ANALYSIS OF INTERNATIONAL OIL PRICE PASS-THROUGH TO INFLATION AND ITS TRANSMISSION CHANNELS IN MALAWI

MASTER OF ARTS (ECONOMICS) THESIS

By

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DECLARATION

I, the undersigned, hereby declare that this dissertation is my own original work which has not been submitted to any other University for similar purposes. Where other people's work has been used, acknowledgements have been made.

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Date

CERTIFICATE OF APPROVAL

The undersigned certify that this thesis represents the student's own work and effort and has been submitted with our approval.

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DEDICATION

To my mum, Avrell Maggie Chirwa. You are simply the best.

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Firstly, I give all the praise, honour and glory to God for making all things possible.

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ABSTRACT

Rising oil prices have adverse effects especially to a non-oil producing economy such as Malawi. However, fuel prices in Malawi are relatively stable which implies that they do not give a true reflection of the volatility of oil prices on the international market. This study therefore investigated the pass-through of international oil price shocks to inflation and its transmission channels in Malawi. Within the environment of Vector Autoregression (VAR) modelling, variance decompositions and impulse response functions were analyzed. The study found low and incomplete pass-through of international oil price shocks to domestic inflation. Only 2.5 percent of the variations in inflation are due to oil price shocks and the cumulative pass-through coefficient was found to be 0.296. This gives room to conclude that the automatic pricing mechanism (APM) for fuel prices and the price stabilization policy, exchange rate movements as well as the high content of food in the consumption basket among other factors play a significant role in limiting the level of oil price pass-through to domestic inflation. The study also found the impact of international oil price shocks on urban inflation to be higher than that on rural inflation. Furthermore, the results weakly support the channel that international oil price shocks are passed through to food inflation, transportation inflation then to headline inflation. A significant channel was found to be that international oil price shocks pass-through to domestic fuel prices which are then passed-through to non-food inflation. The study also found that international oil price shocks significantly affect industrial output which is evidence of supply-side cost push inflation.

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LIST OF ABBREVIATIONS AND ACRONYMS

APM	:	Automatic Pricing Mechanism
CPI	:	Consumer Price Index
FOB	:	Free on board
GDP	:	Gross Domestic Product
IBLC	:	In-Bond Landed Cost
IIP	:	Index of Industrial Production
IMF	:	International Monetary Fund
MERA	:	Malawi Energy Regulatory Authority
NOCMA	:	National Oil Company of Malawi
PCC	:	Petroleum Control Commission
PIL	:	Petroleum Importers Limited
PSF	:	Price Stabilization Fund
RBM	:	Reserve Bank of Malawi
TA	:	Targeted Approach
VAR	:	Vector Autoregression

CHAPTER ONE

INTRODUCTION

1.0 Background

Over the past years, oil shocks have been viewed as a source of economic fluctuations especially among industrialized countries. For instance, in the 1970s two episodes of low growth, high unemployment and high inflation that characterized a number of industrialized countries were said to have been caused by rising oil prices (Brown *et al*, 1995). However, some empirical studies such as Blanchard & Gali, (2007) and De Gregorio *et al*., (2007) have revealed that the pass-through rate of oil prices into inflation has declined over the years mainly due to the decline of real wage rigidities, increased credibility of monetary policy and the decrease in the share of oil in consumption.

Oil price pass-through to inflation, as defined by Mandal *et al* (2012), is the rate at which changes in oil prices are reflected in the general level of prices. Oil is not considered as a final product but is regarded as a production input that affects all other economic activities (Chen, 2009). Changes in international oil prices have first round (direct and indirect) and second round effects to an economy. The first-round direct effect is the oil price changes which occur almost immediately and is passed through to the prices of refined oil products such as fuels used by households (Álvarez *et al*, 2011).

The indirect effect is the change in the cost of producing goods and services which use petroleum products as an input and it is passed through to final prices. Second round effects are those effects triggered by revisions of inflation expectations following the first-round effects. The revised expectations may lead to resetting of final prices either directly or indirectly through wage bargaining (Álvarez *et al*, 2011). The first round effects occur in the short to medium term while the second round effects could be more prolonged.

The extent to which changes in international oil prices pass-through to inflation depends on the structure of the economy. This is so because as the economy grows, its production structure is likely to shift towards services, which are not energy intensive activities. Hence, developing country economies are expected to be more vulnerable to oil price shocks than those of the developed countries (Cheng (2005) in Jumah & Pastuszyn, 2007). The adverse impact of higher oil prices is much more diversified among oil-importing countries. The impact depends on the share of oil cost in national income and the energy efficiency as well as substitution possibilities of the economy (Fofana *et al*, 2009).

Rising oil prices affect African economies differently depending on whether they are net exporters or net importers of the commodity (Jumah & Pastuszyn, 2007). For oil-importing economies, high oil prices could translate into high import bills with adverse effects on inflation, production and employment (Bouakez & Vencatachellum, 2007). In contrast, oil-exporting economies could benefit from high oil prices because an increase in oil revenues improves their balance of payment (Bouakez & Vencatachellum, 2007).

Since oil is an intermediate input in the production process, most African governments such as in Tanzania, Ghana, Nigeria, Ethiopia and Malawi have been subsidizing petroleum products to cushion their economies from the effects of negative oil price shocks (Baig *et al.*, 2007). African governments thus face a considerable dilemma in deciding how much of the increase in oil product prices should be passed through to consumers (Bacon & Kojima, 2006). In the case of full pass-through, domestic prices would also be very volatile and uncertain which would have an impact on the performance of the economy. In this regard, changes in international oil prices should be of concern.

Malawi's reliance on imports is relatively high and has been increasing between 2010 and 2015 by more than 5 percent each year (Government of Malawi, 2015). The country's imports in 2015 increased from $102.55 million (MK51236.4 million) in February 2015 to $155.14 million (MK77509.7 million) in March of the same year. Imported petroleum products such as petrol, diesel and paraffin make up a larger percentage of the country's total imports since Malawi has no refineries for petroleum products. For instance in 2014, petrol made up about 7.4 percent while diesel and other fuels made up about 10.2 percent of total imports (Government of Malawi, 2015c).

Malawi imports about 97% of its refined petroleum products; the balance is contributed by locally-produced ethanol which is sold directly to the oil companies for blending with petrol on a maximum 20:80 ratio of ethanol-petrol (Gamula *et al.*, 2013). Petroleum products are imported into the country mainly through three routes namely Dar Corridor, Nacala Corridor and Beira Corridor (Gamula *et al.*, 2013). The internal storage capacity of these refined petroleum products for the country to avert supply disruptions by natural or manmade emergencies is supposed to be 30 days but this is not the case on ground due to a number of economical and logistical challenges (MERA, 2015). This makes the economy vulnerable to external shocks such that any changes in the international oil prices which determine trends in international prices of refined petroleum products are expected to have an impact on the domestic price level.

Currently, domestic prices of petroleum products are determined through the Automatic Pricing Mechanism (APM) system. Under this system, domestic oil prices are set to respond to changes in In-Bond Landed Costs (IBLC) within a $\pm$5 percent threshold (MERA, 2012). IBLC is the base product price plus port changes and the importer's margin and it is usually in local currency (Wright, 1996). The importer's margin covers costs such as harbor dues, financing and storage costs. The IBLC is the appropriate transfer price from the importer to the distributor in the case of products (Wright, 1996).

With the APM in effect, domestic prices of petroleum products do not give a true reflection of prices of these products on the international market. Figure 1 exhibits a relatively stable trend of fuel price build-up as compared to volatile international oil prices. In the period between 2007 and 2012, both domestic fuel prices and the exchange rate were stable due to the fixed exchange rate policy and the suspension of the APM. Domestic fuel prices moved in the same direction as the exchange rate since fuel is imported such that a depreciation of the domestic currency results in higher prices of imported products.

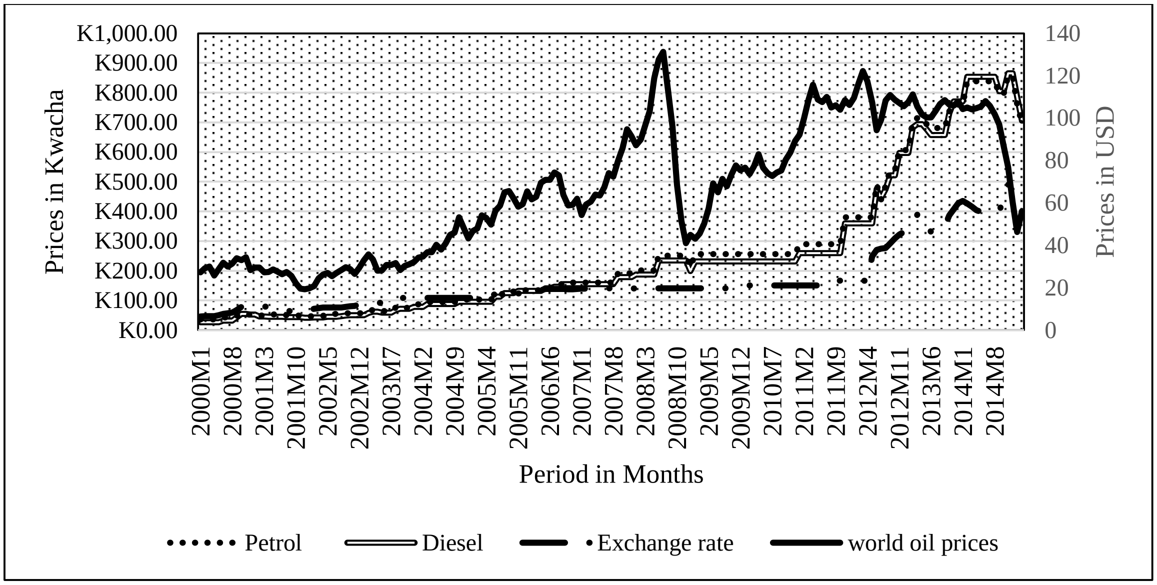

Figure 1 Trends in Fuel Price Build-up and Exchange Rate

Sources: MERA (2015), IMF's International Financial Statistics (2015) and RBM (2015)

Stable domestic fuel prices can be attributed to the regulation of domestic prices for fuel in order to cushion the economy from adverse effects of oil price shocks as well as movements in the exchange rate which affect the level of pass-through of oil price shocks. For instance, there have been instances where international oil prices have gone down but domestic prices have been revised upwards as a result of a depreciation of the exchange rate.

Food has been a major component of Malawi's consumer price basket. Between 2000 and 2011, food was making up 58.1 percent of the consumption basket (Government of Malawi, 2015c). In 2012, the CPI composition was revised and now food makes up 50.2 percent of the consumption basket while maize makes up 30 percent of the overall consumption basket (Government of Malawi, 2015c). Other components include alcoholic drinks and tobacco, clothing and foot wear, housing, water and electricity, furnishing and household, transportation, communication, recreation and culture, education, restaurants and hotels and miscellaneous costs (Government of Malawi, 2015c). Figure 2 is a summary of the components of Malawi's CPI.

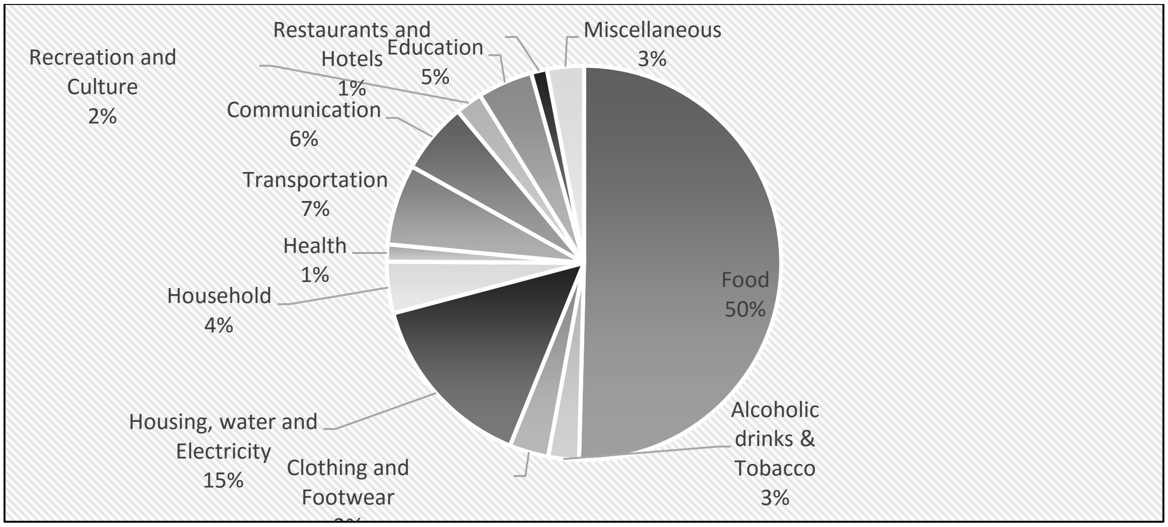

Figure 2 CPI Composition

Source: National Statistics Office, 2015

As such, changes in international oil prices that are passed through to each of these components is expected to vary. Furthermore, usage of petroleum products in rural areas varies from that of urban areas as is evidenced by the varying compositions in the respective consumption baskets such that the pass-through of oil price shocks to rural and urban inflation should also be different. For instance, transportation component makes up 10 percent of the urban consumption basket as compared to 4.4 percent of the rural consumption basket (Government of Malawi, 2015c).

1.1 Statement of the Problem and Justification

Malawi's inflation has been rising tremendously over the past decade with the average inflation for 2015 being inflation in June 2016 being at 21.8 percent (Government of Malawi, 2016). Except for the period between 2007-2010 and 1996-97 when inflation was as low as 6 percent, Malawi has experienced double digit inflation rates with the highest being 94 percent in 1995 (Government of Malawi, 2016). Ndaferankhande & Ndhlovu (2005), Mangani (2011), Ngalawa & Viegi (2011) and Simwaka (2004) examined the dynamics of Malawi's inflation and found that both internal and external shocks play a role in determining inflation. Bernanke & Blinder, (1992) argued that monetary authorities also need to be more concerned with imported cost-push inflation rather than demand-pull inflation particularly for an economy such as Malawi whose reliance on imports is relatively high.

In 2007, there was a sharp rise in crude oil prices on the international market due to the global recession which was followed by a huge fall in crude oil prices caused by declining demand. However, as it can be observed in figure 1, these developments were not reflected in domestic fuel prices as was expected because this was the period when the APM was suspended and the exchange rate was fixed such that domestic fuel prices were not changed regularly. This suspension came about due to the adoption of a fixed exchange rate regime which was adopted in order to ensure a stable exchange rate (MERA, 2012). From 2012, domestic prices have been moving slightly in line with changes in international oil prices following the liberalization of the exchange rate and the re-introduction of the APM. The difference has been in terms of the magnitude of the changes.

It can be concluded therefore that while international oil prices are volatile, domestic fuel prices are relatively stable especially the period before 2012. Since domestic prices of petroleum products do not give a true reflection of the changes on the international oil market, the pass-through of international oil price shocks to inflation is expected to be low and incomplete.

There are a number of studies that analyzed the adverse impacts of international oil price shocks in developed or industrial economies such as Khan & Ahmed (2011), Blanchard & Gali (2007) and Álvarez *et al* (2011) who studied oil price pass-through in Pakistan, USA and the Euro area respectively. A few such studies have been focused on African economies particularly on oil-importing countries. The few include Fofana *et al* (2009), Murgasova *et al* (2009), Kiptui (2009) and Chuku *et al* (2011) who investigated the pass-through of oil price shocks in South African, East African Countries (EAC), Kenya and Nigeria respectively.

In Malawi, Mbuzi (2014) analyzed the pass-through of international oil price shocks on domestic inflation and found an incomplete pass-through. However, the analysis did not focus on the transmission channels for international oil price shocks. The results therefore did not clearly indicate which of the CPI components is affected by oil price shocks and by how much. Furthermore, the study did not disaggregate headline inflation into rural and urban inflation in order to examine whether there exists any differential impact of international oil price shocks. In his study, Mbuzi (2014) used quarterly data. International oil prices as well as prices of petroleum products in Malawi are revised every month and at times the changes happen more than once in a month thus an analysis that uses a higher frequency data could be more informative.

This study therefore differs from the one by Mbuzi (2014) in that it analyzes the pass-through of oil price shocks using a higher data frequency and applies a Vector Autoregression (VAR) model which is more likely the best way of capturing the impact of such changes. It also analyses the transmission channels of the international oil price pass-through and examines the existence of differential impact on rural and urban inflation.

1.2 Objectives of the study

1.2.1 Overall Objective

The main objective of the study is to investigate and analyze the extent to which international oil price shocks pass-through to domestic inflation.

1.2.2 Specific Objectives

The specific objectives are:

- To estimate the pass-through rate at which oil price shocks affect domestic inflation
- To investigate the channel(s) through which oil price shocks influence domestic inflation
- To analyze whether international oil prices shocks have differential impact on rural and urban inflation

1.2.3 Hypotheses

In this regard the hypotheses to be tested are;

- International oil price shocks do not affect domestic inflation
- International oil price shocks have no differential impact on domestic transport, household operations, food and non-food inflation
- International oil price shocks do not affect rural and urban inflation differently

1.3 Significance of the study

This study therefore differs from other studies in that it analyzes the pass-through of oil price shocks using a higher data frequency and applies a Vector Autoregression (VAR) model which is more likely the best way of capturing the impact of such changes. It also analyses the channels through which international oil price shocks are passed-through to consumer price inflation by decomposing inflation into its different components. Furthermore, it includes an analysis of the pass-through rate of international oil shocks into rural and urban inflation. This was done so as to understand how the pass-through differs across locations. Understanding the inflationary effects of international oil price shocks as well as knowing the empirical relationship between these oil price shocks and domestic inflation will help the monetary authority conduct an appropriate inflation policy to accommodate oil price shocks. The results will also help in the assessment of inflation risk.

1.4 Organization of the study

The ensuing analysis is organized as follows: chapter two is an overview of the domestic economy, domestic fuel pricing policies as well as trends in international oil prices; chapter three is a discussion of theoretical linkages, the transmission channels from oil price shock to the macroeconomy as well as empirical literature; chapter four discusses the analytical framework and the methodology for the analysis; chapter five contains estimation results and interpretations; final chapter summarizes and concludes the paper.

CHAPTER TWO

OVERVIEW OF THE ENERGY SECTOR, INFLATION TRENDS AND INTERNATIONAL OIL PRICE TRENDS

2.0 Introduction

This chapter gives an overview of the Malawi economy, trends in inflation as well as international oil prices. The chapter also exposes the institutional framework of petroleum fuel importation, management and pricing practices in Malawi.

2.1 The Malawi Economy

Malawi is one of the least developed nations in Africa. It is an agro-based economy with agriculture contributing over 30 percent to GDP (Government of Malawi, 2015). As such, performance of the Malawi economy is bound to be affected by weather conditions. The annual GDP growth rate over the past two decades has ranged from -10 percent in 1994 to 16.7 percent in the following year with an average of about 4 percent (Government of Malawi, 2015a). Between 2011 and 2014, Malawi faced economic challenges including high inflation, shortage of fuel and foreign exchange due to unfavourable economic and government policies included the fixed exchange rate policy which resulted into an overvalued Kwacha among others. In addition, there was a reduction in donor aid which limited the functions of the government. These among other factors affected the performance of the economy such that within this period the GDP growth rate was as low as 1.9 percent (Government of Malawi, 2015a). In 2015 GDP growth was at 3 percent, a decline from that of 2014 when GDP growth rate was about 6 percent (Government of Malawi, 2015b).

Tobacco is the main export commodity making up about 55 percent of total exports. Other exports include tea, cotton, sugar, peanuts, coffee and pulses. Malawi's main trading partners are South Africa, Egypt, Zimbabwe, the USA, Netherland and Russia (World Trade Organization, 2010). The country's industrial sector on the other hand is under-developed and its contribution to GDP is below 10 percent. As such, most of the industrial products are imported starting from small consumer goods to heavy machinery. Some of the major imported items include petroleum products, transport equipment and some food items. Imports of petroleum products (as a percentage of merchandise imports) have ranged from 7.56 percent in 1994 to 15.7 percent in 2013 while in 2014, 16.4 percent of merchandise imports were fuel imports (Government of Malawi, 2015).

2.2 Trends in Inflation in Malawi

Inflation can be defined as the increases in the general level of prices (Bernanke & Blinder, 1992). The rate of inflation has changed unpredictably since independence. Figure 3 is a representation of the inflation trend from 1990 to 2015. Headline inflation in Malawi has been higher than 10 percent for most of the years. Inflation was volatile in the 1990s and early 2000s mainly due to drought, loss of fiscal discipline and nominal exchange rate depreciation among other things (Matchaya, 2011). Between 1990 and 2000, inflation ranged from 5 percent to 98 percent (Government of Malawi, 2015).

In 1995, overall inflation rose to a record high of 98 percent due to a severe drought that the country experienced in the 1994/95 growing season. There was a decline in headline inflation to about 6 percent in the following year which was attributed to favourable weather conditions and fiscal adjustment facilitated by the Reserve Bank of Malawi (RBM) (Ndaferankhande & Ndhlovu, 2005). Over the next decade, Malawi's inflation ranged from 8 percent to 31 percent.

Between 2002 and 2006, the exchange rate was determined by market forces with occasional intervention by RBM to smoothen its movements. During this period, inflation was relatively stable mainly due to the availability of food especially maize since food made up 58.1 percent of the CPI basket before the basket was revised in 2012. From 2007 to early 2012, Malawi had a fixed exchange rate regime where the official exchange rate was set by monetary authorities. The stable inflation during this period is also attributed to the fixed exchange which cushioned external shocks (Simwaka *et al*, 2012). Inflation rate rose to 37.9 percent in February of 2013 following the devaluation of the Malawi Kwacha by over 50 percent and the subsequent adoption of a liberalized foreign exchange market (Government of Malawi, 2016). Inflation slightly fell after wards following tight monetary policy and favourable weather conditions.

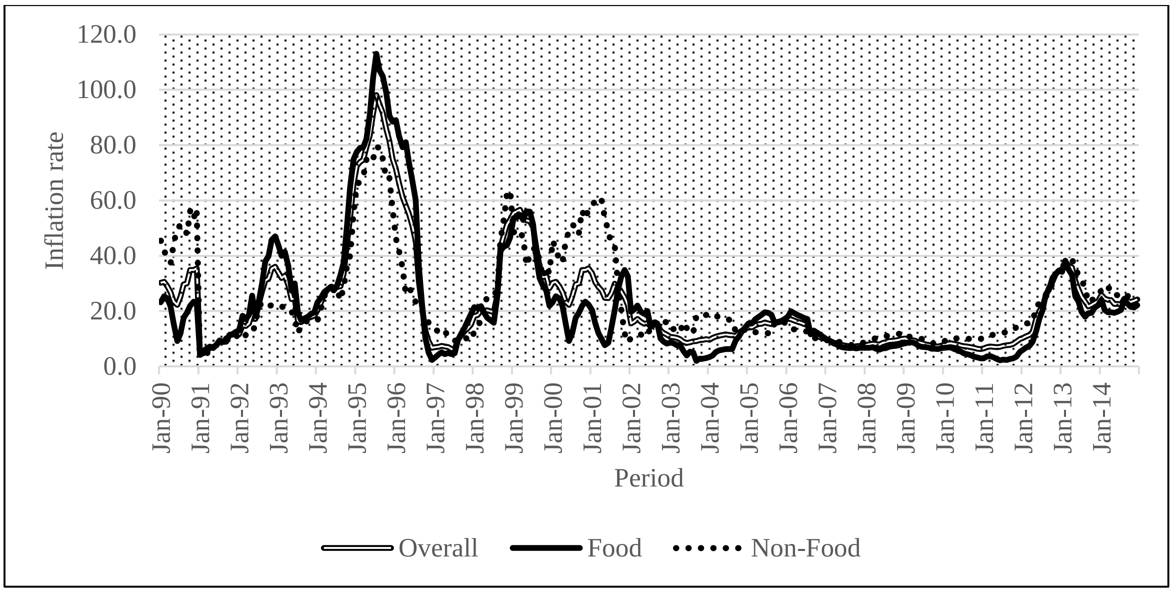

Figure 3 Trends in Malawi's Inflation

Source: National Statistics Office database (2015)

Figure 3 indicates that the trend in overall inflation rate mostly followed the trend of food inflation unlike that of non-food inflation mainly because food makes up a larger component of the CPI basket especially for the period before 2012. While food inflation is largely determined by maize food prices, non-food inflation is largely driven by movements in exchange rate and fuel prices. Therefore, it is expected under normal circumstances for inflation to decline in the period following maize harvest when prices are low and during the tobacco marketing season when the currency tends to appreciate (Lweya, 2015).

One of the primary functions of RBM is to maintain price stability through formulation and conduct of monetary policy (Government of Malawi, 2004c). Currently, the central bank is using an interest rate based monetary policy framework (Government of Malawi, 2016). Under this framework, a change in the policy stance is communicated by changing the policy rate. Thus, an increase in the policy rate signifies a tight monetary policy stance while a decline signifies an expansionary monetary policy stance (Government of Malawi, 2016). The targeted growth in money supply which is agreed by RBM and the IMF is pursued by setting an intermediate target on the growth of reserve money which, through a money multiplier, is directly linked to broad money supply (Government of Malawi, 2016).

Higher levels of inflation are generally undesirable in an economy. Inflation results in a fall in real wages and unequal distribution of income in favor of those making profits while low paid workers are left unprotected (Ndaferankhande & Ndhlovu, 2005). Inflation also negatively affects balance of payments of an economy's current and capital accounts and thus aggravating the foreign exchange constraint on development (Ndaferankhande & Ndhlovu, 2005).

2.3 Energy Sector Regulation

The liquid fuels and gas subsector in Malawi is comprised of petrol, diesel, paraffin, gas and ethanol, where ethanol is a blending agent for petrol. The wholesaling of these products has been dominated by international oil corporations who provide franchises to local Malawians to operate retail points (Government of Malawi, 2004b). The Liquid Fuels and Gas Production and Supply Act of 2004 only allows oil companies to operate two filling stations, such that most retailing of fuel is done through franchising to local business enterprises in various parts of the country.

The Malawi Energy Regulatory Authority (MERA) was established in 2007 under the Energy Regulatory Act of 2004 with the main objective of regulating the energy sector including petroleum products (Government of Malawi, 2004a). Some of MERA's functions include to receive, process, approve, or revoke licenses; to enforce compliance of the Act; to approve tariffs and the price of energy sales and services; and to prescribe and collect fees, charges and levies or rates. In addition to the Energy Regulatory Act, the production, blending, extraction, conversion, importing, transforming, transporting, storing, distributing and selling of liquid fuels and gas is regulated by MERA through the Liquid Fuels and Gas Production and Supply Act of 2004. The Act also gives mandate to the regulator to approve price bands throughout the supply chain for liquid fuels and gas.

2.4 Price-setting mechanism for petroleum products in Malawi

Pricing of petroleum products in Malawi is determined using the Automatic Pricing Mechanism (APM) which was introduced in 2000. Under this system, fuel prices would move up and down in line with world prices, with the Multi-Sector Energy Pricing Committee overseeing the setting of prices (Dept, 2013). Before 2000, domestic prices of petroleum products were being set by government.

Considering that the price fluctuations are very frequent on the international market, the APM is set to respond to In-Bond Landed Cost (IBLC) changes within a $\pm$5 percent threshold. Thus, in a case where the average Free On Board (FOB) prices have dropped by a percentage less than the depreciation of the domestic currency such that the combined effect results in an increase in the IBLC, then an upward adjustment is qualified and a downward adjustment otherwise (MERA, 2012).

The APM was suspended in 2007 following the adoption of a fixed exchange rate and the Targeted Approach (TA) was adopted where the IBLC was fixed and the changes in the IBLC were managed by adjusting the Price Stabilization Fund (PSF) levy in the price build-up. If the landed cost increased to unsustainable levels, the PSF levy was adjusted upwards which then resulted into higher fuel prices. On the other hand, if the landed costs increased to a manageable level, funds in the PSF were used to compensate for losses incurred by the importers and there were no changes made to final consumer prices. As such, the difference between the two pricing systems is that with the APM, when the IBLC increases beyond 5 percent threshold, the prices of petroleum products are revised upwards such that the new and higher cost is reflected in the price build-up while the IBLC was assumed to be fixed under the TA system.

The PSF was created to enable government through MERA control for the volatility of international oil prices. As per its name, it is meant to stabilize prices when there are movements of the IBLC within the plus or minus 5 percent band. When there is a decline in IBLC that is less than 5 percent, then the PSF accumulates funds since importers do not need any compensation for losses. On the other hand, when the increase in IBLC is below the 5 percent band then funds are withdrawn from the PSF to compensate importers for the losses incurred so that prices will be maintained (Dept, 2013).

Until May 2007, all fuel importation was done by the Petroleum Control Commission (PCC). After the formation of MERA in 2007, 80 percent of the country's fuel began to be imported by the Petroleum Importers Limited (PIL) with the remaining 20 percent still being imported by PCC (Dept, 2013). This fuel importation system faced challenges in 2011 when restrictions were imposed on foreign exchange transactions and the country was faced with severe foreign exchange shortages. This led to the establishment of the National Oil Company of Malawi (NOCMA) in June 2011 whose main objective was to manage the country's strategic reserves of fuel, replacing PIL as the principal fuel importer (Dept, 2013). NOCMA began its operations in 2012. In May 2012, following the devaluation of the kwacha and the liberalization of the foreign exchange market, the government increased fuel prices to bring them in line with import costs and the APM was re-introduced (MERA, 2012). In addition, NOCMA's activities were reversed to overseeing the country's strategic reserves while importation of fuel for regular consumption was reverted to the private sector. In December 2015, the role of fuel importation was reversed again to NOCMA in order to promote transparency.

Petroleum products are one of the main sources of revenue for the Malawi government since there are a number of taxes imposed on them. Besides excise and import duties, Malawi's fuel pump prices reflect other government levies including energy regulation levy to finance operational activities of MERA, road levy for road's infrastructure development and rehabilitation, safety net levy for development projects, PSF levy and the Malawi Bureau of Standards access. These levies constitute 34 percent of the pump price of petrol, 27 percent of the pump price of diesel and 21 percent of the pump price of paraffin (MERA, 2015).

2.5 Trends in international oil prices

Before the 1980s, prices were relatively stable unlike the period after 1980. From 1948 to the 1960s, crude oil prices ranged between $2.50 and $3 per barrel. However, prices rose to $116.05 per barrel in 1980 from $51.74 per barrel as a consequence of the Iranian revolution and the invasion of Iran by Iraq in 1979 which led to reduced production of oil (Blanchard & Gali, 2007). Thereafter, prices fell to $29.27 per barrel in 1986 but they rose again in 1990 to $60 per barrel due to the Gulf war and the invasion of Kuwait which disrupted production (Khan & Ahmed, 2011). In 1999, oil prices were as low as $17.37 per barrel following reduced consumption as well as increased production.

From 2000, oil prices had been increasing steadily until July 2008 where prices spiked to $131 per barrel due to the financial crisis which led to reduced production. This rise was followed by a drastic fall due to a decline in demand such that by February 2009 crude oil was being sold at $39.05 per barrel. The Libyan civil war in 2011 led to a rise in oil prices to $103 per barrel (Abounoori *et al*, 2014). Oil prices fell recently to $47.78 per barrel in March 2015.

2.6 Conclusion

This chapter has discussed briefly the structure of the Malawi economy, the structure and institutional framework of the energy sector in Malawi as well as the various fuel price setting policies that have been implemented over time. The chapter also included a discussion on trends in international crude oil prices over time.

CHAPTER THREE

LITERATURE REVIEW

3.0 Introduction

This chapter includes a review of relevant theoretical and empirical literature that aids in the understanding of the dynamics of oil prices pass-through to inflation. A brief discussion of the theories of inflation is followed by an analysis of selected empirical studies on oil price pass-through from Malawi, Africa and the rest of the world.

3.1 Theoretical Literature Review

3.1.1 The Cost-Push Theory of Inflation

This theory attributes the basic causes of inflation to supply-side factors. This implies that rising production costs lead to inflation since firms tend to pass on the higher costs to consumers by raising final prices (Machlup, 1960). In turn, workers through labour unions push employers to raise wages which then raises aggregate demand which eventually fuels inflation further since employers will again incur high production costs resulting from high wages. This process continues since prices in the product and wage market keep rising a process also referred to as the wage-price spiral. Cost-push inflation is usually regarded as being primarily a wage inflation process because wages usually constitute a larger part of the total production costs (Machlup, 1960).

However, this is the case if there exist strong labour unions that persistently negotiate for wage increase (Tang *et al.,* 2010). In addition to wages, an increase in the prices of imported raw-material such as oil or other semi-manufactured good used as component parts in the production process would result in cost-push inflation. Additionally, an exchange rate depreciation of the home currency may also cause cost-push inflation since imported raw-materials will become more expensive (Tang *et al*., 2010).

3.1.2 Transmission Channels of Oil Price Shocks

Despite the impact of oil price shocks on the macro-economy having attracted a significant amount of attention from researchers, there has not been a consensus on their transmission channels. Below are some of the transmission channels that have been identified.

Three broad channels through which international oil prices impact the macro-economy as identified by Bhanumurthy *et al* (2012) are the import channel, the price channel and the fiscal channel. The import channel is the channel that links international oil prices to the current account of the economy that imports oil. An increase in international price of oil results into a higher import bill for the oil importing economy. Assuming that the price elasticity of demand for oil is low, the rise in oil prices tends to worsen the trade balance of the country as a result. Consequently, inflation will rise which in turn will reduce the level of GDP.

The price channel links international oil prices to domestic inflation. For a developing country, an increase in oil prices on the international market leads to a subsequent rise in the general price level due to the direct use of oil at higher prices plus increase in costs of production of final goods using oil as an input. This is the case when there is an unhindered pass-through of oil price increase (Bhanumurthy *et al*, 2012). However, the impact of oil price changes and hence the degree of pass-through in the case of Malawi is countered by the price stabilization policy.

The third channel is the fiscal channel. In the absence of a complete pass-through, an international oil price increase will raise the subsidy on oil and therefore the revenue expenditure of the government. Oil products are heavily taxed in Malawi which makes them another source of government revenue (MERA, 2012). Therefore, a rise in the international prices of oil would entail higher revenue receipts because of an increase in *ad valorem* tax collections on petroleum products.

In addition to the aforementioned channels, Brown *et al* (1995) identified six transmission channels through which international oil price changes affect the performance of macroeconomic variables.

a) **Supply-side shock effect**

This focuses on the direct impact on output due to the change in marginal cost of production caused by an oil price shock. Specifically, rising oil prices reduce the availability of a basic input to production which in turn reduces potential output as such there is a rise in marginal costs and a reduction in output. The increase in international oil prices reduces output in the short-run due to the reduction of capacity utilization which in turn increases unemployment and reduces income.

b) **Wealth transfer effect**

This channel suggests that an increase in international oil prices shifts purchasing power from countries that import oil to those that export oil. Oil exporting countries experience increase in revenue as well as an improvement in their terms of trade. This transfer of wealth is expected to result into reduced aggregate demand of the oil-importing countries while the opposite is expected from oil-exporting countries due to the assumption that marginal propensity to consume in the oil-exporting countries is higher. The oil price shocks in oil-importing countries are transmitted through the demand-side by triggering the reduction of demand for goods and services.

c) **Imported Inflation effect**

An oil price hike generates inflationary pressure in the economy where oil-based products are an important component of consumer price index. The first round effect of an oil price hike is the sudden increase in headline inflation but the pass-through rate depends on the domestic response to the shock. The second round effect is the rise in cost of production costs which is caused by a rise in wages.

d) **Real balance effect**

This is also referred to as the monetary policy channel. An increase in international oil prices would lead to an increase in demand for money which in turn would raise interest rates and consequently impede economic growth by reducing investment. For instance, if consumers expect the short-term effect of a rise in oil prices to exceed its long-term impact on output, they will borrow or dissave to smoothen consumption which in turn raises interest rates and reduces investment.

e) **Sector adjustment effect**

This channel helps in explaining the asymmetric impact of oil price shocks within the sectors of the economy. A rise in international oil prices slows down economic activities which is further retarded by adjustment costs. A fall in international oil prices on the other hand stimulates economic activities although the effect is somewhat offset by the adjustment costs.

f) **The psychological effect**

This channel explains that the uncertainty about future oil prices can affect economic activity by reducing investment demand of firms and consumers. This channel is also known as the uncertainty channel. Uncertainty causes firms and consumers to postpone irreversible investment and consumption decisions following a rise in international oil prices.

These six transmission channels were summarized by Tang *et al* (2010) in the Figure 4.

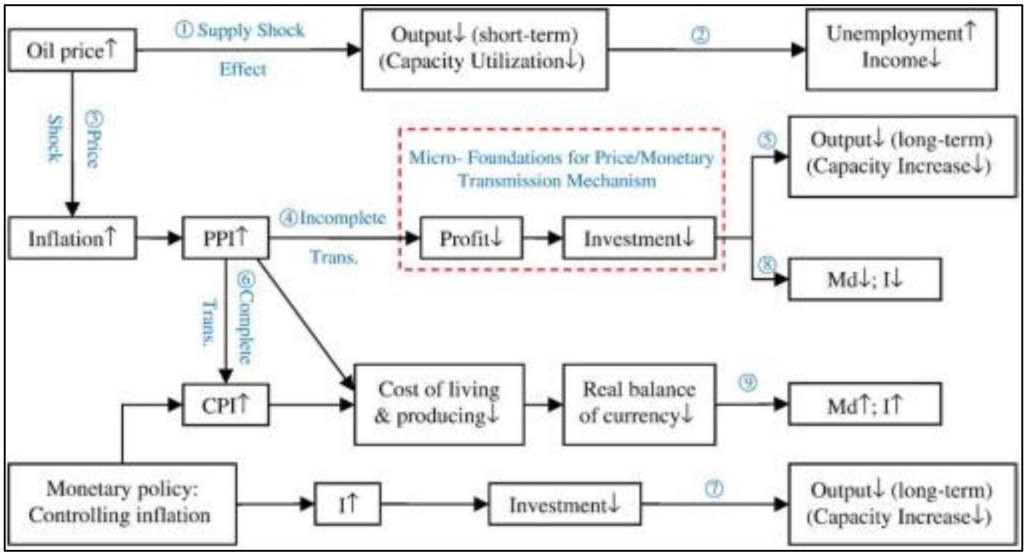

Figure 4 Oil Shocks Transmission Channels

Source: Tang et al (2010)

The analysis in this paper therefore focuses on the price channel as stated by Bhanumurthy *et al* (2012) which is similar to the imported inflation effect as stated by Brown *et al* (1995) and Tang *et al* (2010). This corresponds to arrow 3 in Figure 4 above. This is the case due to the findings by Álvarez *et al* (2011) and Murgasova *et al* (2009) that international oil price shocks are passed-through to inflation via this channel and that most of the other channels discussed above are difficult to track quantitatively. An incomplete pass-through will indicate an insignificant relationship between oil price shocks and domestic consumer prices.

3.2 Empirical Literature Review

There is a lot of literature on the impact of international oil price shocks on the macro-economy. Most of these studies however focused on industrialized or developed economies with a few focusing on oil-importing developing or least developed countries. This section gives a review of some of these studies.

3.2.1 Studies from the rest of the world

Pau *et al.* (2007) examined the impact of international oil prices on domestic prices of petroleum products in Curacao. The analysis was based on the correction factor system which was implemented by the Curacao government with the aim of smoothening oil price fluctuations by fixing domestic oil prices on a quarterly basis. The results indicated that due to the correction factor mechanism, changes in international oil prices were not reflected into domestic prices immediately but that they adjusted with a lag of one quarter. However, the study also found that the system had not always followed international oil price changes, thus in certain periods there was no reaction while in other periods domestic prices fluctuated more than international oil price changes.

Brown *et al.* (1995) used impulse response functions based on VAR model to analyze the rate at which oil price shocks are transmitted to changes in the USA's macroeconomic variables. The study found that oil price shocks lead to transitory effects on real GDP and the federal funds rate. There was a delayed effect on money supply while the impact on inflation was permanent and grew over time.

Blanchard & Gali (2007) conducted a study that aimed at analyzing the nature of the changes in the macroeconomic effects of oil price shocks in the United States of America (USA), France, Germany, the United Kingdom, Italy and Japan. Using Structural Vector Autoregression (SVAR) model, the study found that the pass-through rate of oil price shocks has indeed declined over time. The identified causes include a decrease in real rigidities, the increased credibility of monitory policy, lack of concurrent adverse shocks as well as the decline in the share of oil in consumption and production.

In a study by De Gregorio *et al* (2007) which improved on the study done by Blanchard & Gali (2007) by adding a number of countries investigated whether the decline in the pass-through of oil price shocks into inflation can be generalized to the rest of the world. The study focused on 37 countries, four of which were Africa's oil exporting countries and applied both VAR and the Augmented Phillip's Curve estimation methods. The findings revealed that the decline in the pass-through can be extended to the rest of the countries and not just for the United States. The declining pass-through was partly attributed to the decline in the effect of exchange rate on inflation and the demand-based nature of current oil-shocks, in addition to what was found by Blanchard & Gali (2007).

Jongwanich & Park (2011) examined the extent of the pass-through of food and oil prices shocks to domestic consumer prices in nine developing Asian countries that included China, India, Malaysia, Indonesia, Korea, the Philippines, Thailand and Vietnam by applying VAR modelling. The study found that the pass-through of global oil and food price shocks had been very limited and that consumers bore a small part of these shocks. The analysis implied that the various obstacles to pass-through such as fuel subsidies and fuel price regulation had been strong enough to seriously dilute the impact of global commodity price shocks to domestic inflation in these countries.

Duma (2008) examined the pass-through of external shocks namely exchange rate, oil price and import price shocks to inflation in Sri Lanka using VAR modelling. The study found low and incomplete pass-through of external shocks to consumer inflation. These findings implied that a combination of other factors including the existence of administered prices, high content of food in the CPI basket and low persistence and volatility of the exchange rate were some of the contributing factors. Specifically, the study revealed that external shocks explain 25 percent of the variation in consumer price inflation which reflects that there is room for domestic policies in controlling inflation.

Using a Dynamic Stochastic General Equilibrium analysis technique, Álvarez *et al* (2011) analyzed the impact of current oil price shocks on Spanish and Euro Areas' consumer price inflation. The study revealed that direct inflationary impact of oil price shocks in Spain and Euro Area increases over time as a result of households switching to oil refined products like transport fuels. Indirect effects however were found to be limited for the economy because most industries are low oil intensive. Hahn (2003) investigated the pass-through of external shocks namely oil price shocks, exchange rate shocks and non-oil import price shocks to Euro area inflation. The study found that external shocks explain a large fraction of the variations in all price index and that these shocks contributed largely to inflation in the Euro area since the start of the European Monetary Union.

Abounoori *et al* (2014) examined the nature and causes of oil price pass-through into Iran. Using the dynamic error correction model, the study found that oil price pass-through into inflation in both the short and long-term were positive but incomplete which is indicative of the oil subsidies implemented by the Iranian government. Baig *et al* (2007) reviewed how a number of countries including Malawi responded to the increase in international fuel prices in terms of the pass-through to domestic fuel prices, adjustments to fuel price and taxation regimes as well as changes in fuel subsidies. The study revealed that only half of the developing and emerging market countries sampled had fully passed-through the increase in international fuel prices over the period between 2003 and 2006. They also found that the limited pass-through reflected controls on retail prices and reductions in fuel taxes which had resulted in increases explicit and implicit fuel price subsidies. The pass-through coefficient for Malawi which was calculated as the ratio of domestic fuel price increase to international oil price increase within the sample period was 1.14.

3.2.2 Studies from Africa

Fofana *et al* (2009) conducted a study to track the channels through which increases in international oil prices were affecting the South African economy. The analysis was in three levels; the macro-economic, meso-economic and the micro-economic levels. The study used an economy and energy integrated approach which combined a household survey and an input-output data set. The results showed that an increase in international oil prices have a negative impact on the macro-economy where GDP falls and the current accounts balance worsens resulting from an increase in the value of imports. At meso-economic level, the industrial companies that are in the high intensive oil-use group experienced an increase in their input costs above the economy wide average. The pass-through rate of high paraffin prices was high for rural black households which raised their cost of living.

Murgasova *et al* (2009) investigated the impact of rising international food and oil prices on inflation in member countries of East African Community (EAC) namely Uganda, Rwanda, Tanzania, Burundi and Kenya. The study used VAR modelling and found that international oil and food prices do have an important effect on headline inflation in the EAC although the effect varies across countries. The pass-through from oil into inflation was highly significant while the pass-through from food was less so due to the regions' high degree of self-sufficiency in the production of main tradable food commodities. The study also investigated pass-through channels and found that oil price shocks pass-through to domestic food and transportation (fuel) prices to headline inflation and that the channels were stronger in Burundi, Kenya and Rwanda but weaker in Tanzania and Uganda.

Kiptui (2009) did a similar study on Kenya applying a Phillips Curve approach. The study also revealed that oil prices have significant effects on inflation with a pass-through of 0.05 in the short-run and 0.01 in the long run implying that a 10 percent increase in oil prices results in 0.5 percent and 1 percent increase in inflation in the short and long-run respectively. These results were collaborating the findings by (Murgasova *et al*., 2009).

In order to analyze the impact of oil price distortions on the Nigerian economy, Chuku *et al* (2011) used the vector error correction model (VECM) and Granger Causality test. Specifically, the study investigated the long-run and short-run impacts of oil price shocks on the supply-side of the economy, wealth transfer effect, inflation effect and real balance effect. The study found that oil price shocks are not a major determinant of macroeconomic activity in Nigeria and that its macroeconomic activities do not affect international oil prices. In addition, from the non-linear specification revealed that the impact of international oil price shocks on the Nigerian economy were asymmetric.

3.2.3 Studies from Malawi

There are several studies that have been done with the aim of understanding the main drivers of Malawi's inflation. So far, only two studies by Mbuzi (2014) and (Jombo *et al*, 2014) analyzed the pass-through of external shocks namely exchange rate and oil price shocks to domestic inflation.

Simwaka *et al* (2012) who examined the role of money supply in determining inflation in Malawi found that the growth of money supply drives inflation with lags of about 3 to 6 months whereas exchange rate adjustments and slumps in production play a relatively crucial role in fuelling cost-push inflation.

In order to examine the possible sources of inflation in Malawi from 1970 to the early 2000s, Matchaya (2011) applied VAR modelling and used generalized impulse response functions as well as variance decompositions. The study found that exchange rate, money supply, past values of inflation, recessions and booms were the main determinants of inflation. In addition, the study also found that there was a clear differential impact between booms and recessions such that the impact of recessions was more pronounced as compared to that of a boom.

Mangani (2011) examined the effects of monetary policy on prices in Malawi by tracing channels of its transmission mechanism using VAR modelling. The study revealed that exchange rate unlike money supply was the single most important variable in predicting prices and recommended that monetary authorities should be more concerned with imported cost push rather than demand pull inflation. Ngalawa & Viegi (2011) who investigated the dynamic effects of monetary policy shocks in Malawi also concluded that Malawi imports most of its inflation but did not specify the source.

Jombo *et al* (2014) analyzed the exchange rate pass-through to inflation in Malawi using Augmented Phillips Curve and VAR approaches. The study found the pass-through elasticities of 0.15 and 0.2 which suggests that exchange rate movements have a modest effect on domestic inflation. They also found that monetary policy has no significant impact on inflation, a finding that is similar to earlier studies.

Mbuzi (2014) investigated the impact of oil price shocks, exchange rate shocks and monetary policy changes on inflation by estimating an Augmented Phillip's Curve using the Autoregressive Distributive Lag (ARDL) method. The study found a short-run pass-through of 0.03 percent and 0.05 percent in the short-run and long-run respectively. The results implied that a 10 percent increase in international oil prices results into a 0.3 percent and 0.5 percent change in domestic prices in the short- and long-run respectively. Furthermore, the exchange rate pass-through was found to be 0.22 and 0.35 in the short- and long-run respectively. The study however did not focus on the specific transmission channels of an oil price shock on domestic inflation.

3.3 Conclusion

This chapter has discussed the theoretical and empirical literature on the international oil price pass-through to domestic inflation. The main conclusions drawn from the discussion are that oil price pass-through to inflation was found to be low and incomplete in both oil importing and oil exporting countries mainly due to fuel subsidies as well as fuel price regulation and that the overall impact of oil price shocks on most economies has declined over the past years as a result of wage rigidities, more effective monetary policies and reduced levels of oil consumption among other reasons. Although there have been studies on the pass-through of international oil price shocks to Malawi's inflation, none of these studies have examined the transmission channels of such shocks. In addition, there exists no study that examined differential impacts of international oil price shocks on rural and urban inflation.

CHAPTER FOUR

METHODOLOGY

4.0 Analytical Framework

The Vector Auto regression (VAR) modelling approach was used to analyze how international oil price shocks affect domestic inflation. VAR models are advantageous in that they provide a more theory-free empirical analysis while taking into account interactions of the different variables (Khan & Ahmed, 2011). VAR also enables the tracing of the dynamic responses of domestic prices to international oil price shocks such that it captures both the speed and the size of the pass-through. De Gregorio *et al* (2007) estimated both VAR and Augmented Phillip's Curve equation to analyze pass-through and found that the latter showed some problematic results and this was attributed to some weaknesses of the estimation methodology. It is for the said reasons that VAR model was adopted in this study.

4.1 Model specification and method of analysis

One assumption of regression analysis is that the variables on the right hand side of an equation are predetermined or exogenous (Gujarati, 2004). However, most macroeconomic variables are said to be endogenous such that running a regression using Ordinary Least Squares (OLS) produces inconsistent and biased estimates. One approach to dealing with endogeneity is using VAR analysis as suggested by Sims (1980) in Enders (2015).

In this regard, to estimate the pass-through of oil price shocks to domestic consumer prices, the VAR modelling technique was used. The model incorporated the following variables; Index of Industrial Production (IIP) as a proxy of GDP, international oil prices in US dollars

(OIL), Consumer Price Index (CPI), money supply (M2) and the exchange rate in units of Malawi Kwacha per 1 US dollar (EXR).

4.1.1 The Model

A VAR is an *n*-equation, *n*-variable model in which each variable is in turn explained by its own lagged values, plus current and past values of the remaining *n x 1* variables (Enders, 2015). The simplest case of a VAR model is the reduced form VAR model, where each variable is a linear function of its own past values and past values of all other variables. A reduced form VAR of order *p* in levels of the variables can be expressed as;

$$X_t = A_0 + A_1 X_{t-1} + A_2 X_{t-2} + \ldots + A_p X_{t-p} + \varepsilon_t \tag{1}$$

Where X_t = an *(n x 1)* vector containing each of the *n* variables included in the VAR

A_0 = an *(n x 1)* vector of intercept terms

A_i = *(n x n)* matrices of coefficients

ε_t = an *(n x 1)* vector of error terms

p = the number of lags

Since the right-hand side of equation (1) contains only predetermined variables that the error terms are assumed to be serially uncorrelated with constant variance, each equation in the system was estimated using Ordinary Least Squares (OLS) technique. International oil prices were included in the VAR as an endogenous variable rather than an exogenous variable in order to examine the impact of oil price shocks to the domestic economy.

Reduced-form VAR model has the identification problem because it yields error terms that exhibit cross-equation contemporaneous correlations. One procedure that has been proposed to resolve the identification problem in a VAR framework involves diagonalising the variance-covariance matrix of the VAR system using a triangular orthogonalisation process (Lütkepohl, 1993). This is achieved by estimating the reduced-form VAR model, then computing the Cholesky factorisation of the models' covariance matrix. This procedure is also called recursive VAR modelling procedure. It resolves the identification problem by ensuring that shocks to the VAR system can be identified as shocks to the endogenous variables in each equation (as in a reduced-form VAR) (Lütkepohl, 1993).

However, the weakness of this procedure is that it is sensitive to the ordering of variables in the computation of the shocks. The suggested solution in literature is to place policy variables first in the ordering. This is based on the assumption that policy variables can influence non-policy variables contemporaneously as well as with a lag, while the non-policy variables themselves can only be influenced by the policy variables after a time-lag due, for instance, to delays in the availability of economic data (Bernanke & Blinder, 1992).

The other approach to the identification problem in VAR modelling is to impose restrictions that are based on theory on the matrix that governs the contemporaneous relations among the variables in the VAR to reflect the structure of the economy (Lütkepohl, 1993). The model estimated using this approach is called a Structural VAR model. A major disadvantage of this procedure is that the estimation results are sensitive to the identifying assumptions made (Mangani, 2011). For the purposes of this paper, a reduced-form VAR model was estimated and the cholesky factorisation was adopted to address the identification problem.

In order to study whether pass-through of oil prices into domestic prices varies across locations, three equations were estimated. The first VAR included overall CPI, international oil prices, money supply, exchange rate and IIP. The second VAR included CPI inflation for rural areas, international oil prices, money supply, exchange rate and IIP while the third VAR included CPI inflation for urban areas.

To test the robustness of the estimates and study the pass-through channels, additional equations were estimated where CPI was decomposed into its food, transportation and household operations components (Murgasova *et al* 2009). Thus, four additional models were estimated: the first VAR included food inflation, money supply, IIP, exchange rate, and international oil price; in the second equation, food inflation was replaced with non-food inflation then transportation price index substituted food inflation in the third equation. The fourth equation included household operations index. These sets of VARs enabled the estimation of pass-through from oil prices into local food, non-food, transportation and household operations inflation. The analysis was limited to transport and household operations component of the CPI based on the assumption that they are directly impacted by an increase in international oil prices. With this set of VARs it was possible to estimate the pass-through from international oil prices into local food and non-food price indices. Table 1 shows a summary of the various VAR models that were estimated.

Table 1 Estimated VAR Models

VAR Model	**Variables**
Model 1	OIL, EXR, M2,IIP,CPI
Model 2	OIL,EXR,M2,IIP,CPIR
Model 3	OIL,EXR,M2,IIP,CPIU
Model 4	OIL,EXR,IIP,CPIF
Model 5	OIL,EXR,IIP,CPIN
Model 6	OIL,EXR,M2,IIP,TRANS
Model 7	OIL,EXR,M2,IIP,HHLD

4.1.2 Determining the Lag Length

In a VAR model, lag length selection is critical. Proper selection of lag length for VAR helps in avoiding model over-fitting by limiting the length of lags included in the VAR as well as minimising model misspecification by not selecting a lag length that is too small (Enders, 2015). The Akaike Information Criterion (AIC), Schwartz Bayesian Criterion (SBC) and the Likelihood Ratio (LR) are alternative methods used to determine the appropriate lag length. The LR tests based on the VAR models in the levels of the variables as shown in equation 2:

$$LR = (T - m)(\ln|\Sigma_r| - \ln|\Sigma_{ur}|) \tag{2}$$

Where T is the number of usable observations, m is the number of estimated coefficients including the intercept in the unrestricted system, $\ln|\sum_{r}|\ and \ln|\sum_{ur}|)$ are the logarithms of the determinants of the variance/covariance matrices of the residuals in the restricted and unrestricted VARs, respectively. Equation (2) is the augmented LR statistic by Sims (1980). Statistics follow a χ^2 distribution with degrees of freedom equal to the number of restrictions in the system. The null hypothesis is that the restriction is binding. If the calculated value of the statistic is less than the critical at a pre-specified significance level, we fail to reject the null hypothesis.

4.1.3 Innovation Accounting

The stochastic error terms are referred to as impulses or innovations in VAR. Innovation accounting is a tool used for forecasting in VAR models. It is done through impulse response function and variance decomposition analysis (Enders, 2015). The impulse response functions measure the dynamic marginal effects of each shock on all of the variables in the VAR over time. Variance decomposition on the other hand examines how important each of the shocks is as a component of the overall variance of each of the variables over time. In other words, variance decomposition shows the relative importance of each random innovation to the variables in the VAR. This study used impulse response functions to analyse the size and speed of pass-through of international oil price shocks while variance decomposition was used to determine the importance of international oil price shocks in determining domestic inflation.

4.2 Data Sources, Variable Justification and Expected Signs

The investigation of international oil price pass-through used monthly data that covers the period January 2000 to December 2014. The sample period was chosen by considering the recent developments in which international oil price shocks were both positive and negative. The statistical package used in this study was EViews 9.0. Oil price data is the spot price of Dubai crude oil sourced from the IMF's International Financial Statistics (IFS) database. CPI and Index of Industrial Production (IIP) data were sourced from National Statistics Office while money supply (M2) and exchange rate data were sourced from the

Reserve Bank of Malawi (RBM) database. The exchange rate is expressed as units of Malawi Kwacha per US dollar.

4.2.1 International Oil Price

Malawi is a small and non-oil producing economy such that it cannot influence international oil prices. In addition, Malawi does not import crude oil but refined oil products. Prices of refined oil products follow the same trend of crude oil prices as such Dubai crude oil prices were used in the analysis. An increase in international oil prices leads to increase in prices of petroleum products which is in-turn passed on to consumer prices. However, domestic prices of petroleum products are regulated, as such it is expected that the pass-through of international oil price shocks should be limited and incomplete. Thus domestic prices should be more stable as compared to international prices.

4.2.2 Exchange Rate

The study used official exchange rates as released by the Reserve Bank of Malawi which is expressed in units of Malawi Kwacha per US dollar. Changes in the exchange rate are expected to result into changes in domestic cost of imported goods which in turn leads to changes in the domestic prices. The exchange rate is the major source of imported inflation in Malawi. Specifically, a depreciation of the domestic currency raises the cost of imported raw-materials which translates into high consumer prices.

4.2.3 Index of Industrial Production

This is a measure of economic activity and it is expected to be negatively related to international oil price changes as well as inflation. Since GDP for Malawi is reported annually mainly due to its seasonality nature yet the study used monthly data, it was not possible to use GDP. Hence, IIP was used as a proxy for domestic output as it is recorded monthly thus solving the problem of data frequency. Additionally, oil prices are said to have a more direct impact on the industrial sector.

4.2.4 Money Supply

This variable was included basing on the quantity theory of money which states that inflation is always and everywhere a monetary phenomenon. It is a proxy for the role of monetary policy which is one of the determinants of inflation. Money supply is expected to be positively related with inflation.

4.2.5 Consumer Price Index (CPI)

The all items inflation is measured using the growth rate of CPI. CPI is comprised of both food and non-food costs where 50.2 percent is made up of food items and the remaining 41.9 percent is made up of non-food costs including clothing, foot wear, housing, household operations and transportation. It is expected that inflation is positively related to international oil prices.

4.3 Time Series Properties of the Data

4.3.1 Unit Root Test

Before undertaking estimation of the models specified, a test for stationarity of the variables was conducted to determine whether the series were stationary or not. Regressing a non-stationary time series on another time series that is also non-stationary leads to a spurious regression. A series is said to be stationary if its mean and variance are constant over time and the value of the covariance between the two time periods depends only on the gap between the two time periods and not the actual time at which the covariance is computed (Enders, 2015).

4.3.2 Test for Co-Integration

A series that is non-stationary is differenced to make it stationary and the number of times the series is to be differenced to make is stationary is referred to as the order of integration (Gujarati, 2004). In some cases, the linear combination of non-stationary series integrated of the same order can be stationary in levels. In such a case it is said that the series are co-integrated implying that there exists a long term relationship or equilibrium between them. If the variables are found to be co-integrated, the Vector Error Correction (VEC) model would be used to establish the dynamic relationship between the dependent variable and the regressors.

4.3.3 Test for Serial Correlation

Using time series data may in some cases lead to serially correlated residuals implying that OLS estimates will have large standard errors which results in inefficient, biased and inconsistent estimates (Enders, 2015). This occurs when lagged values of the dependent variables are included as regressors. In this regard, the Breusch-Godfrey serial correlation Lagrange Multiplier (LM) test was used to test for higher order autocorrelation among the errors. This test is applicable whether or not there are lagged dependent variables. The null hypothesis is that there is no serial correlation up to a pre-specified lag order against the alternative of the presence of serial correlation.

4.3.4 Autoregressive Conditional Heteroskedasticity (Arch) Test

The ARCH test is a Lagrange Multiplier (LM) test used to test for conditional heteroskedasticity in the residuals. The test assesses whether the magnitude of past residuals are related to the magnitude of recent residuals. ARCH in itself does not invalidate standard OLS inference but ignoring ARCH effects may result in loss of efficiency. The null hypothesis assumes that there are no ARCH effects up to some order q.

CHAPTER FIVE

ESTIMATION RESULTS AND INTERPRETATION

5.0 Introduction

This chapter presents the estimation results and their interpretations. It contains diagnostic test results and regression results as well as their interpretations.

5.1 Correlation Analysis

In order to examine how the variables are related to each other, an analysis of their correlation coefficient was conducted. Table 2 below shows that CPI, money supply, exchange rate and IIP are positively correlated with international oil prices. The relationship is weaker for IIP as compared to the other variables. This is against the expectation that there should be a negative relationship between international oil prices and industrial output. Money supply and CPI are positively related and there exists a strong relationship supporting the quantity theory of money that states that too much money in the economy is inflationary. IIP is negatively correlated with CPI and exchange rate since a depreciating exchange rate and rising prices tend to discourage investment which in turn reduces production. CPI is also positively correlated with the exchange rate supporting the finding by other researchers that exchange is a significant driver of inflation in Malawi. VAR allows for estimation of variables that are correlated hence correcting for any issues that may arise by high correlation among these variables.

Table 2 Correlation Results

	LogTrans	LogOil	LogHhld	LogExr	LogCPI	LogIIP	LogM2
LogTrans	1	0.86	0.99	0.95	0.99	0.04	0.99
LogOil	0.86	1	0.88	0.78	0.84	0.24	0.89
LogHhld	0.99	0.88	1	0.94	0.99	0.03	0.99
LogExr	0.95	0.78	0.94	1	0.96	-0.21	0.92
LogCPI	0.99	0.84	0.98	0.96	1	-0.03	0.98
LogIIP	0.04	0.24	0.03	-0.21	-0.03	1	0.09
LogM2	0.99	0.88	0.99	0.92	0.98	0.09	1

5.2 Testing For Structural Breaks

Prices of petroleum products such as petrol and diesel are regulated in Malawi as stated earlier in Chapter 2. This is because international oil prices are very volatile implying that if such changes are left un-countered, consumers will bear the larger cost. To cushion consumers and the economy from the effects of international oil price shocks, domestic prices for petroleum products are not determined by market forces. The APM system is the one tool that is used in the determination of maximum prices of petrol, paraffin and diesel. However, the pricing system was suspended between 2007 and 2012 after which it was re-introduced.

These changes and reforms are believed to have had an impact on the data generating process in as far as prices are concerned. An analysis of Figure 1 also indicates that there are structural breaks that correspond to such changes. This necessitated the inclusion of a dummy variable that has the value 1 for the period when the APM was in operation and 0 otherwise in order to account for such policy changes. The statistical significance of including such a dummy was tested using the Likelihood Ratio test specified as:

$$LR = (T - m)(\ln|\Sigma_r| - \ln|\Sigma_{ur}|) \tag{3}$$

Where T is the number of usable observations, m is the number of estimated coefficients including the intercept in the unrestricted system, $\ln|\sum_r|$ *and* $\ln|\sum_{ur}|)$ are the logarithms of the determinants of the variance/covariance matrices of the residuals in the restricted and unrestricted VARs, respectively**.** The null hypothesis for the test is that the restriction is binding.

Two VARs were estimated, one with the dummy variable which was named the "unrestricted VAR" and another without the dummy variable which was named the "restricted VAR" and determinants of the variance were obtained for both estimations. With T = 165, m=17 and the determinants of the variance being 4.43E-11 and 3.11E-11 for the restricted and unrestricted regressions respectively (See Appendix), LR was calculated to be 52.3. At 5 percent level of significance, χ^2 statistic is 16.7496 so we reject the null hypothesis and conclude that the VAR with a dummy is valid. Hence, all the models were estimated with the inclusion of the dummy variable.

5.3 Stationarity Test Results

The efficacy of the VAR model in establishing the relationship among variables is conditional on the assumption of stationarity of the variables. Time series variables ought to be tested for unit root in order to avoid running spurious regressions (Gujarati, 2004). Therefore, Augmented Dickey-Fuller (ADF) test was used to test whether the variables included in the study were stationary. The results as shown in Table 3 indicate that all the variables except non-food CPI were not stationary in levels. Stationarity for these variables was obtained after differencing once. These results are in line with what most researchers have found in regards to Malawian data. For instance, Matchaya, (2011) found that M2, CPI and exchange had a unit root.

Table 3 Unit Root Test Results

Variable	In Levels	1st Difference	Order of Integration
LogFood	1.3228	-6.5647**	I(1)
LogIIP	-1.638	-2.397**	I(1)
LogTrans	-1.2266	-11.9631**	I(1)
LogOil	-2.1678	-8.7795**	I(1)
LogM2	-1.0664	-11.9419**	I(1)
LogExr	-1.2893	-9.9771**	I(1)
LogCPI	-0.0604	-5.4832***	I(1)
LogHhld	-1.6178	-12.1273**	I(1)
LogCPI-R	-0.1043	-4.5721***	I(1)
LogCPI-U	-0.4746	-4.7649***	I(1)
LogNonFood	-2.806**		I(0)

*Note: *, ** Indicate significance at 5% and 1% level of significance respectively.*

5.4 Cointegration Test

According to Enders, (2015), variables are said to be co-integrated if they have the same order of integration. This implies that a long-run relationship exists between them. Thus, having determined that food inflation, log of money supply, log of index of industrial production, log of money supply, log of transportation, log of household operations and log of exchange rate are integrated of order one (I(1)), there was need to test whether there existed a long-run relationship between them. The results of the co-integration test in Table 4 below show that no co-integrating equation was found for Model 4 thus the variables were not co-integrated. Test results for the other two models also indicated that there was no co-integrating equations in the VAR system (see Appendix 2). As such, unrestricted VARs were estimated using the first differences of the non-stationary variables.

Table 4 Co-integration Test with intercept (no trend) in CE and test VAR

Hypothesized number of CE	Eigen Value	Trance Statistic	5% critical Value	P-Value
None	0.13205	56.5347	69.8189	0.3568
At most 1	0.08003	33.1682	47.8561	0.5475
At most 2	0.0557	19.4056	29.7971	0.464
At most 3	0.0466	9.9556	15.4947	0.2842
At most 4	0.0125	2.0813	3.8415	0.1491

5.5 Lag Length Determination

When estimating a VAR, it is critical to determine optimal number of lags to be included in the estimation in order to avoid over-fitting the model by including unnecessary lags or misspecifying the model by omitting important lags (Duma, 2008). To determine the optimal lag length for the VAR models, standard lag length selection criteria used were the sequential modified likelihood ratio (LR) test, the Alkaike Information Criterion (AIC), the Final Prediction Error (FPE), the Hann-Quinn Information Criterion (HQ) and the Schwarz Information Criterion (SC). In cases where the test results indicated different lags as the optimal lag length, the Lag Exclusion criteria test was done to find the lags that were statistically significant. Results indicated that for Model 1, the optimal lag length was 6, for Model 2 the optimal lag length was 2, for Model 3 the optimal lag length was 4 and for models 4, 5, 6, and 7 their optimal lag lengths were 2, 3, 6 and 8 respectively.

5.6 Diagnostic Test Results

Residual tests of the VAR were performed for all the models. A visual inspection of the residuals revealed that there were no major outliers. Using time series data may lead to serially correlated residuals especially in cases where lags are included in the model. This results in OLS estimates having small standard errors that yield inefficient, biased and inconsistent estimates (Gujarati, 2004). Therefore, serial autocorrelation tests were done on all the models. Results of the serial correlation Lagrange Multiplier (LM) test as shown in Table 5 below indicated that the null hypothesis of “no serial correlation” at lag order 8 could not be rejected for all the models.

Table 5 LM Test Results

	LM Statistic	P-Value
Model 1	21.3317	0.6746
Model 2	18.56048	0.8177
Model 3	34.46994	0.5354
Model 4	25.10415	0.4565
Model 5	22.15107	0.627
Model 6	23.85634	0.5259
Model 7	33.72281	0.114

In addition, one assumption in linear regression analysis is that the residuals are normally distributed (Gujarati, 2004). To ascertain this assumption, the Jarque-Bera normality test was conducted. The results of the normality test of the residuals showed that the residuals were multivariate normal. To test for the presence of autoregressive conditional heteroskedasticity, the ARCH LM test was used. The results showed that at all significance levels, the null hypothesis that there exists no ARCH up to order 8 in each individual equation in the VAR models was not rejected. This implies that there was no presence of autoregressive conditional heteroskedasticity in the residuals. The stability of the VAR models was also tested and the results showed that no roots were outside the unit circle which implied that the VAR models estimated satisfied the stability condition.

5.7 VAR Results and Innovation Accounting

5.7.1 Impulse Response Function Analysis

In order to analyze the pass-through of international oil price shocks to domestic inflation, VAR model was estimated and impulse response functions were obtained. The impulse response functions trace the effects on a variable of a given shock to the innovations from an equation in the VAR system over time (Enders, 2015). The persistence of a shock indicates the speed at which the system returns to equilibrium. The faster a shock dampens, the faster the adjustment. In this regard, the analysis is on the effect of an international oil price shock on each of the variables especially on its effect on consumer price inflation. In the estimation, international oil prices were considered as an endogenous variable in order to enable tracing of the impact of an oil price shock on the domestic macroeconomic variables. The impulse response is the middle line and the dotted lines are confidence bands which were computed using the estimated coefficients of the VAR system of equations and Monte-Carlo integration with 1000 repetitions as recommended by Brown *et al* (1995). These results are shown in Figure 5.

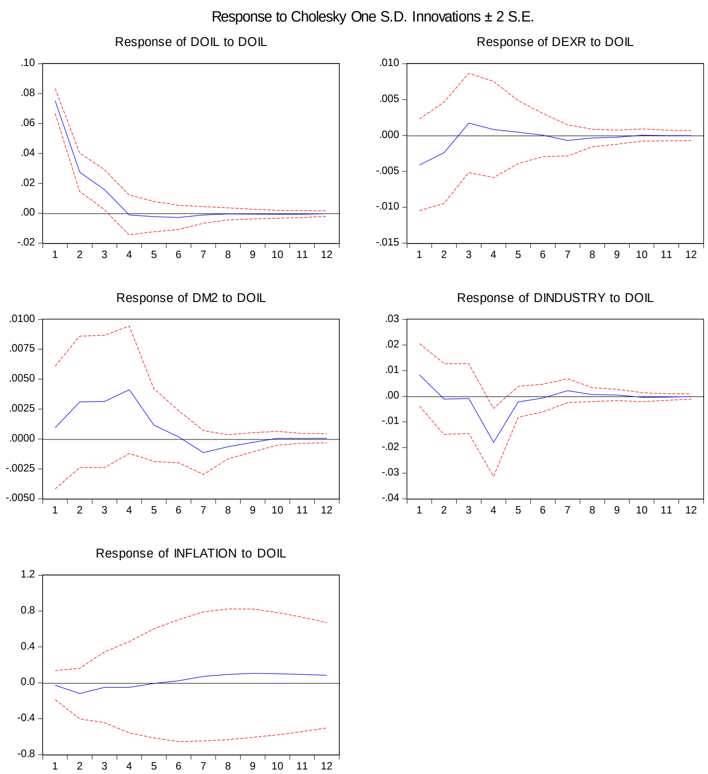

Figure 5 Impulse Response Function for Overall Inflation

From the impulse response functions, it can be observed that a one standard deviation shock originating from international oil prices will result into a positive effect on domestic inflation (bottom graph). The response begins in the second month and reaches its maximum 9 months after the shock, after which it slowly dies but does not return to equilibrium at the end of 12 months. The impact of an international oil price shock on inflation is persistent as compared to that of the other three variables. An international oil price shock has an immediate and positive impact on money supply. The positive effect lasts till the sixth month after which it becomes negative and finally returns to equilibrium after ten months. The maximum effect occurs in the fourth month.

Industrial production responds negatively to a one standard deviation innovation of international oil price shock as evidenced by a decline in output immediately after the shock occurs. The maximum effect occurs around the fourth month and output returns to equilibrium in the sixth month. This is expected since oil is used in the production process such that a rise in oil prices on the international market leads to higher production costs which results in reduced production levels. The response of exchange rate to a one standard deviation shock arising from international oil prices is a depreciation of the local currency. In Malawi, petroleum products make up a larger percentage of imports. As such, a rise in international oil prices will increase the import bill for the country which then worsens trade balance that in turn has adverse effect on exchange rate. The impact is however short-lived as exchange rate returns to equilibrium within the first six months.

More importantly, the impact of an oil price shock on inflation, money supply and exchange rate as captured by the impulse response functions is not statistically significant as evidenced by the confidence bands that are centered around zero. This implies that inflation, money supply and exchange are not significantly affected by international oil price shocks. However, there is a significant response to an oil price shock by the industrial production which is experienced in the fourth month. This implies that international oil price shocks significantly pass-through to industrial production which is evidence of the supply-side effect that was discussed by Brown *et al* (1995).

5.7.2 Variance Decomposition

A variance decomposition assigns the variance of the forecast errors in a given variable to shocks from itself as well as shocks from the other variables in the VAR (Enders, 2015). Variance decompositions provide a tool of analysis to determine the relative importance of one variable in explaining the variations in another variable. The results in Table 6 show the percentages of the forecast error variance in the row variable caused by variations in the column variable generated over a period of 12 months.

Oil price shocks explain a relatively small percentage of the forecast error variance in inflation as well as the other macroeconomic variables. For the sample period, 2.5 percent of the variations in inflation are due to variations in international oil prices while exchange rate shocks cause 14.8 percent of variations in consumer price inflation making it the largest source of the forecast error variance in inflation. Money supply explains 6.6 percent of the variations in consumer price inflation. IIP explains an insignificant amount of less than 1 percent of the variations in inflation. About 75 percent of the variations in consumer price inflation are caused by shocks within itself. As a result, about 17.3 percent of the variations in consumer price inflation are resulting from external shocks giving room for domestic price controlling policies.

Table 6 Variance Decomposition Results

	LogOil	**LogM2**	**LogExr**	**LogIIP**	**LogCPI**
LogM2	1.38	93	0.32	2.33	2.98
LogExr	1.56	0.56	96.6	0.81	0.48
LogIIP	2.21	4.17	0.86	92.5	0.24
LogCPI	2.5	6.6	14.8	0.87	75.3
LogOil	96.7	0.5	1.86	0.16	0.8

The results from the variance decomposition reveal that the pass-through of international oil price shocks to inflation in Malawi is fairly low and incomplete as is expected due to the presence of price regulation of petroleum products. Furthermore, the low pass-through coefficient is indicative of the low proportion of fuel in the composition of the consumption basket as compared to food since fuel is relatively a minor component of direct consumption.

5.7.3 International Oil Price Pass-Through to Rural and Urban Inflation

The results of oil price pass-through to overall inflation does not explain whether the impact of oil price shocks to rural and urban consumer inflation is different or not. As such, national inflation was decomposed to rural and urban inflation. Models 2 and 3 were estimated and the impulse responses obtained are as shown in Figure 6 below. The response of a one standard deviation shock originating from international oil prices to rural inflation is ambiguous. In the initial period, there is a positive response that lasts the first two months which is followed by a negative response the next two months, after which, it eventually returns to equilibrium in sixth month. The response of urban inflation to an oil price shock on the other hand is positive and the full effect occurs in the second month and returns to equilibrium in the next period. Both impulse response functions are centered around zero which implies that they are not statistically significant as is the case with the response of national inflation discussed above.

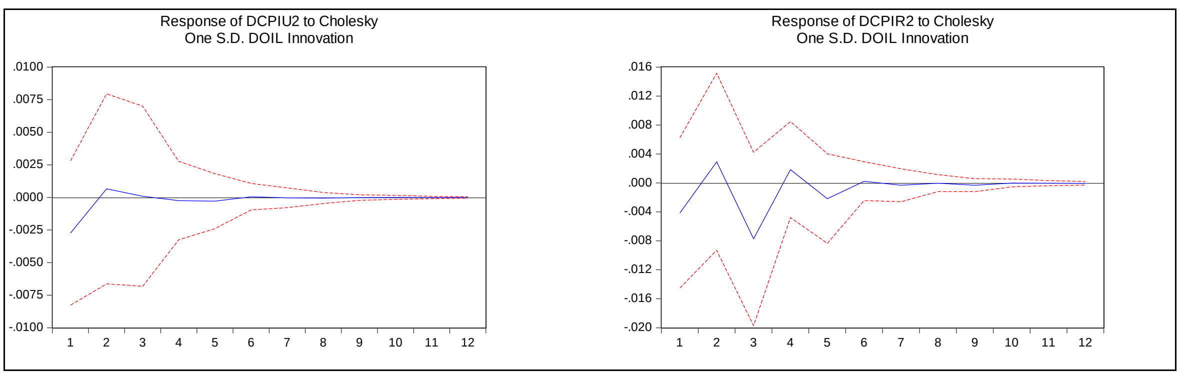

Figure 6 Impulse Response Functions for Rural and Urban Inflation

About 4.1 percent of the variations in rural inflation is due to international oil price shocks while industrial production, money supply and exchange rate explain 2.1, 4.6 and 1.4 percent of the forecast error variance in rural inflation respectively. Over 80 percent of its variations are from within itself. In regards to urban inflation, 14.8 percent of its variations are as a result of international oil price shocks while exchange rate fluctuations, industrial production and money supply changes explain 11.5, 8.7 and 5.01 of the forecast error variance in urban inflation respectively and 60 percent are from variations within itself.

In both cases, exchange rate is the main source of variations as compared to the other variables. However, exchange rate is a source of a larger percentage of the variations in urban inflation than rural inflation and this could be because consumers in urban areas are more vulnerable to exchange rate shocks due to their higher level of expenditure on non-food items which are mostly imported. These results are indicative of the fact that the non-food component in the consumption basket for urban inflation is higher (66.1 percent) than that of the rural consumption basket (32.3 percent) (Government of Malawi, 2015c). The variance decomposition indicates that more of the variations in urban inflation are explained by international oil price shocks as compared to the variations in rural inflation. This outcome is supporting the understanding that the level of consumption of petroleum products in rural areas is lower than that of urban areas such that the impact of international oil price shocks should be more for urban inflation than rural inflation.

5.7.4 Transmission Channels

The impact of international oil prices can pass-through to domestic inflation via different channels such as through local food, fuel, household operations and core prices. International oil prices affect domestic fuel and transportation prices directly and headline inflation indirectly through their impact on the input costs for all other products. In order to trace the specific transmission channels through which international oil price shocks affect inflation, CPI was decomposed to its food and non-food components and then transportation and household operations components such that four additional VARs were estimated. The Impulse response functions obtained from each of the estimations are as shown in Figure 7. These impulse response functions are also statistically insignificant.

The initial response of non-food inflation to an oil price shock is a decline in inflation which only lasts up to the third month as shown in Figure 7. Thereafter, non-food inflation rises and the full effect is reached in the eighth month after which it begins to gradually decline but does not return to equilibrium within the twelve month period. This shows the indirect effect whereby an oil price shock affects the cost of production which in turn affects consumer prices as well as the direct effect since other components are directly affected by an oil price shock such as transportation. Food inflation also rises following a positive shock in international oil prices. The maximum effect is reached in the third month after which food inflation begins to decline until it returns to equilibrium after eight months. This is a result of a positive international oil shock that in turn leads to an increase in the prices of imported food products.

The variance decomposition indicated that international oil price shocks explain 1.2 and 3.8 percent of the variations in food and non-food inflation respectively. This was expected since about 70 percent of the food component of CPI is maize which is grown locally. About 50 percent of the forecast error variance in non-food inflation is explained by variations in exchange rate as compared to food inflation where only 2 percent of the variations are due to exchange rate. In both cases, the full effect comes after a time lag and this could be partly because producers do not pass-through the rising costs to consumers immediately. The impact of international oil prices on food inflation dies faster while that on non-food inflation lasts beyond the twelve month period. Figure 7 also shows that in response to an oil price shock, household operations inflation shoots up in the first two months then it goes down in the third month before it starts to rise again and eventually dies between the seventh and eighth month. The maximum effect is in the second month. Its variance decomposition indicated that 3.7 percent of the variance in household operations inflation is explained by an oil price shock at the end of the year.

Transportation also responds positively to a shock in oil prices. The initial response is relatively small in the first two months but it rises between the third and fourth month after which it declines and rises again in the eighth month. It eventually dies in the tenth month. Considering that transportation costs are directly affected by an oil price shock, the response in the case of Malawi is very low which again can be attributed to domestic price regulation as well as the possibility that transportation index may not be the best proxy for energy or fuel inflation. An oil price shock explains about 4.8 percent of the variance in transportation inflation at the end of the 12 month period while exchange rate explains 17.1 percent of its variations. The impulse responses of non-food, food, transportation and household operations are also not statistically significant. It can be concluded therefore that the impact of oil price shocks to the household operations and transportation components of the CPI is also low and incomplete.

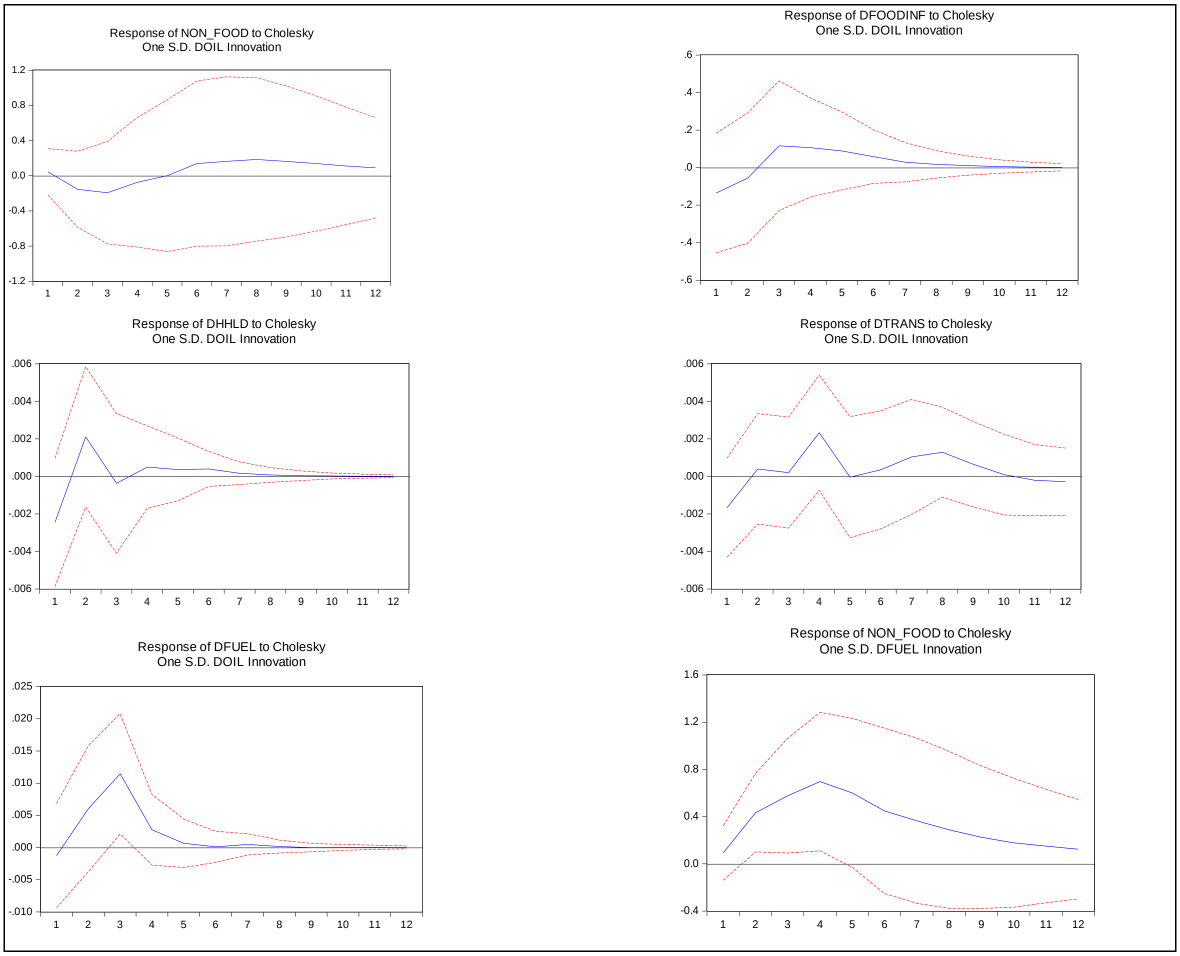

Figure 7 Impulse Response Functions Tracking Transmission Channels

These results weakly support the said transmission channels of an oil price shock to inflation. Thus, to further explore the transmission channels, the impact of international oil price shocks to domestic fuel prices as well as the impact of domestic fuel prices to inflation were analyzed. The impulse response function (bottom left in Figure 7) revealed that an oil price shock yields a significant positive response in domestic fuel prices. The full effect is in the third month and domestic fuel prices return to equilibrium after the sixth month.

The variance decomposition indicated that 5.2 percent of the variations in domestic fuel prices is a result of the variations in international oil prices, about 12 percent are from exchange rate fluctuations and 4.1 percent is explained by shock in IIP while 78.3 percent is from shocks within itself. In turn, domestic fuel prices significantly impact non-food inflation (bottom right in Figure 7) and the full effect is in the fourth month. The impact is persistent and it does not die within the 12 months. Domestic fuel prices explain about 4 percent of the forecast error variance in inflation. Therefore, the significant transmission channel then is that international oil price shocks pass into domestic fuel prices and then to non-food inflation.

5.7.5 Cumulative Pass-Through Coefficients

Having analyzed the impulse response functions and variance decompositions, pass-through coefficients were then obtained by dividing the cumulative impulse responses of price indices (CPI, rural, urban, food, non-food, household operations and transportation) after j months by the cumulative response of oil price after j months of the oil shock (Jongwanich & Park, 2011). A graphical representation of the coefficients is in Figure 8.

The pass-through of an oil price shock to consumer price inflation is negative for the first three months but positive in other months. The cumulative pass-through at the end of the twelve months is 0.296 which indicates that a 10 percent increase in international oil prices leads to an increase in domestic consumer prices of 2.96 percentage points. Thus, the pass-through of an international oil price shock to domestic inflation is low and incomplete and that full impact is experienced with a lag.

The impact of an international oil price shock to non-food inflation is higher than that of food inflation as is expected since Malawi is food self-sufficient. The pass-through to food and non-food inflation is 0.192 and 0.574 respectively indicating that a 10 percent increase in international oil prices results into a 1.92 and 5.74 percent increase in food and non-food inflation. In regards to transportation and household operations, international oil price shock results into a modest pass-through of 0.023 and 0.003 respectively. Therefore, a 10 percent increase in oil prices results in a maximum of 0.23 and 0.03 percent increase in transportation and household operations prices respectively. Cumulative pass-through coefficients for rural and urban inflation were also estimated. A 10 percent increase in international oil prices results in a maximum of 0.18 and 0.12 increase in urban and rural inflation respectively which indicates that the impact is more to urban than rural inflation.

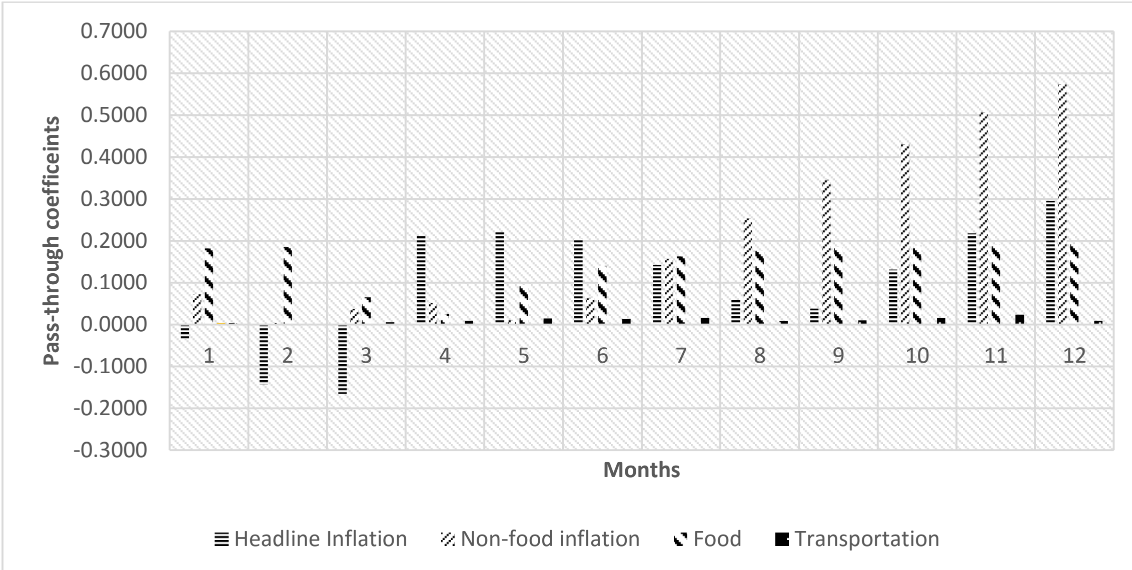

Figure 8 Cumulative Pass-through Coefficients

The estimated cumulative pass-through coefficient of 0.296 shows the average impact of international oil price shock on domestic consumer price inflation during the sample period. These results are a reflection of the average policy response of Malawi to international oil price shocks in that period. It should, therefore, be noted that the pass-through may have been lower or higher than 0.296 at another period due to policy changes.

5.8 Possible Reasons for Low and Incomplete Pass-Through

The most of the impulse response functions are statistically insignificant which implies that international oil price shocks are not significant in determining domestic inflation. However, the impulse response functions showed that inflation responds positively to an international oil price shock despite the response being insignificant. Results of the variance decomposition and the cumulative pass-through coefficients revealed that the pass-through of international oil price shocks to domestic inflation is low and incomplete. These results are not surprising and there are a number of reasons why this is the case for Malawi.

Firstly, domestic fuel prices are regulated by the government through MERA such that consumers do not face the actual market prices of petroleum products. The intervention distorts the fuel prices such that consumers do not adjust to higher international oil prices as domestic fuel prices do not give a true reflection of the prices on the international market. Furthermore, the PSF is used to subsidize any changes in IBLC that are below the 5 percent threshold. For instance, a rise in IBLC following a rise in international oil prices that is below 5 percent does not result into a similar rise in domestic prices but that fuel importers are compensated for their losses using funds from the PSF. Hence, any change in the international oil prices that results in a less than 5 percent change in IBLC is not passed-through to domestic prices. It has also been observed that even in cases where the change is beyond the 5 percent threshold, prices do not always change as expected.

The second possible explanation is the low proportion of fuel in the consumption basket as compared to food since fuel is relatively a minor component of direct consumption. This is corroborated by the fact that transport composition in the CPI basket is only 7 percent compared to food which makes up 50.2 percent of the basket. Another explanation is that pass-through as estimated in this regard did not take into account transportation, distribution and marketing costs of fuel although these make a minor contribution to fuel prices. Pass-through of oil price shocks to inflation is also distorted by exchange rate movements. For instance, a depreciation of the Kwacha against the dollar if not reflected in a corresponding rise in the domestic prices of imports could understate the price pass-through. The presence of taxes in the cost structure of fuel prices in Malawi also contributes to the limited pass-through since in certain cases, to contain the rise in oil prices, authorities resort to adjusting such taxes like the PSF levy.

CHAPTER SIX

CONCLUSION AND POLICY RECOMMENDATIONS

6.0 Introduction

This chapter includes a summary of the estimation results, conclusions drawn from the analysis as well as some policy recommendations and limitations of the study.

6.1 Conclusion

As a small, open and oil importing economy, Malawi is highly dependent on oil which makes it more vulnerable to developments on the international oil market. However, domestic prices of petroleum products are stable relative to the volatile international oil prices. As such, this study examined the rate at which international oil price shocks affect domestic inflation, investigate the channels through which oil price shocks influence domestic inflation rate as well as to analyze whether international oil price shocks have a differential impact on rural and urban inflation. In pursuit of this objective, the VAR modelling approach was used. From the VAR, impulse response functions were used to assess the response of domestic inflation to an international oil price shock. Variance decompositions were used to assess the extent to which international oil price shocks explain the forecast error variance in inflation.

The study found that all the three null hypotheses were rejected. Specifically, it was found that the pass-through of international oil price shocks to domestic headline inflation is low and incomplete, thereby corroborating the findings by Mbuzi (2014). Impulse response functions showed that domestic headline inflation responds positively to an oil price shock whereas variance decomposition indicated that only 2.5 percent of the variations in headline inflation are due to an oil price shock. The maximum cumulative pass-through coefficient that was estimated is 0.296 which indicates that a 10 percent change in international oil prices leads to a change in domestic inflation of 2.96 percentage points.

The study also found that there are differential impacts of international oil price shocks on rural and urban inflation. The estimation results showed that urban inflation responds more to an international oil price shock as compared to rural inflation. In regards to the transmission channels, the study found that international oil price pass-through is more to transportation as compared to household operations. International oil price shocks pass-through the non-food component more than the food component. These results weakly confirm the channel international oil prices affects these CPI components which in turn affect headline inflation. A stronger channel was found to be that international oil price shocks affect domestic fuel prices which in turn affect non-food inflation.

A combination of factors including the domestic fuel pricing system (APM) as well as use of the PSF to stabilize fuel prices, high content of food in the consumption basket among others are what limit how much of international oil price shocks pass-through to domestic inflation.

As such, the major contribution of this study to the already existing literature is that international oil prices shocks do not directly affect domestic headline inflation but that they pass-through to non-food inflation through domestic fuel prices and then to headline inflation. In addition, the study also found that international oil price shocks significantly affect domestic output hence indicating evidence of the supply-side cost-push effect of international oil price shocks.

6.2 Policy Implications

International oil prices have been very volatile and this has adverse economic and welfare effects for a country like Malawi. An automatic pass-through of international oil price changes to domestic oil prices can result into volatile domestic prices of petroleum products which can in turn have adverse effects to consumers, producers and overall growth of the economy. This study has shown that there is a low and incomplete pass-through of international oil price shocks to domestic inflation and that international oil price shocks are not a significant determinant of domestic inflation as is the case in other oil importing African economies such as Kenya, Tanzania, Rwanda, Burundi and Uganda as found by Murgasova *et al* (2009).

The limited effect of international oil price shocks on domestic consumer prices confirms that Malawi's current policies, particularly the use of the PSF, has been effective in cushioning the economy from oil price shocks. The results also indicated that exchange is the major source of external shocks to domestic headline inflation. Therefore, monetary authorities need to strengthen existing policies that are aimed at managing exchange rate movements. A combination of effective policies that target oil price shocks and exchange rate movements will contribute towards reducing non-food inflation which will in-turn lead to a decline in domestic headline inflation.

Regarding strengthening the PSF, in order for any stabilization fund to be self-financing, it is important that the expected price change used for the scheme (5 percent for Malawi) be close to the actual average experienced over the short to medium term. International oil prices have over the past decade been very volatile which may bring some doubt as to whether the 5 percent expected change is still valid. One main problem with this system is that if the basis for calculating the expected price is incorrect, then the scheme could run a persistent deficit which would have to be financed by government (Bacon & Kojima, 2006).

In cases where the PSF has not accumulated enough funds, it will be unable to smoothen price changes without a transfer from government. This can in turn translate to higher budget deficits and a larger consumption loss. As such, coming up with a more sustainable means of price stabilization that does not required government's intervention at any point will be ideal for Malawi. For instance, MERA should strictly follow the APM and adjust prices of domestic petroleum products each time the +/-5 percent threshold is reached to enable accumulation of funds in the PSF. On the other hand, domestic fuel prices that are non-reflective of international price movements imply that the domestic demand for oil products will remain high which will have negative effects on Malawi's balance of payment in the long run.

6.3 Limitations

The study was faced with some minor limitations. The first one is that the study only looked at evidence of the imported inflation channel while there are other four channels through which international oil prices affect the domestic economy as discussed in chapter 3 which are yet to be investigated for Malawi. Another limitation is that the study did not go further to assess second round effects of international oil prices on domestic inflation. To do this would have required use of an input-output table for Malawi. However, the input-output table which was released in 2010 is outdated.

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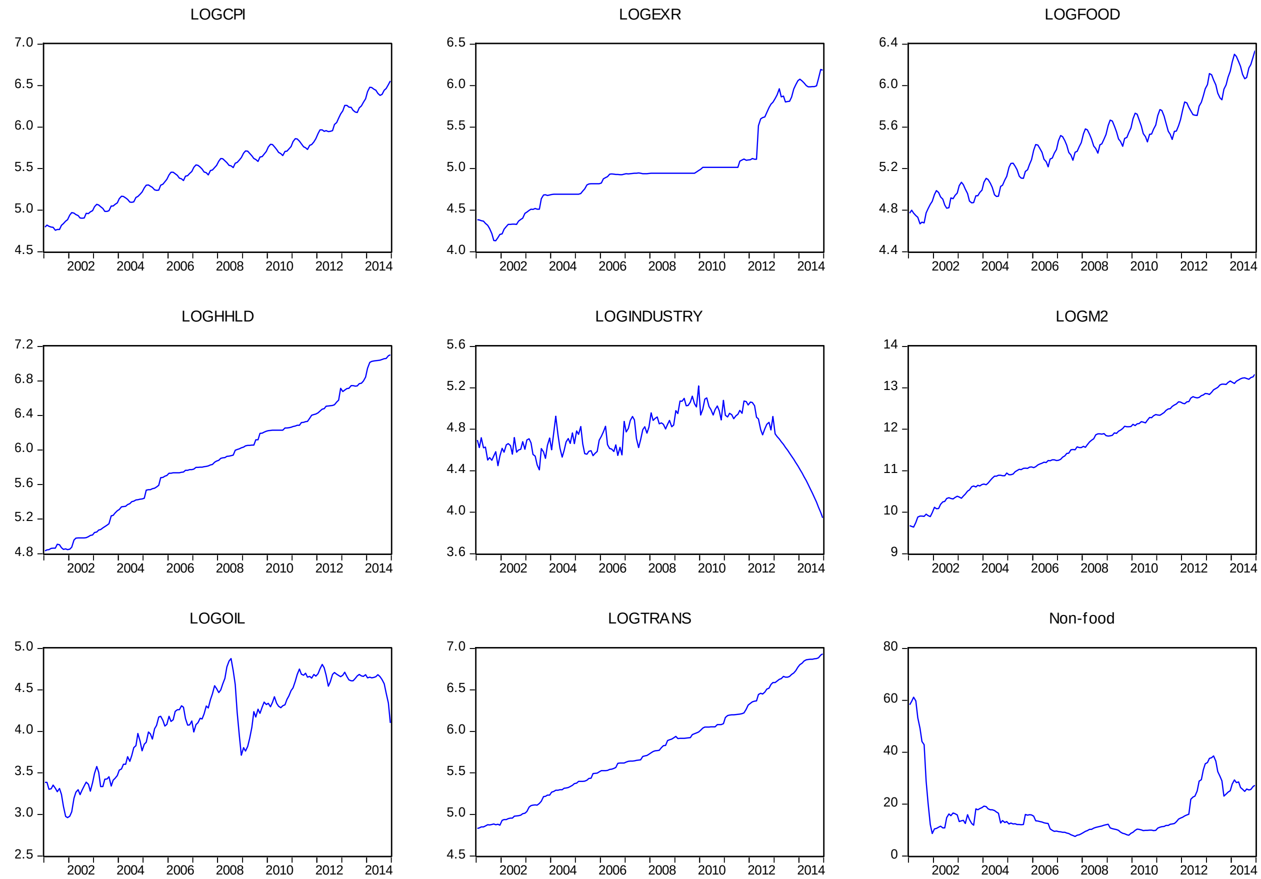
APPENDICES

Appendix 1 Time series plot of the data used



Appendix 2

Restricted VAR estimation results

Vector Autoregression Estimates
Date: 02/04/16 Time: 06:34
Sample (adjusted): 2001M04 2014M12
Included observations: 165 after adjustments
Standard errors in ( ) & t-statistics in [ ]

	DOIL	DM2	DEXR	DINFLATION	DINDUSTRY
DOIL(-1)	0.375314	0.029827	-0.018299	0.029715	0.060819
	(0.08023)	(0.03536)	(0.04402)	(1.15373)	(0.08666)
	[4.67797]	[0.84352]	[-0.41566]	[0.02576]	[0.70180]
DOIL(-2)	0.043959	0.051306	0.044480	1.194023	-0.059574
	(0.08108)	(0.03573)	(0.04449)	(1.16591)	(0.08758)
	[0.54220]	[1.43580]	[0.99982]	[1.02411]	[-0.68026]
DM2(-1)	-0.058849	0.037123	-0.076424	-0.712571	-0.472538
	(0.18600)	(0.08198)	(0.10206)	(2.67477)	(0.20091)
	[-0.31639]	[0.45285]	[-0.74879]	[-0.26640]	[-2.35196]
DM2(-2)	0.179242	-0.294755	0.003582	8.392475	-0.222417
	(0.18572)	(0.08185)	(0.10191)	(2.67071)	(0.20061)
	[0.96512]	[-3.60103]	[0.03515]	[3.14242]	[-1.10872]
DEXR(-1)	-0.189327	0.037037	0.237410	4.391790	-0.184410
	(0.15558)	(0.06857)	(0.08537)	(2.23725)	(0.16805)
	[-1.21694]	[0.54016]	[2.78102]	[1.96303]	[-1.09736]
DEXR(-2)	0.379283	0.060971	0.012384	-1.501480	-0.047579
	(0.15886)	(0.07001)	(0.08717)	(2.28443)	(0.17159)
	[2.38756]	[0.87085]	[0.14207]	[-0.65727]	[-0.27728]
DINFLATION(-1)	-0.000455	-0.001233	0.002679	0.346190	0.001880
	(0.00590)	(0.00260)	(0.00324)	(0.08482)	(0.00637)
	[-0.07712]	[-0.47417]	[0.82781]	[4.08126]	[0.29507]
DINFLATION(-2)	-0.008245	-0.004840	-0.002522	0.245178	-0.002514
	(0.00559)	(0.00247)	(0.00307)	(0.08045)	(0.00604)
	[-1.47392]	[-1.96314]	[-0.82174]	[3.04771]	[-0.41612]
DINDUSTRY(-1)	0.022904	-0.028768	-0.044551	0.218687	-0.305282
	(0.07479)	(0.03296)	(0.04104)	(1.07547)	(0.08078)
	[0.30625]	[-0.87278]	[-1.08563]	[0.20334]	[-3.77904]
DINDUSTRY(-2)	0.090175	-0.064701	-0.015896	1.657206	-0.107027
	(0.07327)	(0.03229)	(0.04020)	(1.05359)	(0.07914)
	[1.23079]	[-2.00368]	[-0.39541]	[1.57291]	[-1.35239]
C	-0.002154	0.025663	0.009383	-0.196975	0.011357
	(0.00800)	(0.00353)	(0.00439)	(0.11502)	(0.00864)
	[-0.26926]	[7.27973]	[2.13795]	[-1.71251]	[1.31448]

R-squared	0.210645	0.118747	0.091630	0.332378	0.129510
Adj. R-squared	0.159388	0.061523	0.032645	0.289026	0.072984
Sum sq. resids	0.857919	0.166647	0.258312	177.4117	1.000977
S.E. equation	0.074638	0.032896	0.040955	1.073324	0.080622
F-statistic	4.109591	2.075120	1.553445	7.666940	2.291179
Log likelihood	199.7584	334.9455	298.7867	-240.1084	187.0351
Akaike AIC	-2.287981	-3.926612	-3.488323	3.043738	-2.133758
Schwarz SC	-2.080918	-3.719549	-3.281260	3.250801	-1.926695
Mean dependent	0.004825	0.022359	0.010992	-0.027273	-0.004680
S.D. dependent	0.081408	0.033957	0.041641	1.272928	0.083735

Determinant resid covariance (dof adj.)	6.04E-11
Determinant resid covariance	4.28E-11
Log likelihood	799.0961
Akaike information criterion	-9.019347
Schwarz criterion	-7.984032

Unrestricted VAR Estimation Results

Vector Autoregression Estimates
Date: 01/31/16 Time: 15:11
Sample (adjusted): 2001M05 2014M12
Included observations: 164 after adjustments
Standard errors in ( ) & t-statistics in [ ]

	DOIL	DM2	DEXR	DINDUSTRY	DFOODINF
DOIL(-1)	0.357746	0.041886	0.004279	0.031661	-0.546313
	(0.08516)	(0.03704)	(0.04640)	(0.08992)	(2.25176)
	[4.20103]	[1.13073]	[0.09222]	[0.35210]	[-0.24262]
DOIL(-2)	0.071986	0.028691	0.041735	0.012145	1.963989
	(0.08656)	(0.03765)	(0.04717)	(0.09140)	(2.28884)
	[0.83165]	[0.76198]	[0.88481]	[0.13288]	[0.85807]
DOIL(-3)	-0.108574	0.028761	-0.001719	-0.200207	-1.783798
	(0.08299)	(0.03610)	(0.04522)	(0.08763)	(2.19434)
	[-1.30835]	[0.79672]	[-0.03801]	[-2.28479]	[-0.81291]
DM2(-1)	-0.018037	0.018790	-0.110670	-0.411141	1.186728
	(0.19487)	(0.08477)	(0.10619)	(0.20576)	(5.15277)
	[-0.09256]	[0.22167]	[-1.04221]	[-1.99811]	[0.23031]
DM2(-2)	0.218311	-0.249926	0.010196	-0.232274	12.64716
	(0.18991)	(0.08261)	(0.10349)	(0.20053)	(5.02175)
	[1.14954]	[-3.02526]	[0.09853]	[-1.15829]	[2.51848]
DM2(-3)	-0.016806	-0.047988	-0.126139	0.161350	4.867204
	(0.19813)	(0.08619)	(0.10797)	(0.20921)	(5.23910)
	[-0.08482]	[-0.55678]	[-1.16831]	[0.77123]	[0.92901]
DEXR(-1)	-0.186221	0.034946	0.272087	-0.174660	4.063340
	(0.15076)	(0.06558)	(0.08215)	(0.15919)	(3.98643)
	[-1.23523]	[0.53287]	[3.31200]	[-1.09718]	[1.01929]
DEXR(-2)	0.287437	0.036936	-0.014092	-0.076274	-6.297659
	(0.15730)	(0.06843)	(0.08572)	(0.16610)	(4.15944)

	[1.82731]	[0.53978]	[-0.16440]	[-0.45921]	[-1.51406]
DEXR(-3)	0.127045	-0.083520	-0.018467	0.109428	5.861182
	(0.15625)	(0.06797)	(0.08514)	(0.16499)	(4.13162)
	[0.81309]	[-1.22879]	[-0.21689]	[0.66325]	[1.41862]
DINDUSTRY(-1)	0.023929	-0.036761	-0.047447	-0.300970	-0.205679
	(0.07724)	(0.03360)	(0.04209)	(0.08156)	(2.04246)
	[0.30980]	[-1.09404]	[-1.12726]	[-3.69012]	[-0.10070]
DINDUSTRY(-2)	0.103076	-0.059710	-0.032255	-0.106084	4.620554
	(0.08029)	(0.03493)	(0.04375)	(0.08478)	(2.12307)
	[1.28380]	[-1.70958]	[-0.73723]	[-1.25129]	[2.17635]
DINDUSTRY(-3)	0.010000	0.020507	-0.003638	-0.039919	-2.227206
	(0.07720)	(0.03358)	(0.04207)	(0.08152)	(2.04133)
	[0.12953]	[0.61066]	[-0.08647]	[-0.48971]	[-1.09106]
DFOODINF(-1)	0.000845	-0.001826	0.001504	0.002365	0.331432
	(0.00319)	(0.00139)	(0.00174)	(0.00337)	(0.08447)
	[0.26447]	[-1.31413]	[0.86407]	[0.70114]	[3.92355]
DFOODINF(-2)	-0.003502	-0.000493	-0.002103	-0.001835	0.188605
	(0.00323)	(0.00140)	(0.00176)	(0.00341)	(0.08538)
	[-1.08468]	[-0.35108]	[-1.19541]	[-0.53818]	[2.20893]
DFOODINF(-3)	-0.002461	-0.000542	0.002243	-0.002359	-0.010948
	(0.00309)	(0.00135)	(0.00169)	(0.00327)	(0.08181)
	[-0.79548]	[-0.40250]	[1.33060]	[-0.72197]	[-0.13382]
C	-0.002688	0.027122	0.012681	0.007529	-0.385154
	(0.00980)	(0.00426)	(0.00534)	(0.01035)	(0.25921)
	[-0.27425]	[6.36032]	[2.37394]	[0.72736]	[-1.48587]
R-squared	0.224477	0.119382	0.118836	0.176569	0.234329
Adj. R-squared	0.145877	0.030131	0.029528	0.093114	0.156727
Sum sq. resids	0.842885	0.159500	0.250290	0.939799	589.3530
S.E. equation	0.075466	0.032828	0.041124	0.079687	1.995524
F-statistic	2.855934	1.337590	1.330639	2.115724	3.019632
Log likelihood	199.4990	336.0112	299.0644	190.5745	-337.5969
Akaike AIC	-2.237792	-3.902576	-3.452004	-2.128957	4.312158
Schwarz SC	-1.935366	-3.600150	-3.149578	-1.826531	4.614584
Mean dependent	0.004826	0.021816	0.011102	-0.004117	0.074390
S.D. dependent	0.081657	0.033334	0.041744	0.083678	2.173065

Determinant resid covariance (dof adj.)	2.32E-10
Determinant resid covariance	1.39E-10
Log likelihood	697.7864
Akaike information criterion	-7.533980
Schwarz criterion	-6.021850

Appendix 3

Co-integration test results for Model 6

Hypothesized number of CE	Eigen Value	Trance Statistic	5% Critical Value	P-Value
None	0.19095	66.3331	69.8189	0.1919
At most 1	0.0935	31.795	47.8561	0.6234
At most 2	0.05897	15.7951	29.7971	0.7266
At most 3	0.03383	5.88807	15.4947	0.7087
At most 4	0.00171	0.27925	3.84147	0.5972

Co-integration test results for model 7

Hypothesised number of CE	Eigen Value	Trance Statistic	5% Critical Value	P-Value
None	0.16704	59.7281	69.8189	0.2438
At most 1	0.0918	29.9359	47.8561	0.7222
At most 2	0.05975	14.2414	29.7971	0.8268
At most 3	0.02511	4.19974	15.4947	0.8868
At most 4	0.00034	0.05466	3.84147	0.8151