98.35798	14.09449

2013 has the highest stability ratio and the subsample of 2001 has the lowest stability ratio. Similarly, among wheat, tea, cooking oil and sugar the subsample of 2005 of wheat has the highest stability ratio among all other variables. It means this subsample has the most volatility. Similarly, subsample of wheat 2009:M1-2012:M12 has the lowest stability ratio among all other variables of interest.

Among metals i.e. Gold and Silver the complete sample period of silver has the highest stability ratio i.e. 66.55.the subsample 2013:M1-2017:M4 of gold has the lowest stability ratio i.e. 7.66.while the subsample 2005:M1-2008:M12 of silver has the highest stability ratio.

4.2.1 Bivariate analysis (correlation matrix):

First we have used the univariate analysis, now we are moving towards bivariate analysis among the variables that are used in this study. Table 2 represents the correlation coefficients among the price series of oil, wheat, sugar, tea, gold and silver. The metals and oil prices have positive linear correlation which indicates the comovement between oil and metal prices, because as oil prices increases the transportation costs and production costs Also increases (Hammoudeh and Yuan, 2008).

Among agriculture commodities i.e. wheat Sugar, tea, and cooking oil prices. All commodities have linear positive correlation. Costs of fertilizers, transportation costs increases because of oil prices increases which increase production costs. (Yuan, and Hammoudeh, 2008 and Tyner, 2010). The results are mentioned below in table 2.

Table 2 (correlation among oil prices and commodities):

CORELATION	OIL	WHEAT	COOKING OIL	SUGAR	TEA	SILVER	GOLD
OIL	1 (0.000)	0.559 (0.000)	0.713 (0.000)	0.530 (0.000)	0.426 (0.000)	0.754 (0.000)	0.627 (0.000)
WHEAT		1	0.948 (0.000)	0.847 (0.000)	0.922 (0.000)	0.836 (0.000)	0.927 (0.000)
COOKINGOIL			1	0.826 (0.000)	0.888 (0.000)	0.938 (0.000)	0.969 (0.000)
SUGAR				1	0.847 (0.000)	0.843 (0.000)	0.888 (0.000)
TEA					1	0.838 (0.000)	0.916 (0.000)
SILVER						1	0.966 (0.000)
GOLD							1

4.3 Data description and Results:

All price series are changed over into log returns R_t by tilizing the changes as given below:

$$X_t = \log (P_t / P_{t-1})$$

Table 3 reports the statistical properties of the return series. Skewness measures the asymmetry of the distribution of series around its mean. It defines the extent to which a distribution differs from a normal distribution. Symmetric distribution has a skewness zero. Long right tail indicates Positive skewness and similarly long left tail indicates negative skewness. The returns series of sugar, cooking oil, gold and silver are positively skewed. While the distribution of tea, wheat, crude oil are negatively skewness. The peakedness and flatness of the distribution of the series can be measured by kurtosis. Normal distribution has a kurtosis of three. If the kurtosis exceeds 3, the distribution is leptokurtic. Similarly Platykurtic distribution has a kurtosis less than three. The price series of all agricultural and metal variables have a value of kurtosis greater than three, so all series of interest are leptokurtic. Jacque bera test measures the skewness and kurtosis both.it is also called a goodness of fit test.it matches the skewness and kurtosis with the normal distribution. According to Jacque Bera test all price series are non-normal at 5% significance level.

All price series of agricultural and metal commodities contain ARCH (Auto regressive conditional hetroskedasticity) effect, which is indicated by the LM-ARCH test at 5% level of significance. As all price series contains ARCH effect so we can apply GARCH Model (Generalized Auto regressive conditional hetroskedasticity) explained by Bollerslev (1986) to measure the volatility.

Table 3 (Data Description):

Commodity	skewness	Kurtosis	Jacque bera	F stat ARCH
Sugar	0.708186	6.627206	119.406	28.713 (0.0175)
Tea	-0.69586	11.86964	634.7832	53.372 (.0008)
Cooking oil	2.861383	18.52078	2154.951	4.915 (0.026)
Wheat	-0.37055	8.739543	263.7462	19.007 (0.000)
Gold	0.313106	5.727965	61.69225	26.831 (0.000)
Silver	1.433196	9.741827	422.639	21.621 (0.000)
Crude brent	-1.03844	5.014678	65.93202	61.099 (0.000)

4.3.1 Results of Bealieu and Miron Seasonal unit root

Beaulieu and Mirron seasonal unit root has been used to check the stationary in monthly data. Under this test, for seasonal unit root detection, we check the stationary using T-statistics. Whereas Wald test is used for the detection of non-seasonal unit root. After the auxiliary regression we check the serial correlation at 1st and 12^{th} lags using Bresch serial correlation LM test .Bealieu and Miron seasonal unit root tests results are mentioned in table 5, both at level and at first difference. We examine 5% significance level using Frances and Hobjin (1997) critical values for seasonal unit root detection. The results show that at level the calculated values of the T-statistics for π_1 are -0.93,-1.85 and -1.53 for oil prices silver and gold prices. The calculated values at zero frequency unit root are greater than critical values, so null hypothesis can't be rejected. After transforming the calculated values of T-statistics for both π_1 and π_2 that is less than the critical values for oil, silver and gold prices. On the other hand the calculated values of F-statistics are greater than critical values so null hypothesis is rejected. therefore oil, silver and gold prices become stationary at first difference whereas for wheat, tea, sugar and cooking oil the calculated values for T-statistics for $\pi_1$are 8.832,-2.755, 1.97,-1.760 at level. This calculated value is less than the critical values at 5% significance level. Which implies that wheat, tea, sugar and cooking oil contain no unit root at zero frequency. Also the calculated value of π_2 is less than calculated values and T-statistic value is greater than critical values which lead to conclusion wheat, tea, sugar and cooking oil contains no unit root at any frequency and is stationary at level. The Bresuch Godfrey serial correlation LM test has been applied at first and 12 lags. There is no problem of autocorrelation at 1st and 12 lags. So we conclude that there is no problem of autocorrelation at 1st and 12^{th} lag but gold and silver prices are non-stationary at level whereas all other variables are stationary at level. The results of Beaulieu and Miron (1992) seasonal unit root are presented in table 4 as under:

Table 4 (Beaulieu and Miron monthly seasonal unit root test):

Hypothesis	Sil	Dsil	Gol	Dgol	Wht	sug	Col	oil	doil	tea
$H_0^t: \pi_1 = 0$	-1.1858 (0.237)	7.745000 (0.0000)	-1.536642 (0.1263)	-2.719309 (0.0072)	8.832341 (0.0121)	1.972653 (0.0503)	-1.760827 (.0803)	-0.93 (-1.93)	-6.75 (-1.93)	0.006 (-2.775)
$H_0^t: \pi_2 = 0$	-4.3876 (0.000)	3.826976 (0.0002)	-5.833412 (0.0000)	-5.104311 (0.0000)	8.832341 (0.0121)	4.515308 (.0000)	-4.008774 (.0001)	-6.52 (-1.94)	-6.60 (-1.94)	-3.2265 (.0015)
$H_0^F: \pi_3 = \pi_4 = 0$	25.92275 (0.0000)	21.05109 (0.000)	28.5667 (0.000)	31.78397 (0.0000)	22.59276 (0.0000)	25.0688 (.0000)	39.63706 (.0000)	47.02 (3.07)	45.89 (3.07)	11.37776 (0.0034)
$H_0^F: \pi_5 = \pi_6 = 0$	28.69248 (0.0000)	21.04676 (0.000)	33.30845 (0.000)	27.81116 (0.000)	22.59276 (0.000)	19.72639 (.0001)	25.77389 (0.0000)	77.12 (3.06)	67.4 (3.06)	25.86556 (.000)
$H_0^F: \pi_7 = \pi_8 = 0$	30.79582 (0.0000)	26.67531 (0.000)	37.59451 (0.000)	27.99825 (0.000)	6.236747 (.0442)	12.95815 0.0015	30.47089 (0.0000)	34.94 (3.10)	35.65 (3.10)	26.45982 (0.000)
$H_0^F: \pi_9 = \pi_{10} = 0$	37.98218 (0.000)	29.06221 (0.000)	34.55903 (0.0000	31.93205 (0.000)	0.160912 0.9227	29.44996 (.0000)	41.32036 (0.0000)	46.88 (3.11)	43.00 (3.11)	25.16350 (0.0000)
$H_0^F: \pi_{11} = \pi_{12} = 0$	37.74691 (0.000)	40.20519 (0.000)	41.94496 (0.000)	17.82098 (.0001)	0.298023 (0.8616)	20.50882 (.000)	19.24302 (0.0001)	25.77 (3.11)	26.45 (3.11)	44.63839 (0. 000)
Auxiliary Regression	D,NC,NT	NC,NT,D	NT,ND,C	ND,C,NT	NC,NT,D	NC,D,NT	D,NC,NT	NT,ND,NC	ND,NT,NC	D,NC,NT

Critical values given by Franses and Hobijn (1997) are in parentheses.

4.3.2 GARCH Results:

As our data is non-normal and leptokurtic in order to examine the behavior we have to use those models that allow the variance to depend upon its history.so model like GARCH (1, 1) is appropriate to capture the volatility clustering effects in the monthly time series data.

By using the GARCH (p, q) Model we estimate the conditional volatility of different commodities that are used in this study. GARCH Model is developed by Bollerslev (1986). The main purpose of this model is to measure the variances in time series data. Results is presented in table 5

Table 5 (GARCH estimations):

Commodity	Alpha	Beta	Persistence of shock	AIC	F-stats (ARCH)
Sugar	0.179	0.499	0.669	3.001	0.163 (0.684)
Tea	0.046	0.929	0.9752	5.433	0.394 (0.528)
Cooking oil	0.281	0.796	0.99	5.285	0.076 (0.782)
Wheat	0.213	0.611	0.811	3.818	0.009 (0.923)
Gold	0.447	0.132	0.577	3.700	0.001 (0.968)
Silver	1.816	0.122	1.938	3.897	0.382 (0.534)
Crude oil	0.334	0.596	0.93	2.278	0.689 (0.406)

As ARCH effect is present in the residual of the return series so it means that mean equation is not adequate to capture the volatility clustering so we move toward the GARCH model based on this mean equation. We have selected the appropriate model based on ARCH test and Akaiake information criterion. So we have selected AR (1)-GARCH (1, 1) for wheat, tea, cooking oil, sugar, silver and gold. The significant coefficients of alpha and beta show the strong validity of the model. The persistence of shock which is the sum of confidents of alphas and betas is less than 1.By using, Residuals diagnostics like ARCH –LM test; we have tested the validity of the model. The results of LM-ARCH test indicate that the problem of hetroskedasticiy is removed. Now the errors are homoscedastic. This is also shown by the insignificant p-values which also show that the residuals are homoscedastic.

4.4 SVAR analysis:

The second goal of this study is to find the impacts of oil prices on agriculture and metals commodity prices. For this purpose we have taken four agriculture commodities i.e. wheat, sugar, cooking oil, tea and two metal i.e. silver and gold prices have been used. The study traces out the impacts of agriculture and metals commodity prices to oil prices. For this purpose have estimated SVAR model of the following variables that are incorporated in this study.

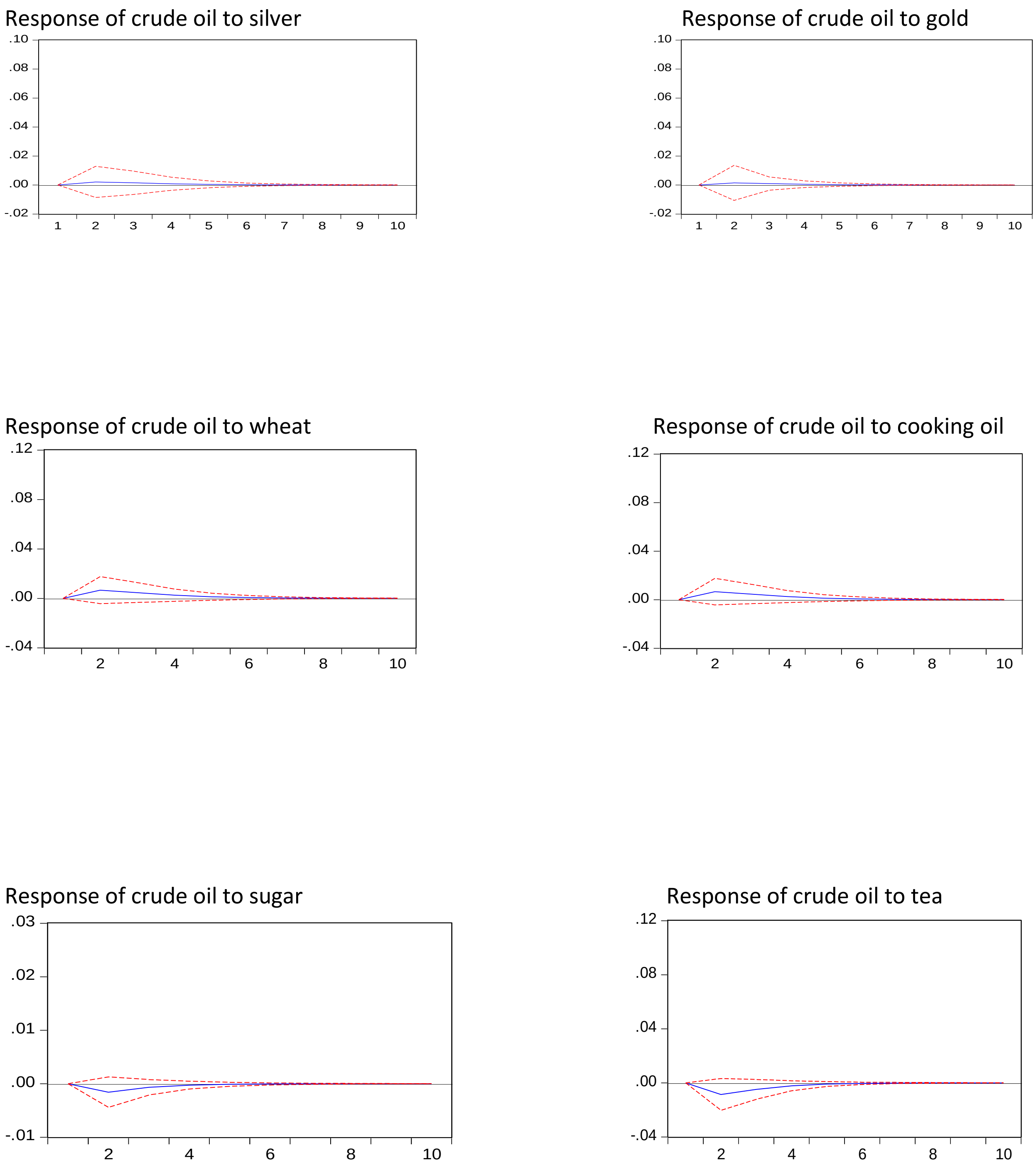
We have used two lags on the basis of Aikake information criteria for estimation of SVAR Model. According to structural factorization we have imposed five restrictions on in case of estimating SVAR for agricultural commodities. Whereas, for metal commodities we have imposed three restrictions.

4.5 Impulse response results:

For investigating the relationship between oil prices and commodity market prices, impulse response function has been employed. As our main goal is to measure the impacts of oil price on commodity markets prices, so we only trace out the responses of explanatory variables.

As we can see that oil price shock causes an slight increment in the silver prices as mentioned in fig 1. Following four months period silver prices starts declining. And completely dies out after five months. Similarly oil price shock causes gold prices to increase but gold prices slightly increased , afterwards it starts declining and completely dies out after six months.

FIG 1: Impulse response function (Response to Generalized One S.D. Innovations ± 2 S.E.)



Among agricultural commodities the reaction of wheat to oil prices shock is initially negative and following a slack of two months it starts lessening and afterwards it remains constant. This indicates that oil prices shock do not have any notable impact on wheat prices. We observe negative response of tea prices following oil price shock. Tea prices start decreasing and after second month then there is constant decrease. This pattern suggests that oil price increment do not have any remarkable impact on tea prices so we can say that tea price is autonomous of oil price shocks. The response of oil price shock to cooking oil price indicates that initially oil price shoots up following oil price shocks and then remains constant over the next eight months.

As we can see initially there is a slight increase in sugar prices following the oil price shocks. After three months it starts declining and it completely dies out after four months. This implies that an increase in oil prices aggravates production cost of agricultural commodities because of increment in costs of fertilizers and transportation. (Hamoudeh and Yuan 2008 and Tyner 2010).

4.6 Variance Decomposition results:

The variance decomposition analysis is utilized to distinguish significance of every variable in portraying the variations in independent variables (Chuku et al 2010).The after effects of variance decomposition investigation over a time of 10 months horizon for oil value are specified in table 6 we can see .that in four months the effect of sugar is 0.0165 % and its commitment modestly increments after some time and achieve 0.01679% following a half year. Similarly the contribution of oil price to wheat is 0.302% over the span of ten month horizon. The oil value stuns clarify bigger variances in the tea costs. The commitment of oil costs to tea is 2.87% of every four month term and it increment over the long haul and ignoring 3.41% following a half year. In this way the tea costs tend to increment after some time. At long last the effect of oil costs to cooking oil costs over a ten months horizon ranges from 1.106% to 1.21%. The slight effect of oil costs recommends that residential costs stickiness concerning worldwide oil prices.(Arshad and Ahmed 2011)

Table 6 (Variance decomposition Analysis):

Period	S.E.	DLCRUDE	DLGOL	DLSIL
1	0.082474	100	0	0
2	0.087531	99.9141	0.028174	0.057722
3	0.088201	99.87322	0.039721	0.087062
4	0.088299	99.86075	0.043105	0.096147
5	0.088314	99.85765	0.043929	0.098418
6	0.088316	99.85696	0.04411	0.098926
7	0.088317	99.85682	0.044147	0.099032
8	0.088317	99.85679	0.044155	0.099053
9	0.088317	99.85679	0.044156	0.099057
10	0.088317	99.85679	0.044157	0.099058

Table 7 (Variance DecompositionAnalysis)

Period	S.E.	DLCRUDE	DLWHT	DLSUG	DLTEA	DLCOL
1	0.086034	100	0	0	0	0
2	0.086034	100	0	0	0	0
3	0.088839	95.71113	0.293252	0.016538	2.872986	1.106089
4	0.088839	95.71113	0.293252	0.016538	2.872986	1.106089
5	0.089125	95.09669	0.301018	0.0167	3.376574	1.209019
6	0.089125	95.09669	0.301018	0.0167	3.376574	1.209019
7	0.089149	95.05458	0.302185	0.016782	3.412587	1.213869
8	0.089149	95.05458	0.302185	0.016782	3.412587	1.213869
9	0.089151	95.05341	0.302233	0.01679	3.41372	1.213849
10	0.089151	95.05341	0.302233	0.01679	3.41372	1.213849

Similarly in case of metals, the contribution of oil price to gold prices is 0.0431% over the span of four month horizon. And it increase over time and reaches 0.044% over six months. Similarly, the contribution of oil prices to silver ranges between 0.057 % to 0.059% over a ten month horizon. The oil prices explain larger variations in in silver prices.

Chapter 6

Conclusion and Policy Recommendation

Conclusion

In this study we have applied GARCH (Generalized autoregressive conditional heteroskedasticity) Model to measure the volatility of all agriculture and metal commodities which can be explained by using appropriate GARCH Model. The second objective is to measure the impacts of oil prices on commodity prices in Pakistan by using SVAR (Structural vector autoregressive technique). For this purpose four agricultural (wheat, cooking oil, sugar, tea) and two metals (silver and gold) have been used in this study.

Monthly data from 2001; M7 to 2017:M4 have been used in this study. As ARCH (Autoregreesive conditional hetroskedasticity) effect is present in all the return series. So we have applied GARCH Model, the results imply that all the coefficients are significant. i.e. The coefficients of variance and mean equations. The post estimation test i.e. LM ARCH test indicates that there is no ARCH effect left. Similarly, for investigating the relationship between commodity market and oil prices, we have used impulse response function. The results of impulse response function, in case agricultural commodities indicate that oil prices do not have notable impact on wheat and tea prices whereas in case of sugar and cooking oil prices there is a slight increase in sugar and cooking oil prices following the oil prices shocks. According to Hamoudeh and Yuan 2008 and Tyner 2010), an increase in oil prices aggravates the costs of production of agriculture commodities as transportation costs also increases

In case of metals there is a slight increase silver and gold prices following the oil price shocks.

As higher production and transportation costs is through increase in oil prices. (Hammoudeh and Yuan, 2008). Similar results are found by using variance decomposition analysis. Both the results of impulse response and variance decomposition analysis aid each other. The results definitely indicate that oil price changes affects agriculture and metal prices. Various commodities have different effects as a result of oil price change i.e. the effects of oil price change upon different commodities is dissimilar.

5.2 Policy implications:

As oil price increase can have serious effects for a country like Pakistan which is an oil importing country. Oil price changes can affect all sectors of the economy which are dependent on oil products. Oil price increase can cause increase in production costs leading to increase in domestic prices. Oil is used as an input in agriculture and metal sector so changes in oil price can affect this sector. There is a dire need that policy makers should pay attention on policies related to oil prices .policy makers should design the agricultural policies in such a way that it won't have negative effects on agriculture sector. Rising agricultural prices can affect the poor seriously. Government should provide subsidies to domestic users regarding oil prices. We should develop alternative energy resources so that dependency on external oil can be reduced. In this way the relevant industries and agriculture sector would not be influenced by the oil price changes. The impacts of oil prices on agricultural and metal commodities can be decreased by the implementations of these policy recommendations.

5.3 limitations of the study:

This study focuses on the relationship between oil and commodity market prices. This study finds out the impacts of oil price changes on commodity market prices by using SVAR approach in case of Pakistan. Four agricultural and two metals commodities are used. As each and every study have certain limitations. As in our case there are some points that deserve further research. We have used four agricultural commodities (wheat, rice, tea, and cooking oil) that are widely used in Pakistan. Future research can find out the impact of oil price change on other commodities of interest. Secondly other studies can focus on how much is the impact of oil price changes on various commodities. Whether all commodities are sensitive to oil price changes or there are only few commodities which are affected. Thirdly future studies can find out the impacts of oil price shocks by decomposing into different components (demand, supply and speculative demand shocks. Finally high crude oil and commodity market prices can cause suspicion on the role of speculations.

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