MONETARY POLICY REACTION FUNCTION IN THE PRESENCE OF OIL PRICE SHOCKS IN KENYA

MUCHERU EZEKIEL MUCHERU

A research project Submitted to the Department of Applied Economics in the school of Economics in partial fulfillment of the requirements for the award of the degree of Master of Economics (Finance) of Kenyatta University.

MAY 2014
DECLARATION

This project is my original work and has not been presented for a degree in any other university or any other award.

Mucheru Ezekiel Mucheru
B.Com. (Finance)
K102/PT/13002/2009.

Signature Date: 17/12/14

Supervisor

This project has been submitted for examination with my approval as the university supervisor.

Dr. Joseph Muniu
Lecturer, Department of Applied Economics
Kenyatta University.

Signature Date: 20/5/14
DEDICATION

I dedicate this research work to my dear wife Anne and to my daughter Sharon.
ACKNOWLEDGMENTS

Above all, I thank Almighty Lord for the strength given unto me to complete this work. I also extend my thanks to my dear wife who stood with me and encouraged me all through.

I am greatly indebted to my devoted supervisor Dr. Joseph Muniu for his guidance, encouragement and intellectual critique of this work. He was always available, ready and willing to assist within and outside office hours, on phone and in person. I am very grateful for his unrelenting support. I further thank Dr. Jacob Oduor who laid the foundation for this work before departing to Tunisia for his new appointment.

To my mentor Dr. Paul Gachanja, I am very delighted of your untiring encouragement and support may the Lord reward you abundantly.

The start and completion of this work would not have materialized without the input of various individuals some of whom I may not be able to mention here.

But nonetheless I thank them all.
TABLE OF CONTENTS

DECLARATION ........................................................................................................ ii
DEDICATION .......................................................................................................... iii
ACKNOWLEDGMENTS ........................................................................................... iv

TABLE OF CONTENTS ......................................................................................... v

LIST OF TABLES .................................................................................................. viii
LIST OF FIGURES ................................................................................................. ix

ABBREVIATIONS ................................................................................................. x

CHAPTER ONE: INTRODUCTION ......................................................................... 1

1.1 Background .................................................................................................... 1

1.2 Channels of Monetary Policy Transmission ...................................................... 5

1.3 Kenya Economic Evaluation Since 1970 ........................................................... 7

1.4 Statement of the Problem ................................................................................ 9

1.5 Research Questions ....................................................................................... 10

1.6 Objectives of the Study .................................................................................. 10

1.7 Significance of the Study ................................................................................ 10

1.8 Organization of the Study .............................................................................. 11

1.9 Scope of the Study ......................................................................................... 11

CHAPTER TWO: LITERATURE REVIEW .............................................................. 13

2.1 Introduction ................................................................................................... 13

2.2 Theoretical Literature ................................................................................... 13

2.2.1 Modern General Equilibrium ...................................................................... 13

2.2.2 Channels of Oil Transmission .................................................................... 14

2.3 Empirical Literature ....................................................................................... 20
LIST OF TABLES

Table 4.1: Stationerity Results .................................................. 29
Table 4.2: AIC Values ................................................................. 30
Table 4.3: Estimation Results ...................................................... 30
Table 4.4: Variance Decomposition Results .................................. 33
Table A1: Data Used in the Study ................................................ 50
LIST OF FIGURES

Figure No.

1.1. A Graph Showing Effects of Oil Price Increase on Microeconomic Variables in Kenya ............................................................... 7

4.1 Impulse Response to One S. D. Innovation with a Standard Error of 
\[ \pm 2 \] ........................................................................................................ 32
ABBREVIATIONS

CBR  Central Bank Rate
ECB  Europe Central Bank
FED  Federal Bank
GDP  Gross Domestic Product
GMM  Generalized Method of Moments
i.i.d. Independent and Identically Distributed
IMF  International Monetary Fund
KNBS Kenya National Bureau of Statistics
OPEC Organization of Petroleum Exporting Countries
VAR  Vector Autoregressive
**Operational Definition of Terms**

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Causality</td>
<td>Is the ability of past values of one variable to predict another variable</td>
</tr>
<tr>
<td>Cointegration</td>
<td>Existence of a long run relationship between variables.</td>
</tr>
<tr>
<td>Divine coincidence</td>
<td>An absence of tradeoff between stabilizing inflation and stabilizing the welfare relevant output gap.</td>
</tr>
<tr>
<td>Economic growth</td>
<td>Is the increase of per capita gross domestic product (GDP) or other measures of aggregate income typically reported as the annual rate of change in real GDP.</td>
</tr>
</tbody>
</table>
Monetary authorities have been confronted with a tradeoff between stabilizing inflation and output whenever there is oil price shock. Such shock induces a systematic response of monetary policy. The response has been criticized as being the source of adverse effect affecting economic activities by mostly derailing economic growth due to exaggerated leaning on stabilizing price levels. Kenya has suffered as a result of being a net importer of oil with oil price shocks destabilizing the economy.

This study investigates Kenya's monetary policy reaction function in midst of oil price shocks and assess the impact the shocks have on inflation and output. The main result is that oil price shocks affects both inflation and output but monetary authority magnifies the effects of the shocks while fighting inflation caused by the shocks. These effects last to a period of four years before stabilizing. This is in line with other studies carried out in other countries which call for monetary authority dealing with underlying shocks that drive real prices other than concentrating on inflation.
CHAPTER ONE

INTRODUCTION

1.1 Background

Since the occurrence of the large oil price shocks in the 1970's, changes in the price of oil have been viewed as a significant source of macroeconomic fluctuations. According to Hamilton (1983) almost all United States’ recessions were preceded by a spike in oil prices. The variations have strong and negative impact on oil importing countries. Oil price increases are a challenge to policy makers in balancing the trade-off between higher inflation and higher unemployment. Bernanke et al. (1997) and Bernanke et al. (2004) suggest that whenever there is an oil price shock, monetary policy makers have historically leaned towards keeping inflation low which accounts for a large portion of the decline in GDP growth during the period.

High oil prices have an adverse impact on businesses, consumers, and the government budget, to name a few. As a result, net oil-importing countries see their terms of trade deteriorate jeopardizing their balance of payment position and possibly leading to lower economic growth than in the absence of the oil shock.

The Kenyan economy underwent major structural reforms since early 1990s with a view to improving the overall macro-economic efficiency. In the oil sector, the Kenya government deregulated the downstream petroleum market operations in October 1994. These reforms included liberalization of distribution and pricing of
petroleum products and partial liberalization of product supply. In July 2007, Energy Regulation Commission was formed with a mandate of regulating energy sector. However, it has been observed that the post deregulation retail prices of petroleum products have not closely followed the changes in international oil prices. It has been argued variously that oil companies are quick to adjust retail petroleum prices upwards when international oil prices are rising and slow to lower prices when oil prices are falling. This implies that retail petroleum prices are sticky downwards which generates non-trivial economic efficiency and asymmetrical costs concerns on the downstream gasoline market.

High crude oil prices cause an inward shift in short run aggregate supply and puts upward pressure on consumer price levels. A sharp jump in the price of crude oil causes an exogenous inflationary shock and the impact is greater when a country is a large-scale importer of oil and has many industries that use oil as an essential input in the production process. Kiptui (2009) adopted a Philips curve approach on Kenya’s economy and found that oil prices influenced inflation in both short-run and long-run. An increase in inflation acts to reduce the growth of real incomes putting downward pressure on consumer demand. Higher inputs costs will also squeeze companies’ profit margin which together with a sluggish growth of demand lead to a cutbacks in planned investment spending.

The monetary policy authorities normally respond to high inflation by increasing short-term interest rates which dampen consumer spending. The tight monetary
policy causes slow economic growth with a possibility of a rise in unemployment and a diminution in the ability of workers to ask for pay increases that keep pace with inflation. Deflationary policies designed to control cost-push inflation will have the effect of reducing real national output.

Oil price increases usually originate from a supply-driven shock or demand-driven shock. Cashin et al. (2012) who carried out a study to determine macroeconomic effects of the two types of shocks found that supply-driven shock has negative effects on economic activities of oil importing countries with demand-driven shocks having long-term inflationary pressure and short-run increase in output. In discriminating price increases due to supply-driven shocks from those caused by demand driven shock, supply driven shocks are associated with decline in global oil production level as well as a decline in real output in oil importing countries during the first year after the shock.

For demand-driven negative shock, oil prices will increase as well as global oil production and real output. Between 1970 and 2011, there have been three key episodes of negative oil price shocks, the Organization of Petroleum Exporting Countries (OPEC) oil embargo of 1973-1974, the Iranian revolution of 1978-1979, and the oil price spike of 2007-2008. Until 2002, Kenya followed a supply driven oil price shock trend after which in the period between 2002 and 2007 changed to demand driven oil price shock trend. This might have been caused by booming economic activity in Kenya as in other emerging economies leading to a
high demand for oil as well as other commodities which are as a result of precautionary and speculative demand of future oil real prices (Unalmis et al., 2012).

During the period between 2002 and 2007 manufacturing sector underperformed dropping from being the second largest economic sector after agriculture to fourth position. It was replaced by transport and telecommunication sector in 2004 and later by wholesale and retail sector in 2007 (World Bank, 2010). Since oil price shock affects largely manufacturing and transport sectors, the study cannot overrule the compensation effect by the sectors whose growth accelerated rapidly. Exogenous shocks are disruptions expected to reoccur now and then, and monetary policy authority remains obliged to ensure price stability and economic growth.

There is nothing the central bank of an oil importing country can do to prevent negative oil price shock from harming the economy but monetary policy can affect the way in which the harm is manifested (Dolan, 2011). This is applicable regardless of the shock origin owing to the fact that all negative oil price shocks are accompanied by inflation. Before monetary policy authority decides on its reaction, it's important to identify the type and intensity of the shock. Adopting wrong measure in fighting inflation on either of the periods, by leaning on either side leads to magnified harm on the neglected side. By accommodating the
shocks, more inflation accompanied by smaller impact on real output and employment is experienced.

The Central Bank of Kenya which has the sole mandate of implementing monetary policy has been targeting inflation through monetary aggregates, which has generated mixed and uncertain results with the latest being in 2011 during Libya unrest. The Kenyan economy experienced steep inflationary pressures and the monetary policy raised the Central Bank Rate (CBR) rate twice in two months, October 2011 and November 2011 without containing the pressure. This led to a further increase in December leading to a revision of commercial banks’ lending rates.

1.2 Channels of Monetary Policy Transmission

In conventional macroeconomic model, interest rate channel has been seen as the primary mechanism at work. An increase in nominal interest rate leads to an increase in real interest rate and the cost of capital particularly with price stickiness. This leads to reduced consumption and investment as households and firms postpone their spending.

Another channel is wealth which is built on the life-cycle model of consumption. It was developed by Ando and Modigliani (1963), in which household’s wealth is a key determinant of consumption spending. The connection to monetary policy comes via the link between interest rates and asset prices. A policy-induced interest rate increase reduces the value of long-lived assets such as stocks, bonds,
and real estate shrinking household’s resources and leading to a fall in consumption.

Broad credit is the third channel developed by Bernanke and Gertler (1989). Asset prices are viewed to be important as they determine the value of collateral firms and consumers use as security for loans. In the presence of information or agency costs, declining collateral values will increase the premium borrowers must pay for external finance, which in turn will reduce consumption and investment.

The fourth channel is the bank lending channel, where banks play a more central role (Bernanke and Blinder, 1988). Banks rely on demand deposits as a source of lending. The central bank requires commercial banks to hold some money as reserve. By changing the reserve percentage the Central bank affects the available funds in commercial banks that can be disbursed as loans. Most household and firms depend on bank financing and changes in supply of loans affect their operations.

The exchange rate channel is another important element for an open economy (Mishkin, 1995). The chain of transmission is from interest rates to the exchange rate via the uncovered interest rate parity condition relating interest rate differentials to expected exchange rate movements. Thus, an increase in the domestic interest rate relative to foreign rates would lead to a stronger currency and a reduction both in net exports and in the overall level of aggregate demand.
Changes in the quantity of assets used by monetary policy affect the underlying prices as investors change their investment portfolios.

1.3 Kenya Economic Evaluation Since 1970

In the first oil price crisis which occurred in 1973, annual inflation rose to 9.3 percent from 5.8 recorded in 1972. The monetary authority increased the treasury bills rate from 1.9 percent in 1973 to 4.6 percent in 1974. However, the inflation didn’t ease but continued rising to record 17.8 percent in 1974 and 19.1 percent in 1975. The authority continued increasing the treasury bills rate to 6.1 percent in 1975 where the inflation eased down to 11.4 percent in 1976. During the period, GDP growth fell from 17.1 percent in 1972 to 5.9 in 1973 and 0.9 percent in 1975. In 1980, the trend was repeated with inflation rising from 8.0 percent in 1979 to 20.7 in 1982 with interest rates rising from 5.3 in 1980 to 14.2 percent in 1983. The GDP growth declined to 1.3 percent in 1983.

The period between 2002 to 2007 experienced increased GDP growth despite increases in oil prices. The increase in oil prices in this period is characterized by increased oil demand due to expanding economies. In 2008 inflation rose to 26.2 percent from 9.8 in 2007, the interest rates rose to 7.7 percent with a decline in GDP growth to 1.5 percent in 2008 from 7.0 percent in 2007.
At this point, it is evident that whenever there was an increase in oil prices inflation rose and monetary authority responded by tightening the policy which was followed by a decline in GDP growth.

Figure 1.1: A Graph Showing Effects of Oil Price Increases on Macroeconomic Variables in Kenya

*Data source: Kenya National Bureau of Standards (KNBS) Word bank development indicators and International Monetary Fund (IMF) staff estimates.*

Figure 1.1 shows how different macroeconomic variables have interacted with rise in oil prices since 1970 as discussed in section 1.3.
Statement of the Problem

According to New Keynesian macroeconomic model, real output oscillates along an increasing growth path. In the long run, this growth path is determined by the supply-side. An increase in the growth rate of the money supply manifests itself in the long run as a proportional increase in inflation rate. In Short-run fluctuations are generated by changes in aggregate demand. Monetary policy should strive to stabilize the growth of aggregate demand in order to minimize fluctuations of real output and inflation. Divine coincidence is expected while striving to stabilize the output. However, the coincidence fails due to presence of exogenous shocks which are central driving forces in business cycle.

Expectations of households and firms react to policy measures. Monetary policy has to consider these expectations and act accordingly building up credibility and transparency. The evaluation of monetary policy should not be based on isolated one-time changes in policy instruments but on a series of changes which are connected by a policy rule.

Woodford (2003) advocated for a timeless perspective, where the policymakers ignore current conditions. In effect, the policy makers implement the policy they would have chosen in the distant past. The potential of monetary policy in maintaining price stability and managing the business cycle with fluctuating oil prices without relying on coincidental gains spurred the need for empirical
assessment of monetary authority behavior through estimation of its reaction function taking into consideration oil price shock.

1.5 Research Questions

Following the economic outcomes in the past periods the following research questions emerged:

i. What is Kenya’s monetary policy reaction function in the presence of oil price shocks?

ii. What impact does oil price shock have on inflation and output in Kenya?

1.6 Objectives of the Study

i. To estimate Kenya’s monetary policy reaction function in the presence of oil price shocks.

ii. To measure the impact of oil price shock on inflation and output in Kenya.

1.7 Significance of the Study

Central bank has been confronted with a trade-off between stabilizing inflation and output while dealing with rising oil prices. Overemphasis on curbing inflation has led to deteriorated economic growth and other macroeconomic activities. Studies done in other countries have revealed that Monetary Policy Authority is to blame for slowed down economic growth in times of high oil prices due to employment of tight monetary policy which is un-proportional to the size of the oil price shock.
With the Kenyan economy having its own characteristics, there was need to conduct a study within and establish whether the trends matched those of other oil importing countries. Rotich et al. (2008) found that monetary policy reaction function for Kenya indicated that CBK followed a rule to target inflation with some allowance for output stabilization. There was need to establish the behavior of monetary policy in the presence of oil price shocks to optimize economic growth.

1.8 Organization of the Study

Chapter one focuses on the introduction to the study. In chapter two, the study review literature from other studies that had been carried out on the same area while chapter three defines a methodology the study adopted in order to fulfill its objectives. Results of the study are highlighted in chapter four with chapter five giving the conclusion.

1.9 Scope of the Study

Until 1970s, Kenya enjoyed a stable economy which was destabilized by the first oil price crisis in 1973. The study intended to analyze the trends of oil prices since 1970 and compare it with economic activities within the period monitoring the Monetary Policy activities. This helped in analyzing the strength as well as weaknesses of the policy. Kenya imports two types of crude oil, murban and slops. Murban takes the highest percentage of import at 99.68 percent with Slops
taking 0.32 percent. The analysis concentrated on murban imports as that of slops was insignificant.
CHAPTER TWO
LITERATURE REVIEW

2.1 Introduction
The literature review focused on both general and empirical studies carried out on monetary policy reactions under exogenous economic shocks.

2.2 Theoretical Literature

2.2.1 Modern General Equilibrium
A general equilibrium model as discussed by Tobin (1969) assumes that market mechanisms create a balance between supply and demand in every market in the economy. The model assumes that individuals seek to maximize utility while firms seek to maximize profits. Both individuals and households have rational expectations and act to the best possible forecast of the future activities.

Goods and labour markets are assumed to be characterized by monopolistic competition. However, as price and wage stickiness is assumed to exist, monetary policy is able to affect the real economy.

Households are assumed to maximize their utility consumption and leisure over time. Households have access to an international credit market for investment or borrowing at the short-term nominal interest rates set by the domestic and foreign central banks. Households decide how much they consume today compared with tomorrow and how they divide their time between work and leisure.
The goods market is characterized by monopolistic competition, with each domestic firm producing a particular kind of good with the aid of labour and capital rented from households. Thus, each firm has a certain degree of monopoly power and can therefore set its price as a mark-up on its nominal marginal costs. The size of the mark-up depends in the long run on households’ propensity to substitute one firm’s type of product for others.

The model also includes a central bank assumed to determine the level of the policy rate in the light of how inflation and GDP are developing. This is a relevant description of monetary policy in most inflation-targeting regimes. The reaction function of the central bank should be regarded as containing most of the relevant information that determines the outlook for future inflation.

2.2.2. Channels of Oil Transmission

From a theoretical perspective, an oil price shock is transmitted to the economy through the following channels:

i. Supply Side

A key insight from the studies on oil and the macro-economy is that the magnitude of the effect of an oil price shock on gross output must be small. Bhanumurthy, *et al.* (2012) asserted that marginal productivity of oil equals the ratio of oil to output prices, that is, the marginal cost of oil measured in terms of domestic product with an assumption of aggregate production function with three inputs (labour, capital and oil) operating at full employment and at equilibrium.
An increase in price of oil raises its cost above marginal product leading to a cutback in amount of oil used in the production. In the process, marginal productivity of labour and capital declines and there is a fall in output. Backus and Crucini, (2000) added that GDP is expected to fall largely when the elasticity of substitution between oil and other inputs is low. A one per cent reduction in oil usage reduces gross output by a percentage corresponding to the cost share of oil (Hamilton, 2008). According to Rotemberg and Woodford, (1996) this share of oil in output is thought to be no larger than 4 percent and may be much smaller. Thus, a 10 percent increase in oil prices, for example, should result in a less than 0.5 percent reduction in gross output.

To explain the much higher real drop in GDP, researchers have turned to additional transmission mechanisms by which oil price shocks might contribute to lower growth, for example capital equipment utilization, uncertainty and investment pauses, labour markets and sectoral shocks. Besides extending the number of channels through which the oil shocks play out, many of the models have invoked the theory of imperfect competition to explain the facts (Bhanumurthy et al, 2012).

The intuitive idea here is that an increase in the price of energy works like a negative technology shock to generate contraction in economic activity. Finn (2000) developed a model with perfectly competitive markets, incorporating energy as an essential input for the utilization of capital. This created an indirect
channel working through the capital stock in addition to the usual direct production function channel for transmitting the impact of fluctuations in energy usage to the macro-economy. Oil price increases depress the future marginal product of capital thereby reducing investment and the future capital stock, and thus can have long-lived effects on output.

A related channel, capital equipment utilization hypothesis, was discussed by Bernanke (1983). He showed in a partial equilibrium model that oil price shocks tend to lower value added, because firms postpone investment as they attempt to find out whether the increase in the price of oil is transitory or permanent. But gauging the importance of such indirect effects of oil on output is far less straightforward than the corresponding exercise for the direct effects.

ii. Wealth Transfer

Higher oil prices leads to redistribution of wealth from net importers to net oil exporters causing a demand redistribution effect. In the short run the net oil importing countries cannot escape the high oil prices due to the low elasticity of energy demands (Rogoff, 2006). As per his study, this is so because most of the energy consuming economic activities are essential and hence consumption of other goods and services get squeezed as well as corporate profits which also affect firm’s spending.

According to Morgan (2012), Net oil exporters, the recipients of the income transfer from the net importers, are likely to save a substantial part of the income
transfer. The ratio of spending and saving of the received transfer depends on the perception on whether the shock is permanent or transitory. The more transitory the effect, the more it is saved. The high oil prices cause demand destruction effect in that it reduces the net demand of goods and services in the global economy. Part of the savings is invested domestically while the other part is invested abroad. Substantial part of the savings is invested in net oil-importing countries. This means some of the initial transfer is recycled into the purchase of assets of net importing economies. The buying of assets in oil importing economies results to asset recycling effect as the global ownership of assets is reshuffled.

Part of the transfer being consumed will be spent on domestic goods while the other part will be used importing goods from oil importing economies hence goods recycling effect. The consumption and investment decisions that determine GDP growth depend on post-transfer income. It is only when the share of income that goes abroad changes that spending plans have to be changed. If the share of the income transfer changes meaningfully, the resulting adjustment in spending can be disruptive to the economy. A strong world economy boosts oil demand which leads to increase in prices and hence the wealth transfer and vice versa when the global economy is weak. At the same time, an oil price driven by demand will act as an automatic stabilizer (Barrel and Pomerants, 2004). It will slow the economy when it's strong and boost it when it's weak. On the other hand, a supply shock will increase the price of oil, decrease demand and increase the
value of oil importers' imports. High net wealth transfer to oil exporting countries reduces the GDP of an oil importing country (Morgan, 2012).

iii. Inflation

Studies have examined the impact of change in oil prices on inflation with major implications being a spiral change in average prices whose volatility reduced in the 1990s. To explain the possible cause of this reduction, Baumeister and Peersman (2008) provided evidence of a considerably less elastic global oil demand curve over time. Accordingly, more recent oil supply shocks are characterized by a much smaller impact on world oil production and a greater effect on oil prices compared to the 1970s and early 1980s, which can also bring about time-varying effects.

LeBlanc and Chinn (2004) estimated the effects of oil price changes on inflation for the United States, the United Kingdom, France, Germany and Japan using an augmented Phillips curve framework. Findings of this study suggested that oil price increases of as much as 10 percentage points led to direct inflationary increases of about 0.1-0.8 percentage points in the USA and some European countries. Hooker (2002) estimated the effects of oil price changes on USA inflation. He modified the Phillips curve to accommodate non linearity and structural break with oil price changes. He found strong evidence of a structural break with oil price changes making a substantial direct contribution to core inflation before 1980 but little or no pass-through since then. He attributed the
results to the fact that monetary policy had become less accommodative of oil price shocks.

iv. Real Balance

This is a change in aggregate expenditures on real production made by the household, business, government, and foreign sectors as a result of a change in the price level which alters the purchasing power of money (Dogru and Soyta, 2010). This is one of three effects underlying the negative slope of the aggregate demand curve associated with a movement along the aggregate demand curve and a change in aggregate expenditures.

The real-balanced effect is based on the realistic presumption that the supply of money in circulation is constant at any given time. When the price level changes, the purchasing power of the available money supply also changes and so too do aggregate expenditures (Bernanke and Gertler, 1995).

v. Demand

Given an oil importing country with flexible exchange rate like Kenya, domestic currency will depreciate while oil exporters' currency appreciate in response to their real income gains. The theoretical case for flexible exchange rates rests on the ability of flexible exchange rates to absorb adverse oil shocks that obviates the need for a prolonged adjustment through excess demand in the goods and labor markets to push prices and wages to the new equilibrium (Cuddington, 1989).
Hamilton (2008) insisted that a key mechanism through which oil price shocks affected the economy was the disruption it caused on consumption of goods and services rather than the changes in operating cost of firms. In a study by Edelstein and Kilian (2009), there are four complementary mechanisms through which consumer expenditure is affected. First, higher energy prices reduce consumer’s discretionary income. The level at which it’s reduced depend on consumer reliance on energy use and elasticity of its demand. The lesser elastic the demand is, the more discretionary income is reduced.

With unitary inelastic demand of energy, effect of a unit change in energy price is bounded by energy share in consumption. The second one is that changing energy prices create uncertainty about the future path of the price of energy, causing consumers to postpone purchases of consumer durables (Bernanke 1983). This uncertainty effect is limited to consumer durables. Third, consumption may fall in response to energy price shocks, as consumers increase their precautionary savings and finally consumption of durables that requires energy will tend to decline as households delay or forego purchases of energy-using durables.

2.3 Empirical Literature

The oil price shocks of the 1970s were typically attributed to exogenous shortfalls in oil production whereas the prolonged build-up in oil prices that started in 1999 is commonly said to be mainly driven by shifts in the demand for crude oil (Hamilton 2003, 2009b). However, during these periods several industrial
countries, including the United States, were just dismantling price controls, which may have affected both real economic events and the accuracy of the data recorded then. Knowing what drives an oil price increase is important for understanding the impact on the economy and for designing the appropriate monetary policy response. For this reason, it is crucial for a forward-looking central bank to understand the transmission of oil shocks to inflation so that it can implement appropriate policy. Kiptui (2009) adopted a Philips curve approach to estimate pass-through of oil prices to inflation in Kenya and found a significant pass-through of 0.05 in the short-run and 0.1 in the long-run.

Lilien (1982) formulated dispersion hypothesis where an increase (decrease) in oil prices led to a contraction (expansion) in the sector that made use of oil in its production process. Moreover, this led to expansion (contraction) in oil efficient sectors as resources were reallocated from oil intensive sectors. This scenario was experienced in Kenya in year 2002 to 2007 where manufacturing sector was overtaken by transport and telecommunication and wholesale and retail sectors respectively.

To test for asymmetric effects of oil price increases and decreases, Mork (1989) separated the oil price variable into upward and downward movements. The rationale was that while price moves up and down, it has opposite and symmetric effects on the production possibility frontier causing some costly resource reallocation. Consequently, those two effects worked against, and could largely
offset, each other when oil prices fell while they operated in the same direction when oil prices increased.

In response to the apparent instability of the oil price- Gross Domestic Product (GDP) relationship, a series of specifications of oil price changes was investigated. The price change specifications distinguished not only increases from decreases (Mork, 1989), but also the relative magnitudes of increases (Hamilton, 1996a), and the surprise content of shocks at different dates attributable to recent oil price volatility (Lee et al. 1995). These specifications improved the statistical fit of regressions of GDP changes on oil price changes and other macroeconomic variables, but did not entirely settle the question of whether a stable, long-term relationship between oil prices and prominent macroeconomic indicators existed.

Rodriguez and Sánchez, (2005) emphasized oil price shocks and monetary shocks as the largest source of variation in real GDP in the euro area with a loss of 2 percent in every 100 percent increase in oil prices. Baumeister and Peersman, (2008) in their study on economic consequences of oil price shocks highlighted the effects of increases in oil price on inflation as direct and indirect. Direct effects pass through to consumer price and its effects are prompt. The indirect effect pass through rising production cost of non-energy goods and services and their effects are delayed and can be influenced by monetary policy. Moreover these shocks can cause higher inflation expectations which may lead to second-
round effects which are higher wages demand creating a sustained spiral of high
cost and prices.

A study by Maturu et al. (2006) found the degree of price rigidity in Kenya high
at 0.7 to 0.8 implying fixed prices for as long as 3 to 5 months. Rigidities in prices
and wages leads to increases in production cost due to supply-driven oil price
shock and presence of non-linearities in the product and labor markets. As a result
inflation raises prompting central banks to raise their policy rates which place
additional downward pressure on growth (Cashin et al, 2012).

Many factors have contributed to changes in oil prices ranging from instability in
oil producing countries to relentless growth of economies such as China and
India. The underlying consequences of oil price increases are always different
depending on the source of oil price shift. Supply driven oil price increases have
adverse effects to the economy compared to demand driven oil price increases.

Studying periods of distinguished oil price increases in Euro area and USA.
Peersman and Van (2009) found both central banks increased their interest rates
in year 1999-2000 by approximately 200 basis points with Europe central Bank
(ECB) keeping the interest rate constant in year 2003-2005 and USA increasing
its rate by 2.5 percent. In year 2007-2008, the Federal bank (FED) lowered their
interest rate while the ECB slightly tightened monetary policy. From these
reactions, it’s clear that central banks have reacted differently in different oil
episodes and also different banks reacted differently within the same episodes.
The different timing and pass through effect in different countries determine the reaction policy adopted by the central bank in that country.

2.4 Monetary Policy Reactions

Bernanke et al. (1997) implicitly take the stand that exogenous oil price shocks are inherently adverse aggregate supply shocks that are both recessionary and inflationary. They argue that the recessionary impact in the absence of a monetary policy reaction is weak, but that the potential inflationary impact can be substantial, owing to wage price setting dynamics. By combating the inflationary pressure, the central bank causes recession. This argument has been supported by the fact that conventional explanation have failed to explain the link between oil price shocks and the 1974–1975 recessions and 1982. Unless existence of wage price spiral is evidenced, Bernanke et al. (1997) rationale on monetary policy reaction is weak and oil price shocks will not be expected to cause inflation. Recent literatures have violated this argument but supporting the fact that oil price shocks do not operate in isolation. Among the studies are Nakov and Pescatori (2010) who discourage welfare maximizing central banks from reacting to innovations in oil price shocks. Kilian (2008) observes that policy-makers should respond not to the price of oil, but directly to the underlying demand and supply shocks that drive the real price of oil along with other macroeconomic variables.
Rotich et al. (2007) have affirmed that the Central bank of Kenya react to Inflation, GDP growth and exchange rate in a consistent and predictable fashion. This is in line with Taylor’s preposition of having a predictable rule-based policy. Since economic agents (households and firms) are forward looking and their supply or demand depends on future expectations which also depends on today’s conditions, there is need for continuous optimizing process. The aggregate demand shocks can be amplified by increased precautionary savings and increased cost of operating durables that use energy (Edelstein and Kilian, 2009).

Empirical evidence suggests that the supply channel of transmission is weak and that the demand channel of transmission dominates in practice (Kilian, 2008). Considering these two factors, one expects oil price shock occurring in isolation to be recessionary and deflationary with no reason for monetary policy authority to raise interest rates. If both the aggregate demand and the aggregate supply curves shift to the left, as seems plausible, the net effect on the domestic price level is likely to be small, so there is little need for central bankers to intervene.

2.5 Overview of Literature

From the literature review, the impact of oil price increases to the economy and channels via which it affects the economy is outlined. It’s clear that these price increases are exogenous shocks which the central bank has no control over, particularly if the country is a net-oil importer. Since the only prompt effects are the direct effects, indirect effects can be countered while second round effects can
be avoided all together. For this to happen, the central bank has to be forward looking and have policies which can mitigate the effects.

It’s worth noting that in the 1970s, the effects of oil price increases were severe than late 1990s and early 2000s. Oil prices pass through to inflation which the central bank targets in its policies. However the rules have not responded as the authority would wish leading to a spiral of economic instabilities. Since the monetary policy authority cannot prevent oil price shocks from harming the economy, the best that can be done is to mitigate the loss. Monetary policy reaction function has been estimated earlier on (Rotich et al, 2007) but did not take oil price shocks into account. This study took into account the shocks to bridge the gap owing to the fact that the economic instabilities arising out of oil price shocks could not be ignored.
CHAPTER THREE

METHODOLOGY

3.1 Introduction

This chapter provides the research design and techniques used in investigating the monetary policy reaction to shocks originating from changes in oil prices in Kenya. The study adopted a forward looking approach as evidenced in Clarida et al. (2000) and Rotich et al. (2007).

3.2 Research Design

The aim of the study was to investigate the responsiveness of monetary policy in the fact of oil price changes in the Kenyan economy. Non experimental research design was adopted where quantitative data was used to achieve objectives set in chapter one. To achieve reliable results, time series data was used ranging from 1970 to 2012. The study used secondary data on GDP, inflation, interest rate and global oil prices.

3.3 Theoretical Model

Following new Keynesian dynamic stochastic general equilibrium (DSGE) model as presented by Erceg et al. (2000) firms are monopolistic competitors who produce goods using the following constant returns technology.

\[ Y_i(i) = F(A_i, K_i, N_i(i)) = A_i K_i^a N_i(i)^{1-a} \]  

(3.1)
Where $A_t$ is Solow residual, $K_t$ is capital stock which is predetermined in period $t$.

$N_t$ is labour and $a < 1$.

The optimal capital and labor requirements are given by:

$$ r = mc_t \partial F_t(i) / \partial K_t $$

(3.2)

$$ w_t = mc_t \partial F_t(i) / \partial N_t(i) $$

(3.3)

Where $r$ denotes interest rate for the borrowed capital while $w_t$ denotes real wage.

It is assumed that all output is either consumed or invested.

The price level is given as

$$ P_t = \left[ (1 - \theta)P_t^{1-\theta} + \theta P_t^{1-\theta} \right]^{1-\theta} $$

(3.4)

Where $P_t$ is the optimal price that any individual in the economy would set if in charge of price setting.

3.3.1. Monetary Authority Money Aggregate Target

The real money demand at level $m_t$ is given as:

$$ m_t = \chi_s y_t - \chi_y R_t + u_t $$

(3.5)

Assuming flexible prices, targeted change on real money balance will be given by

$$ \Delta m_t^* = \chi_s \Delta y_t^* - \chi_y \Delta R_t^* + \Delta u_t $$

(3.6)

Adding targeted inflation to equation (3.6) gives nominal money growth rate given as:

$$ \Delta M_i^* = \Delta m_t^* + \pi^* $$

(3.7)
Forward looking monetary policy should accommodate expected misses in targeted inflation and output. The money target should thus be:

\[
\Delta M_t' = \Delta M_t^* + \beta (E(\pi_{t+1}) - \pi^*) + y_{gap}
\]

(3.8)

Where \( \Delta M_t^* \) is the long run equilibrium change in the nominal monetary base.

\( \pi_{t+1} \) is the rate of inflation in period \( t+1 \).

\( y_{gap} \) is output gap given as \( y_{t+m} - y_t^* \) and \( y_t^* \) is potential output estimated as trend from real output \( y_t^* = \hat{\alpha}_0 + \hat{\alpha}_1 Trend \).

\( \pi^* \) and \( y^* \) are the targets for inflation and output respectively.

3.4 **Empirical Model and Estimation Technique**

Adding available information at the time of policy making; target monetary aggregate becomes:

\[
\Delta M_t' = \Delta M_t^* + \beta \left( E[\pi_{t+n} | \Omega_t] - \pi^* \right) + \gamma \left( E[y_{t+m} | \Omega_t] - y_t^* \right)
\]

(3.9)

Where \( \pi_{t+n} \) is the rate of inflation in period \( t+n \).

\( y_{t+m} \) is real output and \( y_{t+m}^* \) is potential real output at period \( t+m \).

\( \Omega \) is the information available to the policy maker.

The above equation assumes that the monetary authority has perfect control over monetary base which is not the case due to exogenous factors such as external
shocks (for example oil price shocks, global financial crises among others). To relax the assumption, the relationship is specified as:

$$\Delta M_t = \rho(L)\Delta M_{t-1} + (1 - \rho) \Delta M_{t-1}^I + \nu O_t$$

(3.10)

Where $$\rho(L) = \rho_1 + \rho_2 L + ... + \rho_n L^{n-1}$$ and $$\rho \in [0,1]$$ captures the degree of oil price shock smoothing. $$O_t$$ is exogenous oil price shock assumed to be independent and identically distributed (i.i.d.).

Oil price shock is measured as net oil price increase (NOPI) as developed by Hamilton (2003).

$$\Delta s_t^{\text{NOPI}} = \max[0, s_t - s_t^*]$$

(3.11)

Where $$s_t$$ is nominal price of oil in logs and $$s_t^*$$ is the highest oil price in the preceding three years.

Let $$\alpha = \Delta M_t^* - \beta \pi^*$$ and $$x_t = y_t - y^*$$ then combining equation (3.9) to equation (3.10) yields the policy reaction function

$$\Delta M_t = (1 - \rho) \alpha + (1 - \rho) \beta \pi_{t+m} + (1 - \rho) x_{t+m} + \rho(L)\Delta M_{t-1} + \nu O_t + \epsilon_t$$

(3.12)

Where the error term $$\epsilon_t$$ is a linear combination of the forecast errors of inflation, output and the exogenous disturbance oil price shock.
Equation (3.12) was estimated for Kenya using the Generalized Method of Moments (GMM) with optimal weighing matrix. J-Statistic was used to test over-identification restriction in the GMM estimation.

To meet objective two, Vector Autoregressive (VAR) analysis was used. VAR analysis entails estimating regression equations in which the current value of each variable is expressed as a function of lagged values of itself and of each of the selected variables. No variable is assumed to be exogenous a priori and no variable is excluded from the autoregressive equation for any of the variables in the system. Impulse response analysis links the current value of the error term to the future values of $\Delta M_i$, or equivalently, the current and past values of the error term to the current values of $\Delta M_i$.

The equation is given as:

$$y_{i,n} = \sum_{i=0}^{\infty} \psi_i e_{i,n-i}$$  \hspace{1cm} (3.13)

Where $\{\psi_i\}_{i \geq 1} = \frac{\partial y_{i,j+n}}{\partial e_{j}}$

The response of $y_{i,j+n}$ to a one-time impulse in $y_{i,j}$ with all other variables dated $t$ or earlier held constant.

Variance decomposition separates the variations in an endogenous variable into the component shocks to the VAR. This variance decomposition provides
information about the relative importance of each random innovation in affecting the variables in the VAR.

3.4.1 Definition and Measurement of Variables

In the models, the variables used are $M_t, \pi, y$, and $\nu_t$ where $M_t$ is monetary base at time $t$ (generally M3). $\pi$ is inflation measured as change in consumer price index, $y$ is output measured as real GDP and $\nu_t$ is exogenous oil price shocks estimated by equation (3.11). Monetary base, inflation and oil price shock was estimates in their log form. The data was applied on annual basis from 1970 to 2012.

3.4.2 Data Type and Sources

The study made use of published data for the period ranging from 1970 to 2012. The main sources of these data included: World Bank, Kenya National Bureau of Statistics publications, Central bank of Kenya, and USA Department of Energy.

3.4.3 Diagnostic Tests

Before analysing data, Augmented Dickey Fuller (ADF) tests was used to test for stationarity of the data. This was to ensure that time series properties were not violated. After estimation of the model, all the relevant diagnostic tests to ascertain the econometric validity of the estimated model were carried out.
3.4.4 Data Analysis

The study achieved the two objectives as stipulated in chapter one. To achieve the first objective, collected data was analyzed as stipulated in section 3.4. Generalized Method of Moments (GMM) with optimal weighting matrix was conducted using Eviews computer programme (version 3.1). To achieve the second objective, VAR analysis was employed where impulse response and variance decomposition were interpreted.
CHAPTER FOUR

EMPERICAL RESULTS AND INTERPPRETATION

4.0 Introduction

This chapter presents the empirical results of collected data based on the empirical model developed in the previous chapter. The time series properties were investigated before running the regression and thereafter diagnostic test were carried to establish the validity of the model.

4.1 Unit Root Test Results

Non stationary time series data used for analysis might give spurious results because estimates obtained from such data will possess non constant mean and variance. For the reason that this study used time series data, it was important to establish the stationary of the data. In this regard Augmented Dickey Fuller (ADF) was used to test for unit roots. The unit roots results of the variable in the model are reported in table 4.1.
Table 4.1. Stationarity Results

<table>
<thead>
<tr>
<th>Series</th>
<th>K</th>
<th>Constant</th>
<th>Critical value</th>
<th>Constant and trend</th>
<th>Critical value</th>
<th>Conclusion</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\Delta M_t$</td>
<td>1</td>
<td>-1.002474</td>
<td>1% -3.5973 5% -2.9339 10% -2.6048</td>
<td>-3.823428</td>
<td>1% -4.1958 5% -3.5217 10% -3.1914</td>
<td>Stationary</td>
</tr>
<tr>
<td>$\pi$</td>
<td>1</td>
<td>-4.385996</td>
<td>1% -3.5973 5% -2.9339 10% -2.6048</td>
<td>-4.409406</td>
<td>1% -4.1958 5% -3.5217 10% -3.1914</td>
<td>Stationary</td>
</tr>
<tr>
<td>$X$</td>
<td>1</td>
<td>-2.971126</td>
<td>1% -3.5973 5% -2.9339 10% -2.6048</td>
<td>-3.009578</td>
<td>1% -4.1958 5% -3.5217 10% -3.1914</td>
<td>Stationary</td>
</tr>
<tr>
<td>$O$</td>
<td>1</td>
<td>-4.349743</td>
<td>1% -3.5973 5% -2.9339 10% -2.6048</td>
<td>-4.60483</td>
<td>1% -4.1958 5% -3.5217 10% -3.1914</td>
<td>Stationary</td>
</tr>
<tr>
<td>$\Delta M_{t-1}$</td>
<td>1</td>
<td>-0.665991</td>
<td>1% -3.5973 5% -2.9339 10% -2.6048</td>
<td>-3.915289</td>
<td>1% -4.1958 5% -3.5217 10% -3.1914</td>
<td>Stationary</td>
</tr>
</tbody>
</table>

K is lag value

*Source: Estimated from the study data*

Table 4.1 shows the results after testing for stationarity condition using Augmented Dickey Fuller test. The data on monetary aggregate and its lag, inflation, output gap and oil price shock were all stationery.

### 4.2 Lag Selection Criteria

Akaike information criteria was used to determine the lag length shown in table 4.2.
Table 4.2. AIC values

<table>
<thead>
<tr>
<th>Lag length</th>
<th>AIC value</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.680002**</td>
</tr>
<tr>
<td>2</td>
<td>0.680744</td>
</tr>
<tr>
<td>3</td>
<td>0.830138</td>
</tr>
<tr>
<td>4</td>
<td>0.923887</td>
</tr>
</tbody>
</table>

_Source: Estimated from the study data_

Table 4.2 shows the results of Akaike Information criteria test. The model adopted a lag length of one as it had the lowest value in the test.

\[
\Delta M_t = (1 - \rho) \alpha + (1 - \rho) \beta \pi_{t+n} + (1 - \rho) \pi_{t+m} + \rho (L) \Delta M_{t-1} + \nu \delta_t + \varepsilon_t
\]  

(4.1)

The model equation above was estimated the period from 1970 to 2012 using GMM with oil price shock, inflation, GDP gap, 2 and 3 lags of monetary base, and 2 lags of GDP gap as instruments. The lag period was limited to 2 and 3 to minimize serial correlation and maintain the strength of the instrument.

Table 4.3 Estimation results with money base as the dependent variable.

<table>
<thead>
<tr>
<th>Independent variables</th>
<th>Coefficient</th>
<th>Std. Error</th>
<th>t-Statistic</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lag monetary base (Log)</td>
<td>0.906006</td>
<td>0.048888</td>
<td>18.53220</td>
<td>0.0000</td>
</tr>
<tr>
<td>Constant ((\alpha))</td>
<td>4.321861</td>
<td>2.471094</td>
<td>1.748967</td>
<td>0.0888</td>
</tr>
<tr>
<td>Inflation (Log)</td>
<td>-1.526443</td>
<td>1.762841</td>
<td>-0.865900</td>
<td>0.3923</td>
</tr>
<tr>
<td>GDP gap</td>
<td>0.894926</td>
<td>0.541111</td>
<td>1.653868</td>
<td>0.1068</td>
</tr>
<tr>
<td>Oil price shock (Log)</td>
<td>-2.006405</td>
<td>0.352905</td>
<td>-5.685404</td>
<td>0.0000</td>
</tr>
<tr>
<td>R-squared</td>
<td>0.821594</td>
<td>Mean dependent var</td>
<td>1.019613</td>
<td></td>
</tr>
<tr>
<td>Adjusted R-squared</td>
<td>0.801771</td>
<td>S.D. dependent var</td>
<td>0.871257</td>
<td></td>
</tr>
<tr>
<td>S.E. of regression</td>
<td>0.387909</td>
<td>Sum squared resid</td>
<td>5.417051</td>
<td></td>
</tr>
<tr>
<td>Durbin-Watson stat</td>
<td>2.650527</td>
<td>J-statistic</td>
<td>0.008821</td>
<td></td>
</tr>
</tbody>
</table>

_Source: Estimated from the study data_

36
4.3 Diagnostic Tests

The regression had a correlation coefficient ($R^2$) of 0.82 and an adjusted $R^2$ of 0.80 as shown in table 4.3. This meant that inflation, GDP gap and previous period monetary base and oil price shock explain 80 percent of the variations in monetary base. The over-identification of the model was tested using J-statistics and the null hypothesis stating that the model is valid was accepted at 5 percent significance level by the fact that the J statistic value ($0.008821 \times 41 = 0.361661$) is less than the critical value (9.49). Durbin Watson test was used to test for autocorrelation and it is evident there is no autocorrelation since $d > d_{1-0.05}$ and $d_{1-0.05} < (4 - d) < d_{0.05}$ where $d_{1-0.05}$ is 1.29584 and $d_{0.05}$ is 1.72048.

4.4 Results and Interpretations

The coefficient that captures policy inertia was fairly high at 0.91 which is statistically significant with a standard error of 0.05, an indication that monetary policy adjusts the monetary base M3 smoothly. The results show a very slow speed of adjustment of 0.09 percent of the desired short term interest rate per annum. Policy inertia produces interest rates that are less volatile. Smoothing at times reflects various institutional rigidities such as a fixed monthly meeting schedule and perhaps certain sociological and political influences. Goodhart (1999) suggested that large interest rate changes may be taken as adverse signal of inconsistency and incompetence. Also smoothing helps the central bank to manage expectations particularly when the policy is forward looking. Bernanke
(2004) argued that since policymakers cannot be sure about the underlying structure of the economy or the effects that their actions will have on economic outcomes, and because new information about the economic situation arrives continually, the case for policymakers to move slowly and cautiously when changing rates seems intuitive. The estimated result in this study yielded an equivalent adjusting coefficient to that obtained by Rotich et al. (2007).

The estimated coefficient of oil price shock was -2.006. This means that a 2 percent increase in oil price shock will force the monetary authority to decrease the desired change in monetary aggregate by 1 percent in order to retain inflation at the desired level. This is statistically significant. Economic theory states that increase in factors of production such as oil leads to increased prices if the increase is passed to the consumer. Monetary authority on the other hand applies contractionary measures to reduce the inflation by reducing money supply. In the study model, this is achieved by reducing the change in monetary aggregates.

Hooker (1999) inferred that oil prices were operating indirectly on GDP through monetary policy. This was as a result of fighting the core inflation which was affected by the increase in the oil prices. His inference concurs with the findings on this study.

Estimate of the coefficient on inflation was -1.53 implying that whenever monetary authority increased the change in monetary aggregate by 1 percent inflation gap fell by 1.53 percent. The relationship between the two is similar to
that reported by Rotich et al (2007). However, the coefficient is not statistically significant which is not surprising considering several researches which have doubted the ability of monetary aggregates in estimation and forecasting inflation. Among them is Lucas (2006) who asserted that money supply measure plays no role in estimation, testing, or policy simulation of New Keynesian models. Lucas (2006) added that the role for money in the long run is sometimes verbally acknowledged, but the models themselves are formulated in terms of deviations from trends that are themselves determined somewhere off stage. GDP gap increases by 0.89 units whenever monetary authority increases the money aggregate change by 1 percent to fight inflation. The coefficients are statistically significant as reduced money supply means reduced investments as well as consumption in household level.

4.5 Impact Analysis

Figure 4.1 presents the impulse response graphs that document the impact of a one off oil price shock on monetary base, GDP gap and inflation.
Figure 4.1 Impulse Response to one S. D. Innovation with a standard error of ± 2.

Source: Estimated from the study data

From figure 4.1, at 95% confidence levels, Inflation changed positively by 0.06, peaking in the first year and diminished in the second year to reach trough before vanishing completely by the third year. Within the same time, monetary policy
authority activities can be traced through monetary base changes where it reduced leisurely until the end of the period where it raised after inflation started falling. From the response, it took the authority three periods to clear the impact caused by oil price shock with mixed results from inflation to deflation before stabilizing.

From the results, persistent oil price shocks would throw the economy to dismay like one experienced in year 2011 and early 2012.

The GDP gap changed positively to 0.02 by the third year and decreased to 0.0 by the sixth year after oil shock. This is in line with Rotemberg and Woodford (1996) statement that a 10 percent increase in oil price will affect the GDP growth by less than 0.5 percent. It’s worth noting that the gap increased from the time of the shock and started decreasing by the fourth period the same time inflation was stabilized. It took two periods extra to stabilize the output gap. This concurs with (Dolan, 2011) where monetary authority can decide how oil price shock affects the economy.

Table 4.4 reports the variance decomposition of the VAR variables covering 12 periods. Figures in column three to six are expressed in percentage.
Table 4.4. Variance decomposition results

<table>
<thead>
<tr>
<th>Variable affected by innovation</th>
<th>Period</th>
<th>Monetary base</th>
<th>Inflation</th>
<th>GDP gap</th>
<th>Oil price shock</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monetary base</td>
<td>1</td>
<td>100.0000</td>
<td>0.000000</td>
<td>0.000000</td>
<td>0.000000</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>87.83779</td>
<td>1.177484</td>
<td>1.556742</td>
<td>9.427981</td>
</tr>
<tr>
<td></td>
<td>8</td>
<td>83.73481</td>
<td>1.468879</td>
<td>3.144767</td>
<td>11.65154</td>
</tr>
<tr>
<td></td>
<td>12</td>
<td>82.30070</td>
<td>1.248264</td>
<td>4.990490</td>
<td>11.46055</td>
</tr>
<tr>
<td>Inflation</td>
<td>1</td>
<td>0.002240</td>
<td>99.99776</td>
<td>0.000000</td>
<td>0.000000</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>4.134087</td>
<td>80.00292</td>
<td>9.158856</td>
<td>6.704141</td>
</tr>
<tr>
<td></td>
<td>8</td>
<td>5.028661</td>
<td>75.60483</td>
<td>13.01179</td>
<td>6.354717</td>
</tr>
<tr>
<td></td>
<td>12</td>
<td>5.325587</td>
<td>74.18202</td>
<td>13.98520</td>
<td>6.507189</td>
</tr>
<tr>
<td>GDP gap</td>
<td>1</td>
<td>0.159894</td>
<td>0.378083</td>
<td>99.46202</td>
<td>0.000000</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>1.989186</td>
<td>1.517106</td>
<td>95.43140</td>
<td>1.062308</td>
</tr>
<tr>
<td></td>
<td>8</td>
<td>2.454700</td>
<td>3.643636</td>
<td>92.43928</td>
<td>1.462383</td>
</tr>
<tr>
<td></td>
<td>12</td>
<td>2.568293</td>
<td>4.133469</td>
<td>91.22049</td>
<td>2.077744</td>
</tr>
</tbody>
</table>

Source: Estimated from the study data

From table 4.4, oil price shock affects the inflation by about 6.5 percent. This is in agreement with Kiptui (2009) who found a significant pass-through of oil prices to inflation in Kenya. Internationally, De Gregorio et al. (2007) using cointegrated VAR model for G7 countries found that except for Japan and United Kingdom, oil price increases affected inflation in the rest of the countries. From the table, the monetary authority responds with their response greatly attributing to the oil price shock to a tune of 11 percent.

The monetary authority response affects the GDP gap by about 2 percent by the fourth period. These results simulate with Hooker’s (1999-2000) examination of oil price-GDP relationship. The study asserts that oil price shock affects the core inflation and the monetary policy authority affects the GDP as they control the inflation. It’s important to note that the monetary authority response affects the
GDP gap from the first period unlike the oil price shock which does not affect the variables in the first period. Also the effects of monetary authority response to GDP gap are higher than those of oil price shock and vice versa to inflation.

This concurs with Bernanke et al. (1997) and Bernanke, Gertler, and Watson (2004) suggestions that monetary policy makers lean towards controlling inflation at an expense of GDP growth.
CHAPTER FIVE

SUMMARY, CONCLUSIONS AND POLICY IMPLICATIONS

5.1 Introduction

This chapter summarizes the study findings and makes the necessary conclusions. The policy implications from the findings and areas for further research are also proposed.

5.2 Summary

The objectives of this study were to estimate Kenya's monetary policy reaction function in the presence of oil price shocks and to measure the impact of oil price shock on inflation and output in Kenya. This was done in chapter four and as noted that monetary authorities adjust monetary base smoothly with policy inertia of 0.91.

An increase in oil price shock by 2 percent leads to monetary authority decreasing monetary base by 1 percent to reduce the inflation which increased by 1.5 percent. From the study's variance decomposition results, the monetary policy reaction attributes to the oil price shock to a tune of 11 percent. The increase in core inflation is due to increased cost of factors of production in our case oil prices which serves as a source of energy for production. From variance decomposition oil price shock contributes to the inflation variance by about 6.5 percent.
During this time firms engage in resource reallocation by declining energy use through production function directly reducing output and labor’s marginal product. This fall reduces the wage and labor supplied as many laborers choose leisure over work. If this effect persists, it affects the future capital marginal product causing the firms to cut down their investments. From our study results this reduced investment leads to reduction in output gap worth 0.89 billion. Also affecting the output gap is the monetary policy with its effects being about 2 percent by the fourth period.

5.3 Conclusion

From this study monetary policy reaction greatly affect the way economic variables behave whenever there is an oil price shock. This is in line with Cashin et al (2012) where oil price shock in the presence of non-linearities in the product and labor markets with rigidities in price and wages, increases production costs and as a result inflation raises. According to Hooker (1999) countries with highly flexible domestic oil prices have been able to maintain low and stable inflation rates despite wide fluctuations in oil prices in international markets this is as a results to the fact that monetary policy has become less accommodative of oil price shocks.

Finn’s (2000) depicted that oil price shock causes sharp, simultaneous decreases in energy use and capital usage. This decline in energy use work through the firm’s production function reducing output and labor’s marginal product which
reduce wage and labor supply. A permanent reduction of the same leads to reduced future capital investment.

Inflation prompts central banks to raise their policy rates which place additional downward pressure on growth. The study has demonstrated the cycle of events in case of oil price shock with the monetary authority being the key determinants of how the economy will be affected. Following Mork (1989) who stated that effects of fluctuating oil prices can offset each other, monetary authority should not exert stringent contractionary measures but should consider the source of shock as argued by Nakov and Pescatori (2010) who discourage welfare maximizing central banks from reacting to innovations in oil price shocks.

Davis and Haltiwanger (2001) found that both oil-price and monetary shocks were the use of reduced labor demand in all industrial sectors. However the magnitude of oil price shocks effects were higher than those of monetary policy. Firms are able to change the wage rate only by reducing employment, so as to take advantage of the no-shirking condition that links wages and unemployment in the efficiency wage model.

Bernanke et al. (1997) further argues that exogenous oil price shocks are inherently adverse aggregate supply shocks whose impact in the absence of a monetary policy reaction is weak. Monetary authority should also heed Kilian (2008) advice that policy-makers should respond not to the price of oil, but directly to the underlying demand and supply shocks that drive the real price of
5.4 Policy Recommendations

In the light of the research findings, Kenyan economy suffers whenever there is oil price shock due to magnification of the effects by the monetary authority activities. This effect can be reduced by working on the underlying forces which increase the inflationary pressure without necessarily trying to reduce the pressure by employing very tight policies. The binding constriction is not on output, but rather the impact on inflation, i.e. the Philips curve.

To safeguard the economy from fluctuating oil price, storage facilities can be used for speculation demand of oil in the country where the stored oil act to cushion the economy from such shocks originating due to low supply of oil globally. This is in line with research carried out by Kilian and Murphy (2010) and Alquist and Kilian (2010) where oil speculative storage mitigates the negative impact caused by oil shortage and convert the oil variable to be durable in the model.

The monetary authority should seek to manage expectations efficiently in order to improve the flexible price equilibrium. For this to apply, the authority has to be credible and transparent as advised by Natal (2009). The banks and financial agents should have the right model of the economy. This is possible considering that the Central Bank of Kenya which has the mandate of monetary policy is the
supervisor of all commercial banks in Kenya who operate under the same platform of Kenya Bankers Association.

Kenya should encourage foreign direct investments to reduce the effect of wealth transfer as oil exporters would invest part of the sale proceeds in the economy. This encourages wealth recycling where most of it will be left within. This will reduce the pressure asserted on exchange rate and capital outflows.

Oil price shock set to reduce output significantly can be offset by choosing to loosen monetary policy. Segal (2011). Monetary authority tends to fear inflation due to the second round effect. However other countries have shown the disappearance of such effects since 1980s.

5.5 Areas for Further Research

As discussed in section 4.4, the correlation between monetary aggregates and inflation remains unresolved in macroeconomic theory, the study recommends further study on appropriateness of monetary aggregates on inflation forecasting in Kenya. Also since the study has assumed perfect information, further research using imperfect information and inflexible prices is recommended.
REFERENCES


<table>
<thead>
<tr>
<th>Year</th>
<th>Change in broad monetary base (Log)</th>
<th>Inflation (Log)</th>
<th>GDP gap in billions</th>
<th>Oil price shock (Log)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1970</td>
<td>-0.12042</td>
<td>0.34</td>
<td>0.037162</td>
<td>0.00</td>
</tr>
<tr>
<td>1971</td>
<td>-0.57831</td>
<td>0.58</td>
<td>0.324009</td>
<td>0.07</td>
</tr>
<tr>
<td>1972</td>
<td>-0.27927</td>
<td>0.77</td>
<td>0.580867</td>
<td>0.06</td>
</tr>
<tr>
<td>1973</td>
<td>0.025674</td>
<td>0.97</td>
<td>0.525757</td>
<td>0.11</td>
</tr>
<tr>
<td>1974</td>
<td>-1.00829</td>
<td>1.25</td>
<td>0.412749</td>
<td>0.60</td>
</tr>
<tr>
<td>1975</td>
<td>0.042363</td>
<td>1.28</td>
<td>0.17431</td>
<td>0.05</td>
</tr>
<tr>
<td>1976</td>
<td>0.213879</td>
<td>1.06</td>
<td>-0.00998</td>
<td>0.00</td>
</tr>
<tr>
<td>1977</td>
<td>0.602748</td>
<td>1.17</td>
<td>0.10877</td>
<td>0.02</td>
</tr>
<tr>
<td>1978</td>
<td>0.291311</td>
<td>1.23</td>
<td>0.145458</td>
<td>0.00</td>
</tr>
<tr>
<td>1979</td>
<td>0.268491</td>
<td>0.90</td>
<td>0.240433</td>
<td>0.17</td>
</tr>
<tr>
<td>1980</td>
<td>-0.90201</td>
<td>1.14</td>
<td>0.257452</td>
<td>0.20</td>
</tr>
<tr>
<td>1981</td>
<td>0.330458</td>
<td>1.06</td>
<td>0.196448</td>
<td>0.04</td>
</tr>
<tr>
<td>1982</td>
<td>0.490446</td>
<td>1.32</td>
<td>0.007231</td>
<td>0.00</td>
</tr>
<tr>
<td>1983</td>
<td>0.023705</td>
<td>1.06</td>
<td>-0.1888</td>
<td>0.00</td>
</tr>
<tr>
<td>1984</td>
<td>0.45749</td>
<td>1.01</td>
<td>-0.35527</td>
<td>0.00</td>
</tr>
<tr>
<td>1985</td>
<td>0.205524</td>
<td>1.11</td>
<td>-0.373</td>
<td>0.00</td>
</tr>
<tr>
<td>1986</td>
<td>0.944261</td>
<td>0.40</td>
<td>-0.19756</td>
<td>0.00</td>
</tr>
<tr>
<td>1987</td>
<td>0.599097</td>
<td>0.94</td>
<td>-0.0768</td>
<td>0.00</td>
</tr>
<tr>
<td>1988</td>
<td>0.503641</td>
<td>1.09</td>
<td>0.089017</td>
<td>0.00</td>
</tr>
<tr>
<td>1989</td>
<td>0.743298</td>
<td>1.14</td>
<td>0.170091</td>
<td>0.01</td>
</tr>
<tr>
<td>1990</td>
<td>0.987054</td>
<td>1.25</td>
<td>0.224274</td>
<td>0.10</td>
</tr>
<tr>
<td>1991</td>
<td>1.055822</td>
<td>1.30</td>
<td>0.071388</td>
<td>0.00</td>
</tr>
<tr>
<td>1992</td>
<td>1.433105</td>
<td>1.44</td>
<td>-0.26787</td>
<td>0.00</td>
</tr>
<tr>
<td>1993</td>
<td>1.432564</td>
<td>1.66</td>
<td>-0.51027</td>
<td>0.00</td>
</tr>
<tr>
<td>1994</td>
<td>1.457276</td>
<td>1.46</td>
<td>-0.56419</td>
<td>0.00</td>
</tr>
<tr>
<td>1995</td>
<td>1.645147</td>
<td>0.19</td>
<td>-0.4645</td>
<td>0.00</td>
</tr>
<tr>
<td>1996</td>
<td>1.69688</td>
<td>0.95</td>
<td>-0.36986</td>
<td>0.08</td>
</tr>
<tr>
<td>1997</td>
<td>1.69661</td>
<td>1.06</td>
<td>-0.59803</td>
<td>0.00</td>
</tr>
<tr>
<td>1998</td>
<td>0.938269</td>
<td>0.83</td>
<td>-0.56517</td>
<td>0.00</td>
</tr>
<tr>
<td>1999</td>
<td>1.295897</td>
<td>0.76</td>
<td>-0.61727</td>
<td>0.00</td>
</tr>
<tr>
<td>2000</td>
<td>1.201998</td>
<td>1.00</td>
<td>-0.83017</td>
<td>0.17</td>
</tr>
<tr>
<td>2001</td>
<td>1.283211</td>
<td>0.76</td>
<td>-0.73065</td>
<td>0.00</td>
</tr>
<tr>
<td>2002</td>
<td>1.550888</td>
<td>0.29</td>
<td>-0.94642</td>
<td>0.00</td>
</tr>
<tr>
<td>Year</td>
<td>Value</td>
<td>Growth</td>
<td>Change</td>
<td>Rate</td>
</tr>
<tr>
<td>------</td>
<td>--------</td>
<td>--------</td>
<td>--------</td>
<td>------</td>
</tr>
<tr>
<td>2003</td>
<td>1.668106</td>
<td>0.99</td>
<td>-0.91792</td>
<td>0.01</td>
</tr>
<tr>
<td>2004</td>
<td>1.77451</td>
<td>1.07</td>
<td>-0.65087</td>
<td>0.13</td>
</tr>
<tr>
<td>2005</td>
<td>1.695972</td>
<td>1.01</td>
<td>-0.2676</td>
<td>0.13</td>
</tr>
<tr>
<td>2006</td>
<td>1.970733</td>
<td>1.16</td>
<td>0.204524</td>
<td>0.07</td>
</tr>
<tr>
<td>2007</td>
<td>2.119206</td>
<td>0.99</td>
<td>0.806527</td>
<td>0.04</td>
</tr>
<tr>
<td>2008</td>
<td>2.081491</td>
<td>1.42</td>
<td>0.738863</td>
<td>0.14</td>
</tr>
<tr>
<td>2009</td>
<td>2.16891</td>
<td>0.97</td>
<td>0.83805</td>
<td>0.00</td>
</tr>
<tr>
<td>2010</td>
<td>2.368231</td>
<td>0.60</td>
<td>1.369662</td>
<td>0.00</td>
</tr>
<tr>
<td>2011</td>
<td>2.388598</td>
<td>1.15</td>
<td>1.743051</td>
<td>0.00</td>
</tr>
<tr>
<td>2012</td>
<td>2.340837</td>
<td>1.04</td>
<td>0.2361</td>
<td>0.00</td>
</tr>
</tbody>
</table>

*Source: World bank.*