EXCHANGE RATE PASS THROUGH TO DOMESTIC PRICES IN ZAMBIA

BY

HUMPHREY FANDAMU

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DECLARATION

I, Humphrey Fandamu, declare that this dissertation:

(a) Represents my own work;

(b) Has not previously been submitted for a degree at this or any other University; and

(c) Does not incorporate any published work or material from another dissertation.

Signed…………………………………………………

Date……………………………………………………...

APPROVAL

This Thesis of **Humphrey Fandamu** has been approved as a fulfilling the requirement for the award of the degree of Doctor of Philosophy by the University of Zambia.

Examiner 1: …………………………………. Signed.………………Date………….

Examiner 2: …………………………………. Signed: ………………Date………….

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Chairman of Board

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ABSTRACT

The major objective of the thesis was to examine the exchange rate pass through to domestic prices in Zambia. The first specific objective examined the exchange rate pass through to consumer prices using the SVAR. Results have shown from that exchange rate passthrough is incomplete and asymmetrical. Results also show that Kwacha depreciation increases consumer price inflation in Zambia. This means that exchange rate movements have the capacity of impairing inflation targets in Zambia. Therefore, to achieve price stability, policy makers should not only focus on monetary stability but also on the exchange rate stability. The second specific objective examined the exchange rate pass through to sectoral prices in the agriculture, manufacturing and services sectors. The findings have shown that the services sector is the most affected sector by exchange rate movements. This is followed by the manufacturing and agriculture sectors. This is likely because the services sector is dominated by wholesale and retail sector, tourism sector and financial services which are sensitive to exchange rate changes. The manufacturing sector is affected because it heavily depends on imported inputs. This sends the signal to policy makers to boost our manufacturing sector and reduce its heavy dependence on imports. Zambia needs to encourage the use of local inputs to reduce dependence on imported inputs. The government should also encourage local tourism thereby reducing the impact of external shocks to this sector. This will reduce the impact of external shocks to the sector. The agriculture sector is least affected by exchange rate movements. This could mean there is less foreign trade in the sector. The government needs to encourage foreign trade in the sector. Finally, the thesis examined the impact of Chinese presence, multilateral and regional globalisation on the exchange rate pass through in Zambia. Results show that Chinese presence has a greater effect than regional globalisation on the exchange rate passthrough to consumer prices. This shows that China has a greater influence on Zambia. There is need to strengthen China-Zambia trade relations to reduce trade cost and trade tariffs on goods imported from China. This may have the reducing effect on the exchange rate pass through to consumer prices and consequently on inflation in Zambia. There could be need to strengthen and increase regional trade since regional trade has a lower effect on the exchange rate passthrough to consumer price inflation.

DEDICATION

To mum and my late dad.

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LIST OF ABBREVIATIONS

ADF	Augmented Dickey Fuller
AIC	Akaike Information Criterion
ARDL	Autoregressive Distributed lag
BOZ	Bank of Zambia
CBU	Copperbelt University
CPI	Consumer Price Index
CSO	Central Statistics Office
ERPT	Exchange Rate Pass Through
FDI	Foreign Direct Investment
FEVD	Forecast Error Variance
FPE	Final Prediction Error
GDP	Gross Domestic Product
HP	Hodrick and Prescott
HQ	Hannin and Quinn
IFS	International Financial Statistics
IMF	International Monetary Funds
LCP	Local Currency Pricing
MOFNP	Ministry of Finance and National Planning
NARDL	Non-Linear Autoregressive Distributed lag
OGL	Open General License
OLS	Ordinary Least Squares

PCP	Producer Currency Pricing
PP	Philip Perron
SADC	Southern African Development Community
SDR	Special Drawing Rights
SIC	Schwarz Information Criterion
SVAR	Structural Vector autoregressive
UK	United Kingdom
UNDP	United Nation Development Programme
USA	United States of America
VAR	Vector Autoregressive
VECM	Vector Error Correction
WDI	World Development Indicators

CHAPTER 1

INTRODUCTION

1.1. Background

There has been intense debate in many countries over the optimal exchange rate regime since the collapse of the fixed exchange rate system. Many scholars have advocated for a flexible exchange rate regime because of its theoretical potential benefits of automatic macroeconomic adjustments (Swift, 2001). One challenge of a fixed exchange rate regime is the need for an international flow of reserves for adjustment in the case of balance of payments disequilibria. For instance, if an economy has a balance of payments deficit on the current account, and the domestic currency must remain at the same value, the State must engage in the foreign exchange market. It must supply foreign reserves to maintain the value of the domestic currency. This means that the country must have a huge pool of foreign reserves to run a fixed exchange rate regime. Thus, in terms of the correction of a current account balance of payments deficit, it would mean foreign reserves leaving the country (Swift, 2001). Thus, a fixed exchange rate regime is very expensive to maintain due to the need to keep a lot of foreign reserves.

On the other hand, under a flexible foreign exchange regime, a country does not need to keep a lot of foreign reserves to maintain the value of its domestic currency. There is, therefore, no need for a flow of international reserves to correct disequilibria in the balance of payments. This is because balance of payment surpluses and deficits are corrected through an automatic adjustment of the exchange rate. This alters the relative import and export prices. Therefore, even if there were external or exogenous shocks to the economy, such as the 2008 global financial crisis (Ndulo et al, 2009), the economy will adjust until it settles at a new equilibrium. There will be neither need for the State to defend the domestic currency value nor for an international flow of foreign reserves. This is a desirable feature of the flexible exchange rate regime.

A flexible exchange rate regime facilitates relative price adjustments in the wake of country specific shocks (Friedman, 1953). The theoretical underpinning of this assertion is that relative price adjustments generate expenditure switching between home and foreign goods (Friedman, 1953). This argument assumes that domestic prices of imported goods respond to nominal exchange rate movements. For instance, if there is a current account deficit, the domestic currency will automatically depreciate. This should cause import prices to increase. This will consequently lead to a reduced demand for imports. What this means is that goods produced in the domestic economy become relatively cheaper than imported goods. This causes an increase in the demand for goods produced in the domestic economy. This increases domestic consumption, aggregate demand and consequently domestic output. Furthermore, the depreciation of the domestic currency will lead to an increased competitiveness and demand of the country's exports. This mechanism should lead to a balance of payments equilibrium if import and domestic prices adjust fully to changes in the nominal exchange rate. If the exchange rate pass through to domestic prices is low or if domestic prices respond weakly to changes in the nominal exchange rate and, therefore, domestic prices do not fully adjust to exchange rate movements, the expenditure switching will be very small. This will limit the desirability of the flexible exchange rate regime (Swift, 2001).

The direction of this discussion clearly shows that under a flexible exchange rate regime, the transmission mechanism of exchange rate changes to affect variables such as import and export prices, domestic prices, domestic consumption and output depends on the degree of responsiveness of these prices to changes in the exchange rate. This responsiveness of import, export and domestic prices to changes in exchange rate has become known as the exchange rate pass through (ERPT).

The exchange rate pass through can be defined as the degree to which nominal exchange rate movements are transmitted into first import prices and then to consumer prices in a domestic economy, other things being equal (Selin, 2016). Exchange rate pass through can be complete or incomplete. Exchange rate pass through is said to be complete if domestic prices fully adjust to exchange rate changes (Natalia & Luciana, 2014). Incomplete exchange rate pass through occurs when exchange rate changes are not fully transmitted into domestic prices so that trade prices in the first step and domestic prices in the second step exhibit low reaction to exchange rate changes (Gaula et al, 2002). By implication therefore, complete exchange rate pass through will occur when exchange rate changes are fully reflected in the prices so that there is a one-to-one transmission from exchange rates to prices. Early models of the exchange rate pass through claimed that exchange rate changes should be fully reflected in the prices (Friedman, 1953).

Branson (1972) and Magee (1973) carried out empirical work on the exchange rate pass through in the 1970s. They investigated the exchange rate pass through for developed countries such as the USA and European countries. They wanted to find out if indeed the exchange rate pass through would be complete as purported by theory advanced by Friedman (1953). Their findings showed that the exchange rate pass through was incomplete. They also found that external balances of major trading partners of the USA and European countries were not very responsive to movements in the exchange rate as predicted. The theorists imagined that the irresponsiveness of both the prices and the balance of payment observed in their studies was due to temporal price rigidities inherent in perfectly competitive markets and the relative demand and supply elasticities for traded goods in the short run (Swift, 2001). However, further research in developed countries showed that the incomplete exchange rate pass through was more of a reality than what theory offered. Further exploration of research in the 1970s, 1980s and 1990s onwards showed that the exchange rate pass through was not just incomplete, but asymmetric and declining over time. Some countries recorded large significant declines and others yielded less declines in the exchange rate pass through (Mann, 1986; Gus et al 2010; Olivei 2002; Otani et al, 2003). This behavioural pattern of exchange rate movements in relation to domestic prices and macroeconomic variables brought more confusion among researchers. This is because it totally contradicted economic theory.

The exchange rate pass through puzzle generated research in the 1970 and 1980s to investigate the reasons for the incomplete and the declining nature of the exchange rate pass through among many countries. And since the perfectly competitive models became handicapped in explaining the behaviour of the exchange rate pass through in developed countries, as is evidenced in the foregoing discussion, some models that sought to explain the exchange rate pass through paradox evolved. Some of these models are macroeconomic while others are microeconomic in nature.

Fischer (1977), Phelps and Taylor (1997) and Taylor (1979, 2000) used the new Keynesian models to explain the incomplete and asymmetric nature of the exchange rate pass through. They ascribed the incomplete and asymmetric nature of the exchange rate pass through to wage and price stickiness. These emerge from staggered price adjustment due to multi-period contracts. They also identified low inflation and inflation persistence as other factors that explain the incomplete and asymmetric exchange rate pass through. Other researchers identified exchange rate flexibility (Froot and Kemperer, 1989), trade cost (Obsterfield and Rogoff, 2000) and the degree of substitutability between foreign and domestic goods (Dornbusch, 1987) as other determinants of incomplete exchange rate pass through.

The new open economy macroeconomic models such as the pricing to market model are microeconomic in nature. These models assume imperfect competition. They identify product differentiation and pricing to market behaviour as major determinants of the incomplete exchange rate pass through (Bitans, 2004). Furthermore, within the microeconomic models of the exchange rate pass through, some authors have assumed oligopolistic, monopolistic and duopolistic market structures to analyse the determinants of the exchange rate pass through. The empirical results from these models with different sets of assumptions are diverse (Bache, 2007).

What is observed from this discussion is that there seems to be no one model that can completely outline the factors that determine the exchange rate pass through. In addition, results from empirical studies that have employed both macroeconomic and microeconomic models with different types of econometric techniques, identify a huge spectrum of factors that seem to determine the incomplete exchange rate pass through. In several cases the factors that determine exchange rate pass through, are country specific (Campa and Goldberg, 2002; Bitans, 2004; Kassi et al, 2019).

It is important to state that much of the research on the behavioural pattern and what determines the exchange rate pass through, have predominantly been done in the developed countries like the USA, German and Japan (Branson, 1972; Magee, 1973; Menon, 1995; Swift, 2001; Malenbaum, 2015). There is little and scanty work on the exchange rate pass through in developing countries like Zambia. This coupled with the findings that there is no model so far that seems to give adequate answer to the incomplete exchange rate pass through puzzle, creates motivation to conduct a study on the exchange rate pass through in the developing country like Zambia.

1.2. Problem Statement

Zambia liberalised the exchange rate regime in 1994 thereby moving away from the fixed exchange rate to the flexible exchange regime. The drive towards the flexible exchange rate regime was motivated by the desirable feature of the flexible exchange rate system. The fixed exchange rate regime is cumbersome especially when the balance of payment is in disequilibrium. For instance, to correct the current account deficit and maintain the value of the currency, the State has to engage in the foreign exchange market and supply foreign reserves (Swift, 2001). Thus, a fixed exchange rate regime is very expensive to maintain. This is because the state has to maintain a huge of pool foreign reserves to correct balance of payment disequilibrium and maintain the local currency value.

Under a flexible foreign exchange regime, a country does not need to keep a huge pool of foreign reserves to maintain the value of its domestic currency and correct the deficit. There is, therefore, no need for a flow of international reserves to correct disequilibria in the balance of payments. This is because balance of payment surpluses and deficits are corrected through an automatic adjustment in the exchange rate (Friedman, 1953). For instance, if there is a current account deficit, the domestic currency will automatically depreciate. This should cause imports to become expensive relative to domestically produced goods. This will consequently lead to a reduced demand for imports in the domestic economy. This causes an increase in the demand for goods produced in the domestic economy. This increases domestic consumption, aggregate demand and consequently domestic output. The depreciation of the domestic currency will lead to increased international competitiveness of the countries' exports because exports have become cheaper relative to the imports due to local currency depreciation. This mechanism should lead to a balance of payments equilibrium if imports and domestic prices adjust fully to changes in the nominal exchange rate (Swift, 2001). However, this theory has a caveat; it ignores the problem of inflation that arises from depreciation which mirrors the exchange rate and inflation situation in Zambia.

Zambia has witnessed a rapid depreciation of the Kwacha with the corresponding rise in inflation since the exchange rate was liberalised in 1994. For instance, Cheelo and Banda (2015) show that between 2008 and 2015, the Kwacha depreciated by 108 per cent cumulatively against the US Dollar. In 2015 alone, the Kwacha fell by 51 per cent against the US Dollar and 31.1 per cent against the South Africa Rand. During the same period, Zambia recorded increased rates of inflation. For instance, inflation increased from 7.9 per cent in June 2014 to 14.5 per cent in October 2015 and peaked at 22 per cent in February 2016 (Chipili, 2021). The Kwacha has continued to depreciate against major currencies (Zgambo, 2015). This creates a motivation to empirically assess how prices respond to exchange rate fluctuations and examine the degree of exchange rate passthrough to prices in Zambia.

Therefore, the main objective of this study to examine the exchange rate pass through (ERPT) to domestic prices in Zambia. The study examines whether exchange rate pass through to consumer prices is asymmetric or symmetric in nature. This helps us to understand how consumer prices respond to domestic currency appreciation and depreciation. In addition, the study examines the exchange rate pass through to sectoral prices of different sectors of the economy. These are agriculture, manufacturing and services sectors. The purpose of doing so is to examine how these sectors respond to exchange rate movements. Finally, the study goes further to examine the impact of globalisation on the exchange rate pass through to consumer prices in Zambia. The study does so by examining specifically the impact of bilateral trade, regional and multilateral globalisation on the exchange rate pass through to consumer prices in Zambia. We use the impact of Chinese presence (imports from China) to measure the impact of bilateral trade on the exchange rate passthrough to consumer prices.

1.3. Objectives of the Study

The major objective of this study is to examine the exchange rate pass through to domestic prices in Zambia.

The specific objectives of the study are outlined as follows:

1. To examine the exchange rate pass through to domestic consumer prices using the symmetric and asymmetric approach.
2. To examine the exchange rate pass through to sectoral prices of the agriculture, manufacturing and the services sectors.
3. To examine the impact of the globalisation on the exchange rate pass through to consumer prices.

1.4. Hypothesis of the Study

1. Ho: Exchange rate pass through to consumer prices is symmetric.
   Ha: Exchange rate pass through to consumer prices is asymmetric.
2. Ho: Exchange rate pass through to sectoral prices is incomplete.
   Ha: Exchange rate pass through to sectoral prices is complete.
3. Ho: Globalisation does not have impact on the exchange rate pass through to consumer prices.
   Ha: Globalisation has impact on the exchange rate pass through to consumer prices.

1.5. Significance of the Study

The major objective of this study was to estimate the exchange rate pass through (ERPT) to domestic prices in Zambia for the period covering 1983 to 2017. The study in its first specific objective examines the exchange rate pass through to consumer prices in Zambia using the symmetric and asymmetric models. In the second specific objective, the study examines the sectoral exchange rate pass through to agriculture, manufacturing and services sectors. In the third specific objective, this study examines the impact of globalisation on the exchange rate passthrough to consumer prices. In the third objective, bilateral globalisation is defined as Chinese imports, regional globalisation is defined as imports from SADC countries and multilateral globalisation is defined as trade openness. Thus, defining globalisation by these three variables implies that in the third objective the study examines the impact of Chinese presence, multilateral and regional globalisation on the exchange rate pass through to domestic consumer price inflation. In examining the impact of globalisation on the exchange rate passthrough, the study accounts for the effect of globalisation in the exchange rate passthrough to consumer price inflation. From these objectives, the significance of the study is drawn.

Overall, the study is vital in that it estimates the exchange rate pass through to domestic prices to evaluate how domestic prices respond to exchange rate flexibility since exchange rates in Zambia are flexible. This is vital because the degree of variability of the exchange rate pass through may have implication for inflation targeting. For instance, Minella et al (2003) indicate in their empirical study that the greater degree of variability of the exchange rate pass through implies greater difficulty for attaining inflation targets. The greater the degree of variability of the exchange rate pass through implies that the domestic economy is more sensitive to external shocks and therefore, the impact of the exogenous shocks to domestic prices is amplified (Ekanayake, 2010). The estimates of the exchange rate pass through will enable the Bank of Zambia, policy makers, firms and consumers to closely monitor inflation pressures arising from exchange rate fluctuations. This is vital because other than food and non-food inflation, inflation in Zambia is driven by exchange rate movements. Thus, estimating the degree to which exchange rate changes affect prices in Zambia is vital. This is because it signals to the Bank of Zambia that monetary policies should also consider an aspect of exchange rate smoothening.

Another significance of this study lies in examining the exchange rate pass through to consumer prices using the asymmetric model. Most of the studies of the exchange rate pass through assume that the exchange rate pass through is symmetric in nature (Obsterfield and Rogoff, 2000; Swift, 2001; Otan et al, 2003; Natalia and Luciana, 2014; Chewe, 2015; Zgambo, 2015; Lionel et al, 2017). Such studies do not decompose the exchange rate into exchange rate depreciation and appreciation. This implicitly means that exchange rate depreciation and appreciation have the same effect on prices. For instance, the studies that have been done in Zambia have all assumed symmetry to analyse the exchange rate pass through to prices (Chewe, 2015; Zgambo, 2015; Lionel et al 2017). However, this assumption may not be realistic in the sense that exchange rate depreciation and appreciation may have different effects on prices. The current study contributes to literature by decomposing exchange rate into Kwacha depreciation and appreciation to examine the differential effect of Kwacha depreciation and appreciation on consumer prices. This is vital especially to academicians and researchers as this will help in correctly characterising the exchange rate pass through to prices.

The study examines the exchange rate pass through to different economic sectors namely the agriculture, manufacturing and services sectors as the third objective. The main aim in this objective is to evaluate not only the degree of the exchange rate pass through to sectoral prices but also which of these sectors are very sensitive to exchange rate fluctuations. This is vital as it may help policy makers to design sector specific exchange rate and economic policies that will help the sectors to be cushioned against or be resilient to exchange rate shocks. The estimates of the exchange rate pass through to sectoral prices is also very important for firms in their investment decisions. Not only that, knowing how sensitive the sector in which a firm is located is vital for firms to design unique hedging instruments against the exchange rate exposure. This is vital, especially that in the recent past, the Kwacha has excessively depreciated, and has been affecting various economic sectors differently.

Finally, this study has taken another view of modelling the exchange rate pass through to prices in that, it incorporates globalisation variables thereby investigating the impact of multilateral globalisation (multilateral trade), bilateral trade (Chinese imports) and regional trade (regional globalization) on consumer prices in Zambia. It is vital to understand that a large volume of empirical studies on the exchange rate passthrough do not account for globalisation. Only a few such studies have taken globalisation into account. An example of such studies are studies done by Ozkhan and Erden (2015) Benigno and Faia (2016) and Villavicencio and Mignon (2017). There is an argument in the literature that lack of accounting for globalisation in the exchange rate pass through models incorrectly characterize the exchange rate pass through (Benigno and Faia, 2016; Villavicencio and Mignon, 2017). Benigno and Faia, (2016), Villavicencio and Mignon (2017) conclude from the empirical findings that accounting for globalisation increases the exchange rate pass through. If indeed accounting for globalisation variables increase the exchange rate pass through, it could mean that the abundant mass of the empirical studies that have not accounted for the same did not correctly characterize the exchange rate pass through. This could mean that the exchange rate pass through estimates from such studies may not be precise. Probably, this could explain the discernable paradox where empirical studies show low and incomplete exchange rate pass through to domestic prices and yet local currency depreciation is accompanied by corresponding rise in inflation. This could entail adjusting the exchange rate pass through models to include the globalisation variables to correctly present the exchange rate pass through effects. This necessitates the need to explore this realm to broaden literature on the exchange rate pass through. This study contributes to the less explored realm of literature by investigating the effect of accounting for bilateral trade, regional and multilateral globalisation on the exchange rate pass through.

Another significance of this study lies in the methodology used to examine the impact of globalisation on the exchange rate pass through. The few studies that have accounted for globalisation in the exchange rate pass through use the single equation with the Ordinary least squares (OLS) method of estimation. Therefore, these studies do not analyze the short and long run effects simultaneously in the exchange rate passthrough. This study differs in the methodological aspect in that it uses the vector error correction model (VECM). This technique enables this study to assess the short and long effects of accounting for globalisation on the exchange rate pass through. This serves as a contribution to the empirical literature. Examining the effects of accounting for globalisation in the short and long run would also help researchers, academicians, and policy makers to assess if the argument of the large magnitude of the exchange rate pass through holds in which period, short run or long run. For policy makers, this is vital to correctly design economic and exchange rate policies that into account the timing.

The other significance lies in the inclusion of the Chinese imports (Chinese presence) in modelling the exchange rate pass through to consumer price inflation. This may help in ascertaining the influence of the Chinese presence in Zambia. China is fast spreading its influence around the world including Zambia. Therefore, ascertaining the Chinese presence influence is a positive direction for Zambia to begin to think of how to relate with China in terms of trade and other areas of cooperation. This is very important to policy makers for trade policy.

1.6. Organisation of the Study

Having established the significance of this study, the rest of the study is structured as follows. Chapter two provides a brief outline of the macroeconomic performance of the Zambian economy from 1964 to 2021. Chapter three presents literature review. Chapter four examines the exchange rate pass through to consumer price inflation using symmetric and asymmetric models. The chapter applies the structural vector autoregressive (SVAR) to achieve the objective. Chapter five examines the exchange rate pass through to the three sectors of the economy namely, agriculture, manufacturing and the services sectors. The SVAR is used in this chapter as an econometric model. Chapter six investigates the impact of Chinese presence, regional and multilateral globalisation on the exchange rate passthrough to consumer price inflation in Zambia. The chapter applies the VECM as an econometric technique to achieve the objective. Finally, chapter seven concludes the study by summarizing the main findings of chapter four, five and six respectively. Chapter seven highlights policy implications, contribution of this study, limitations of the study and possible areas of further research.

CHAPTER 2

OVERVIEW OF MACROECONOMIC PERFORMANCE.

2.1. Introduction

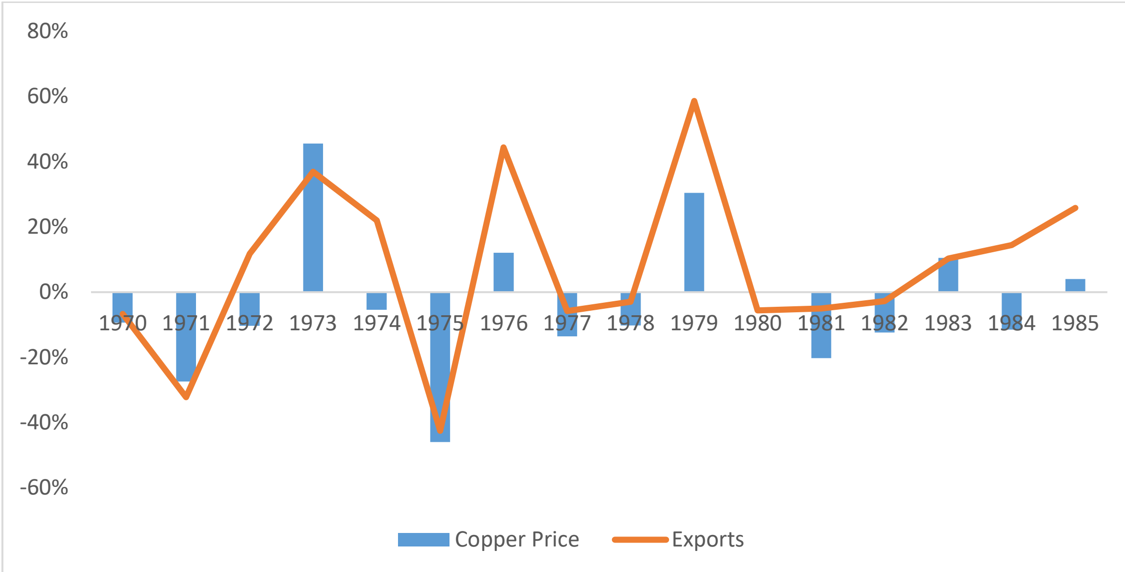
This chapter provides a brief outline of the macroeconomic performance of the Zambian economy from 1964 to 2021.

2.2: Brief Outline of Macroeconomic Performance

At independence in 1964, Zambia was one of the most prosperous countries in Southern Africa, classified as a middle-income nation with percapita income of US$243 per person (Cheelo, et al, 2020). The Zambian economy was highly undiversified, dominated by a vibrant mining sector, which contributed almost 50% to GDP. Revenue from the mining sector, was the main source of government revenue and foreign exchange earnings. Revenue from the mining sector accounted for 90% of export earnings (UNDP, 2006). Revenue from the mining sector shaped the Zambian economy and its development.

In the 1970s and 1980s, the economy was hit by external shocks. These adversely affected the economy. In 1970s, for instance, copper prices drastically reduced at the international commodity market as can be seen in Figure 2.1. In 1970 copper prices deteriorated by 9% and further reduced by 27% in 1971. In the same year (1971) oil prices increased by 33% as shown in Figure 2.2. The copper prices continued with a downward trend during the sample period recording a reduction of 46% and 30% in 1975 and 1979 respectively. During the same period oil prices skyrocketed. For instance, oil prices increased by 221% and 115% in 1974 and 1979 respectively as shown in figure 2.2.

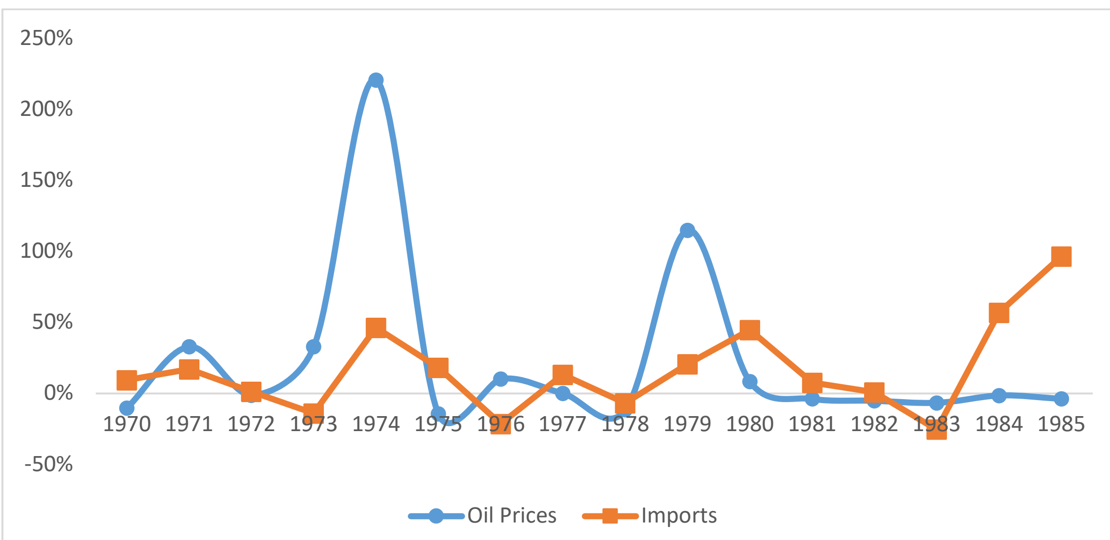
Figure 2.1: Percentage Changes in Copper Prices and Exports, 1970-1985



Source: Zamstats and World Bank

In the 1980s, the picture is similar. Copper prices continued with a downward trend, decreasing by 20% in 1981 and 12% in 1984 respectively.

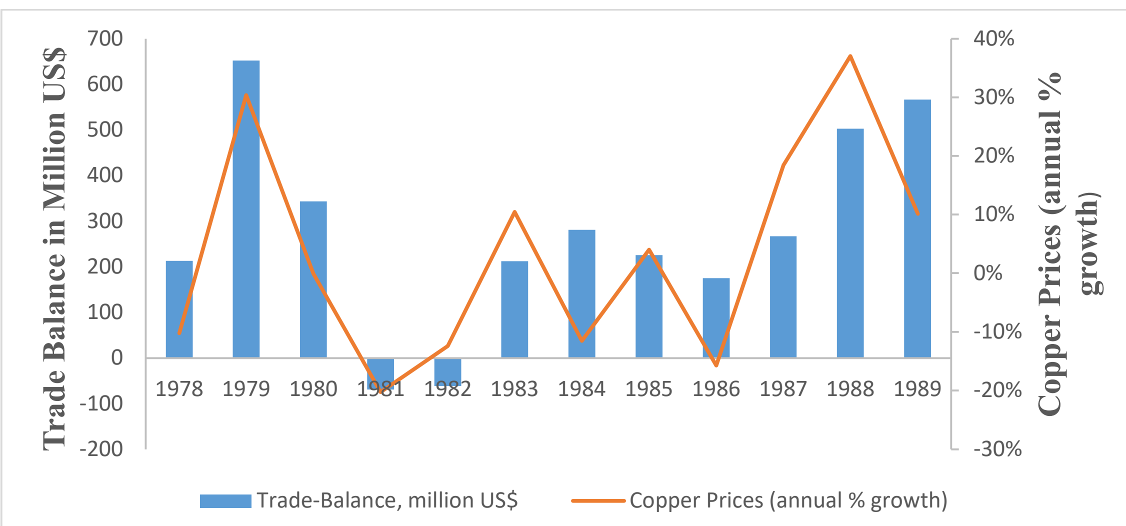
Figure 2.2: Percentage Changes in Oil Prices and Imports; 1970-1985.



Source: Zamstats and World Bank

Therefore, copper price and oil price shocks interchangeably hit the economy in the 1970s and 1980s. These shocks negatively affected the economy. It should be noted that the economy is a copper dependent. Copper exports accounts for most of export revenue and contributes significantly to GDP (see table 2.2). Because Zambia depends on copper heavily for its economic growth and export revenue, fluctuations in copper prices adversely affects the economy. This is the reason why downward trends in copper prices in the 1970s and 1980s negatively affected the economy. Fluctuations in copper prices coupled with increases in oil prices in the 1970s and 1980s as explained above affected the economy. For instance, due to a reduction in copper prices in the same period, copper exports revenue reduced which negatively affected trade balance as shown in figure 2.3. The increase in oil prices in the same period worsened the situation. Zambia being an importer of oil, the import value rose sharply especially after the oil shock of 1973/1974 and 1979/1980 as shown in figure 2.2. The two external shocks namely the oil price and copper price shocks worked simultaneously thereby causing a worsening of the terms of trade, trade balance, current account and consequently the balance of payment as can be observed in figure 2.3 and figure 2.6. Figure 2.3 clearly shows that trade balance improved in 1979 due to sharp increase in copper prices which increased by 30%. However, due to copper price reduction in 1980s, the trade balance worsened the whole period and later improved in the last three years of 1980s.

Figure 2.3: Trade Balance and Percentage Changes in Copper Prices, 1970-1989

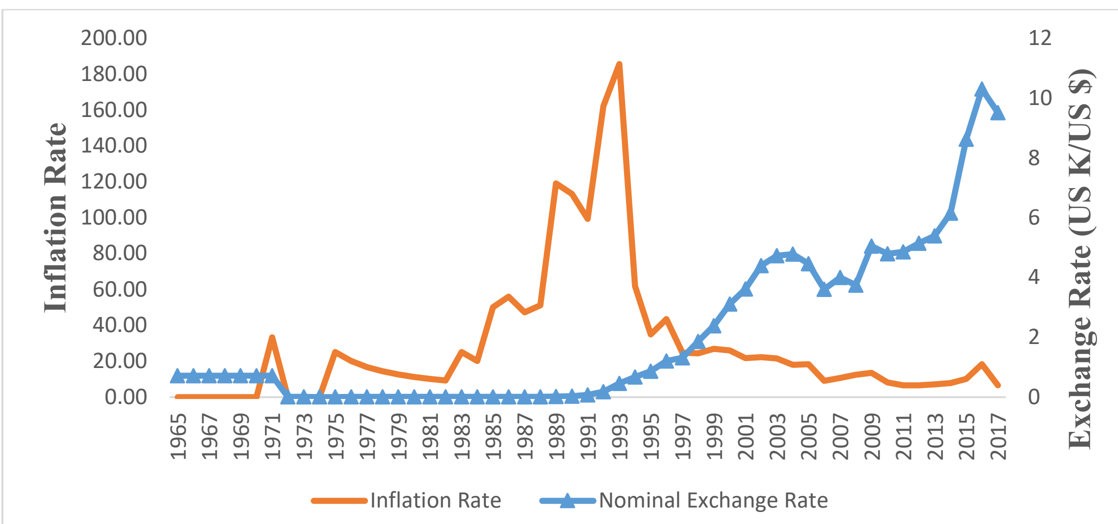


Source: IMF (IFS) and World Bank

As mentioned earlier, copper export earnings account for a bigger percentage of gross domestic product and fiscal revenue. Therefore, due to external shocks in 1970s and 1980s, copper export revenues reduced. This caused a corresponding reduction in the contribution of copper revenue to fiscal revenue. The reduction in fiscal revenue could have contributed to the growth in the budget deficit during the same period. There was, therefore, an increase in government borrowing from commercial banks in order to solve the internal financial imbalance. In addition, the government borrowed externally by making several arrangements with IMF and other donors to cure external imbalance (Cheelo et al, 2020). During the same period, the economy went into deep recession. Kalinda and Floro (1992) contend that other than low aggregate demand, this recession could have been due to deterioration in terms of trade which originated from external shocks during the sample period. As the balance of payment worsened further in the 1980s the economy was thrown into deep indebtedness and rapid inflation (Kalinda and Floro, 1992).

Figure 2.4 below shows trends in inflation and nominal exchange rate from 1965 to 2017. It clearly indicates that inflation was stable in the early years after independence in 1964. Thereafter, between 1970s and mid-1990s, inflation rapidly increased. Inflation reduced and stabilized between the late 1990s and 2000s.

Figure 2.4: Trends in Inflation and Nominal Exchange Rate, 1965-2017



Source: WDI

Before 1964 and 1970, inflation was zero but rose to 33.3% in 1971. It increased to 50% and 59% in 1985 and 1986 respectively. By 1989 inflation had increased to 119.13%. This trend continued in the early 1990s and reached its peak in 1993 when inflation rose to

186%. Several macroeconomic variables continued with a downward trend during the same period. Real GDP growth for instance grew by an average of 1.52% from 1971 to 1980. Between 1981 and 1990 real GDP grew at an average rate of 1.08% and -0.9% between 1991 and 1994. On the other hand, FDI as net inflows were lower during the same period averaging around 1% to 3 % from 1970s to early 1990s (see table 2.2).

To deal with these macroeconomic imbalances in the 70s, 80s and early 1990s, the government came up with a number of measures such as price controls, exchange controls, trade controls and interest rate ceilings (Chipili, 2010). During this period, the exchange rate regime was fixed while the fiscal and monetary policies were expansionary (Chipili, 2010; Cheelo, et al 2020). The government tried to restructure the economy to diversify away from copper dependence and to reduce the dominance of state-owned corporations. However, the diversification strategy failed to yield tangible results. As explained earlier, the main reason for worsening of the terms of trade and trade balance was due to failure to diversify away from copper. It can be argued that the failure to make adjustments in the economy to achieve diversification could have been due to structural rigidities both from the supply side and the demand side and policy reversals. The structural bottle necks include import and capital biased industries, lack of skilled work force and lack of necessary market infrastructure especially in rural areas during the 1970s and 1980s (Kalinda and Floro, 1992; Meller and Simpasa, 2015).

When the measures that were put in place in 1970s, 1980s and early 1990s to deal with macroeconomic imbalances failed, the government liberalized the economy in the early 1990s with the support of IMF and the Word Bank. Some market-oriented reforms were implemented as part of the liberalization package. These include the end to product price controls and consumer subsidies, privatization of state copper mines and other state-owned corporations in manufacturing and services sectors. The banking sector was also liberalized in that interest ceilings were removed, and treasury bills auction was introduced in 1993. In 1994, the current account, capital account and exchange rates were fully liberalized. Hence all exchange rate controls were completely removed (Chipili, 2010; Cheelo et al, 2020).

The removal of exchange rate controls in 1994 ushered in the flexible exchange rate regime in Zambia. Prior to exchange rate liberalization that occurred in 1994, exchange rate had been fixed since 1964. At independence in 1964, Zambia adopted the Zambian pound, which replaced the British pound. The Zambian pound was pegged to the British pound at K1.70 per British pound from 1964 to 1971. In 1971 when the US Dollar emerged as the only reserve currency under the Bretton Woods System, the Zambian Kwacha was introduced and pegged to the US Dollar at K0.643 per US Dollar until 1976. From 1976 to 1983 the Zambian Kwacha was pegged to SDR (Chipili, 2010). The exchange rate remained fixed until 1994 when it was fully liberalized. Full exchange rate liberalization occurred in 1994 when exchange controls were completely suspended. After the exchange rate liberalisation of 1994, all the exchange controls and import restrictions were removed (Mungule 2004; Chipili, 2010; Mulele, 2011; Shula 2015).

In summary, from 1964 to date, the Zambian exchange rate system has undergone two types of exchange rate regimes. These are the fixed and floating exchange rate regimes. Table 2.1 summarizes the exchange rate regimes in Zambia since 1964 to date.

Table 2.1: Exchange Rate Regimes, 1964-2021

Episode	Period	Type of Exchange Rate Regime
1	1964-1971	Fixed Exchange Rate: Zambian Pound pegged to British Pound
2	1971-1976	Fixed Exchange Rate: Zambian kwacha pegged to US Dollar
3	1976-1983	Fixed Exchange Rate: Zambian Kwacha pegged to SDR
4	1983-1985	Zambian Kwacha pegged to trading partners currencies
5	1985-1987	Foreign currency Auction system
6	1987-1989	Fixed Exchange rate: Zambian Kwacha Fixed US Dollar
7	1991-1992	Flexible but not fully flexible
8	1994- 2021	Freely Floating Exchange rate System

Source: Mungule (2004), Chipili (2010), Mulele (2011)

Figure 2.4 shows the trend in nominal exchange rate between 1964 and 2017. The trend is constant from 1970s to early 1990s. This is because the fixed exchange rate regime was in place until 1994. After exchange rate liberalization in 1994, exchange rate started rising, reaching its peak in 2003 at K4.73/US$ reflecting the market conditions. However, after 2003, the exchange rate started trending downwards due to among other things, the rise in copper prices. In 2008, the exchange rate started to rise again. This could have been due to the global financial crisis. Since 2009 exchange rate has been trending upwards due to among other things, fluctuations in copper prices. This has adversely affected export earnings (see Figure 2.7).

After the liberalization of the economy in the 1990s, the economy recorded the improvements in some macroeconomic variables. It is clear from table 2.2 below that the period before the exchange rate liberalization is characterized by low growth rate in real GDP and FDI. Real GDP grew steadily after 1994. For instance, real GDP grew at an average of 8.71% from 2006 to 2010. The robust economic growth following economic liberalization was due to growth in all the economic sectors. (Chipili 2010). Foreign direct investment also shows an upward trend from 1994 to 2017 recording its peak in the period from 2006 to 2010 at 6.51% of GDP as shown in table 2.2 below. The reduction in real growth and FDI between 2011 and 2021 could be explained by the increase in debt which might have increased the debt burden thereby negatively affecting the economy. FDI reduced due to reduction in investment in the mining sector due to low copper prices.

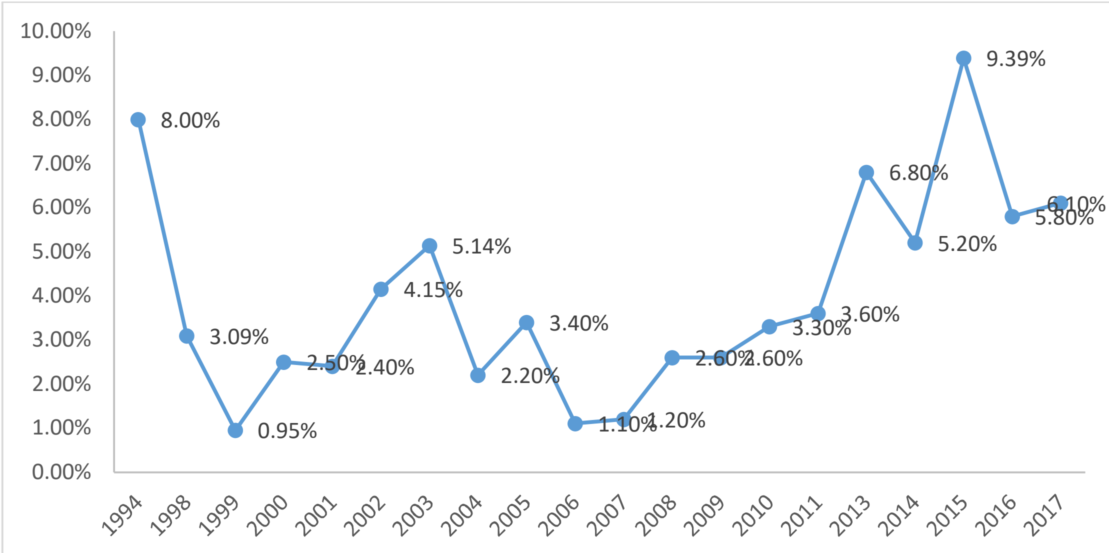
Table 2.2: Trends in Selected Macroeconomic Variables

Year	Real GDP Annual % Growth	FDI (% of GDP)	Copper exports Share of Total Exports (%)	Copper exports Share of GDP (%)
1981-1990	1.08%	2.14%	81.29%	30.39%
1991-1994	-0.90%	3.28%	84.37%	27.06%
1995-2000	3.52%	4.15%	74.78%	19.76%
2001-2005	6.21%	5.57%	84.00%	20.75%
2006-2010	8.71%	6.51%	88.30%	27.40%
2011-2017	4.71%	5.50%	86.04%	30.57%
2018-2021	1.80%	-0.20%	73.54%	28.58%

Source: Zamstats, BOZ and MOFNP

The Fiscal deficit improved after economic liberalization. For instance, the fiscal deficit as a percentage of GDP reduced from 8% in 1994 to 0.95% in 1999. However, it increased again to 5.14% in 2003 as shown in figure 2.5. Between 2003 and 2012 fiscal deficit as a percentage of GDP remained below 3.6%. It shows an upward trend from 2013 onwards due to increase in government debt which was motivated by expansion in government spending.

Figure 2.5: Budget Deficit (% of GDP), 1994-2017

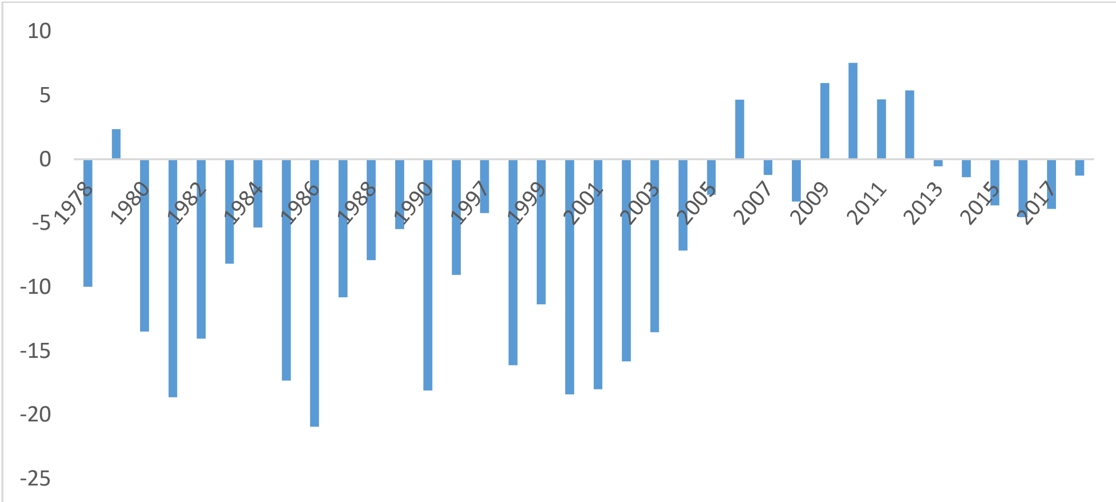


Source: MOFNP

The inflation rate on the other hand sustainably declined to single digits from 186% in 1993 to 9% in 2006. This decline in inflation could have been due to the strict adherence to economic reforms aimed at achieving the monetary policy goal of price stability in the.

The external sector shows improvements since exchange rate liberalization. Both imports and exports grew especially after 2003. The current account also improved. It remained in deficit from 1970s up to part of early 2000s and started improving after 2001, recording a surplus in 2006 as depicted in figure 2.6. It was the first surplus ever recorded since 1980s. Figure 2.6 shows that between 2009 and 2012, the current account recorded surpluses. The current account balance remained in good health until 2018, albeit, with some minor fluctuations relative to the picture in 1980s and 1990s as shown in figure 2.6.

Figure 2.6: Current Account Balance (% of GDP), 1978-2018

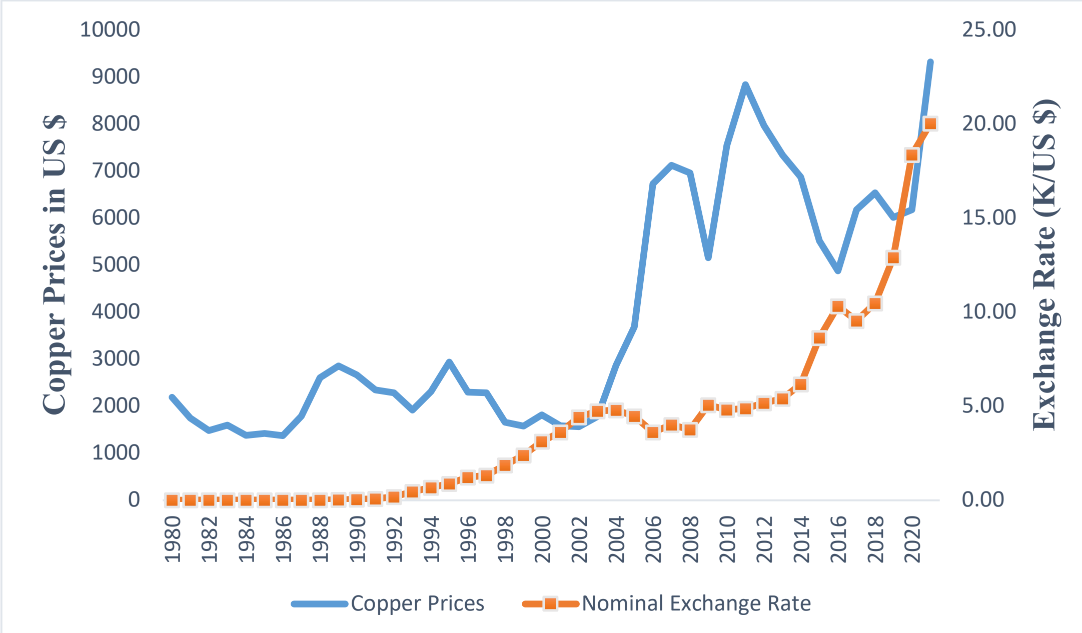


Source: WDI

Though some macroeconomic indicators have shown remarkable improvements after the economic and exchange rate liberalization of 1990s, the economy largely remains copper export dependent. The export sector is still not diversified. It can be seen in table 2.2 that in 1980, copper exports as a share of total exports accounted for 94.54%. Between 1981 and 2000, copper exports still maintained a bigger portion of total exports ranging between an average of 74.78% and 82.29%. Between 2001 and 2017 the average share of copper exports as a percentage of total exports ranged between 84% and 86%. These figures confirm that the export sector is still undiversified with heavy dependency on copper. Not only does copper export account for bigger percentage of total exports but also accounts for a bigger share as a component of GDP. Percentages displayed in table 2.2 show that from 1980 to 2017, copper export share in GDP ranged between 29% and 31%.

The heavy dependence on copper revenue makes the macroeconomic variables like the exchange rate to fluctuate when copper prices swing. Figure 2.7 shows reciprocal movements between copper prices and exchange rate (ZMK/USD). This reciprocal movement between the two variables is clearly seen during the period of flexible exchange rate regime after 1994. Though there are several macroeconomic variables that explain fluctuations in the exchange rate, there is a discernible decline in exchange rate following an increase in copper prices. On the contrary, it can be observed from figure 2.7 that a down swing in copper prices is followed by an upswing in exchange rate.

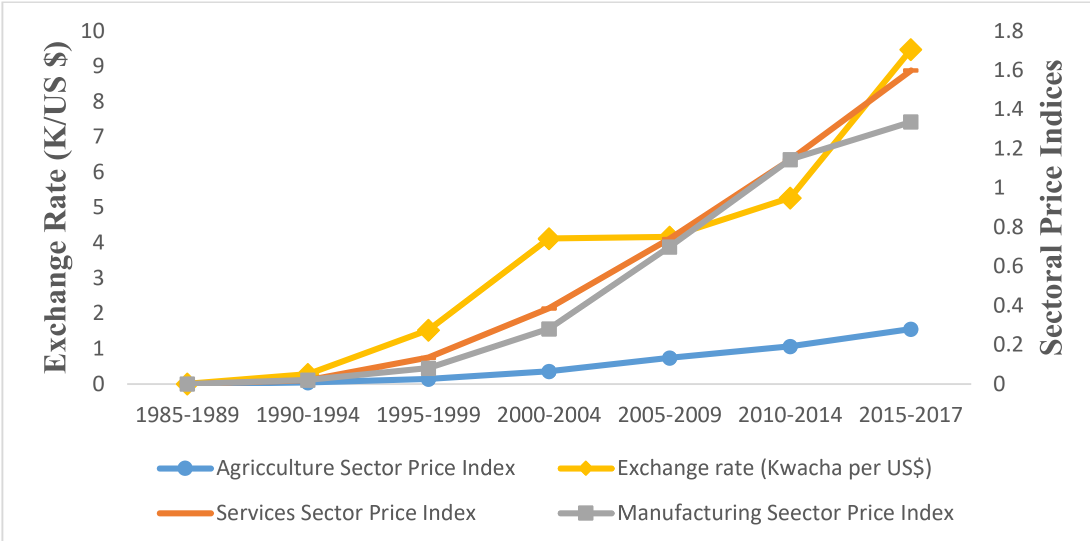
Figure 2.7: Reciprocal Trends in Copper Prices and Exchange Rate, 1980-2021



Source: WDI and World Bank

The swings in the exchange rate make the economy vulnerable to external shocks in the sense that when the exchange rate swings upwards (Kwacha depreciation), the other sectors of the economy especially the productive sectors such as the manufacturing, agriculture and services sectors respectively get affected. This could be because these sectors especially the manufacturing sector depends on imported raw materials which become more expensive when the Kwacha depreciates. Figure 2.8 shows that exchange rate and sectoral prices trend upwards together especially after exchange rate liberalisation in 1994. This indicates that the sectoral prices in the manufacturing, agricultural and services sectors are positively influenced by exchange rate movements. A rise in the exchange rate is matched by the rise in sectoral prices. The rise in services sector prices could be because the sector is dominated by wholesale and retail trade which is import dependent. Thus, exchange rate changes are easily reflected in services sector prices (figure 2.8).

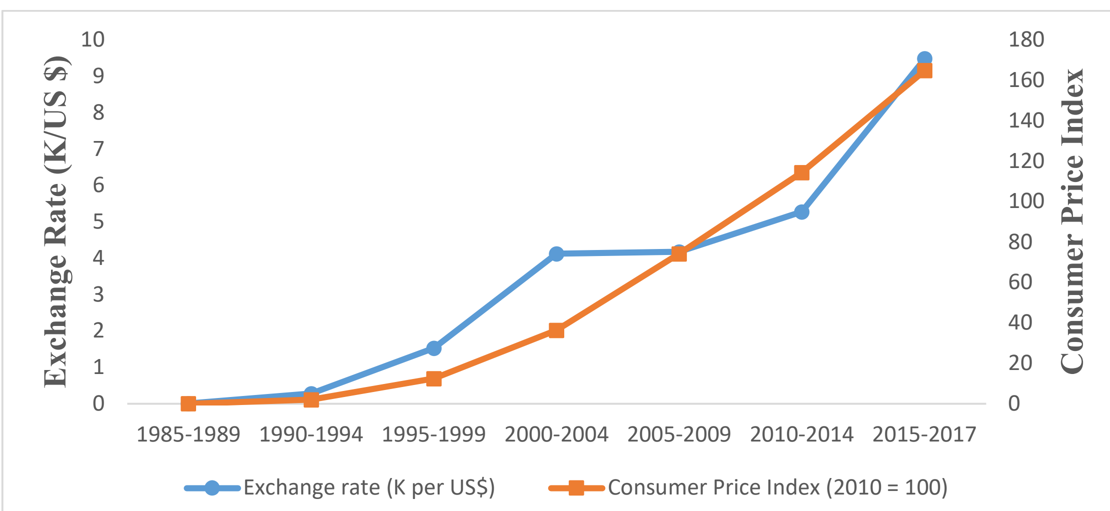
Figure 2.8: Trends in Exchange Rate and Sectoral Prices



Source: Zamstats

In the like manner the consumer prices are positively influenced by exchange rate movements. A rise in exchange rate is matched by a rise in inflation (figure 2.9). This indicates that exchange rate movements might explain movements in consumer and sectoral prices inflation in Zambia. Hence the need to diversify the economy and reduce in imports.

Figure 2.9: Trends in Exchange Rate and Consumer Prices



Source: Zamstats

2.3. Conclusion

In conclusion, the foregoing discussion shows that, the importance of copper export revenue in shaping the structure of economy has remained the same before and after economic liberalization. This partly explains the macroeconomic imbalances and the Kwacha deterioration that the economy experiences whenever copper prices wane. The pattern is clear that whenever copper prices increase, Kwacha appreciates. On the other hand, when copper prices trend downwards, the Kwacha depreciates. This makes the economy prone to copper price shocks. This calls for further efforts to diversify the economy in Zambia if the country is to be resilient to external economic shocks.

CHAPTER 3

EXCHANGE RATE PASS THROUGH TO DOMESTIC PRICES: LITERATURE REVIEW

3.1. Introduction

Theoretical literature on the exchange rate pass through has evolved in three stages. The first-generation theoretical models were macroeconomic in nature. These were based on the law of one price. These models assumed perfectly competitive conditions. In these models, price was modelled as a function of the exchange rate. The law of one price assumptions meant that the exchange rate pass through to prices should be complete. However, Subsequent studies that were done in 1970s showed that the exchange rate pass through was incomplete. The studies proved that the first generational models of the exchange rate pass through could not explain the incomplete exchange rate through puzzle. This led researchers to develop models that could explain the exchange rate through puzzle.

The second-generation models of the exchange rate pass through were microeconomic in nature. They can be categorised into two groups namely the perfect competitive and imperfect competitive models. The earlier pioneers of the perfect competitive models and imperfect competitive models were Branson (1972) and Dornbusch (1987) respectively. Under perfect competitive models, firms are assumed to have zero mark-ups since firms have no power over the price of the product. This assumption as will be explained in the subsequent sections leads to complete exchange rate pass through. On the other hand, earlier imperfect competitive models assume constant mark-ups. Dornbusch (1987) for instance, was one of the earliest researchers to model the exchange rate pass through using Cournot oligopolistic model. Dornbusch (1987) assumed constant mark-up and a homogenous product, thus making the model to be static in nature. Since the emergence of Dornbusch (1987) model of the exchange rate pass through, there evolved several static models which assumed imperfect competition under different market conditions; some applying monopolistic competition, product differentiation and others assuming product discrimination to model the exchange rate pass through.

The second-generation models of the exchange rate pass through being static in nature had short comings in that they could not model intertemporal feedbacks. This led to the emergence of the third-generation models also called the dynamic imperfect competitive models of the exchange rate pass through. One such imperfect competitive dynamic model of the exchange rate pass through is called the pricing to market model, developed first by Krugman (1987) and Marston (1990) and later popularised by Betts and Devereux (1996).

There is a plethora of evidence that the fundamental theoretical and empirical explanation of the low, incomplete and asymmetric exchange rate pass through to prices is the pricing to market behaviour of exporters (Knetter, 1989; Freenstra et al, 1996; Campa and Goldberg, 2002). Under the pricing to market, exporters vary their mark-ups in response to exchange rate fluctuations to stabilise import prices in the face of competition to maintain market share. Knetter (1989, 1993), Marston (1990) and Knetter (1993) confirm that there is significant evidence that the degree of pricing to market varies substantially across industries thus, suggesting that understanding industry structure is a critical dimension for understanding the exchange rate pass through (Bache, 2006). In the next section the study discusses theoretical literature from the past to the present.

3.2. Theoretical Literature

3.2.1. Macroeconomic Models of Exchange Rate Pass Through

3.2.1.1. The Law of One Price

The law of one price is a traditional macroeconomic model where markets are assumed to be perfectly competitive. The theory of the law of one price states that assuming there is no transportation cost and that there are no barriers to trade, the price of a homogenous commodity in two countries should cost the same price when expressed in the same currency. According to Dornbusch (1987), the law of one price entails that the relative national price levels in a common currency are independent of exchange rate movements because the exchange rate movements simply reflect, passively, divergent national trends. The law of one price can be expressed as follows:

$$P_t = E_t \, P_t^* \tag{1}$$

Where P_t domestic price is index; E_t is nominal exchange rate expressed as domestic currency units over foreign currency units and P_t^* is foreign price index. Applying logs to equation (1) would yield an econometric model for exchange rate pass through as shown in equation (2).

$$InP_t = \alpha InE_t + \beta lnP_t^* + \mu_t \quad (2)$$

Where E_t is the nominal exchange rate which is a measure of the exchange rate pass through to price movements. If the coefficient $\alpha = 1$, it implies the complete exchange rate pass through to prices but. If $\alpha < 1$, it would mean incomplete exchange rate pass through.

The earlier researchers in the 1970s investigated whether the exchange rate pass through was complete for the US against its trade partners. Their findings showed that the exchange rate pass through was incomplete. They put forward reasons for the incomplete exchange rate pass through. They perceived the incomplete exchange rate pass through as a short run phenomenon. They contended that the exchange rate pass through could be incomplete due to sticky prices in the short run. However, in the long run prices should be able to adjust leading to the complete exchange rate pass through. They advanced reasons for price stickiness in the short run namely trade contracts, invoice decisions and menu cost argument among other factors (Magee, 1973).

The argument for trade contract to cause the incomplete exchange rate pass through is that in trade contracts, exporters and importers fix the price, quantity and exchange rate well in advance of the actual delivery date. Trade contracts also specify whether payments will be based on the current spot rate or forward rate. If payment is specified in terms of the future spot rate, then the responsiveness of prices to changes in exchange rate will be high holding all else equal. However, if payment for the goods is specified in terms of the forward rate which may be significantly different from the spot rate, the exchange rate pass through will be incomplete. In addition, theorists argue that invoice decisions also play an important role in determining the short run exchange rate pass through. For instance, if the contract is fixed in the importer's currency also called local currency pricing (LCP), exchange movements will not have impact on prices leading to incomplete exchange rate pass through. On the other hand, if the exporter fixes the contract in exporters currency also called producer currency pricing (PCP), the exchange rate pass through will be complete. Therefore, the degree of pass through in this case will depend on invoice decisions of the exporting firms (Mann 1986).

Menu cost explanation was sighted as another cause for price rigidity in the short run. According to menu cost argument, firms/exporters face menu cost resulting from changing the price. Therefore, if the exchange rate changes are temporal or short term; exporters may be reluctant to change prices. If exchange rate fluctuations are seen as short term, exporters may not want to bore their clients with frequent price changes. Not only that frequent price changes could lead to information cost especially if the distribution channel or network for the product is quiet long. Thus, exporters will be more reluctant to respond to exchange rate movements when such movements are transitory. This reluctance induces incomplete exchange rate pass through (Giovannomi and Fisher, 1986). Exporters respond to exchange rate changes when exchange rate induced cost changes are perceived to be permanent by exporters. Thus, in the long run, exchange rate pass through is expected to be complete.

3.2.2. Microeconomic Models of Exchange Rate Pass Through

3.2.2.1. Perfectly Competitive Models of Exchange Rate Pass Through

The perfectly competitive models of the exchange rate pass through assume that both the exporter (supplier) and importer (buyer) are price takers such that a single exporter and importer cannot influence the price of the product. They take price as given. Thus, under perfect competitive models, suppliers equate price with marginal cost to arrive at equilibrium. If price is equal to marginal cost, it means that firms have no power over the price of the product and consequently there is no mark-up. This means that exchange rate movements cannot be absorbed into mark-ups. Therefore, exchange rate movements must be fully reflected in or absorbed into the prices. This entails complete exchange rate pass through. If there are possibilities for suppliers to take advantage of exchange rate movements to make gains by maintaining less than complete pass through, such gains will not last long. This is because such gains will trigger massive entry of firms in a market until the gains are eliminated. The resultant effect is the complete exchange rate pass through (Swift, 2001).

According to the perfect competitive models of the exchange rate pass through, there could be incomplete exchange rate pass through in the short run which could necessitate the gains due to exchange rate changes. However, in the long run such gains must be wiped away due to entry of firms in the market. Therefore, as long as the exchange rate pass through is incomplete firms will continue to enter. Entry of firms in the market stops when the exchange rate pass through is complete. This means long run equilibrium has been reached and thus gains are completely wiped out. According to the perfect competitive models of the exchange rate pass through incomplete and complete exchange rate pass through are a matter of timing as opposed to magnitude of trade effect (Marshall, 1923; Lerner, 1944).

Branson (1972) derived a perfectly competitive model of the exchange rate pass through using the elasticity approach by deriving demand and supply elasticities. He assumed two countries in an integrated market. Country D is an importer of good *y* while country F is an exporter of good *y*. Therefore, the demand and supply equations for the product can be specified as follows:

$$Q_S = S(P_{y,D}) \tag{3}$$

$$Q_D = D(P_{y,F}) \tag{4}$$

Where Q_D and Q_S are quantities demanded of good *y* in country D (importer) and quantities supplied of good *y* in country F (exporter). While $P_{y,F}$ is exporter's home currency price and $P_{y,D}$ importer's home currency price respectively. Assuming the law of one price, the domestic price could be expressed as follows:

$$P_{yD} = EP_{y,F} \tag{5}$$

Where E is the nominal exchange rate. It is expressed as domestic currency units over foreign currency units. At equilibrium demand for good *y* in country D (importer) must be equal to supply for good *y* in country F. Combing equation (3) and (4) and taking into account the law of one price expressed in equation (5), the equilibrium condition can be expressed as follows:

$$Q_s = S(P_{y,D}\ ) \ = S(EP_{y,F}) \tag{6}$$

Assuming constant elasticity of demand and supply and expressing the model in log form, we have the following:

$$lnQ_D = d_y lnP_{y,F} \tag{7}$$

$$lnQ_S = S_y(lnE + lnP_{y,F}\ ) \tag{8}$$

Where equation (7) is the demand (import) equation while equation (8) is the supply (export) equation. S_y is the price elasticity of supply for exports while d_y is price elasticity of demand for exports. Equilibrating the right-hand side of equations (7) and (8), equation (9) can be derived as follows:

$$d_y lnP_{y,F} \ = \ S_y(lnE + lnP_{y,F}\ )$$

$$d_y lnP_{y,F} \ = \ S_y lnE + S_y lnP_{y,F}\ )$$

$$d_y lnP_{y,F} - S_y lnP_{y,F} \ = \ S_y lnE$$

$$(d_y - \ S_y)\ lnP_{y,F} \ = \ S_y lnE$$

$$lnP_{y,F} \ = \left[\frac{S_y}{(d_y - \ S_y)}\right] lnE \tag{9}$$

Simplifying and dividing both sides of equation (9) by (-S_y) we have the following:

$$lnP_{y,F} \ = \left[\frac{-1}{(1 - {}^{d_y}\!/_{S_y})}\right] lnE \tag{10}$$

Differentiating equation (10) yields equation (11).

$$\left(\frac{dP_{y,F}}{P_{y,F}}\right) = \left[\frac{-1}{\left(1 - {d_y}/{S_y}\right)}\right] dE/E \tag{11}$$

Rearranging equation (11) gives the expression for the exchange rate pass through for exports.

$$\left(\frac{dP_{y,F}}{P_{y,F}}\right) \Big/ \left(\frac{dE}{E}\right) = \frac{-1}{(1 - {d_y}/{S_y})} \tag{12}$$

Equation (12) gives insights into the exchange rate pass through. Assuming constant cost industry under perfect competition, the supply curve is infinitely elastic in the long run. Therefore, equation (12) shows that when the supply of good y (S_y) is big exchange rate pass through will be close to one or complete in the long run. The observed incomplete exchange rate pass through in the short run is viewed as price stickiness or rigidities due to factors such as menu cost constraints, trade contracts and invoice decisions which are seen as transient in nature. Branson (1972) acknowledged that there could be incomplete pass through which allows firms to make exchange rate induced profit or loss. However, these will quickly disappear because in the long run there is possibility of entry and exist of firms which ensures that exchange rate induced gains/loss are eliminated. This leads to the complete exchange rate pass through. The exchange rate passthrough equation (12) tells us that the exchange rate pass through depends on the interaction between price demand elasticity of export, price elasticity of supply of export and market conditions (Swift, 2001). For example, if demand for exports is elastic but price elasticity of supply is inelastic, exchange rate pass through will be close to zero and otherwise close to one.

Branson (1972) model of the exchange rate pass through identifies price elasticity of demand and supply for exports as major determinants of the exchange rate pass through. Other factors such as variations in mark-up and market power which contribute to exchange rate pass through are not considered. This is because the model assumes that perfect competition under constant cost industry prevails.

However, studies that were done to test the validity of the competitive models showed that the exchange rate pass through to prices was incomplete both in the short run and in the long run. Theorists such as Dornbusch (1987), Campa and Goldberge (1987) argued that the failure to explain the incomplete exchange rate pass through by perfectly competitive models was as a result of the assumption that firms have no control over the price of the product. This means that firms take price as given. In other words, under perfectly competitive models, firms are unable to vary mark-ups. They contended that this assumption may be far from reality. Thus, Dornbusch (1987), Campa and Goldberge (1987) viewed mark-up variations and market power of firms as important factors in modelling the exchange rate pass through. Thus, they developed models that assume imperfect competition to model exchange rate pass through.

3.2.2.2. Imperfectly Competitive Models of Exchange Rate Pass Through

Under imperfect competitive market structures firms are assumed to have some degree of monopoly power of over the price of the product. This allows them to vary their mark-ups as a response to exchange rate movements. This ability to vary mark-ups ensures that the exchange rate pass through is incomplete. Since imperfect competitive market structures are more commonplace than perfectly competitive market structures, modelling the exchange rate pass through with the imperfect competitive model may closely mirror the behavioural pattern of the exchange rate pass through. It is for this reason that some theorists such as Dornbusch (1987), Campa and Goldberge (1987) developed the imperfect competitive models to explain the incomplete exchange rate pass through. Under imperfect competitive models of the exchange rate pass through there are two categories namely the static and dynamic models.

3.2.2.2.1. Static Models of the Exchange Rate Pass Through

One of the most widely used static models of imperfect competition for modelling the exchange rate pass through in empirical analysis is the Cournot oligopoly model. This was derived by Dornbusch (1987). Dornbusch (1987) is one of the pioneers of the imperfect competitive models of the exchange rate pass through. Dornbusch (1987) used Cournot oligopoly model to explain the incomplete exchange rate pass through. He explained the exchange rate passthrough as a consequence of variations in mark-up due to strategic interaction between domestic firms and foreign firms. He assumed that labour is the only factor of production. He further assumed that labour wages are not fully flexible, and marginal cost being fixed. Therefore, Dornbusch (1987) regarded price as mark-up over labour cost unit so that changes in exchange rate act as a shock to unit labour cost or marginal cost (Swift 2001).

To study the exchange rate pass through behaviour, Dornbusch (1987) applied the Cournot oligopolistic model to a homogenous product sold in geographically segmented markets. Dornbusch (1987) supposed that there are n domestic firms and n* foreign firms producing a homogenous product. Domestic firms face w as marginal labour cost expressed in home currency of domestic firms while foreign firms face w* as marginal labour cost expressed in home currency of the foreign firm. On the other hand, q and q* are quantities sold by domestic and foreign firms respectively. He assumed that all the firms face the same demand curve in their respective domestic markets. Therefore, to maximize profit each firm must choose quantities of the sales taking the quantity of sales of other firms as given.

The following Swift (2001)'s formulation the inverse demand curve facing the oligopolistic firm can be expressed as follows:

$$\mathrm{P} = \mathrm{F}(\mathrm{Q}) \tag{13}$$

Where P is the price of the product and Q is the quantity sold in the domestic market such that $Q = nq + n^*q^*$. The elasticity of the inverse demand curve can be specified as follows:

$$\theta = -\frac{QF''(Q)}{F'(Q)} \tag{14}$$

The profit maximising equations for each domestic and foreign firm respectively can be expressed as:

$$\pi = \mathrm{F}(\mathrm{Q})q - wq \tag{15}$$

$$\pi^* \ = \mathrm{F}\left(\frac{\mathrm{Q}}{\mathrm{e}}\right)q^* - w^*q^* \tag{16}$$

Where π denotes profit for the domestic firm and π^* is profit for the foreign firm. e is the exchange rate expressed as domestic currency units over foreign currency units. The first order conditions for the profit equations (15) and (16) can be specified as follows:

$$\mathrm{F}(Q) + qF'(Q) = w \tag{17}$$

$$\mathrm{F}(Q) + q^*F'(Q) = ew^* \tag{18}$$

The first order conditions (17) and (18) are for each firm that is domestic and foreign firm respectively. To arrive at the first order conditions for the entire oligopolistic industry, equations (17) and (18) are multiplied by n and n* respectively and then summed up. The first order conditions for all firms that is the foreign firms and domestic firms can be specified as follows:

$$n\mathrm{F}(Q) + nqF'(Q) = nw \tag{19}$$

$$n^*\mathrm{F}(Q) + n^*q^*F^{'}(Q) = n^*ew^* \tag{20}$$

Equations (19) and (20) can be summed up as follows:

$$n\mathrm{F}(Q) + n^*\mathrm{F}(Q) + nqF'(Q) + n^*q^*F'(Q) = nw + \ n^*ew^* \tag{21}$$

Equation (21) can be simplified as follows:

$$(n + n^*)\mathrm{F}(Q) + (nq + n^*q^*)F'(Q) = nw + \ n^*ew^* \tag{22}$$

Since $Q = nq + n^*q^*$, equation (22) can further be simplified as

$$(n + n^*)\mathrm{F}(Q) + \ QF'(Q) = nw + \ n^*ew^* \tag{23}$$

Equation (23) can be totally differentiated as follows:

$$(n + n^*)\mathrm{F}'(Q)d(Q) + \ QF''(Q)d(Q) = \ n^*w^*de \tag{24}$$

The elasticity of the slope of inverse demand curve given in equation (14) can be transformed as follows:

$$-\theta F'(Q) = QF''(Q) \tag{25}$$

Equation (13) can be totally differentiated as follows,

$$dP(Q) = F'(Q)d(Q) \tag{26}$$

Substituting equation (25) and (26) into (24) we shall have:

$$(n + n^*)dP - QF'(Q)d(Q) = \ n^*w^*de \tag{27}$$

Since $dP = F'(Q)d(Q)$ as shown in equation (26), equation (27) can further be transformed as:

$$(n + n^*)dP - \theta dP = \ n^*w^*de \tag{28}$$

Simplifying (28) we have

$$\frac{dP}{de} = \frac{n^*w^*}{n + n^* - \theta} \tag{29}$$

Equation (29) can be re-arranged to obtain an equation for the exchange rate pass through to import prices as follows:

$$\frac{dP/_P}{de/_e} = \left[\frac{n^*}{n + n^* - \theta}\right]\left[\frac{ew^*}{P}\right] \tag{30}$$

Where assumption is made that $n + n^* > \theta$ holds for stability purpose

Note that $\frac{dP/_P}{de/_e}$ is elasticity of import price due to exchange rate movements or exchange rate pass through. If we let $\frac{dP/_P}{de/_e} = \gamma$, then equation (30) can be rewritten as:

$$\gamma = \left[\frac{n^*}{n + n^* - \theta}\right]\left[\frac{ew^*}{P}\right] \tag{31}$$

Therefore equation (31) is the elasticity equation or the exchange rate pass through equation. Equation (31) has two main components. The first one is the relative number of foreign firms in the market denoted as $\frac{n^*}{n+n^*-\theta}$. The second component is the ratio of marginal cost to price for foreign suppliers denoted as $\left[\frac{ew^*}{P}\right]$. It is clear from equation (31) that the smaller the mark-up over the price $\left[\frac{ew^*}{P}\right]$, the greater the exchange rate pass through. This should be the case for more competitive market. On the other hand, as mark-up increases, exchange rate pass through reduces. This is the case for less competitive markets. This model demonstrates that in highly competitive market structures where mark-up is smaller, exchange rate pass through will be higher. In the market structures where firms have some control over the price of the product and therefore, mark-up is high, the exchange rate pass through will be low. The term $\frac{n^*}{n+n^*-\theta}$ gives a picture of the percentage of foreign firms or market share of foreign firms in the domestic market (the importing nation). Thus, if $\frac{n^*}{n+n^*-\theta}$ approaches 1, it means that the percentage of the foreign firms relative to domestic firms is bigger. This also means that the portion of imported goods relative to domestic goods is bigger which entails that the degree of pass through to import prices is greater for a simple reason; a bigger portion of the goods are affected by exchange rate movements. On the contrary if $\frac{n^*}{n+n^*-\theta}$ approaches zero, it means there are more domestic firms and less foreign firms in the domestic market. This implies that very few goods are affected by exchange rate movements. Therefore, the exchange rate pass through will be very smaller. The other determinant of the exchange rate pass through in this model is elasticity of the inverse demand curve denoted as θ. When $\theta = 0$, exchange rate pass through will be low and when θ is positive, exchange rate pass through will be higher. This shows that exchange rate pass through also depends on the nature of the demand curve (Krugman, 1987; Feenstra, 1987; Swift, 2001; Atkenson and Burstein, 2008).

Thus, in conclusion, this model suggests that the degree of the exchange rate pass through to import prices depends on the market structure. If the market structure is perfectly competitive mark-up is non-existent and therefore, pass through will be complete assuming constant cost industry. On the other hand, if the market structure is less competitive, mark-up will be higher and therefore, the exchange rate pass through will be incomplete. Also, the composition of foreign and domestic firms matters for the exchange rate pass through. The bigger the percentage of foreign firms in the domestic market relative to the local firms leads to increased pass through and otherwise less pass through. Finally, the model has also demonstrated that the exchange rate pass through depends on the nature of the demand curve.

Since the emergence of the cournot oligopolistic model of the exchange rate pass through as developed by Dornbusch (1987), a number of static imperfect competitive models of pass-through alternative to cournot have evolved. Some of these models have modelled the exchange rate pass through assuming monopolistic competition and differentiated goods (Salop, 1979; Kanda 2013). Bernard et al (2003) have used Bertrand price competition under imperfect competition in modelling the exchange rate pass through. Atkeson and Burstein (2008) assume Cournot quantity competition to strategic interaction to model pass through. Other authors such as Martin Philips (1995), Baniak and Philips, (1995) have modelled pass through by taking into account the presence of economies of scale in oligopolistic market structures. They caution, however, that the pass through depends on the nature and degree of substitutability between differentiated goods.

All these static models conform to one conclusion that market structure is what determines the degree of the exchange rate pass through. According to these models, what determines whether or not mark-up will be existent or non-existent is market structure and when mark-up is existent, pass through will be incomplete. On the contrary, the absence of mark-up means pass through will be complete. It is clear from the discussion above that imperfectly competitive market structure is the major explanation of the incomplete exchange rate pass through.

The short coming of the static imperfect competitive models of the exchange rate pass through is that they do not take into account intertemporal feedbacks (Swift 2001). Imperfect competitive static models explain well that what determines the incomplete pass through is the variations in mark-up by exporters. However, the models do not explain factors such as uncertainty and expectations that affect exporter's decisions in varying the mark-up when there are changes in exchange rate. This short coming in static models has necessitated the emergence of the dynamic models that take such factors into account.

3.2.2.2.2. Dynamic Models of Exchange Rate Pass through

As earlier explained the static models have a short coming in that they do not account for intertemporal factors that affect pricing decisions of exporters. The dynamic models seek to explain the incomplete exchange rate pass through as a natural consequence of expectations and uncertainty in the market environment. For instance, the models contend that exporters can only make adjustments to the price as a response to exchange rate movements when exchange rate movement are perceived or expected by exporters to be permanent. If on the other hand firms perceive that exchange rate changes are transient, they will adjust their mark-ups so that exchange rate changes do not affect import prices. This leads to incomplete pass through. Therefore, the dynamic models of exchange rate pass through incorporate uncertainty and expectations into market structure to model exchange rate pass through.

In modelling exchange rate movements, Krugman (1987) contend that exporters are more likely to pass exchange rate changes to prices when they perceive exchange rate changes as permanent. However, if the exporters expect that exchange rate changes are going to be temporal, they may not want to pass exchange rate changes to prices for several reasons. First, temporal changes in exchange rate affect producer's cost less as compared to permanent exchange rate changes. Therefore, firms become less responsive if exchange rate movements are seen as temporal. Second, firms face menu cost resulting from changing price. Therefore, if the exchange rate changes are temporal, firms may be reluctant to change prices. Third, exporters may not want to bore their clients with frequent price changes due to exchange rate changes which are transient. Fourth, frequent price changes could lead to information cost especially if the distribution channel or network for the product is quiet long. Thus, exporters will be more reluctant to respond to exchange rate movements when such movements are transitory, and this reluctance induces incomplete pass through. According to Giovannomi and Fisher (1986) and Taylor (2000), exporters respond to exchange rate changes when exchange rate induced cost changes are perceived to be permanent.

Dixt (1989) argue that firms incur irretrievable sunk cost as they try to penetrate the market. Therefore, firms may not want to lose the market share anyhow. For instance, if the exporter's currency appreciates against importer's currency, import prices must increase in response to depreciation of importer's currency. This could lead to reduced demand for imports and lead to loss of the market share on the part of the exporter. Because exporters incur cost to penetrate that market, they may be reluctant to increase the price of the product. An exporter would rather absorb part of exporter currency appreciation in their profit margins through variation of mark-up. Therefore, the full impact of importer's currency depreciation on import prices will be reduced which implies incomplete pass through. In like manner, firms that have made significant fixed investments in the market and are established, may be reluctant to leave the market even if they are not able to recover variable cost for fear of losing the market share. This causes import prices to be irresponsive to exchange rate movements. Thus, entry and exit decisions matter for exchange rate pass through (Baldwin, 1994; Swift 2001).

Froot and Kemperer (1989), developed a model within the dynamic class of models in which they contend that corporate planning in which an oligopolistic firm is ready to sacrifice short term profit for long term profit is crucial to modelling exchange rate pass through. According to Froot and Kemperer (1989), firms make investments in the market share through current pricing practices. In this model long term or future profits depend on investment in current market share. Froot and Kemperer (1989) argue that firms do not invest in the future market share if they expect current exchange rate changes to be temporal. On the contrary, if firms expect exchange rate changes to be permanent, they would be more likely to invest in the future market share for long term purposes. This may lead to price competition among firms which would cause higher rates of pass through.

The dynamic models of the exchange rate pass through under imperfect competition outline a number of factors that can explain incomplete pass through. Thus, in addition to market structure, the number of firms in the market, demand and supply elasticities, and marginal cost, dynamic factors such as expectations and perceptions that the exporter holds on whether exchange rate movements would be transient or permanent, sunk cost and corporate planning regarding short and long-term profits are quite vital in determining the exchange rate pass through.

3.2.2.2.2.1. Pricing to Market Model of Exchange Rate Pass Through

The pricing to market theory of the exchange rate pass through was an offshoot of the short coming of the static models of imperfect competition because they did not account for dynamic features in modelling exchange rate pass through. Though the static imperfect competitive models of the exchange rate pass through offered better explanation of the incomplete exchange rate pass through relative to competitive models, economists in the 1980s could not explain certain pricing behaviours of exporters using static imperfect competitive models. For instance, in the 1980s, economists could not match the pricing behaviour of the Japanese exporters and the static imperfective models. In the 1980s when the Japanese yen appreciated against the US dollar, the Japanese exporting firms began discriminating between the US and other markets in pricing their products as a result of exchange rate fluctuations. This price discrimination between the US and other markets practised by the Japanese exporters led to different degrees of incomplete exchange rate pass through to import prices in respective markets (Krugman, 1987; Marston, 1990). This led researchers such as Krugman (1987) and Marston (1990), to empirically investigate this pricing behaviour of Japanese exporters. They discovered that the Japanese exporters were practising what is called the pricing to market in pricing their products so as to preserve the markets they held dearly.

Pricing to market refers to the propensity of exporting firms to maintain constant destination -currency prices in the awake of exchange rate changes which results not only in incomplete pass through in the segmented markets but divergent incomplete exchange rate pass through in different markets (Marston 1990; Swift, 2001). It is a form of third-degree price discrimination propounded by Pigou (1920), where different markets depending on their price demand elasticity pay different prices for the same product.

In modelling the exchange rate pass through in the pricing to market model as advanced by Marston (1990) also called the market share model, assume that an exporting firm from country A exports its product to country B. Assume also that E_t is the bilateral exchange rate which is defined as units of currency of country B (the importing nation) over units of currency of country A (the exporting nation). The import price in country B can be defined as follows:

$$P_t^{IMP} = E_t \, P_t^F \tag{31}$$

Where ${P_t}^{IMP}$ is the import price in country B; P_t^F is the exporter's price and E_t is the nominal exchange rate. The next step is to model the exporter's price. The exporting firm is assumed to operate under imperfect competition and therefore, the firm has some control over the export price. Therefore, the exporter sets a mark-up over marginal cost. Thus, the export price can be expressed as follows:

$$P_t^F = MK_t \, MC_t^F \tag{32}$$

Where P_t^F is export price; MK_t is mark-up and MC_t is marginal cost in exporter's currency. Mark-up is assumed to respond to importer's domestic production and competitive demand pressure (Przstupa & Wrobel, 2011). Competitive demand pressure is defined as a relationship between domestic prices and foreign price in terms of importer's currency (Przstupa & Wrobel, 2011). Therefore, the mark-up can be expressed as follows:

$$MK_t = \gamma \left[\frac{{P_t}^H}{E_t \, {MC_t}^F}\right]^\alpha {Y_t}^{H\beta} \tag{33}$$

Where parameters α and β range between zero and one that is $[0 < \alpha < 1, \; 0 < \beta < 1]$ and γ and is the constant.

Equation (33) shows that price in the destination market (importing nation) is the product of the mark up over marginal cost ${MC_t}^F$ where mark-up is determined by demand pressure $[{Y_t}^H]^\beta$ in the importing nation, the pricing to market term $[{P_t}^H]^\alpha$ and exchange rate E_t as shown in equation (33). According to Campa and Goldberge (2002), when there are exchange rate movements, exporters work through the mark-up to affect pass through. For instance, if importers' currency depreciate, exporters may want to lessen the effect of depreciation on the price in the importing nation. What exporters do is absorb this loss in part or whole by reducing mark-up. This way, exporters are able to maintain their market share. However, this leads to incomplete exchange rate pass through to import prices. Combining 32 and 33 generates:

$$P_t{}^{IMP} = \gamma[E_t MC_t^F]^{1-\alpha}\,[P_t{}^H]^{\alpha}\,[Y_t{}^H]^{\beta} \tag{34}$$

Therefore, as long as mark-up varies with exchange rate, pass through will be incomplete.

Taking logs of equation (34) leads to the following equation:

$$P_t{}^{IMP} = \gamma + (1-\alpha)E_t + (1-\alpha)MC_t{}^F + \alpha P_t{}^H + \beta Y_t{}^H \tag{35}$$

In equation (35) the term $(1-\alpha)E_t$ captures exchange rate movements in relation to price while $(1-\alpha)MC_t{}^F$ captures foreign cost; $\alpha P_t{}^H$ and $\beta Y_t{}^H$ capture pricing to market and demand pressure respectively. It should be noted that the coefficient for exchange rate and foreign production cost is the same being $(1-\alpha)$ implying that the pass through of exchange rate and foreign cost to import prices is the same. However, in practice as Barhoumi (2006) put it, this restriction does not hold. Bache (2006) and Barhoumi (2006) argue that exchange rates are more volatile than costs. Therefore, the degree to which they are passed to prices may vary (Pryzstupa and Wrobel, 2011). Therefore, a reasonable supposition is that exporters will be more willing to absorb into their mark-ups changes in exchange rate than changes in costs which are likely to be permanent. In practice therefore, this restriction is relaxed and equation (35) can be transformed as follows:

$$P_t{}^{IMP} = \theta + \psi E_t + \phi MC_t{}^F + \delta P_t{}^H + \pi Y_t{}^H \tag{36}$$

Where $P_t{}^{IMP}$ is import price; E_t is exchange rate; $MC_t{}^F$ is foreign marginal cost; $P_t{}^H$, and $Y_t{}^H$ are the price level and demand pressure in the importing country and $\theta, \psi, \phi, \delta$ and π are parameter coefficients. In equation (36) ψ and ϕ are assumed not to be equal in empirical studies because exchange rates are more volatile than costs and therefore the rate at which exchange rate and cost may pass through to prices may differ.

Equation (36) is the model for exchange rate pass through. According to this model E_t captures exchange rate pass through to import prices. If E_t is equal to one, exchange rate pass through is complete and when E_t is zero, exchange rate pass through is incomplete. According to this model, what determines exchange rate pass through is variations in mark up when there are exchange rate changes. The model shows that exporters under imperfect competitive market have some degree of monopoly market power over the price of the product that enables them to vary their mark-up over marginal cost when there are exchange rate changes.

3.2.2.2.2.2. Macroeconomic Factors and Pricing to Market Models

Modern theoretical literature on the exchange rate pass through has emphasised the need to interact macroeconomic factors and pricing to market models to model the exchange rate pass through. Researchers such as Taylor (2000), Deverux and Engel (2002) have contended that macroeconomic factors interplay with firms' decisions to absorb or pass through exchange rate to prices and therefore the need to incorporate macroeconomic factors in pricing to market models in modelling exchange rate pass through.

Taylor (2000) explains the interaction between low inflation, monetary policy, monetary policy stability and pricing decisions of exporters. According to Taylor (2000) exchange rate pass through is endogenous to a nation's monetary policy and monetary stability. Therefore, the more stable the country's monetary policy and the lower the inflation rate, the lower the exchange rate pass through. Taylor (2000) argues that low inflation reduces the pricing power of firms which means firms have less power to pass through the cost arising from exchange rate fluctuations to prices. Taylor further suggests that the extent to which exchange rate changes affect prices depends on whether exporters perceive exchange rate changes to be permanent or transitory/temporal. Temporal exchange rate changes have little effect on marginal cost and market (Chewe, 2015). Therefore, when exchange rate changes are perceived to be of transient nature, firms do not react to exchange rate changes. What firms do in this case is to adjust their mark-ups or profit margins so that prices in the importing market are not affected. This causes incomplete pass through. On the other hand, if exchange rate changes are perceived to be permanent, firms will react to exchange rate fluctuations because firms take it that their marginal cost will be permanently affected. In this case the exchange rate pass through will be very high. The Tylor (2000) hypothesis asserts that a high inflationary environment provides a conducive atmosphere for firms to perceive increased cost resulting from exchange rate movements as permanent. Therefore, high inflationary environment entails higher exchange rate pass through, and low inflationary environment means low exchange rate pass through. Studies done by Bailliu and Fujii (2004), Maria-Dolores (2009), and Frankel et al (2012), Ozkhan & Erden (2015), find that low inflationary environment negatively affect exchange rate pass through, thus, confirming the Tyalor (2000) Hypothesis.

Deverux and Engel (2002), argue in support of Taylor (2000) that exporters prefer to set price in the currency of the country which has stable monetary policy and stable or low inflation. For instance, if the importing nation has stable monetary policy and low inflation, the exporter would rather invoice the transaction in the importer's currency. This is called local currency pricing (LCP). In this case exchange rate pass through will be incomplete.

Mann (1986) also argues that inflation volatility should have a positive effect on exchange rate pass through. This is because inflation volatility brings in uncertainty among firms. Therefore, firms will be more willing to adjust the prices so as to maintain their profit margins (Mann, 1986). Mann (1986) further contend that low inflationary volatility may also signal stable monetary policy which leads to low exchange rate pass through. However, if it is perceived by firms that volatility in inflation is temporal exporters/firms may not adjust the price (Ozkhan & Erden, 2015). In this case inflation volatility may lead to low exchange rate pass through and other wise high exchange rate pass through.

In like manner exchange rate volatility induces uncertainty among firms and may cause firms to be more willing to adjust the prices so as to maintain their profit margins (Mann 1989). McCathy (2000), Campa and Goldberge (2002) show in their studies that low exchange rate volatility is associated with low exchange rate pass through. However, Froot and Klemperer (1989) contend that the expected impact of exchange rate volatility on exchange rate depends on whether exporters perceive exchange rate volatility as temporal or permanent. If for instance exporters perceive exchange rate volatility as transient/temporal, they will not increase the price of the product for fear of losing their market share in the competitive international market. In this case exchange rate volatility may lead to low exchange rate pass through. On the other hand, the exporters may increase the price when they perceive exchange rate volatility to be permanent. In this case exchange rate volatility will positively impact on the exchange rate pass through.

Campa and Goldberge (2002) have postulated that the degree of openness also called globalisation is a vital determinant of the degree of exchange rate pass through. They contend that the more open a country is, the higher the degree of exchange rate pass through. They assume that the more open a country is the greater the volume of imports which implies a larger share of imported goods in the domestic market. This means a larger percentage of the goods in domestic economy are affected by exchange rate changes. Campa and Goldberge (2002) further, explain that this positive relationship between trade openness and exchange rate pass through can be derived from the Cournot oligopolistic model of exchange rate pass through as explained by Dornbusch (1987). In this model Dornbusch (1987) showed that a larger share of imports in the domestic market implies a lower elasticity of substitution between foreign and domestic goods/firms. Dornbusch (1987) showed that pass through elasticity may be higher if the number of foreign firms (exporters) is higher than that of the domestic firms. However, (Ozkhan & Erden, 2015) argue that trade openness may lead to higher international competition among multinational firms which may result in pricing to market behaviour thereby reducing the extent of exchange rate pass through. This might reduce the exchange rate pass through (Ozkhan and Erden, 2015). Their argument is that foreign exporters may want to preserve their market share in the face of international competition in the export market. If this condition prevails, trade openness (globalisation) may negatively impact the exchange rate pass through to prices. Not only that the proponents of this strand claim that trade integration could also lower tariffs. This could lead to the reduction in the exchange rate pass through.

Business cycles have also been suggested in literature as vital determinants of the exchange rate pass through that are closely related with pricing behaviour of firms. According to Faryna (2016), exporting firms tend to pass through cost emanating from exchange rate shocks to prices when the economy of an importing nation is growing. On the other hand, during recession exporting firms become reluctant to pass exchange rate induced cost to prices. Thus, during recession, exporting firms adjust their mark-ups or profit margins and therefore absorb exchange rate fluctuations to maintain market share. This causes low pass-through during recession and higher pass-through during boom. This introduces asymmetries or nonlinearities in modelling exchange rate pass through. Thus, according to Faryna (2016), incomplete exchange rate pass through is associated with recession while higher pass through is associated with economic boom.

Thus, from the forgoing discussion, indeed macroeconomic variables such as inflation, inflation volatility or stability or and instability in monetary policy, exchange rate volatility, trade openness and the state of the economy can play an important role in modelling exchange rate pass through. Literature shows that these macroeconomic variables can interact with the market structure to model exchange rate pass through.

3.2.3. Theories of Asymmetry and Non-Linearity in Exchange Rate Pass Through

The pricing to market theory is the microeconomic foundation for the asymmetric and non-linear response of exchange rate pass through to prices. The theory states that foreign firms are likely to adjust mark-ups in response to exchange rate changes to stabilize prices in the importing nation (Dornbusch 1987; Krugman, 1987; Kassi et al 2019). The pricing to market model is well explained by market share model by Marston (1990). According to Marston (1990), foreign exporters thrive to maintain their market share in their export market (importing nation). Therefore, when the local currency of the importing nation (export market) depreciates against the exporter's currency, prices of the imported goods in the importing nation will be expensive. This reduces competitiveness or market share of the exporter's goods. Therefore, to avoid loss of market share or competitiveness, the foreign exporter is likely to absorb depreciation of the importing nation's local currency (by reducing the mark-ups) to stabilise import prices in the importing nation. This causes exchange rate pass through to be asymmetric and incomplete. On the other hand, if the local currency of the importing nation (export market) appreciates against the foreign exporter's currency, imported goods in the importing nation (export market) will become cheaper. In this case, the market share of the foreign exporter is not negatively affected in the export market. Therefore, the foreign exporter is not likely to absorb the importing nation's local currency appreciation. The exporter may maintain their mark-ups in this case. Therefore, according to Marston (1990) market share model, foreign exporters are prone to pass through importer's local currency appreciation than depreciation of importer's local currency. This being the case, Marston (1990) concludes that exchange rate pass through is likely to be higher during appreciation of importer's currency (i.e exchange rate depreciation) and lower during depreciation of importer's currency (i.e exchange rate appreciation). Therefore, in the market share model, it is because of the desire to maintain market share by foreign exporters that leads to asymmetries and non-linearity in the exchange rate pass through.

Knetter (1994) on the other hand, propounded the capacity or binding constraints theory of the exchange rate pass through. According, Knetter (1994), when foreign firms are facing production constrains and trade restrictions, they may not be able to match the huge demand for their goods in the importing nation (export market) when local currency of the importing nation appreciates against foreign exporters' currency. This is because when importer's local currency appreciates against foreign exporter's currency, importers will find it cheaper to buy imported goods. This scenario triggers huge demand for foreign goods. However, if there are production constraints on the part of foreign exporters/producers, their production cannot increase to meet demand in the importing nation. According to Knetter (1994), under the assumption of capacity constraints, foreign firms will be more inclined to pass through depreciation of importer's currency and absorb importer's currency appreciation. Therefore, the exchange rate pass through is likely to be higher during importer's currency depreciation (exchange rate appreciation) than during importer's currency appreciation (exchange rate depreciation). Note that the two models; the market share model and the binding constraints model will produce contrary results.

Pollard and Coughlin (2004) explained asymmetries and non-linearity in the exchange rate pass through due to menu cost. Menu cost is the cost that is incurred when a seller changes the price. According to the menu cost argument, changing prices could be costly. Whether exporters will change price or not, depends on the size of exchange rate changes. If it is costly for an exporter to the change price, exchange rate pass through for small and larger exchange rate changes may differ (Faryna, 2016). In the menu cost contention, there exist a threshold of exchange rate changes such that if exchange rate changes are of larger magnitude, that is above a threshold, foreign producers/firms do change their prices. This makes exchange rate pass through to be complete. If exchange rate changes are below the threshold, foreign exporting firms may not change the price. This leads to incomplete exchange rate pass through. The menu cost hypothesis contends that exchange rate pass through may be asymmetric with respect to the size of exchange rate changes. This is because firms are likely to adjust prices if the changes in exchange rate are larger (Cheikh, 2012).

Price rigidity also offers explanation for asymmetries in the exchange rate pass through. Prices are rigid downwards. According to Peltzman (2000), prices rise faster than they fall. When the importer's currency appreciates against the exporter's currency, an exporter has to increase the export price to maintain the profit margin. On the other hand, when the importer's currency depreciates against the exporter's currency, the exporter has to reduce the export price. However, because prices are normally sticky or rigid downwards, exporters increase export price by a bigger margin when there is exporter's currency depreciation (importer's currency appreciation) than they decrease export price when there is exporter's currency appreciation (importer's currency depreciation). Therefore, exchange rate pass through is higher to import prices during exchange rate appreciation (importer's currency depreciation) and lower during importer's currency appreciation.

Pollard and Coughlin (2004) advanced the production switching argument as another possible explanation for asymmetries in the exchange rate pass through. According to the production switching argument, a foreign exporter/producer has an alternative to use local inputs or foreign inputs depending on the direction of exchange rate changes. For instance, if the foreign/exporter producer's currency depreciates, it will be more profitable to use local inputs which entails complete pass through to import prices. On the other hand, if the producer/exporter's currency appreciates, the producer/exporter switch to make use of the imported inputs which means zero pass through. Thus, according to the production switching assertion, the exchange rate pass through should be higher when exporter's currency appreciates and lower otherwise thereby leading to asymmetries in the exchange rate pass through. In what follows cross country and country specific studies in Africa and outside Africa on the exchange rate pass through are discussed.

3.3. Empirical Literature

3.3.1. Cross Country Studies Outside Africa

Knetter (1993) estimated the exchange rate pass through using the pricing to market model for exporters from German, Japan and UK. The findings showed incomplete exchange rate pass through in these markets. Knetter (1993) provided explanation for incomplete pass through. The explanation was that if exporters in these markets face a lot of competition, they tend to vary mark-ups in response to exchange rate fluctuations to stabilise domestic prices in the export markets. In modelling exchange rate pass through Knetter (1993), ignored the macroeconomic determinants of exchange rate pass through which have become vital in explaining asymmetric exchange rate pass through. Macroeconomic variables such as exchange rate and inflation volatility, money supply, trade openness and output gap can influence the degrees of the exchange rate pass through.

Webber (2000) modelled asymmetries in the exchange rate pass through for Asian currencies. Webber (2000) found that Asian currencies did not transmit the full extent of the exchange rate changes to prices after the crisis as they did before the crisis period. This confirmed the presence of not only incomplete exchange rate pass through to prices but also the presence of asymmetries. In like manner, Feestra et al (1996) carried out a study to analyse the effects of market share on the exchange rate pass through by studying the auto industry for forty-eight countries using panel data econometric approach. They found evidence of incomplete exchange rate pass through. In addition, they also found the non-linear relationship in the exchange rate pass through indicating that appreciation and depreciation do have different impacts on exchange rate pass through.

Byrne et al (2012) applied the pricing to market model in investigating the size and the nature of the exchange rate pass through to import prices for a panel of fourteen emerging economies composed of Latin American and Asian countries. They employed econometric techniques that controlled for panel heterogeneity and thus distinguished long and short run effects of exchange rate movements. Finally, they also accounted for asymmetries in their study. In this model, the authors regressed import price on exchange rate, marginal cost and mark-up. They found that exchange rate pass through is incomplete for both Latin American and Asian countries. Their study showed evidence of pricing to market. Their study also gave evidence of asymmetries in the exchange rate pass through. However, their model did not account for the time varying effect of the exchange rate pass through hence could not analyse the declining exchange rate pass through over time.

Erden and Ozkan (2015) applied the dynamic conditional correlation generalised autoregressive conditional heteroskedasticity (DCC-GARCH) model to generate time varying exchange rate pass through and then applied a threshold panel regression to account for nonlinear or asymmetric effects of the exchange rate pass through to inflation. They grouped 88 countries into three categories namely advanced, developing and less developed countries. Their study covered the period from 1980 to 2013 with monthly data. The findings showed that exchange rate pass through is incomplete, low and declining. They also found that exchange rate pass through positively responded to average inflation and inflation volatility but negatively responded to trade openness, exchange rate volatility and output gap. They finally discovered that exchange rate pass through is low in developing countries with low inflation rate. The challenge with their model was that they could not account for endogeneity and feedback effects among the variables they used in the model. Though they accounted for asymmetries, they did not assess the asymmetries in the long run.

3.3.2. Country Specific Studies Outside Africa

Prystupa and Wrobel (2011) investigated the exchange rate pass through to prices in Poland, a small open transition economy. They assessed the level of linearity and asymmetry of exchange rate pass through to import and consumer prices. They found that exchange rate pass through is incomplete both in the short and long run. They confirmed no evidence of asymmetric response to depreciation and appreciation. The econometric model they used did not account for endogeneity among the variables. However, they did not account for time varying effect in the exchange rate pass through model thereby failing to assess how exchange rate pass through responds during periods of average and high inflation.

Some researchers considered the role of increased global competition in low exchange rate pass through. For instance, Otani et al (2003) analysed exchange rate pass through to Japanese import prices for the United States of America. They found exchange rate pass through to prices to be declining. They attributed the declining nature of the exchange rate pass through to increased global competition. On the other hand, Gust et al (2010) examined the exchange rate pass through to import prices. The results showed that import prices fell from 0.5 in 1980s to less than 0.2 in the 1990s. Their findings indicated that increased global trade competition causes exporters to be more aware of competitor's price and thus less responsive to exchange rate fluctuations (Malenbaum 2015). Campa and Goldberg (2002) pointed out in their study that changes in composition of trade or import structure contribute to declining pass through in industrialised countries.

Faryna (2016) estimated the extent of the exchange rate pass through to domestic prices in Ukraine taking into account non-linearities and asymmetries with respect to the magnitude and direction of exchange rate movements. Faryna (2016) also included inflationary environment and business cycle factors in their regression. Faryna (2016) employed the threshold parameters in the autoregressive distributed lag (ARDL) Model to account for asymmetries. The findings showed that the impact of currency depreciation on the exchange rate pass through is more than that of domestic currency appreciation. Further, investigations revealed that prices respond in a nonlinear manner or differently to small, medium and large exchange rate changes respectively. The results from this study showed that exchange rate pass through is higher in periods of extremely large appreciations, high inflationary environment and economic slump.

Marston (1990) applied the pricing to market model in modelling exchange rate pass through for Japan and its trading partners. Marston (1990) found evidence of pricing to market behaviour of Japanese exporters which is responsible for incomplete exchange rate pass through. Marston (1990) discovered that Japanese exporters applied price discrimination between the US and other markets in pricing their products as a result of exchange rate fluctuations. This price discrimination between the US and other markets practised by Japanese exporters led to different degrees of incomplete exchange rate pass through to import prices in respective markets. The study confirmed that exchange rate pass through to prices was not just incomplete but asymmetric and non-linear.

3.3.3. Cross Country Studies in Africa.

Kassi et al (2019) made an assessment of the asymmetric relationship between exchange rate and consumer prices in 40 sub-Saharan African countries using quarterly data for the period starting from 1990 to 2017. They applied the non-linear autoregressive distributed lag (NARDL) and the dynamic panel model to conduct their study. Their findings showed that for the entire panel exchange rate pass through to consumer price was incomplete and higher during the period of local currency appreciation than during the period of local currency depreciation. The study, therefore, confirmed the presence of asymmetries in the exchange rate pass through. They also found that exchange rate pass through is non-linear with respect to the size of exchange rate. However, the analysis does not show how the effect of macroeconomic environment such as differences in inflation among countries impact on exchange rate pass through.

Razafimahefa (2012), conducted a study of the exchange rate pass through to prices and its determinants for countries in sub-Saharan Africa using annual data for the period from 1985 to 2008 using a panel cointegration method of estimation. The study found that exchange rate pass through in sub-Saharan Africa is incomplete and larger during exchange rate depreciation than during exchange rate appreciation. Further, the findings in this study showed that countries with flexible exchange rate regime and higher income have low exchange rate pass through. On the other hand, the study found that countries with fixed exchange rate regime and low incomes have higher exchange rate pass through. Finally, the study also found that countries with low inflation environment and prudent and stable monetary and fiscal policies have lower exchange rate pass through.

Revelli (2020), examined the degree of the exchange rate pass through to consumer price index in Cameroon and Kenya for the period from 1991 to 2013. He used the SVAR model analysis to estimate the exchange rate pass through to domestic prices in the two countries. The finding of this study showed that the exchange rate pass through is incomplete for the two countries ranging from 0.18 to 0.58 over a year in Kenya and 0.58 and 0.89 for the entire sample period for Cameroon. The study also applied the variance decomposition to determine the relative importance of the shocks to consumer price inflation for both countries. The results showed that exchange rate shocks are moderate in the case of Kenya and significant for Cameroon. Thus, the study concluded that exchange rate fluctuations remain a potential source of inflation in the two nations.

3.3.4. Country Specific Studies in Africa

Bakkou et al (2015) evaluated the exchange rate pass through to domestic prices in Morocco for the period from 1979 to 2014. They applied the single error correction model to achieve their objective. Their results showed incomplete exchange rate pass through to domestic prices. Bada et al (2016) examined exchange rate pass through to import and domestic prices in Nigeria for the period spanning from 1995 to 2015 using vector error correction model. Their findings indicated that exchange rate pass through to import and consumer prices is incomplete. However, they found that exchange rate pass through to import prices is greater than that of consumer prices. The challenge with these studies is that they used single equation models which fail to capture endogeneity among the variables.

Mwase (2006), investigated exchange rate pass through to consumer price inflation in Tanzania using the structural autoregressive (SVAR). Mwase (2006) used sample data from 1990 to 2005 to conduct the study. The finding of the study showed that exchange rate pass through for Tanzania is incomplete and declining over time. However, the study does not assess the asymmetries present in the exchange rate pass through. Therefore, the study does not decompose exchange rate into depreciation and appreciation. This means, the study assumes that exchange rate appreciation and depreciation have the same effect on prices in Tanzania.

Wu (2017) used the linear and non-linear framework to study the role of exchange rate and policy determinants in driving inflation in Malawi using the VAR and SVAR. Wu (2017) studied the interactions between non-food prices, headline inflation and exchange rate by taking into account the period before and after exchange rate liberalisation that took place in 2012. The study found that exchange rate pass through has jumped from zero to 11% after exchange rate liberalisation. The finding confirms that exchange rate pass through in Malawi is also incomplete. This study, however, does not isolate the effects of appreciation and depreciation on prices in the economy. This is equivalent to assuming that Kwacha appreciation and depreciation have the same effects on domestic prices.

Sheffeni and Ocran (2013), assessed exchange rate pass through to domestic prices in Namibia for the period from 1993 to 2011. They made use of the impulse response functions and variance decomposition obtained from the SVAR to understand exchange rate pass through to domestic prices. Their findings indicated that there is high and lasting, though not complete exchange rate pass through to consumer price inflation in Namibia. Results from the variance decomposition also showed that exchange rate movements are vital in explaining fluctuations in consumer price inflation.

3.3.5. Exchange Rate Pass Through Studies in Zambia

Exchange rate pass through studies are scanty in Zambia. Not much has been done in this area. To the author's knowledge, there are three studies that directly address exchange rate pass through issue in Zambia namely Chewe (2015), Zgambo (2015) and Lionel et al (2019). However, none of these studies address asymmetries and globalisation in the exchange rate pass through to domestic prices in Zambia as is the case in this thesis.

Chewe (2015) for instance examined the exchange rate pass through to domestic prices in Zambia using monthly data from 1994 to 2013. Chewe (2015) employed SVAR and VECM models to analyse exchange rate pass through domestic prices in Zambia. The study showed that exchange rate pass through to domestic prices is incomplete. The study further showed that a shock to exchange rate causes domestic prices to increase in Zambia. Zgambo (2015), on the other hand examined exchange rate pass through to domestic prices in Zambia using quarterly data from 1993 to 2014. He used SVAR model to carry out his study. The study confirmed incomplete exchange rate pass through to domestic prices in Zambia. Finally, Lionel et al (2019) did a study on exchange rate and inflation dynamics using the SVAR model. Using a combination of short run and zero restrictions to identify relevant global and domestic shocks, Lionel et al (2019), found that exchange rate pass through to consumer prices depends on the shock that originally caused the exchange rate to fluctuate. However, this study does not assess the effects of asymmetries in the exchange rate pas through to domestic prices. In addition, the study does not account for the effects of globalisation on the exchange rate pass through.

3.4. Conclusion

This chapter has given a discussion on the theoretical and empirical literature on the exchange rate pass through to prices. It is clear that the earlier theories of the exchange rate pass through which were based on competitive models assumed one to one relationship between exchange rate movements and prices. These earlier theoretical models concluded complete exchange rate pass through to prices. However, Subsequent studies that were done in 1970s showed that exchange rate pass through to prices was incomplete. This led researchers to develop models that could explain the exchange rate pass through puzzle. An example of such models that explained incomplete exchange rate pass through is the pricing to market of exchange rate pass through developed first by Krugman (1987) and Marston (1990) and later popularised by Betts and Devereux (1996). Empirical studies have shown that the fundamental explanation of low, incomplete and asymmetric exchange rate pass through to prices is the pricing to market behaviour of exporters (Knetter, 1989; Freenstra et al, 1996; Campa and Goldberg, 2002; Malenbaum, 2015). Recent literature identifies globalisation as another important determinant of the exchange rate pass through (Ozkhan and Erden, 2015; Benigno and Faia, 2016; Villavicencio and Mignon, 2017). However, literature on the effect of globalisation on the exchange rate pass through is scanty but developing.

It should be mentioned here that most of the studies on exchange rate pass through, even the ones done in Zambia do not account for asymmetries (Chewe, 2015; Zgambo, 2015; Lionel et al, 2019). Therefore, they do not decompose exchange rate into Kwacha depreciation and appreciation. This means these studies assume that exchange rate appreciation and depreciation have the same effects on domestic prices, an assumption that is far from reality. The current study differs from the those that were done earlier and thus contributes to literature by accounting for asymmetries in modelling exchange rate pass through to domestic prices in Zambia. In addition, from reviewed literature, most of the studies that have accounted for asymmetries in the exchange rate pass through have tended to use the NARDL models (Kassi et al., 2019; Hoa and Hafradb, 2020; Anderl and Caporale 2021). The challenge with the NARDL model is that it is a single equation model which does not analyse the feedback effects among variables. The current study fills this gap by applying the SVAR model to examine the asymmetric exchange rate passthrough to domestic prices in Zambia. The SVAR model accounts for the feedback effects among variables in the model. Second, the current study contributes to empirical literature in the sense that there is no study that has been in Zambia that accounts for asymmetries in the exchange rate passthrough. The other contribution to literature is that the current thesis accounts for globalisation in examining the exchange rate pass through to prices in Zambia. Most of the exchange rate passthrough studies do account for globalisation effects on the exchange rate pass through. Okzhan and Erden (2015), Benign and Faia (2016) and Villavicencio and Mignon (2017) have put a proposition that accounting for globalisation increases the degree of exchange rate pass through. Their studies have shown that indeed accounting for globalisation increases exchange rate pass through. However, these studies used the OLS method of estimation to account for globalisation. This thesis contributes to literature in terms of methodology in that it applied the VECM to account for globalisation thus accounting for feedback effect among variables. Finally, literature on the exchange rate pass through to sectoral prices is quite scant. The current thesis goes further and contributes to literature by examining the exchange rate pass through to some sectors in Zambia thereby contributing in terms of literature to the less explored realm of literature.

CHAPTER 4

EXCHANGE RATE PASS THROUGH TO CONSUMER PRICES

4.1. Introduction

The exchange rate pass through to domestic prices continues to be a field of interest to both researchers and policy makers. This is especially so because there seem to be a close connection between the exchange rate and inflation. The exchange rate pass through (ERPT) is the degree to which exchange rate fluctuations are passed on to prices along a distribution chain (Guillermo et al, 2011). The conventional transmission mechanism of exchange rate movements to prices occurs in two phases. In the first phase, exchange rate changes affect import prices. In the second phase, the domestic producer and consumer prices are affected as imported goods enter the domestic economy (Guillermo et al, 2011). A higher degree of exchange rate pass through implies that a bigger percentage of exchange rate changes are reflected in prices, which may cause inflationary pressure in the domestic economy. This has implications for monetary policy. The exchange rate pass through as explained earlier can be complete or incomplete. It is said to be complete if exchange rate changes are fully reflected or transmitted to the prices. On the other hand, it is said to be incomplete or less than complete if exchange rate changes are not fully reflected in the prices (Gaula et al, 2002; Natalia and Luciana, 2014). Higher degree of the exchange rate pass through means that a bigger percentage of exchange rate changes are reflected in the prices. This may have implications for inflation. Thus, higher degree of the exchange rate pass through implies that, monetary authorities must respond with appropriate actions to maintain their inflation target. On the other hand, lower degree of the exchange rate pass through to prices means monetary authorities have less work to maintain inflation target (Minella et al (2003). Minella et al (2003) indicate in their empirical study that the greater degree of the exchange rate pass through implies greater difficulty for attaining inflation targets. The greater the degree of the exchange rate pass through implies that the domestic economy is more sensitive to external shocks. Therefore, the impact of exogenous shocks to domestic prices is amplified (Ekanayake, 2010).

Recently several exchange rate pass through to domestic prices studies have been carried out. Some studies focused on evaluating the degree of exchange rate pass through while others focused on asymmetries and non-linearity of the exchange rate pass through. The earlier theoretical models of the exchange rate pass through were based on the law of one underpinned by perfect competitive conditions. These models assumed complete exchange rate pass through to prices. However, studies that were done in the 1970s showed that the exchange rate through passthrough was incomplete (Menon, 1995; Branson, 1972; Magee, 1973; Swift; 2001). Thus, the studies that were done in the 1970s showed that the earlier models of the exchange rate pass through could not explain the incomplete exchange rate pass through puzzle (Dornbusch, 1987; Krugman, 1987; Betts and Devereux, 1996). This led researchers to develop models such as the pricing to market model to explain the exchange rate pass through puzzle. There is abundant evidence that the fundamental theoretical explanation of low or incomplete and asymmetric exchange rate pass through is the pricing to market behaviour of exporters (Freenstra et al, 1996; Campa and Goldberg, 2005). For instance, Marston (1990), Knetter (1993) and Kassi et al (2019, confirm in their studies that the exchange rate pass through to prices is not only asymmetric and non-linear but incomplete.

Zambia is an interesting case to study the exchange rate pass through to prices. This is because in the past decades, the economy has witnessed rapid depreciation of the Kwacha. This creates a motivation to study how domestic consumer prices respond to exchange rate changes. It is also vital to understand how domestic consumer prices react to Kwacha appreciation and depreciation.

This chapter, therefore, examines the symmetric and asymmetric nature of the exchange rate pass through to domestic consumer prices using a combination of the pricing to market model and the structural autoregressive (SVAR) model. In doing so, this chapter achieves the first objective of this study. More specifically the chapter aims at examining the degree of the exchange rate pass through to domestic consumer prices using the symmetric and the asymmetric approaches. The difference between the symmetric and asymmetric approach is that under the asymmetric exchange rate pass through, it is assumed that exchange rate depreciation and appreciation have different effects on prices. This necessitates the need to examine the exchange rate pass through to consumer prices due to exchange rate appreciation and depreciation respectively. In the asymmetric approach the exchange rate is decomposed into Kwacha depreciation and appreciation. On the other hand, in the symmetric approach, it is assumed that exchange rate appreciation and depreciation have the same effect on domestic consumer prices. Therefore, the exchange rate is not decomposed into depreciation and appreciation under the symmetric approach.

The current chapter makes a contribution to the body of knowledge and the empirical literature on the exchange rate pass through to consumer prices. Most of the studies of the exchange rate pass through to prices including the studies done in Zambia, have tended to assume that the exchange rate pass through to prices is symmetric in nature (Chewe, 2015; Zgambo, 2015; Natalia and Luciana, 2014; Lionel et al 2017). This implies that the impact of exchange rate depreciation and appreciation on the prices is the same. The studies that assume symmetry of the exchange rate pass through, do not split exchange rate changes into depreciation and appreciation in modelling the exchange rate pass through. The assumption of symmetry in the exchange rate pass through may not be realistic. This is because exchange rate depreciation and appreciation may not have different effects on prices (Kassi et al, 2019; Delloro et al, 2017; Hoa and Hafradb, 2020). This chapter intends to make contribution to literature on the exchange rate pass through by assuming that exchange pass through to prices is asymmetric. To this end, the chapter decomposes exchange rate into Kwacha depreciation and appreciation respectively to model the exchange rate pass through to consumer prices in Zambia. This serves as a contribution to literature on exchange rate pass through in Zambia. If indeed asymmetries are present in modelling exchange rate pass through, it may mean that past studies on exchange rate pass through that have not accounted for asymmetries may have incorrectly characterized exchange rate passthrough. This may also mean, such studies obtained inaccurate results in their findings. Models of the exchange rate passthrough may have to be adjusted accordingly to account for asymmetries. Thus, this study contributes to exchange rate passthrough literature by studying asymmetries in the exchange rate passthrough.

4.2. Methodology and Model Specification.

4.2.1. Theoretical Model: Pricing to Market Model

The theoretical model used in this study for abstracting the exchange rate pass through to consumer price in Zambia is the pricing to market model advanced by Marston (1990). The pricing to market theory, models the exchange rate pass through to import prices. To make this model adaptable for analyzing the exchange rate pass through to consumer prices, modifications are made. Such augmentations have been applied in studies done by Menon (1995), Goldberge and Knetter (1997) and Jeffi (2010).

In the pricing to market model, the exporter of a product is assumed to have some control over the price of the product. Therefore, the exporter sets the price of the product by setting price as mark-up over marginal cost to maximize profit.

To start with, we assume that an exporting firm from country A exports its product to country B. Assume that E_t is the bilateral exchange rate which is defined as units of currency of country B (the importing nation) over units of currency of country A (the exporting nation). The import price in country B can be defined as follows:

$$P_t^{IMP} = E_t \, P_t^F \qquad (1)$$

Where ${P_t}^{IMP}$ is the import price in country B; P_t^F is the exporter's price and E_t is the nominal exchange rate. The next step is to model the exporter's price. The exporting firm is assumed to operate under imperfect competition and therefore, the firm has some control over the export price. Therefore, the exporter sets a mark-up over marginal cost. The export price can be expressed as follows:

$$P_t^F = MK_t \, MC_t^F \qquad (2)$$

Where P_t^F is the export price; MK_t is mark-up and MC_t is the marginal cost in exporter's currency. The mark-up is assumed to respond to importer's domestic production and competitive demand pressure (Przstupa and Wrobel, 2011). Competitive demand pressure is defined as a relationship between domestic and foreign price in terms of importer's currency (Przstupa and Wrobel, 2011). The mark-up can be expressed as follows:

$$MK_t = \gamma \left[\frac{P_t{}^H}{E_t\, MC_t{}^F}\right]^{\alpha} Y_t{}^{H^{\beta}} \tag{3}$$

Where parameters α and β range between zero and one that is $[0 < \alpha < 1,\ 0 < \beta < 1\,]$ and γ is the constant. Combining 2 and 3 will generate equation (4) below:

$$P_t{}^{IMP} = \gamma[E_t MC_t^F]^{1-\alpha}\, [P_t{}^H\,]^{\alpha}\ [Y_t{}^H\,]^{\beta} \tag{4}$$

Taking logs of equation (4) we have the following equation.

$$P_t{}^{IMP} = \gamma + (1-\alpha)E_t + (1-\alpha)MC_t{}^F + \ \alpha P_t{}^H + \beta Y_t{}^H \tag{5}$$

In equation (5), $P_t{}^{IMP}$ is the import price and the term $(1-\alpha)E_t$ captures exchange rate movements in relation to the price while $(1-\alpha)MC_t{}^F$ captures foreign cost; $\alpha P_t{}^H$ and $\beta Y_t{}^H$ capture pricing to market and demand pressure respectively. In empirical work the demand pressure $(Y_t{}^H)$ is normally proxied by GDP, output gap or production index while pricing to market $(P_t{}^H)$ is proxied by overall price level in the economy. Marginal cost $(MC_t{}^F)$ is normally proxied by the US Dollar price of crude oil. It should be noted that the coefficient for exchange rate and foreign production cost is the same being $(1-\alpha)$. This implies that the pass through of exchange rate and foreign cost to import prices is the same. However, in practice as Barhoumi (2006) put it, this restriction does not hold. Bache (2006) and Barhoumi (2006) argue that exchange rates are more volatile than costs. Therefore, the degree to which they are passed to prices may vary. Thus, a reasonable supposition is that exporters will be more willing to absorb into their mark-ups changes in exchange rate than changes in costs which are likely to be permanent. In practice therefore, this restriction is relaxed. With this in mind, equation (5) can be transformed as follows:

$$P_t{}^{IMP} = \theta + \psi E_t + \phi MC_t{}^F + \ \delta P_t{}^d + \pi Y_t{}^d \tag{6}$$

Where ${P_t}^{IMP}$ is the import price and the superscript d, denotes domestic. Therefore ${P_t}^d$ and ${Y_t}^d$ are domestic aggregate price level and demand pressure respectively in the importing nation. Equation (6) is ERPT equation which is widely used for estimating the exchange rate pass through to import prices where ψ is the ERPT coefficient. Exchange rate pass through equation as specified in equation (6) is normally estimated in first difference.

Since the first objective in this chapter is to examine the symmetric and asymmetric exchange rate pass through to consumer prices in Zambia, modifications to the import equation (6) must be made. Jeffri (2016) assumes that a basket of goods consumed in the domestic economy is a function of locally produced goods and imported goods. Therefore, the import price must enter the consumer price equation with respective weight. Thus, the consumer price equation in log form can be specified as follows:

$$P_t = \phi {P_t}^{IMP} + (1 - \phi){P_t}^d \tag{7}$$

Where P_t is consumer price; ϕ represents the weight for imported goods consumed in the domestic economy; $(1 - \phi)$ represents the weight for goods produced and consumed in the domestic economy. Replacing ${P_t}^{IMP}$ in equation (6) with the right-hand side of (7), we have equation (8)

$$P_t = \phi\theta + \phi\psi E_t + \phi\varphi {MC_t}^F + \phi\pi {Y_t}^d + [\phi\delta + (1 - \phi)]{P_t}^d \tag{8}$$

Equation (8) can be written as follows:

$$P_t = \tau + zE_t + \eta MC_t^F + \omega Y_t^d + \varphi P_t^d \tag{9}$$

Equation (9) is the equation that measures the exchange rate pass through to consumer prices in the domestic economy. Where E_t is the nominal exchange rate; MC_t^F is the foreign marginal cost and Y_t^d is the demand pressure facing the exporter; the coefficients $\tau = \phi\theta$ is the intercept; $z = \phi\psi$ is ERPT to consumer prices; $\eta = \phi\varphi$ measures foreign cost; $\omega = \phi\pi$ captures demand pressure in the importing economy facing the exporter and $\varphi = [\phi\delta + (1 - \phi)]$ measures pricing to market

The model for modelling the symmetric exchange rate pass through to consumer prices in Zambia is abstracted from the theoretical model (9). It can be expressed in first difference and log form as follows:

$$\Delta CPI_t = \beta + \gamma \Delta EXR_t + \rho \Delta OIL_t + \pi \Delta GAP_t + \tau \Delta MSG_t + DUME + \mu \qquad (10)$$

Where *CPI* is the log of consumer price index. The CPI represents domestic consumer prices. *EXR* is the log of nominal exchange rate; *OIL* is the log of the US dollar price of crude oil. It is a proxy for foreign marginal cost. *GAP* is output gap, a proxy for demand pressure. In equation (10), μ is the error term. *MSG* is money supply growth. On the other hand, $\beta, \gamma, \rho, \pi, \tau$ are coefficients to be estimated and γ measures the exchange rate pass through to domestic consumer prices in Zambia. *DUME* is a multiplicative dummy variable that controls for exchange rate liberalization that took place in the first quarter of 1994 in Zambia.

Another objective of this chapter is to examine the asymmetric exchange rate pass through to domestic consumer prices in Zambia. This implies, examining the degree of the exchange rate through to domestic consumer prices due to local currency appreciation and depreciation. Thus, to allow for asymmetries in the ERPT, we decompose nominal exchange rate (*EXR*) into positive (Kwacha depreciation=DEP) and negative (Kwacha appreciation=APP) using the concept of the partial sums of squares. To do so, we follow Bahmani-Oskooee et al. (2016) procedure as follows:

$$\mathrm{DEP}_t = \sum_{j=1}^{t} \Delta EXR_j^{+} = \sum_{j=1}^{t} max\,(\Delta\ EXR_j\,, 0) \qquad (11)$$

$$\mathrm{APP}_t = \sum_{j=1}^{t} \Delta EXR_j^{-} = \sum_{j=1}^{t} min\,(\Delta\ EXR_j\,, 0) \qquad (12)$$

Therefore, the asymmetric ERPT equation can be expressed as follows:

$$\Delta CPI_t = \beta + \gamma DEP_t + \sigma APP_t + \rho \Delta OIL_t + \pi \Delta GAP_t + \tau \Delta MSG_t + DUME + \mu \qquad (13)$$

It is vital to mention that there is a theoretical argument that macroeconomic variables such as exchange rate volatility, inflation volatility, money supply, average inflation (stable monetary policy) and treasury bills can influence exchange rate passthrough

(Taylor, 2000; Razafimahefa, 2012; Ozkhan and Erden, 2015; WU, 2017). New models of the exchange rate passthrough are now augmenting the pricing to market models with macroeconomic variables (Razafimahefa, 2012; Ozkhan and Erden, 2015; Taylor, 2000; WU, 2017). Broad money and the T-bill rate are two major intermediary variables to capture the effects of the monetary policy stance and the market's response (WU, 2017). Therefore, money supply growth is included in the exchange rate passthrough equation as a control variable and to capture the effects of monetary policy stance and market response.

4.2.2. Econometric Model: Structural Vector Autoregressive (SVAR) Model

The pricing to market model of the exchange rate pass through to domestic prices is a dynamic model. Thus, the structural vector autoregressive (SVAR) model is well suited for this study. This is because the SVARs are dynamic in nature and allow a researcher to trace out the dynamic response of a variable to exogenous shocks; in this context the dynamic response of prices to exchange rate shocks. Finally, with SVAR, this chapter can also assess the speed and magnitude of exchange rate shocks on the prices. Thus, SVARs pose several advantages in the exchange rate pass through studies. This chapter applied the SVAR to model the exchange rate pass through to domestic prices in Zambia. The SVAR can be modelled as follows:

$$AY_t = A_0 + \sum_{i=1}^{P-1} A_1 Y_{t-1} + B\varepsilon_t \tag{14}$$

Where A is n x n matrix of coefficients for variables in the current period. A_0 is n x 1 column vector of constants while Y_{t-1} is n x 1 column vector of lagged endogenous variables. A_1 to A_p is n x n matrix of coefficients of the lagged endogenous variables Y_{t-1} to be estimated. p is the optimal lag length and ε_t is a n x 1 column of uncorrelated structural shocks corresponding to each Y variable in equation (14). B is matrix of coefficients that measures the direct effect of some ε_t on more than one Y variable with variance-covariance matrix E(ε_t, ε_t')= Σ_{ε}.

The challenge with the SVAR model presented in equation (14) is that it is not directly observable. Therefore, it cannot be directly estimated to derive the true values of matrices A and B. This is because the theoretical construct of the SVAR expressed in equation (14) contains coefficients on both sides of the structural equation. Therefore, there are more unknown parameters to be estimated than the number of equations. Thus, the sampling information may not be adequate to help derive the true values of A and B without imposing identifying restrictions so that some coefficients are not estimated. The reason for this is that the population contains an infinite set of different values of A and B with the same probability distribution for the observable data. This makes it impossible to deduce or conclude from the sample data alone what the true values of A and B are. This implies that parameters are not identified (Gottschalk, 2001) and Chipili (2010). Since the SVAR cannot be directly estimated, the remedy is to estimate a reduced form VAR and then decipher or extract the structural shocks from the estimated reduced form VAR residuals or white noise errors. To obtain a reduced form VAR, equation (14) is pre-multiplied by A^{-1} as follows:

$$A^{-1}(A\mathrm{Y}_t = \mathrm{A}_0 + \sum_{i=1}^{P-1} \mathrm{A}_1 \mathrm{Y}_{t-1} + \mathrm{B}\varepsilon_t)$$

And get the reduced form VAR expressed below:

$$\mathrm{Y}_t = \Gamma_0 + \sum_{i=1}^{P-1} \Gamma_1 \mathrm{Y}_{t-1} + e_t \tag{15}$$

Where $\Gamma_0 = A^{-1}\mathrm{A}_0$, $\Gamma_1 = A^{-1}\mathrm{A}_1$; $\Gamma_2 = A^{-1}\mathrm{A}_2$; ,.., ; $\Gamma_p = A^{-1}\mathrm{A}_p$ and $e_t = A^{-1}\mathrm{B}\varepsilon_t$ is an n x 1 a vector of white noise errors with zero mean and constant covariance variance matrix $E(e_t, e_t') = \Sigma_e$. The white noise errors of the reduced form VAR can be expressed in an equation as follows:

$$e_t = A^{-1}\mathrm{B}\varepsilon_t = H\varepsilon_t \tag{16}$$

Where $H = A^{-1}\mathrm{B}$. Equation (16) relates the reduced form residuals (e_t) and the structural shocks (ε_t). The covariance-variance matrix can be expanded as follows:

$$E(e_t, e_t') = \mathrm{H}\, E(\varepsilon_t, \varepsilon_t')\mathrm{H}' = \mathrm{H}\, \Sigma_e H' = \Omega \tag{17}$$

The estimated covariance matrix in equation (17) can now be used to decipher or recover structural shocks since the covariance matrix contains both the structural shocks (e_t) and the reduced form VAR residuals (ε_t) through equation (16) which is part of equation (17).

To do so restrictions on the coefficients to be estimated must be imposed on matrix A or B or on both, so that some coefficients are not estimated. It should be noted that matrix A relates contemporaneous relations between endogenous variables while Matrix B determines the effect of the shocks on the current period variables. Imposing restrictions on matrix A or B or on both, implicitly means imposing restrictions in the SVAR in equation (14). For instance, imposing restrictions on Matrix A is equivalent to imposing restrictions on the contemporaneous relations among the endogenous variables of the structural model expressed in equations (14). These restrictions are based on economic intuition. When we impose restrictions, the number of unknown parameters in the structural model (SVAR) will now be equal to the number of equations in the estimated VAR. This makes it possible to recover the structural shocks. Identification, therefore, is the process of recovering structural shocks from the reduced form VAR residuals by way of imposing restrictions on matrix A or B or both.

There are different types of approaches to imposing identifying restrictions. These are the short and the long run approaches. The short run approach was introduced by Sims (1986) and Bernanke (1986). Under this approach identifying restrictions are imposed on the contemporaneous interactions among the Y variables. An example of the short run model is the AB model detailed by Amisano and Giannini, (1997). The AB model imposes a structure or short run restrictions on matrix A and B. As restrictions are imposed on A and B, the following assumptions are necessary. First, the structural shocks are assumed orthogonal or uncorrelated to each other. Second, the variances of shocks are normalized to one. On the other hand, under the long run approach, restrictions are imposed on the long run dynamic effect of the shocks on certain variables in the VAR (Chipili, 2010; Blanchard and Quah, 1989; Shapiro and Watson 1988).

In this study, the short run approach, specifically the Amisano and Giannini, (1997) AB model is adopted as an identification strategy which produces the Cholesky identification structure. It should be noted that the AB model is the same expressed in equation (16). In equation (16), there are n^2 identified unknown elements in A and B. However, the symmetric property variance covariance matrix $E(e_t, e_t{}')=\Omega$ imposes $n(n+1)/2$ identifying restrictions on n^2 elements of A. Therefore, at least $n^2 - n(n+1)/2$

restrictions must be imposed to identify elements in A and B. When these restrictions are imposed, it becomes possible to produce structural impulse response functions (Amisano and Giannini, 1997; Chipili 2010).

Following Amisano and Giannini, (1997) AB model, the identification strategy for symmetric exchange rate pass through to domestic consumer price model in this chapter is expressed as follows:

$$\mathrm{Y}_t{}' = OIL, GAP, MSG, EXR, CPI \tag{18}$$

Where elements in $\mathrm{Y}_t{}'$ are expressed in equation (18). This produces the following identification structure expressed in matrix form below:

$$\begin{bmatrix} 1 & 0 & 0 & 0 & 0 \\ a_{21} & 1 & 0 & 0 & 0 \\ a_{31} & a_{32} & 1 & 0 & 0 \\ a_{41} & a_{42} & a_{43} & 1 & 0 \\ a_{51} & a_{52} & a_{53} & a_{54} & 1 \end{bmatrix} \begin{bmatrix} e_t^{OIL} \\ e_t^{GAP} \\ e_t^{MSG} \\ e_t^{EXR} \\ e_t^{CPI} \end{bmatrix} = \begin{bmatrix} b_{11} & 0 & 0 & 0 & 0 \\ 0 & b_{22} & 0 & 0 & 0 \\ 0 & 0 & b_{33} & 0 & 0 \\ 0 & 0 & 0 & b_{44} & 0 \\ 0 & 0 & 0 & 0 & b_{55} \end{bmatrix} \begin{bmatrix} \varepsilon_t^{OIL} \\ \varepsilon_t^{GAP} \\ \varepsilon_t^{MSG} \\ \varepsilon_t^{EXR} \\ \varepsilon_t^{CPI} \end{bmatrix}$$

Where $\varepsilon_t{}^{OIL}$, $\varepsilon_t{}^{GAP}$, $\varepsilon_t{}^{MSG}$, $\varepsilon_t{}^{EXR}$, $\varepsilon_t{}^{CPI}$ are oil price shock, output (a proxy for demand pressure) shock, money supply growth shock, exchange rate shock and consumer price index shock. With this sort of identification, 35 restrictions were imposed as follows: 10 zero restrictions and 5 normalization restrictions on matrix A and 20 zero restrictions on matrix B. The identification scheme presented above in matrix form yields the following system of shocks or equations equivalent to the system of shocks obtained under the recursive ordering or Cholesky decomposition.

$$\varepsilon_{OIL_t} = \mu_{OIL\ t} \tag{19}$$

$$\varepsilon_{INDEX_t} = \mu_{OIL\ t} + \mu_{GAP\ t} \tag{20}$$

$$\varepsilon_{MSG_t} = \mu_{OIL\ t} + \mu_{GAP\ t} + \mu_{MSG\ t} \tag{21}$$

$$\varepsilon_{EXR_t} = \mu_{OIL\ t} + \mu_{GAP\ t} + \mu_{MSG\ t} + \mu_{EXR\ t} \tag{22}$$

$$\varepsilon_{CPI_t} = \mu_{OIL\ t} + \mu_{GAP_t} + \mu_{MSG\ t} + \mu_{EXR\ t} + \mu_{CPI\ t} \tag{23}$$

Applying the AB model for identification in the asymmetric model of the exchange rate pass through to domestic consumer prices yields the following identification strategy which equivalent to recursive ordering or Cholesky decomposition:

$$\mathrm{Y}_t{}' = OIL, GAP, MSG, EXR, DEP, APP, CPI \tag{24}$$

$$\begin{bmatrix} 1 & 0 & 0 & 0 & 0 & 0 \\ a_{21} & 1 & 0 & 0 & 0 & 0 \\ a_{31} & a_{32} & 1 & 0 & 0 & 0 \\ a_{41} & a_{42} & a_{43} & 1 & 0 & 0 \\ a_{51} & a_{52} & a_{53} & a_{54} & 1 & 0 \\ a_{61} & a_{62} & a_{63} & a_{64} & a_{65} & 1 \end{bmatrix} \begin{bmatrix} e_t^{OIL} \\ e_t^{GAP} \\ e_t^{MSG} \\ e_t^{DEP} \\ e_t^{APP} \\ e_t^{CPI} \end{bmatrix} = \begin{bmatrix} b_{11} & 0 & 0 & 0 & 0 & 0 \\ 0 & b_{22} & 0 & 0 & 0 & 0 \\ 0 & 0 & b_{33} & 0 & 0 & 0 \\ 0 & 0 & 0 & b_{44} & 0 & 0 \\ 0 & 0 & 0 & 0 & b_{55} & 0 \\ 0 & 0 & 0 & 0 & 0 & b_{66} \end{bmatrix} \begin{bmatrix} \varepsilon_t^{OIL} \\ \varepsilon_t^{GAP} \\ \varepsilon_t^{MSG} \\ \varepsilon_t^{DEP} \\ \varepsilon_t^{APP} \\ \varepsilon_t^{CPI} \end{bmatrix}$$

Where $\varepsilon_t{}^{OIL}$, $\varepsilon_t{}^{GAP}$, $\varepsilon_t{}^{MSG}$, $\varepsilon_t{}^{DEP}$, $\varepsilon_t{}^{APP}$, $\varepsilon_t{}^{CPI}$ are oil price shock, output gap (a proxy for demand pressure) shock, money supply growth shock, Kwacha depreciation shock, Kwacha appreciation shock and consumer price index shock respectively. In the asymmetric model, the AB model of identification imposed 51 restrictions as follows: 15 zero restrictions and 6 normalization restrictions on matrix A and 30 zero restrictions on matrix B. This produces the following system of structural shocks for the asymmetric exchange rate pass through model:

$$\varepsilon_{LNOIL_t} = \mu_{LNOIL\ t} \tag{25}$$

$$\varepsilon_{INDEX_t} = \mu_{OIL\ t} + \mu_{GAP\ t} \tag{26}$$

$$\varepsilon_{MSG_t} = \mu_{OIL\ t} + \mu_{GAP\ t} + \mu_{MSG\ t} \tag{27}$$

$$\varepsilon_{DEP_t} = \mu_{OIL\ t} + \mu_{GAP\ t} + \mu_{MSG\ t} + \mu_{DEP\ t} \tag{28}$$

$$\varepsilon_{APP_t} = \mu_{OIL\ t} + \mu_{GAP\ t} + \mu_{MSG\ t} + \mu_{DEP\ t} + \mu_{APP\ t} \tag{29}$$

$$\varepsilon_{CPI_t} = \mu_{OIL\ t} + \mu_{GAP\ t} + \mu_{MSG\ t} + \mu_{DEP\ t} + \mu_{APP\ t} + \mu_{CPI\ t} \tag{30}$$

The above identification strategy is called the AB or the Cholesky identification scheme. It is also called the zero short run restrictions. This because in the Cholesky identification scheme some shocks have no contemporaneous effect on one or more of the endogenous variables. The current study assumes that exchange rate is more exogenous as compared to prices (sectoral and consumer prices) in Zambia. There is a discernible co movement between exchange rate and prices in Zambia. For instance, when Kwacha depreciates against the US$ Dollar prices rise (Cheelo & Banda 2015; Chewe 2015, Zgambo, 2015). Figures 2.8 and 2.9 of chapter two show that a rise in exchange rate (Kwacha depreciation) is matched by a rise in sectoral and consumer price indices respectively. Therefore, the study applied the Cholesky identification or zero short run restrictions so that price indices show be placed last in the recursive ordering since prices in Zambia seem to be driven by exchange rate among other things.

As explained above, the AB identification scheme presented above in matrix form for both the symmetric and asymmetric models of the exchange rate pass through to domestic prices produces the recursive ordering or Cholesky decomposition scheme. The economic assumption behind the recursive ordering is that the variable that is ordered first is more exogenous than the ones that come later. Thus, in this study, oil price (*OIL*) is ordered first because it is assumed to be more a exogenous variable. Oil price is determined in the world market and as such it is independent to the Zambian economy. Oil price shock is expected to contemporaneously affect other variables in the system namely the output gap, exchange rate and domestic consumer price and not vice versa. The only shock that can affect the oil price is the oil price shock. This is equivalent to claiming that all other coefficients in the oil price equation that is equation 19 in the symmetric model and equation 25 in the asymmetric model are equal to zero. Second in the order of variables is output *(GAP*). Output gap is ordered second because it is assumed to be contemporaneously affected by oil price and not vice versa. However, it is assumed that output gap shocks contemporaneously affect money supply growth, exchange rate and consumer price index. Money supply growth is ordered third because it is assumed to contemporaneously affect exchange rate and not vice versa. Exchange rate is expected to be contemporaneously affected by shocks of the variables ordered earlier except consumer price index. However, exchange rate is not contemporaneously affected by the consumer price index. The consumer price index is ordered last because it is assumed to be affected contemporaneously by all shocks in the system and yet does not affect other variables in the system. This identification as explained and shown in the matrix above produces a just or exactly identified SVAR.

Having identified the SVAR, two types of analyses are performed in this study to examine the dynamic interactions between exchange rate and consumer prices and to assess the dynamic path of the exchange rate pass through. These two types of analyses are impulse responses functions and variance decomposition. Impulse response functions measure the effect of one standard deviation exogenous shock on the current and future values of the endogenous variables in the system (Chewe, 2015; Zgambo, 2015). Since the current study focuses on the exchange rate pass through to consumer prices, impulse response functions would trace the effect of one standard deviation exogenous shock to exchange rate on consumer prices in the domestic economy. The tracing of the dynamic path of consumer prices due to a shock in exchange rate is referred to as the exchange rate pass through. However, an important requirement for impulse response functions and variance decomposition is the stability of the SVAR. This implies that impulse response functions must decline to zero overtime after a shock to the endogenous variable (Chewe, 2015).

It is vital to note that the impulse response functions can also be used to estimate the exchange rate pass through elasticity by making use of cumulative impulse response functions. Following, Leigh and Rossi (2002), Capistrain et. al (2011) and Guillermo et. al (2014) formulation, the exchange rate pass through elasticity (ERPTE) is defined as the ratio of the cumulative response of consumer price inflation to cumulative exchange rate change in response to exchange rate shock. It can be expressed as follows:

$$ERPTE_s = \frac{\%\ \Delta CPI_{t,t+s}}{\%\Delta EXR_{t,t+s}} \tag{31}$$

Where $ERPTE_s$ is the exchange rate pass through elasticity s periods after a shock that took place at time t. $\%\Delta CPI_{t,t+s}$ is the cumulative consumer price inflation changes s periods after an exchange rate shock at time t. It is interpreted as the cumulative impulse response of consumer price inflation due to a shock in exchange rate s periods after a shock that occurred at time t. Finally, $\%\Delta EXR_{t,t+s}$ is the cumulative exchange rate change in response to its own shock s periods after the shock at time t. The cumulative consumer price inflation response can be interpreted as the percentage change in the corresponding consumer price index at period *t+s* due to one standard deviation depreciation shock at time t. Therefore, the ratio of the cumulative responses of consumer price inflation to exchange rate depreciation and appreciation is an elasticity (Guillermo et al 2014).

Variance decomposition on the other hand, gives information about the proportion of variation in an endogenous variable due to own shock versus shocks to the variables in the system (Guillermo et al 2014). Variance decomposition enables a researcher to determine the relative importance of each structural shock in explaining percentage variance of the endogenous variables in the system (Guillermo et al 2014). In case of the current study therefore, the variance decomposition of consumer price inflation gives a picture of the relative importance of the shock from consumer price inflation itself and shocks from other variables in the SVAR in explaining the percentage variance in the consumer price inflation in Zambia.

4.2.3. Optimal Lag Length

Before estimating the VAR model, it is vital to establish the optimal lag order. Optimal lag length facilitates estimation of consistent and efficient estimates, impulse responses functions and variance decomposition. Estimating the VAR model with a smaller number of lags than optimal may lead to model misspecification and inconsistent results. On the other hand, too many lags than optimal reduce the degrees of freedom in small and finite samples thereby leading to imprecise estimates. In addition, though introducing more lags improves the fit, this may also increase the danger of over fitting. To avoid this problem various information criteria are available to decide on the optimal lag length of a VAR. These include Akaike information criterion (AIC), Schwarz information criterion (SIC), Hannin and Quinn information criterion (HQ) and Final prediction error (FPE).

4.2.4. Unit Root Test

It is a requirement that variables are stationary in estimating the SVAR. Therefore, unit root tests are performed to establish whether data are stationary or non-stationary. In establishing stationarity, a common test is the Augmented Dickey-Fuller (ADF) test procedure which is done by estimating the following equation:

$$\Delta Y = a_0 + \delta Y_{t-1} + \sum_{i=1}^{n} \Delta Y_{t-1} + \mu_t \qquad (32)$$

Where $\delta = \rho - 1$, the null and the alternative hypothesis could be written as follows; H: $\delta = 0$ and H: $\delta \prec 0$ respectively. Several augmentations based on AIC and SIC are made to equation (32) to achieve residuals that are non-serially correlated. If the null hypothesis H: $\delta = 0$ is rejected and we fail to reject the alternative H: $\delta \prec 0$ then Y_t is stationary and otherwise nonstationary.

To complement the ADF test, the Philip Peron (PP) test is usually done to further confirm the stationarity of variables. The PP test is the modified version of the ADF test in that, instead of adding lagged variables to the test equation to account for serial correlation, it non-parametrically adjusts the t-statistic of the coefficient δ. This reduces equation 32 to equation 33 expressed below. However, the null hypothesis is the same as that of the ADF test.

$$\Delta Y = a_0 + \delta Y_{t-1} + \mu_t \qquad (33)$$

4.3. Type of Data, Data Sources and Variable Description

This study employed quarterly data from the first quarter of 1985 to the last quarter of 2017. The source of data on consumer price index (CPI) and exchange rate were obtained from the International Financial Statistics (IFS), while data on money supply growth and oil prices were obtained from World Development Indicators and the World Bank Commodity Prices (World Bank pink sheet) respectively. Data on GDP from which output gap was estimated were obtained from the World Development Indicators.

All the variables are expressed in logarithm except for money supply growth and output gap. Consumer price index expressed as CPI is used as a measure of consumer prices. It is a composite function of the price of the imported and domestically produced goods and services. Consumer price index in this study is based on 2010 prices. It captures the pass through of exchange rate to consumer prices. The exchange rate is measured as the ratio of the units of the Kwacha over the units of the US Dollar (ZKM/USD). This study used the nominal exchange rate to capture exchange rate passthrough to consumer price inflation. Kwacha currency depreciation (DEP) is expressed as positive changes in exchange rate (ZMK/USD) while Kwacha appreciation is expressed as negative changes in exchange rate (ZKM/USD). The money supply growth is the annualized percentage changes in money supply (MS2).

Output gap (GAP) which is taken as a measure of demand pressure facing foreign firms in the export market is calculated using the Hodrick and Prescott (1997) filter (HP filter). The Hodrick and Prescott (1997) filter computes the output gap as the difference between the actual and the potential or trend output (GDP). The Hodrick and Prescott Filter (HP) endeavors to extract potential output using past values of the GDP series. The underlying neo-classical assumption of this statistical method is that the output gravitates towards equilibrium such that the past values of actual GDP give a good indicator of potential output for a long time.

The HP filter can be specified as follows:

$$Min \sum_{t=1}^{T}(Y_t - Y_t^*)^2 + \lambda \sum_{t=2}^{T-1} [(Y_{t+1} - Y_t^*) - (Y_t - Y_{t-1}^*)]^2 \quad (34)$$

Where Y_t is the actual GDP; Y_t^* is the potential GDP and t = 1,2,3….,T. The term $\sum_{t=1}^{T}(Y_t - Y_t^*)^2$ in equation (34) minimizes the distance between the actual and the potential GDP. The second component $\sum_{t=2}^{T-1} [(Y_{t+1} - Y_t^*) - (Y_t - Y_{t-1}^*)]^2$ minimizes the change in the trend in the GDP series whereas λ is the weighting factor for smoothness of the trend. The challenge is what should be the optimal λ. For instance, if $\lambda = 0$ the trend will be equal to actual GDP series and if $\lambda = \infty$ the trend will reduce to linear trend. However, Hodrick and Prescott (1997) originally chose $\lambda = 1600$ for quarterly series and $\lambda = 100$ for annual series. The Hodrick and Prescott (1997) choice for λ has become the industry a *de facto* standard (Canova, 1993).

DUME is the dummy variable that accounts for exchange rate liberalization that occurred in the first quarter of 1994. It was generated as follows; a time dummy variable was first generated which took the value of zero before 1994Q1 and one after 1994Q1. The time dummy variable was later interacted with exchange rate by multiplying a time dummy variable and exchange rate.

4.4. Empirical Results.

This section of the chapter presents the findings of the study for chapter four. The section begins by presenting the descriptive analysis and summary statistics of the variables that were used for analysis. The section proceeds to presenting and analyzing the findings from the SVAR model for the symmetric and the asymmetric models. The impulse response function and the variance decomposition are presented. Finally, the section also presents the calculated exchange rate pass through elasticity before making conclusion.

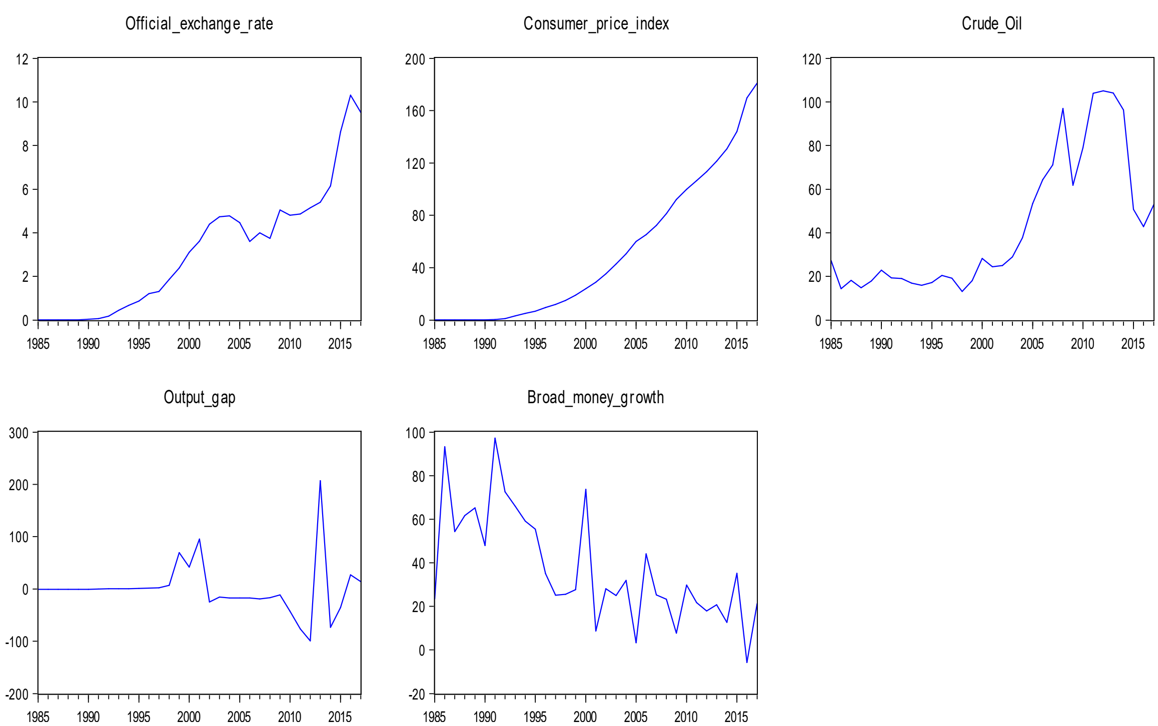
4.4.1. Descriptive Analysis

The figure 4.1 displays the level series of the data for the variables that were used for analysis in this chapter. Figure 4.1 shows that exchange rate rose from 1994 to 2015. The rise in exchange rate, however, is characterized by some minor swings during this period. It can also be observed in figure 4.1 that the period before 1994 is characterized by low volatility in exchange rate. This is so because before 1994, the economy had the fixed exchange rate regime in place. It is worthwhile to mention that under the fixed exchange rate regime exchange rate hardly changes. Therefore, the period of tranquility in the exchange rate is expected before 1994 when exchange rates were not yet liberalized. Beyond 1994 exchange rate shows an upward trend as this marks the period when exchange rates were liberalized, reflecting market conditions. This period ushered in the flexible exchange rate regime. The consumer price index series display an upward trend for the entire sample period after liberalization as shown in figure 4.1. The trend in the consumer price index follows the pattern of exchange rate. This indicates that consumer prices might be influenced by movements in exchange rate. It also signals that consumer price index might have been affected by exchange rate liberalization.

The graphical analysis of figure 4.1 shows that the oil price was quiet low between 1986 and 2000. However, oil price rose sharply to maximum in 2008 and later exhibit swings between 2008 and 2017. On the other hand, the money supply growth shows a downward trend especially in 2000s. This might reflect the tight stance of monetary policy to achieve price stability. Finally, output gap displays less variations especially before 2000. A rise in output gap from 2009 to 2010 indicates improvements in economic performance.

The summary statistics displayed in table 4.1 show that consumer price index (CPI), output gap (GAP), oil price (Oil), money supply growth (MSG) and exchange rate (EXR) in that order are the most volatile variables based on standard deviation. All the variables are not normally distributed as confirmed by their respective skewness, kurtosis and the Jarque Bera statistics. This is not surprising as it is expected for financial and price data. According to literature, most financial and price data exhibit non normal distribution. This is because they are generated from distributions which are characterised by fat tails (Koay and Kwek, 2006; Hassan, 2009; Chipili, 2010).

Figure 4.1: Graphical Presentation of Level Series of the Variables



Source: Author's computations

Table 4.1: Summary Statistics: 1983 to 2017

Variable	Consumer Price Index	Nominal Exchange Rate	Oil Price (US$)	Output Gap	Money Supply Growth
Mean	51.2666	3.1931	42.4416	-0.2241	37.3969
Std. Dev.	54.6340	2.8419	30.5948	51.5097	24.9902
Skewness	0.8480	0.7044	0.9454	1.8694	0.6720
Kurtosis	2.5182	2.8991	2.4641	9.3673	2.7695
Jarque-Bera	17.0967	10.9729	21.2435	297.592	10.2261
Probability	0.0002	0.0041	0.0000	0.00000	0.0060
Obs	132	132	132	131	132

Source: Author's computations

4.4.2. Unit Root Test Results

Table 4.2 presents unit root test results for variables included in the SVAR model. The Augmented Dickey Fuller (ADF) tests were applied to the series of the variables included in the model and the results are tabulated in table 4.2. As explained earlier, the null hypothesis of unit root in variables is rejected when the ADF statistics are greater than the critical values and other wise accepted. The unit root tests results in table 4.2 show that all variables are stationary at first difference. For all variables, their test statistic is greater than their respective critical values at 1%.

Table 4.2: Unit Root Test

	Level	First Difference	Mackinnon Critical Values	
Variable	ADF	ADF	Critical value	Critical value
	t-statistics	t-statistics	1% Level	5% Level
CPI	-1.895200	-11.60780*	-4.031	-4.030
EXR	-2.178340	-6.002137*	-4.031	-4.030
OIL	-2.752579	-4.287143*	-4.031	-4.030
GAP	-2.019674	-4.643152*	-4.031	-4.030
DEP	-3.313710	-7.32958*	-4.031	-4.030
APP	-3.221715	-4.939403*	-4.031	-4.030
MSG	3.155802	-4.520954*	-4.031	-4.030

* and ** denote variable is integrated at 1% and 5% respectively

Notes: CPI=consumer price index; EXR=exchange rate; APP= Kwacha appreciation; DEP=Kwacha depreciation; OIL= price of crude (US $ Dollars); GAP= output gap; MSG=money supply growth.

Source: Author's computations

4.4.3. Optimal Lag Length Results

Before estimating the VAR model, the optimal lag length had to be established. Table 4.3 below displays the selection criteria results for optimal lag selection. The Akaike Information Criterion (AIC), Hannan and Quinn Criterion (HQ), Final Prediction Error (FPE), Schwarz information criterion (SC) and the likelihood ratio test information criteria were used to decide on the optimal lag length. The information criteria namely the LR, FPE, AIC, SC and HQ indicated optimal lag of two for the symmetric model. Therefore, the symmetric SVAR was estimated with optimal of two. On the other hand, the asymmetric model was estimated with lag one because the information criteria namely the FPE, AIC SC, LR and HQ indicated the optimal lag of one.

Table 4.3: Optimal Lag Selection for Symmetric SVAR

Optimal lag Order for Symmetric Model						
Lag	LogL	LR	FPE	AIC	SC	HQ
0	80.7078	NA	0.00000	-1.1829	-1.07150	-1.1377
1	169.6133	169.4760	0.00000	-2.1815	-0.97510	-1.7027
2	195.8367	47.9399*	7.64e-0*	-2.2006*	-1.51301*	-1.90985
3	209.3236	23.60200	0.00000	-2.02070	-0.23820	-1.29640
Optimal Lag Selection for Asymmetric SVAR						
Lag	LogL	LR	FPE	AIC	SC	HQ
0	78.3410	NA	0.00000	-1.13710	-1.026200	-1.09200
1	171.2487	177.1729	7.70e-0*	-2.1899*	-1.524830*	-1.91967*
2	195.1054	43.64473*	0.00000	-2.17220	-0.952900	-1.67680

Source: Author's computations

4.4.4. SVAR Estimates for Symmetric Model.

This section presents results from the symmetric SVAR estimates. The summary results from the symmetric SVAR, impulse response function and the variance decomposition are presented in this section. The section also presents the calculated exchange rate pass through elasticity. The entire output for the symmetric SVAR for exchange rate pass through to domestic prices is displayed in appendix B.

4.4.4.1. The Summary Results from SVAR Output for Symmetric Model.

The equations from 35 to 39 summarize the SVAR estimates. These equations represent the system of shocks from the SVAR. The figures in parenthesis are p-values while figures which are not in parenthesis are the coefficients which represent the impact of a shock on the variable of interest. Of great importance is equation 39 which shows the impact of the exchange rate shock (*EXR*) on consumer prices inflation (*CPI*). The coefficient of the exchange rate shock of 0.2155 is positively significant at 1%. This result implies that if the exchange rate shock coefficient increases by 1%, domestic consumer inflation will increase by 0.22%. Since, the exchange rate shock coefficient of 0.2155 is less than one, it means that the exchange rate pass through to consumer prices is incomplete.

$$\varepsilon_{OIL} = \underset{(0.0000)}{0.1504}\mu_{OIL} \quad (35)$$

$$\varepsilon_{GAP} = \underset{(0.0633)}{0.0439}\mu_{OIL} + \underset{(0.0000)}{0.0403}\mu_{GAP} \quad (36)$$

$$\varepsilon_{MSG} = \underset{(0.7911)}{-1.4495}\mu_{OIL} - \underset{(0.3138)}{20.2941}\mu_{GAP} + \underset{(0.0000)}{9.1856}\mu_{MSG} \quad (37)$$

$$\varepsilon_{EXR} = \underset{(0.020)}{-0.1242}\mu_{OIL} - \underset{(0.8094)}{0.0476}\mu_{GAP} - \underset{(0.636)}{0.0004}\mu_{MSG} + \underset{(0.0000)}{0.0896}\mu_{EXR} \quad (38)$$

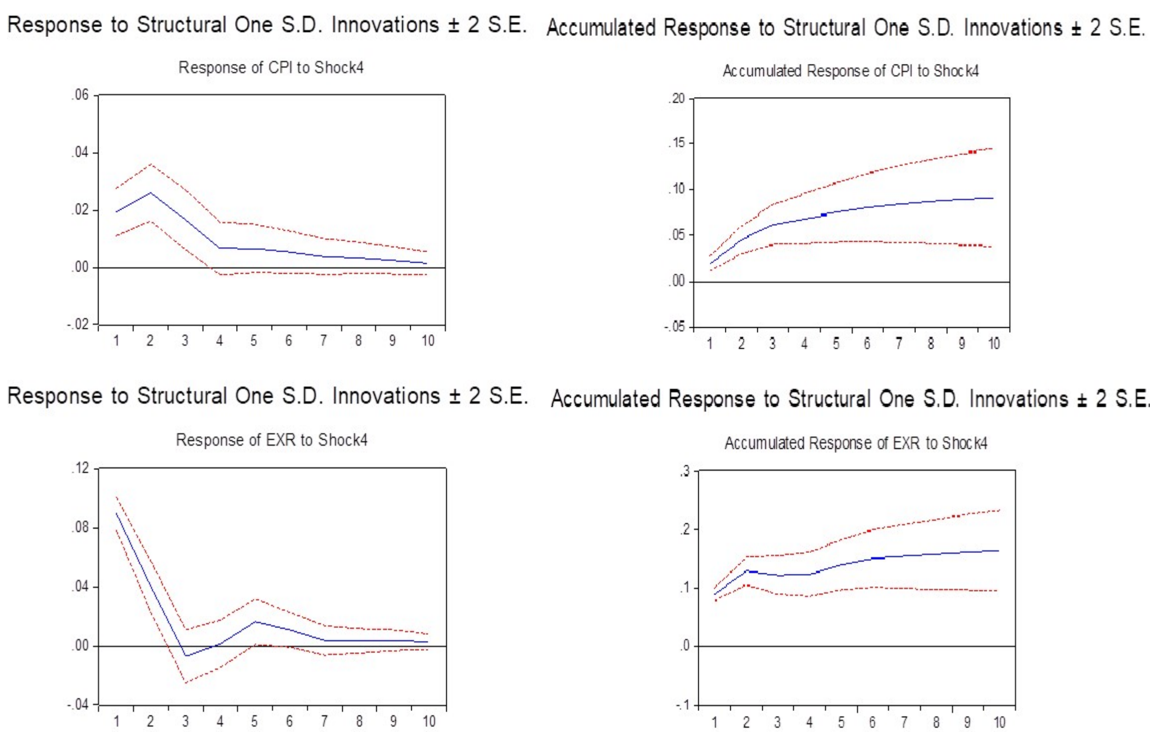
$$\varepsilon_{CPI} = \underset{(0.282)}{0.0290}\mu_{OIL} - \underset{(0.8046)}{0.0242}\mu_{GAP} + \underset{(0.8613)}{7.46e.}\mu_{MSG} + \underset{(0.000)}{0.2155}\mu_{EXR} + \underset{(0.0000)}{0.044}\mu_{CPI} \quad (39)$$

4.4.4.2. Impulse Response Function Analysis for Symmetric Model

To have a clear picture of the magnitude of the exchange rate pass through to domestic consumer prices, the study computed the structural impulse response functions and cumulated structural impulse response functions. According to Sims (1986), impulse response functions trace the impact of a shock from an endogenous variable to other variables within the system through the dynamic structure.

Figure 4.2 displays the non-cumulated and cumulated structural impulse response functions of exchange rate and domestic consumer price inflation respectively. The upper panel of figure 4.2 displays the non-cumulated and cumulated structural impulse response functions of consumer price inflation due to a shock in exchange rate. The lower panel of figure 4.2 shows the non-cumulated and cumulated structural impulse response functions of exchange rate due to the shock in exchange rate. In figure 4.2, shock 4 is the exchange rate shock in the system. Figure 4.2 shows that the response of consumer price inflation due to the shock in exchange rate is statistically significant at 1% level but last for 10 quarters and thereafter become insignificant. Therefore, it takes 11 quarters for the impact of the exchange rate shock on domestic consumer prices to die out. One structural standard deviation shock in exchange rate causes domestic consumer price inflation to increase in quarter 1 and reach maximum in quarter 2 at 2.6%. Thereafter decreases significantly until quarter 11 when the shock becomes insignificant as shown in figure 4.2.

Figure 4.2: Impulse Response Function for Symmetric Model



Source: Author’s computations

4.4.4.3. Exchange Rate Pass- Through Elasticity for Symmetric Model

To provide a better understanding of the evolution of the exchange rate pass through, the exchange rate pass through elasticity (ERPTE) to domestic consumer prices was calculated. In estimating the exchange rate pass through elasticity this study followed Leigh and Rossi (2002), Capistran et al (2011) and Guillermo et al (2014) formulation as specified in equation 31.

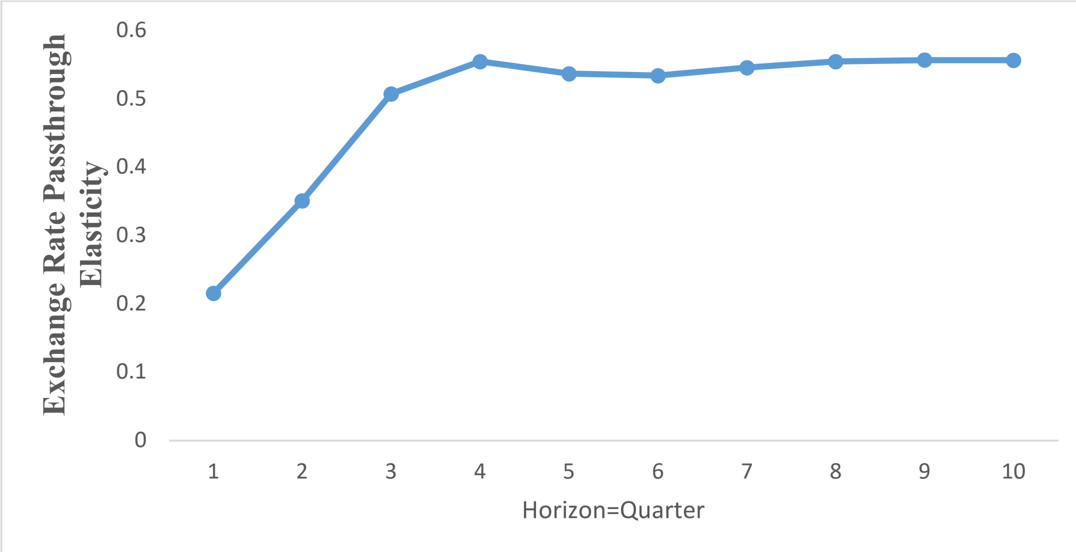
Table 4.4 displays the calculated exchange rate pass through elasticity. Table 4.4 shows that one standard deviation shock of 0.0896 to exchange rate increases domestic consumer prices by 0.0193 which corresponds to the exchange rate pass through elasticity of 0.2155 in the first quarter. This means that the exchange rate shock of 8.9% increases domestic consumer prices by 2.2%. It is vital to notice that the exchange rate pass through elasticity for the entire period is below one. This means exchange rate pass through to domestic consumer prices is incomplete. The average exchange rate pass through elasticity for the whole period is 0.49 which is less than one as shown in table 4.4 and figure 4.3. The elasticity of the exchange rate pass through being less than one is a confirmation of the pricing to market behavior practiced by exporters. This implies that foreign producers absorb part of the exchange rate fluctuations in their profit margins to maintain their market share in the import nation (Zambia in this case).

Table 4.4: Exchange Rate Pass-through Elasticity for Symmetric Model

Period	Cumulative Response of Exchange Rate (EXR) to Exchange Rate Shock	Cumulative Response of Inflation (CPI) to Exchange Rate	Exchange Rate Passthrough Elasticity
1	0.0896	0.0193	0.2155
2	0.1294	0.0454	0.3505
3	0.1223	0.0620	0.5069
4	0.1238	0.0686	0.5542
5	0.1401	0.0751	0.5364
6	0.1509	0.0805	0.5334
7	0.1546	0.0843	0.5452
8	0.1579	0.0875	0.5542
9	0.1617	0.0899	0.5563
10	0.1643	0.0913	0.5558
Average Exchange Rate Passthrough for 10 quarters			0.4908

Source: Author’s computations

Figure 4.3: Exchange Rate Pass Through Elasticity Graph for Symmetric Model



Source: Author's Computations

4.4.4.4. Variance Decomposition for Symmetric Model

To understand the importance of the shocks from the endogenous variables in the system on consumer price inflation, the study computed the forecast error variance decomposition (FEVD). Table 4.5 presents the variance decomposition of consumer price inflation (*CPI*). The results from table 4.5 show that the consumer price inflation inertia (shocks to consumer price inflation) and exchange rate shocks are the major determinants of variance in domestic consumer price inflation. The Shocks to consumer price inflation (inflation inertia) account for more than 61% for ten quarters. Defining quarter one as short run, it can be said that in the short run the impact of own shock to consumer price inflation is about 84%. However, as one goes further in the future, the impact decreases to 61% for the entire period. Exchange rate shocks on the other hand account for more than 34% of variance in inflation in the long run and 15% in the short run. The impact of the exchange rate shock is smaller in the short run but greater in the long run. These results in table 4.5 indicate that exchange rate shock is a vital determinant of variation in domestic consumer price inflation. Money supply growth shock, oil price shock and the output gap (demand pressure) shock explain less of the variance in the consumer price inflation.

Table 4.5: Variance Decomposition for Symmetric Model

Period	S.E.	Oil Price Shock	Output gap Shock	Money Supply Growth Shock	Exchange Rate Shock	Consumer Price Index Shock
1	0.1504	0.0025	0.0140	0.0006	15.9377	84.0452
2	0.1562	0.1793	0.2948	0.0169	31.6362	67.8729
3	0.1625	2.1503	0.3150	0.2064	35.2536	62.0746
4	0.1637	2.1368	0.4566	0.2516	34.6966	62.4584
5	0.1653	2.3038	0.8693	0.3718	34.3472	62.1079
6	0.1654	2.3236	0.8821	0.5767	34.4099	61.8078
7	0.1656	2.4411	0.8733	0.7137	34.3998	61.5722
8	0.1657	2.4305	0.8741	0.7434	34.4726	61.4793
9	0.1658	2.4263	0.8738	0.7473	34.5150	61.4377
10	0.1658	2.4240	0.8726	0.7517	34.5153	61.4364

Source; Author's computation

4.4.4.5. SVAR Stability and Diagnostic Tests for Symmetric Model

Diagnostic tests for the SVAR were conducted namely, the stability test, test for serial correlation, heteroscedasticity and normality. The stability test was conducted to ensure that the estimated SVAR is well specified and stationary. Therefore, the AR roots table and AR roots graph were used to test for stability of the SVAR. The AR roots table in table 4.6 and the AR roots graph in appendix B show that the SVAR is well specified, stable and stationary. This is because the inverse roots of the characteristic polynomial have modulus value of less than one and lie within the circle. This entails that the SVAR is stable and stationary. Stability of the SVAR as indicated and confirmed by stability test means that if there is an unanticipated shock in the system, the whole system will be in disequilibrium. However, after some time, the system should revert to equilibrium.

The diagnostic test results tabulated in table 4.6 show that the SVAR model does not have heteroscedasticity. The probability value 0.0529 for heteroscedasticity show that the null hypothesis of homoscedasticity cannot be rejected. However, the normality and serial correlation tests indicate that the model suffers from non-normally of residuals and serial correlation. Non-normality of residuals could be due to outliers in the sample. This is not surprising especially with exchange rate data. For instance, due to excessive depreciation of the currency at certain periods of time, there could be outliers. Several exchange rate passthrough studies have found non-normality of the models involving the exchange rate variable. For instance, Chewe (2015), Zgambo (2015) in their respective studies on the exchange rate through to prices in Zambia, confirm non-normality of data.

Table 4.6: SVAR Stability and Diagnostic Tests for Symmetric Model

AR Roots For VAR Stability for Symmetric Model		
0.659517	0.659517	
0.259865 - 0.467504i	0.534874	
0.259865 + 0.467504i	0.534874	
-0.004190 - 0.531309i	0.531325	
-0.004190 + 0.531309i	0.531325	
0.441376 - 0.152603i	0.467012	
0.441376 + 0.152603i	0.467012	
-0.218482	0.218482	
-0.142637 - 0.104795i	0.176995	
-0.142637 + 0.104795i	0.176995	
No root lies outside the unit circle; VAR satisfies the stability condition		
VAR Diagnostic Test for Symmetric Model		
Test Type	LM-Stat/ Chi-square	Prob
Lagrange Multiplier test for Serial Correlation	46.8219	0.0051
White Test for Heteroscedasticity	372.6094	0.0529
VAR-Jarque Bera-Residual Normality test	64.14488	0.0000

Source: Author’s computations

4.4.5. SVAR Estimates for Asymmetric Model.

This section presents results for the asymmetric exchange rate pass through to consumer prices from the SVAR estimates. The purpose of the asymmetric model was to ascertain the differential impact of exchange rate depreciation and appreciation on domestic price as explained earlier. Therefore, the summary results from the estimated asymmetric SVAR are presented in this section. The entire output of the asymmetric SVAR is presented in the appendix B. This section also presents impulse response functions and the variance decomposition from the asymmetric SVAR. Finally, an analysis of the calculated exchange rate pass through elasticity is presented before conclusion for this section is made.

4.4.5.1. Summary Results from SVAR Output for Asymmetric Model.

Equations from 40 to 45 summarize the SVAR estimates. These equations represent the system of shocks from the asymmetric SVAR output. The figure in parenthesis are p-values while figures which are not in the parenthesis are the coefficients which represent the impact of a shock on the variable of interest.

To explain the asymmetries in the exchange rate pass through to domestic consumer prices inflation, equation 45 is made use of. Equation 45 shows the impact of Kwacha depreciation shock (*DEP*) and Kwacha appreciation shock (*APP*) to domestic consumer price inflation (*CPI*). It measures the exchange rate pass through to consumer price inflation due to Kwacha depreciation and appreciation. The coefficient of Kwacha depreciation shock of 0.2796 is positively significant at 1%. Since the coefficient is positive, it means Kwacha depreciation increases consumer price inflation. Specifically, if the Kwacha depreciates by 1% domestic prices will increase by 0.28%. On the other hand, the Kwacha appreciation variable (*APP*) has a negative sign. This implies that Kwacha appreciation has a negative effect or has a reducing effect on domestic consumer prices. However, equation 51 shows that the coefficient of Kwacha appreciation is not significant. This implies that Kwacha appreciation does not significantly influence domestic consumer prices. These findings show that consumer prices are very sensitive (responsive) to Kwacha depreciation and insensitive (irresponsive) to Kwacha appreciation. These findings indicate that exchange rate depreciation and appreciation do not have the same effects on domestic consumer prices in Zambia. This confirms the presence of asymmetries in the exchange rate pass through to domestic consumer price inflation. Furthermore, the exchange rate pass though coefficient for depreciation (*DEP*) and appreciation (*APP*) are less than one. This means that the exchange rate pass through to consumer price inflation in both cases is incomplete.

$$\varepsilon_{OIL} = 0.1579\mu_{OIL} \quad (40)$$
(0.0000)

$$\varepsilon_{GAP} = 0.0233\mu_{OIL} + 0.0389\mu_{GAP} \quad (41)$$
(0.2835) (0.0000)

$$\varepsilon_{MSG} = -7.275\mu_{OIL} - 8.5439\mu_{GAP} + 5.4731\mu_{MSG} \quad (42)$$
(0.0176) (0.4876) (0.0000)

$$\varepsilon_{DEP} = -0.1598\mu_{OIL} + 0.0739\mu_{GAP} - 0.0013\mu_{MSG} + 0.0771\mu_{DEP} \quad (43)$$
(0.000) (0.6705) (0.2914) (0.0000)

$$\varepsilon_{APP} = -0.0076\mu_{OIL} - 0.0709\mu_{GAP} - 0.001\mu_{MSG} + 0.1298\mu_{DEP} + 0.0313\mu_{APP} \quad (44)$$
(0.685) (0.3154) (0.050) (0.0003) (0.0000)

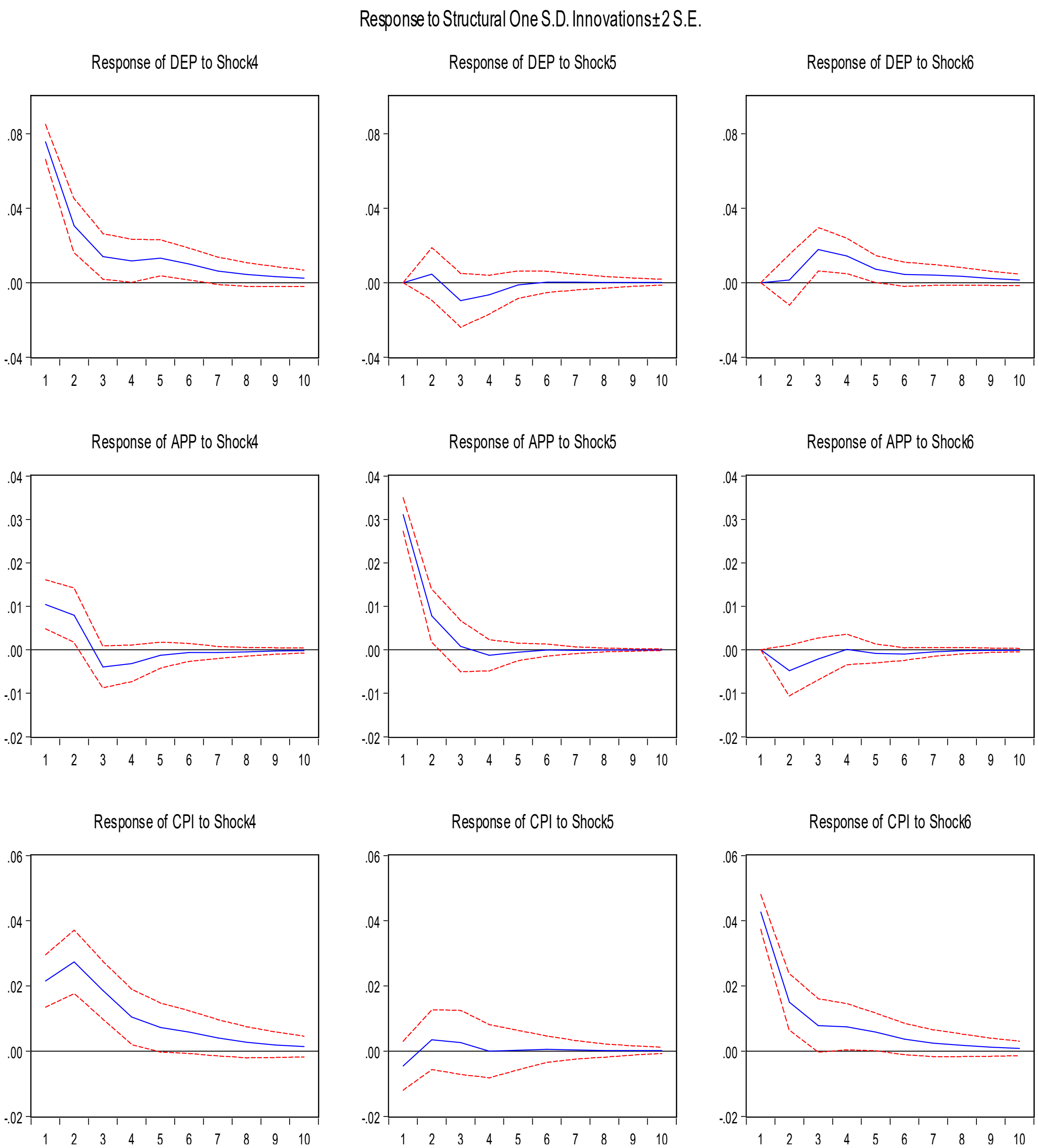
$$\varepsilon_{CPI} = 0.0126\mu_{OIL} - 0.0733\mu_{GAP} - 0.0012\mu_{MSG} + 0.2796\mu_{DEp} - 0.0939\mu_{APP} + 0.04\mu_{CPI} \quad (45)$$
(0.6347) (0.428) (0.097) (0.000) (0.448) (0.000)

4.4.5.1. Impulse Response Function of Consumer Price Index

To have a better understanding of the asymmetric effects of exchange rate appreciation and depreciation to domestic consumer price inflation, the study employed the impulse response functions. Figure 4.4 presents the impulse responses of domestic consumer prices (*CPI*) to Kwacha depreciation (*DEP*) and appreciation (*APP)* respectively. It should be noted that in figure 4.4, shock 4 is Kwacha depreciation (*DEP*) shock which shows the response of consumer price inflation to the shock in Kwacha depreciation. Shock 5 is Kwacha appreciation (*APP)* shock. It shows the response of consumer price inflation to the shock in Kwacha appreciation.

Figure 4.4 shows that one standard deviation shock to Kwacha depreciation causes domestic consumer price inflation to increase and reach a maximum of 2.8% in quarter two. Beyond quarter two, the response of consumer price inflation declines but remains significant. The shock remains persistent and significant up to quarter eight. Beyond quarter eight, the impulse becomes insignificant. On the other hand, consumer price inflation responds weakly to one standard deviation shock to Kwacha appreciation as is evidenced in figure 4.4. The response of consumer price inflation to Kwacha appreciation is weak and tails off immediately after a shock. Figure 4.4 shows that the impact of a shock to Kwacha depreciation on consumer price inflation is far much greater and persistent than the effect of the shock to Kwacha appreciation. There is a substantial difference between the impact of Kwacha depreciation and appreciation shocks on consumer price inflation. This indicates the presence of asymmetries in the exchange rate pass through to domestic consumer price inflation.

Figure 4.4: Asymmetric Exchange Rate Pass Through to Domestic Prices



Source: Author's computations

4.4.5.2. Exchange Rate Pass-Through Elasticity for Asymmetric Model

To provide a better understanding of the evolution of the exchange depreciation and appreciation pass through to domestic consumer price inflation, the study calculated the exchange rate pass through elasticity (*ERPTE*) of domestic price due to depreciation and appreciation. In estimating the exchange rate pass through elasticity, the study followed Leigh and Rossi (2002), Capistran et al (2011) and Guillermo et al (2014) formulation. *ERPTE* is defined as the ratio of cumulative response of domestic price inflation to cumulative exchange rate changes in response to exchange rate respectively.

$$CERPTE_s = \frac{\%\ \Delta DCPI_{t,t+s}}{\%\Delta DEP_{t,t+s}} \tag{46}$$

$$CERPTE_s = \frac{\%\ \Delta DCPI_{t,t+s}}{\%\Delta APP_{t,t+s}} \tag{47}$$

Where $ERPTE_s$ is the exchange rate pass through elasticity s periods after a shock that took place at time t. $\%\Delta CPI_{t,t+s}$ is the cumulative consumer price inflation changes s periods after Kwacha depreciation and appreciation shock at time t respectively. Finally, $\%\Delta DEP_{t,t+s}$ and $\%\Delta APP_{t,t+s}$ are the cumulative Kwacha depreciation and cumulative Kwacha appreciation changes in response to own shocks s periods after the shock at time t respectively.

Table 4.7 displays the exchange rate pass through elasticity due to Kwacha depreciation and appreciation. Table 4.7 also displays the cumulative structural impulse response functions of domestic consumer price inflation (*CPI)* to exchange rate depreciation and appreciation shocks. The cumulative impulse response functions of Kwacha depreciation and appreciation due to own shocks are also displayed.

Since the significant impact of the shock to Kwacha depreciation on consumer price inflation last up to quarter eight, the study computed the exchange rate pass through elasticity up to quarter eight. In table 4.7, it can be observed that one standard deviation shock of 0.08 in Kwacha depreciation increases domestic consumer prices by 0.02. This corresponds to exchange rate pass through elasticity due to Kwacha depreciation of 0.23

in the first quarter. This means that Kwacha depreciation of 7.7% increases domestic consumer prices by 2%. Also note that for the entire period (that is eight quarters), the exchange rate pass through due to Kwacha depreciation is less than complete in Zambia. The average exchange rate pass through elasticity due to Kwacha depreciation is 0.48.

Table 4.7 shows the exchange rate pass through elasticity due to Kwacha appreciation. For the entire period, the average Kwacha appreciation pass through elasticity is about 0.37. The finding shows that consumer price inflation is very responsive to Kwacha depreciation and less responsive to Kwacha appreciation. This finding further confirms that Kwacha depreciation has greater significant impact on domestic price inflation than Kwacha appreciation. This confirms the presence of asymmetries in the exchange rate pass through to domestic consumer price inflation. The irresponsiveness of prices to Kwacha appreciation could be because prices are sticky downwards.

In addition, comparing the symmetric and asymmetric exchange rate pass through elasticity in table 4.7, exchange rate depreciation and appreciation do not have the same effects on consumer price inflation. This refutes the assumption that exchange rate pass through is symmetric and linear; an assumption which most of the exchange rate pass through studies have made. It can be concluded from the findings in this study that considering asymmetries in modelling exchange rate pass through to prices is very important.

Finally, it should be noted that the exchange rate pass through is incomplete both for depreciation and appreciation since their coefficients are less than one. This finding is in line with the pricing to market theory which states that exporters absorb part of exchange rate fluctuations into their mark-up to stabilize prices in the export market. They do this to maintain their market share in the export market. However, this action by exporters to absorb exchange rate fluctuation into mark-up to maintain market share, causes exchange rate pass through to be incomplete (Marston, 1990).

Table 4.7: Exchange Rate Pass-Through Elasticity (ERPTE)

Cumulated response of	DEP	APP	CPI	CPI	Elasticity Due to	Elasticity Due to
Impulse Response of	DEP	APP	DEP	APP	DEP	APP
Period						
1	0.0771	0.0313	0.0206	-0.003	0.2674	-0.094
2	0.1082	0.0397	0.0395	0.0029	0.3653	0.0726
3	0.1235	0.0412	0.0518	0.0081	0.4194	0.1968
4	0.1318	0.0411	0.0591	0.0114	0.4483	0.2770
5	0.1362	0.0407	0.0631	0.0132	0.4635	0.3234
6	0.1387	0.0404	0.0654	0.0141	0.4713	0.3482
7	0.1401	0.0403	0.0666	0.0145	0.4754	0.3608
8	0.1408	0.0402	0.0672	0.0148	0.4775	0.3672
Average Exchange Rate Pass-Through for 11 Quarters					0.4607	0.2315

Note: Dep=Kwacha depreciation; APP=Kwacha appreciation; CPI= consumer price index

Source: Author's Computations

4.4.5.3. Variance Decomposition for Asymmetric Model

Table 4.8 displays the variance decomposition of domestic consumer price inflation due to shocks in the oil prices, output gap, money supply growth, Kwacha depreciation, Kwacha appreciation and own shocks. It can be observed in table 4.8 that Kwacha depreciation shock explains a bigger percentage of variance in consumer price inflation than Kwacha appreciation. Depreciation shock explains 17.22% variance in consumer price inflation in the first quarter while Kwacha appreciation explains 0.35%. Between quarter two and eight, Kwacha depreciation explains between 23% and 26% variation in consumer price inflation while Kwacha appreciation explains between 1% and 2% for the same period. This clearly signals that the impact of Kwacha depreciation and appreciation on consumer price inflation is not the same. This is a further confirmation that asymmetries are present in the exchange rate pass through to domestic consumer price inflation. These results suggest that accounting for asymmetries in the exchange rate pass through is very important. However, table 4.8 also shows that consumer inflation shock (*CPI*) among all the variables account for a bigger percentage in explaining changes in domestic price inflation. For instance, price inflation shock account for 79% and 68% variation of consumer price inflation in the quarter one and eight. However, table 4.8 shows that, while own shocks in consumer price inflation account for a bigger portion in its own variance, Kwacha depreciation is a vital determinant of inflation in Zambia as it also explains a bigger portion of variation in consumer price inflation. The output gap, Oil prices and money supply growth explain below 4% variance in consumer price inflation respectively for the entire period.

Table 4.8: Variance Decomposition of CPI for Asymmetric SVAR

Variance Decomposition of Consumer Price Index (CPI)							
Period	S.E.	OIL	GAP	MSG	DEP	APP	CPI
1	0.1573	0.4495	0.1010	2.5737	17.2161	0.3506	79.3091
2	0.1603	0.5990	0.1424	3.4101	22.6314	1.2300	71.9871
3	0.1605	0.6799	0.1502	3.4884	24.6037	1.8442	69.2336
4	0.1605	0.6913	0.1489	3.4738	25.3112	2.0697	68.3051
5	0.1605	0.6900	0.1480	3.4629	25.5486	2.1350	68.0155
6	0.1605	0.6888	0.1477	3.4587	25.6232	2.1518	67.9299
7	0.1605	0.6884	0.1476	3.4573	25.6455	2.1559	67.9053
8	0.1605	0.6883	0.1476	3.4569	25.6520	2.1569	67.8983

Note: LNOIL=oil price; GAP=Output Gap; MSG=Money Supply Growth
DEP=depreciation; APP=Appreciation & CPI=Consumer Price Index
Source: Author's computations

4.4.5.4. SVAR Stability and Diagnostic Tests for Asymmetric Model

Diagnostic tests for the SVAR were conducted namely, the stability test, test for serial correlation, heteroscedasticity and normality. The stability test was conducted to ensure that the estimated SVAR is well specified and stationary. Therefore, the AR roots table and AR roots graph were used to test for stability of the SVAR. The AR roots table in table 4.9 and the AR roots graph in appendix B show that the SVAR is well specified, stable and stationary. This is because the inverse roots of the characteristic polynomial have modulus value of less than one and lie within the circle. This entails that the SVAR is stable and stationary. Stability of the SVAR as indicated and confirmed by stability test means that if there is an unanticipated shock in the system, the whole system will be in disequilibrium. However, after some time, the system should revert to equilibrium. However, the model suffers from heteroscedasticity and serial correlation. The normality test for residuals indicates that the residuals are not normally distributed, and this could be due to outliers in the sample. This is not surprising especially with exchange rate data. For instance, due to excessive depreciation of the currency at certain periods of time, there could be outliers. Several exchange rate passthrough studies have found non-normality of the models involving the exchange rate variable. For instance, Chewe (2015), Zgambo (2015) in their respective studies on the exchange rate through to prices in Zambia, confirmed non-normality of residuals.

Table 4.9: SVAR Stability and Diagnostic Tests for Asymmetric SVAR

AR Roots For VAR Stability For Asymmetric Model		
	Root	Modulus
	0.537304	0.537304
	0.326438 - 0.130231i	0.351457
	0.326438 + 0.130231i	0.351457
	0.170875 - 0.073677i	0.186083
	0.170875 + 0.073677i	0.186083
	0.113627	0.113627
No root lies outside the unit circle. VAR satisfies the stability condition		
VAR Diagnostic Test for Asymmetric SVAR		
Test Type	LM-Stat/ Chi-square	Probability
Lagrange Multiplier test for Serial Correlation	63.59200	0.0031
White Test for Heteroscedasticity	1016.792	0.0048
VAR-Jarque Bera-Residual Normality test	278.7502	0.000

Source: Author’s computations

4.5. Conclusion

The results in this chapter show that the exchange rate pass through to consumer prices is incomplete in the symmetric and asymmetric models. The results from this chapter have also shown that asymmetries are present in the EPRT. It is clear from the results presented in this chapter that Kwacha depreciation has a greater significant impact on domestic price inflation than Kwacha appreciation. It follows that depreciation amplifies consumer price inflation in Zambia. The impulse response function analysis showed that the shock to Kwacha depreciation is very persistent while that of appreciation is not. The impulse response of consumer price inflation due to the shock in Kwacha appreciation tails off within a short period of time. In addition, the exchange rate pass through elasticity estimations show that the exchange rate pass through elasticity due to Kwacha depreciation is significantly greater than that of appreciation. Finally, the forecast error variance decomposition for consumer price inflation due to Kwacha depreciation and appreciation show that depreciation explains a bigger portion of variance in consumer price inflation. On the other hand, appreciation shock has a negligible impact in explaining variance in consumer price inflation. It is clear from these results that the impact of Kwacha depreciation on consumer price inflation is greater than that of appreciation. This shows that it is very important to account for asymmetries in modelling exchange rate pass through to prices.

CHAPTER 5

EXCHANGE RATE PASS THROUGH TO SECTORAL PRICES

5.1. Introduction

The plethora of literature on the exchange rate pass through have tended to concentrate on the effects of exchange rate fluctuations on domestic consumer prices. There is scanty empirical literature on the exchange rate pass through to sectoral prices especially in Africa. It is vital to study the exchange rate pass through to various economic sectors. This is because exchange rate movements can affect firm decisions, production and expectations. As Castro and Nino (2018) put it, firms of various sectors pay attention to how exchange rate shocks affect the local price of imported inputs, production cost and expectations about future pricing behavior. For instance, exchange rate appreciation can lead to increase in the price of inputs, which affects production, pricing decisions and future prices at firm level in various sectors. However, Due to structural differences across sectors such as the degree of trade openness, product differentiation, competition and the degree of responsiveness of demand to price, various sectors may be affected differently by exchange rate shocks (Hahn, 2007). Some sectors may be more affected than others with some sectors responding within a short period of time while others taking a longer period.

Empirical evidence from studies show that sectors of the economy are affected differently by exchange rate shocks. For instance, Hahn (2007) used the SVAR framework to investigate the effects of exchange rate shocks on sectoral activity and prices in the Euro area. Hahn (2007) found substantial difference in the impact of exchange rate shocks on sectoral activity and prices. The findings showed that exchange rate shocks have more impact in the manufacturing sector followed by trade and transport services sectors. Knetter (1993) on the other hand studied the pricing behavior of the exporting firms across the industries in the following countries, UK, USA and Japan. He used a two-way fixed effects model to conduct this study. The findings from this study showed that there is a great variation in the exchange rate pass through to industry prices across industries. These findings show that various industries respond differently to exchange rate shocks. Campa et al (2005) investigated the differential impact of the exchange rate pass through to sectoral prices of nine sectors in the euro area countries. They found not only incomplete exchange pass through but that different sectors are affected differently by exchange rate movements. Parsely (2012) did a study of the exchange rate pass through across imported different categories of final goods for South Africa. He found that the exchange rate pass through across goods differs depending on the source of the country. Finally, Solorzano (2017) carried out a study in which he investigated the effect of exchange rate fluctuations on the prices of the final goods and service in Mexico. In his study he focused on whether contrasting exchange rate pass through is also associated with region and product specific characteristics. The findings from this study showed that the exchange rate pass through to prices is not only incomplete but differs across regions and industries. Solorzano (2017) sighted a few region and product specific characteristics responsible for differential exchange rate pass through across regions and products. These are demand conditions, economic development, and distance to the U.S. border, import intensity, price change dispersion and expenditure share. This study among others showed that examining the exchange rate pass through to sectors and regions in the economy is critical to the understating of how exchange rate shocks spill over to rest of the economy. Such findings could be of great help for the design of not only sector specific monetary, exchange rate and fiscal policies but also policies for different regions in the economy.

The finding from Solorzano (2017) and others sighted above do indicate that to understand the transmission mechanism of exchange rate to the rest of the economy, sectoral analysis of the exchange rate pass through is essential. Studying how exchange rate shocks are propagated to various sectors of the economy is very important. This is because it will help policy makers to respond quickly to international shocks and design sector specific policies aimed at cushioning the effects of external shocks especially to those sectors that are very sensitive to international shocks such as exchange rate fluctuations. Therefore, an understanding of the differential effects of exchange rate fluctuations on various sectors of the economy will help policy makers avoid designing one size fits all policies for various sectors.

The purpose of this chapter is to examine the exchange rate pass through to sectoral prices and assess the propagation of exchange rate shocks to sectoral prices in the Zambian context with particular focus on the agriculture, manufacturing and services sectors. For Zambia, sectoral exchange rate pass through study presents a great opportunity to kick start this work. This is because to the best of the knowledge of the author, no study has been done in Zambia that examines the exchange rate pass through to sectors. Not only that, empirical literature on the exchange rate pass through to various sectors of the economy is quite rare. It should be mentioned here that, it could have been interesting to have analyzed the asymmetries in the sectoral exchange rate pass through to sectoral prices in Zambia. However, it could not be possible to apply asymmetries to sectoral exchange rate passthrough. This is because the sample size is quite short due to data unavailability. The sample is from 1985 to 2017 (32 data points). To account for asymmetries, one needs to decompose exchange rate into depreciation and appreciation using partial sums of squares. This could have reduced the data points further for depreciation and appreciation variables.

5.2. Methodology and Econometric Specification

This section investigates the exchange rate pass through to sectoral prices in the agriculture, manufacturing and services sectors. To do so, the current section adopts the pricing to market framework developed in chapter 4. Therefore, the model for modelling the exchange rate pass through to sectoral prices is abstracted from the theoretical model specified in equation (9) in chapter 4 in the methodology section. It can be expressed in log form and in first difference as follows:

$$\Delta SPRICE_t = \beta + \gamma \Delta LNEXR_t + \rho \Delta LNOIL_t + \pi \Delta GAP_t + Dume + \mu \quad (1)$$

In equation (1), SPRICE is the log of sectoral price index representing prices in each sector. *LNEXR* is the log of nominal exchange rate; *LNOIL* is the log of US Dollar price of crude oil. It is a proxy for foreign marginal cost. *GAP* is output gap which is the proxy for demand pressure. The last term μ is the error term. On the other hand, $,\beta, \gamma, \rho$ and π are coefficients to be estimated and γ measures the exchange rate pass through to sectoral prices. The variable *Dume* is an interactive dummy variable of exchange rate which accounts for exchange rate liberalization that took place in 1994. It is constructed by interacting exchange rate with the time dummy variable. The time dummy variable takes the value one the period after 1994 the year in which exchange rate was fully liberalized in Zambia and the value of zero before 1994.

4.2.1. Econometric Models: Structural Autoregressive (SVAR) Model

To investigate the exchange rate passthrough to sectoral prices, this section of the study applied the SVAR developed in chapter 4 in section 4.2.2. Therefore, following Amisano and Giannini, (1997) AB model, the identification strategy for the exchange rate pass through to domestic sectoral price model in this study is expressed as follows:

$$\mathrm{Y}_t{}' = LNOIL, GAP, LNEXR, SPRICE \tag{2}$$

Where elements in $\mathrm{Y}_t{}'$ are expressed in equation (2) thereby producing the following identification structure:

$$\begin{bmatrix} 1 & 0 & 0 & 0 \\ a_{21} & 1 & 0 & 0 \\ a_{31} & a_{32} & 1 & 0 \\ a_{41} & a_{42} & a_{43} & 1 \end{bmatrix} \begin{bmatrix} e_t^{LNOIL} \\ e_t^{GAP} \\ e_t^{LNEXR} \\ e_t^{SPRICE} \end{bmatrix} = \begin{bmatrix} b_{11} & 0 & 0 & 0 \\ 0 & b_{22} & 0 & 0 \\ 0 & 0 & b_{33} & 0 \\ 0 & 0 & 0 & b_{44} \end{bmatrix} \begin{bmatrix} \varepsilon_t^{LNOIL} \\ \varepsilon_t^{GAP} \\ \varepsilon_t^{LNEXR} \\ \varepsilon_t^{SPRICE} \end{bmatrix}$$

Where $\varepsilon_t{}^{LNOIL}$, $\varepsilon_t{}^{GAP}$, $\varepsilon_t{}^{LNEXR}$, $\varepsilon_t{}^{SPRICE}$ are oil price shocks, output gap (demand pressure) shocks, exchange rate shocks and sectoral price shocks respectively. With this sort of identification, 22 restrictions were imposed: 6 zero restrictions and 4 normalization restrictions in matrix A and 12 zero restrictions in matric B. The identification scheme presented above in matrix form yields the following system of shocks or equations equivalent to the system of shocks obtained under recursive ordering.

$$\varepsilon_{LNOIL_t} = \mu_{LNOIL\ t} \tag{3}$$

$$\varepsilon_{LNGAP_t} = \mu_{LNOIL\ t} + \mu_{GAP\ t} \tag{4}$$

$$\varepsilon_{LNEXR_t} = \mu_{LNOIL\ t} + \mu_{GAP\ t} + \mu_{LNEXR\ t} \tag{5}$$

$$\varepsilon_{SPRICE_t} = \mu_{LNOIL\ t} + \mu_{GAP\ t} + \mu_{LNEXR\ t} + \mu_{SPRICE\ t} \tag{6}$$

As explained above, the AB identification scheme presented above in matrix form for the exchange rate pass through to domestic sectoral prices is equivalent to recursive ordering or Cholesky decomposition scheme. The economic intuition behind this identification is that the variable that is ordered first is more exogenous than the ones that follow. Thus, in this study, oil price (*LNOIL*) is ordered first being the most exogenous variable. Oil price is determined in the international market and as such, it is independent to the Zambian economy. Oil price shock is expected to contemporaneously affect other variables in the system namely output gap, exchange rate and sectoral price and not vice versa. The only shock that can affect oil price is the oil price shock. This is equivalent to saying that all other coefficients in the oil price equation (3) are equal to zero. With four variables in the VAR, this means three zero restrictions in the first row of matrix A are imposed. Second in the order of variables is output gap (*GAP*). Output gap is ordered second because it is assumed to be contemporaneously affected by oil price and not vice versa. However, output gap shocks contemporaneously affect exchange rate and sectoral price. Exchange rate is expected to be contemporaneously affected by oil price shocks, output gap shocks and shocks of itself. However, exchange rate is not contemporaneously affected by sectoral price. Sectoral price is ordered last because it is assumed to be affected contemporaneously by all shocks in the system and yet does not affect other variables in the system. It is vital to state here that the SVAR was applied to each sector in estimating exchange rate pass through to sectoral prices.

Having identified the SVAR, two types of analyses were performed in this study to examine the dynamic interactions between exchange rate and sectoral prices and to assess the dynamic path of the exchange rate pass through. These two types of analyses are impulse responses functions and variance decomposition. Impulse response functions measure the effect of one standard deviation of the exogenous shock on the current and future values of the endogenous variables in the system (Chewe, 2015; Zgambo, 2015). Since the current study focuses on the exchange rate pass through to sectoral prices, impulse response functions would trace the effect of one standard deviation of the exogenous shock to exchange rate on sectoral prices in the three sectors: agriculture, manufacturing and services sectors. The tracing of the dynamic path of sectoral prices due to a shock in exchange rate is referred to as the exchange rate pass through. However, an important requirement for impulse response functions and variance decomposition is the stability of the SVAR. This implies that impulse response functions must decline to zero overtime after a shock to the endogenous variable (Chewe, 2015).

It is vital to note that the impulse response functions can also be used to estimate the exchange rate pass through elasticity by making use of the cumulative impulse response functions. Following, Leigh and Rossi (2002), Capistran et. al (2011) and Guillermo et. al (2014) formulation, the exchange rate pass through elasticity (ERPTE) is defined as the ratio of cumulative response of sectoral price inflation to cumulative exchange rate change in response to shocks in exchange rate.

$$ERPTE_s = \frac{\%\ \Delta SPRICE_{t,t+s}}{\%\Delta LNEXR_{t,t+s}} \tag{7}$$

Where $ERPTE_s$ is the exchange rate pass through elasticity s periods after a shock to exchange rate that took place at time t. $\%\Delta SPRICE_{t,t+s}$ is cumulative sectoral price inflation changes s periods after an exchange rate shock at time t. Finally, $\%\Delta LNEXR_{t,t+s}$ is cumulative exchange rate change in response to its own shock s periods after the shock at time t. Cumulative sectoral price inflation responses can be interpreted as the percentage change in the corresponding sectoral price index at period *t+s* due to one standard deviation exchange rate shock. Therefore, the ratio of cumulative responses of sectoral price inflation to cumulative responses in exchange rate is an elasticity (Guillermo et al 2014).

Variance decomposition on the other hand, gives information about the proportion of variation in an endogenous variable due to own shock versus shocks of other variables in the system (Chewe, 2015; Zgambo 2015). Variance decomposition enables a researcher to determine the relative importance of each structural shock in explaining the percentage variance in the endogenous variables in the system (Guillermo et al 2014). In case of the current study therefore, variance decomposition of sectoral price inflation gives a picture of the relative importance of the shocks from sectoral price itself and the shocks from other variables in the SVAR in explaining the variance in sectoral price inflation.

As explained in the previous chapter, the optimal lag and the order of integration of variables must be established before estimating the SVAR model.

5.3. Type of Data, Data Sources and Variable Description

This study employed annual data from 1983 to 2017. The source of data on exchange rate and sectoral GDP for agriculture, manufacturing and services sectors is the World Development Indicators (WDI), while data on oil prices were obtained from the World Bank Commodity Prices (World Bank pink sheet). Finally, annual GDP, which was used to generate output gap, was obtained from World Development Indicators. The sectoral prices were constructed from the sectoral GDP for each sector.

All the variables are expressed in logarithm except for output gap. Sectoral price index for each sector is expressed as SPRICE. It is used as a measure of price inflation in each sector. The SPRICE captures the pass through of exchange rate to sector prices for each sector. To construct sectoral price indices, the study followed the procedure for constructing the GDP deflator. The GDP deflator is normally considered as the comprehensive measure of inflation since a wide number of goods and services are included in its construction. It is constructed by dividing nominal GDP by real GDP. Using the same procedure, sectoral price for each sector was constructed by dividing nominal sector GDP by real sector GDP for each sector based on 2010 prices. The sector price index so constructed should be taken as a measure overall price inflation in each sector. It is expresses as follows:

$$SPRICE = \frac{Nominal\ Sectoral\ GDP\ in\ Each\ Sector}{Real\ Sectoral\ GDP\ in\ Each\ Sector} \qquad (8)$$

The exchange rate is measured as the ratio of the units of the Zambian Kwacha over the units of the US Dollar (ZKM/USD). The exchange rate is the measure of the exchange rate pass through. The study used the nominal exchange rate to capture inflation since exchange rate pass through studies are inflation studies. The oil price variable (*LNOIL*) is measured in US Dollars per barrel. It is a proxy for marginal cost facing the foreign exporters. Finally, Output gap (*GAP*) which is taken as a measure of demand pressure facing foreign firms in the export market is calculated using the Hodrick and Prescott (1997) filter (HP filter) as explained in chapter four. The Hodrick and Prescott (1997) filter computes the output gap as the difference between the actual and the potential or trend output (GDP

5.4. Empirical Analysis of the Sectoral Models

This section of the chapter presents the findings of the study for chapter five. The section begins by presenting the descriptive analysis and summary statistics of the variables that were used for analysis. The section proceeds to presenting and analyzing the findings from the SVAR model for each sector. The impulse response function and the variance decomposition are also presented. Finally, the section presents the calculated exchange rate pass through elasticities for each sector. Comparison of the exchange rate pass through and elasticity among the sectors is done before making conclusion.

5.4.1. Descriptive Analysis

Figure 5.1 displays the trends in the level series of the variables. Figure 5.1 shows that exchange rate and all the sectoral prices namely the index of agriculture prices (agric-prices), manufacturing prices (manu_price) and services prices (services_price) trend upwards from early 1990s to 2017. These four variables exhibit a flat curve the period before early 1990s. This is the period that was characterized by fixed exchange rate regime. The trade openness variable exhibit cyclic patterns. Oil price trends shows relative tranquility from 1983 to 2000. The price for crude oil was relatively low before 2000 and began to rise after 2000. The output gap displays irregular pattern as shown in figure 5.1.

The descriptive statistics displayed in table 5.1 show that the oil price shows more variability than any other variable followed by sectoral prices and exchange rate based on standard deviation. Among the sectoral prices, the services sector price index (SPRICE3) is the most volatile followed by the price index in the manufacturing sector (SPRICE2) and agricultural price index (SPRICE1). All the variables except the oil price are normally distributed as indicated by the Jarque-Bera statistics and their respective p-values (table 5.1). For all the variables except oil price, the p-value is greater than 5%. However, the oil price is not far from being normally distributed as indicated by the kurtosis statistics and the probability of the Jarque-Bera statistics.

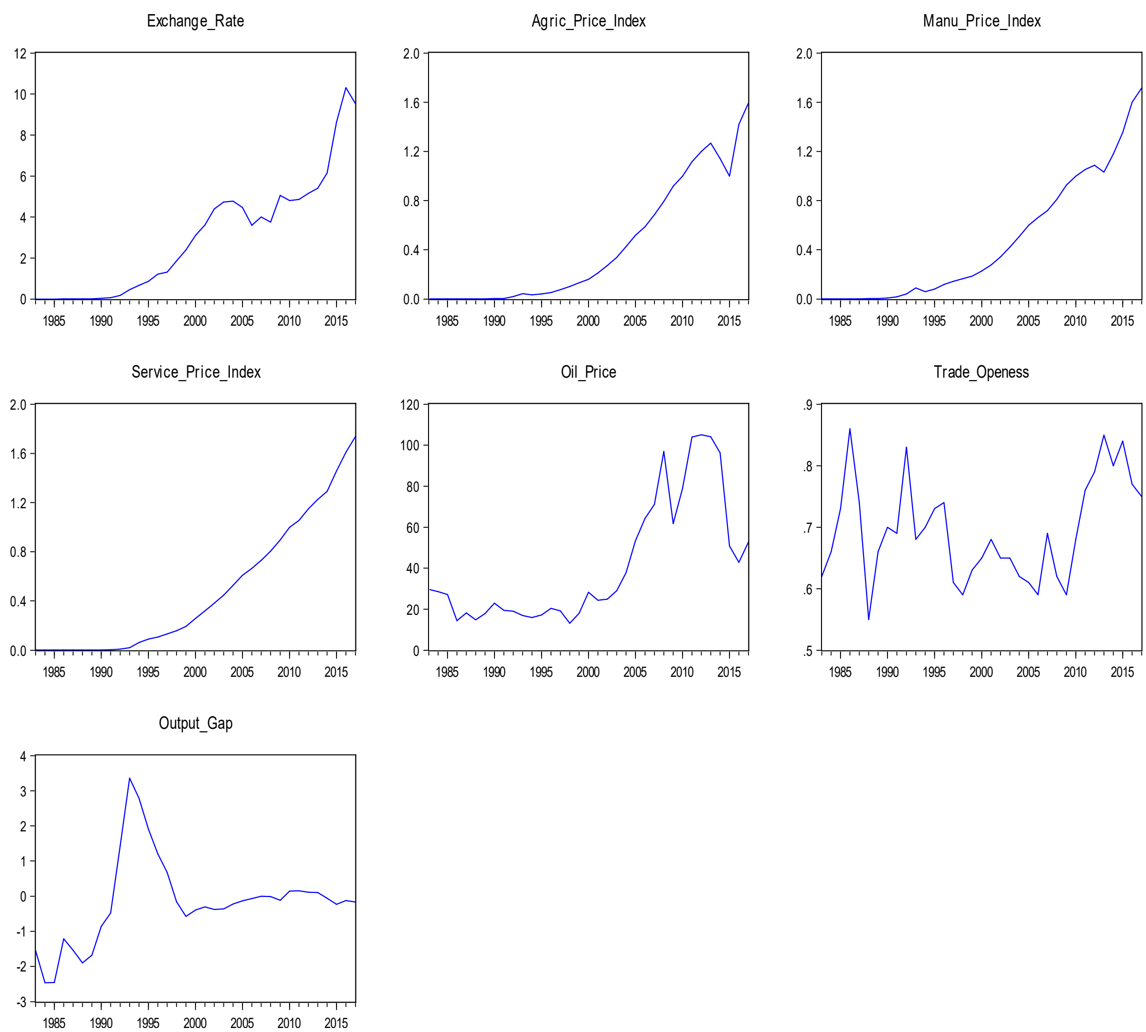
Table 5.1: Summary Statistics for Variables: 1985 to 2017

Variable	SPRICE1	SPRICE2	SPRICE3	EXRATE	OIL	GAP
Mean	0.43	0.47	0.48	3.01	41.68	-0.16
Std. Dev.	0.50	0.51	0.54	2.89	30.19	1.24
Skewness	0.84	0.88	0.86	0.76	1.03	0.70
Kurtosis	2.28	2.59	2.47	2.93	2.66	4.25
Jarque-Bera	4.89	4.80	4.69	3.42	6.35	5.14
Probability	0.09	0.09	0.10	0.18	0.04	0.08
observations	35	35	35	35	35	35

Note: SPRICE1=prices index in agriculture sector; SPRICE2 =prices index in manufacturing sector; SPRICE3= are price index in services sectors; EXRATE=exchange rate; Oil=oil price in US Dollar per barrel; Gap=output gap.

Source: Author's computation

Figure 5.1: Graphical Presentation of Level Series of The Variables



Source: Author's computations

5.4.2. Unit Root Test Results

Table 5.2 presents the unit root test results for the variables. The results in table 5.2 show that all the variables are stationary at first difference since the ADF and PP statistics are greater than their respective critical values at 1% level of significance. The price index for manufacturing sector (SPRICE2) is stationary at level and first difference.

Table 5.2: Unit Root Test for all Variables

	Level		First Difference		Mackinnon Critical Values	
Variable	ADF	PP	ADF	PP	Critical value	Critical value
	t-stat	t-stat	t-stat	t-stat	1% Level	5% Level
SPRICE1	-1.253	-0.627	-6.825*	-10.19*	-4.263	-4.285
SPRICE2	-4.754*	-4.754*	-6.561*	-15.82*	-4.263	-4.285
SPRICE3	-3.367	-3.376	-5.499*	-7.660*	-4.263	-4.285
EXRATE	-1.629	-1.179	-5.848*	-8.202*	-4.263	-4.285
OIL	-2.282	-3.317	-5.523*	-5.523*	-4.263	-4.285
GAP	-3.057**	-1.841	-4.070**	-3.883*	-4.263	-4.285

* and ** denote variable is integrated at 1% and 5% respectively. 5% critical value is -3.552973

Note: SPRICE1=prices index in agriculture sector; SPRICE2 =prices index in manufacturing sector; SPRICE3= price index in services sector; EXRATE=exchange rate; Oil=oil price in US Dollar per barrel; Gap=output gap

Source: Author's computations

5.4.3. Optimal Lag Length Results

Table 5.3 displays the results of the information criterion for lag length selection namely the Akaike Information Criterion (AIC), Hannan and Quinn Criterion (HQ), Final Prediction Error (FPE) and the Schwarz information Criterion (SIC or SC) that were used to determine the optimal lag length. All the information criteria indicate the optimal lag length of one for all the three sectors as shown in tables 5.3.

Table 5.3. Var Lag Order Selection Criterion for all Sectors

Var Lag Order Selection Criterion for Agriculture Sector						
Lag	LogL	LR	FPE	AIC	SC	HQ
0	-13.329	NA	4.46E-05	1.333	1.6995	1.4545
1	6.8690	32.823*	3.49e-05*	1.0707*	1.1699*	1.4351*
2	19.403	17.233	4.64E-05	1.2873	3.1195	1.8946
Var Lag Order Selection Criterion for Manufacturing Sector						
Lag	LoGL	LR	FPE	AIC	SC	HQ
0	-0.2717	NA	0.0000	0.5170	0.8834	0.6384
1	17.1142	28.2520*	1.84e-05*	0.4304*	0.5297*	0.5948*
2	25.2328	11.1632	0.0000	0.9229	2.7551	1.5303
Var Lag Order Selection Criterion for Services Sector						
Lag	LogL	LR	FPE	AIC	SC	HQ
0	-21.1798	NA	0.0001	1.5737	1.7570	1.6345
1	12.6786	57.1360	1.60e-0*	0.1576*	1.3737*	0.7612*
2	32.0504	27.8471*	0.0000	0.2468	1.8958	0.7934

Source: Author's computation

5.4.4. SVAR Results for Agriculture Sector

The entire output for the SVAR model for the exchange rate pass through to sectoral prices in the agriculture sector is presented in appendix C. The estimated SVAR is justified or exactly identified. The short run restrictions were imposed to identify the SVAR through structural factorization.

Equations from 9 to 12 summarize the SVAR estimates for the agriculture sector. These equations represent the system of shocks from the SVAR for agriculture sector. The figures in parenthesis are p-values while figures which are not in the parenthesis are the coefficients representing the impact of a shock on the variable of interest. Of great importance is equation 12, which represents the impact of exchange rate shock (*LNEXR*) to sectoral prices (*SPRICE*). The coefficient of 0.23 in equation 12 indicates that if exchange rate shock increases by 1% (which also means Kwacha depreciation by 1%), sectoral price inflation in the agriculture sector will increase by 0.23%. By extension, if the Kwacha depreciates by 10%, about 2.3 % of that will be passed to agriculture prices. As can be observed, since the exchange rate pass through shock is 0.23 being less than 1, it means that exchange rate pass through to agriculture prices is incomplete. This confirms that pricing to market theory holds in the agriculture sector. The pricing to market theory contends that the exchange rate pass through may not be complete. This is because exporters absorb part of the exchange rate changes in their mark-up to stabilize prices in the export market. The reason for this is to maintain their market share in the export market (Marston, 1990).

$$\varepsilon_{LNOIL} = \underset{(0.00000)}{0.2723}\mu_{LNOIL} \quad (9)$$

$$\varepsilon_{LNGAP} = \underset{(0.0667)}{-0.5732}\mu_{LNOIL} + \underset{(0.0000)}{0.4891}\,\mu_{GAP} \quad (10)$$

$$\varepsilon_{LNEXR} = \underset{(0.0360)}{-0.2109}\mu_{LNOIL} - \underset{(0.0000)}{0.3171}\,\mu_{GAP} + \underset{(0.0000)}{0.1499}\,\mu_{LNEXR} \quad (11)$$

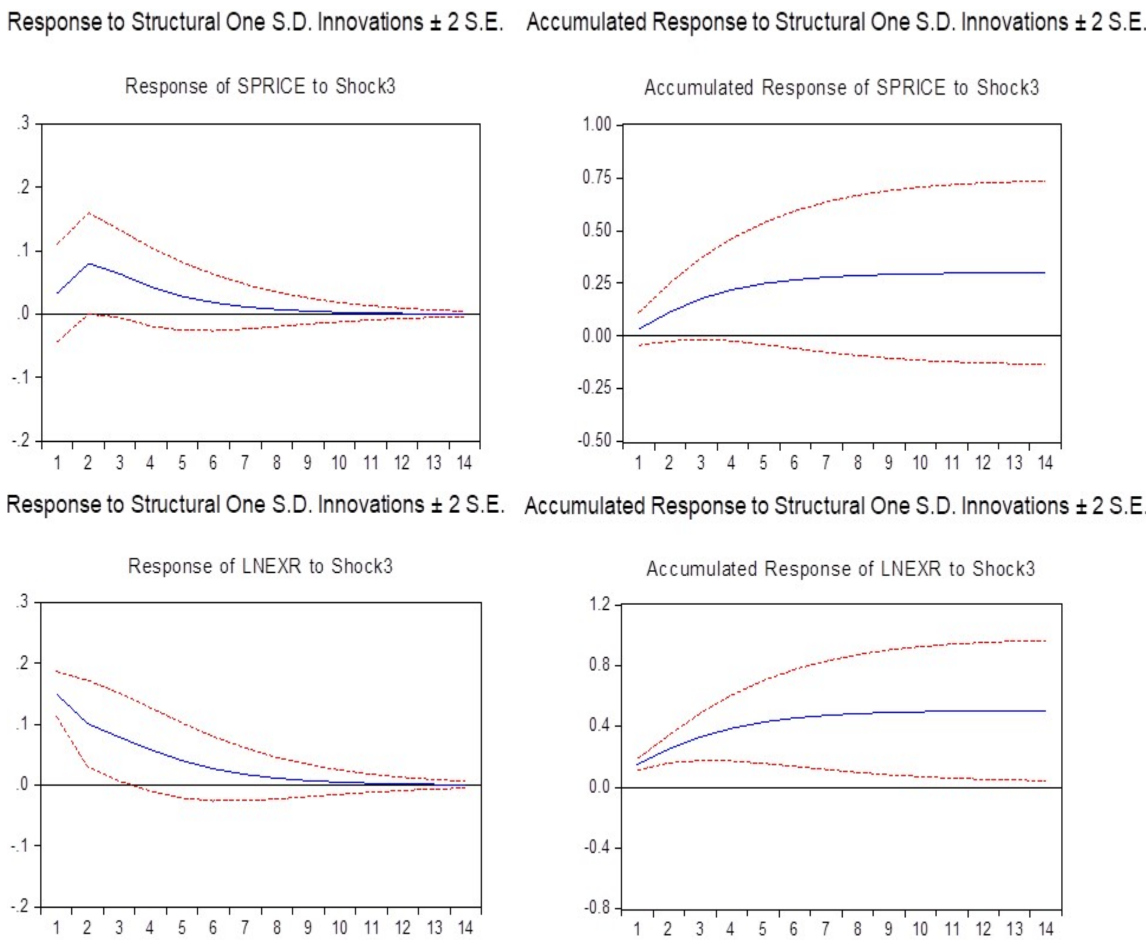
$$\varepsilon_{SPRICE} = \underset{(0.5748)}{0.0882}\mu_{LNOIL} + \underset{(0.0235)}{0.2554}\mu_{GAP} + \underset{(0.3778)}{0.22540}\mu_{LNEXR} + \underset{(0.00000)}{0.2201}\mu_{SPRICE} \quad (12)$$

5.4.4.1. Impulse Response Function Analysis for Agriculture Sector

The impulse response function allows the evaluation of the impact of exchange rate on sectoral prices over a specified horizon. The non-cumulated and the cumulated structural impulse response functions of both the sectoral price and exchange rate due to the shock in the exchange rate are presented in figure 5.2. The upper part of figure 5.2 presents the impulse response and cumulated response function of sectoral price in the agriculture sector due to a shock in exchange rate. The lower part of figure 5.2 shows the impulse response function and cumulated response function of exchange rate due to the shock in exchange rate.

In the SVAR for agriculture sector, shock 1, shock 2, shock 3 and shock 4 are oil price shock (*LNOIL*), output gap or demand Pressure (*GAP*) shock, exchange rate shock (*LNEXR*) and agricultural price (*SPRICE*) shocks respectively. Figure 5.2 present the response of prices in the agriculture sector (*SPRICE*) to the shock in exchange rate. It can be observed in figure 5.2 that the initial one standard deviation shock to exchange rate causes agriculture price inflation to increase to a maximum of 8% in period two and thereafter begins to decline. The response of agriculture price inflation to one standard deviation in exchange rate last up to eight periods and beyond that, responses become insignificant as shown in figure 5.2. Considering only the significant responses of sectoral prices to a shock in exchange rate, the cumulative impact reaches maximum at 28.7% in period eight (see figure 5.2 and table 5.4). The lower part of figure 5.2 and table 5.4 do show that in period eight the cumulative impulse response of exchange rate to shock in exchange rate is 0.4844 that is 48.44%. Comparing the cumulative response of sectoral price in this sector and the cumulative impulse response of exchange rate, the exchange rate pass through is less than complete in the agriculture sector. This confirms further that the exchange rate pass through in the agriculture sector follows pricing to market model.

Figure 5.2: Impulse Response Functions Graph for Agriculture Sector



Source: Author’s computations

5.4.4.2. Exchange Rate Pass Through Elasticity to Agriculture Prices

To provide a better understanding of the evolution of the exchange rate pass through, we calculated the exchange rate pass through elasticity (ERPTE) in the agriculture sector. In estimating the exchange rate pass through elasticity, we followed Leigh and Rossi (2002), Capistran et. al (2011) and Guillermo et. al (2014) formulation. ERPTE is defined as the ratio of cumulative response of agricultural price inflation to cumulative exchange rate change in response to its own shock as specified in equation (31) of chapter 4.

Table 5.4 displays the exchange rate pass through elasticities. Table 5.4 also displays cumulative impulse response function of agriculture sector prices (*SPRICE*) and cumulative impulse response function of exchange rate due to the shock in exchange rate. The study calculated elasticities up to period 8, because the response of agriculture price inflation to a shock in exchange rate last up to period 8 as can be seen in figure 5.2.

In table 5.4, one can observe that one standard deviation shock of 0.1499 to exchange rate increases agriculture sector price inflation by 0.034, which corresponds to exchange rate pass through elasticity of 0.23 in the first period. This means that exchange rate appreciation (Kwacha depreciation) of 14.99% increases agriculture prices by 3.4%. The impact of the initial one standard deviation shock in exchange rate on agricultural prices last up to period eight. The exchange rate pass through elasticity in period eight is 0.59. The average exchange rate pass through elasticity for the entire period under consideration is 0.52. It is vital to note that the exchange rate pass through elasticity in the agriculture sector as displayed in table 5.4 is an increasing function. It increases with time. Furthermore, results in table 5.4 clearly shows that exchange rate pass through is less than complete in the agriculture sector. This is because the exchange rate pass through elasticity is less than one for the entire period. The finding of incomplete exchange rate pass through to agriculture prices is a confirmation that the pricing to market theory holds in the agriculture sector. The findings of incomplete pass through is similar to the findings of Zgambo (2015) and Chewe (2015). Zgambo found the pass-through elasticity of 0.41.

Table 5.4: Exchange Rate Elasticity for Agriculture Sector

	Cumulative Response of Exchange Rate (*LNEXR*)	Cumulative Response of Sectoral Price *(SPRICE)*	Exchange Rate Pass Through Elasticity
Period	To Exchange Rate Shock (*LNEXR*=Shock 3)	To Exchange Rate Shock (*LNEXR*=Shock 3)	*ERPTE*
1	0.14991	0.03379	0.22540
2	0.25100	0.11401	0.45423
3	0.32987	0.17777	0.53890
4	0.38824	0.22081	0.56875
5	0.42848	0.24898	0.58106
6	0.45530	0.26731	0.58710
7	0.47292	0.27924	0.59045
8	0.48443	0.28700	0.59245
Average Exchange Rate Pass Through			0.51729

Source: Author's computations

4.4.4.3. Variance Decomposition for Agriculture Sector

To understand the relative importance of the shocks from endogenous variables in the system on sectoral price inflation in the agriculture sector, the study computed the forecast error variance decomposition (FEVD). Table 5.5 presents the variance decomposition of the agriculture sector price inflation *(SPRICE).* Results from table 5.5 show that the price inflation inertia in the agriculture sector (own shock) and output gap (demand pressure) shocks are the major determinants of the variance in agriculture sector price inflation. Own shocks to agricultural prices account for more than 60% for the entire period. Demand pressure account between 22% and 33% variation in the prices in the agriculture sector for the entire period. On the other hand, exchange rate shock only account for 12% variance in agriculture sector prices for the entire period. Finally, oil price shock has a minor effect on the agriculture prices accounting between 2% to 3.5%. It can be observed that the impact of output gap (demand pressure) shocks and own shocks to sectoral prices is greater in the initial period but decreases with time. On the other hand, the impact of exchange rate shocks on agriculture prices is initially smaller but gets bigger with time.

In conclusion, exchange rate fluctuations have less impact on prices in the agriculture sector as compared to output gap and sectoral price shocks. Prices in the agriculture sector are majorly explained by price inertia (own shocks) and output gap (demand pressure) shocks and less by exchange rate fluctuations and oil price shocks. These findings show that the agriculture sector is less exposed to exchange rate exposure. This might mean there could be less international trade in the agriculture sector.

Table 5.5: Variance Decomposition for Agriculture Sector

Variance Decomposition of Sectoral price					
Period	S.E.	Oil Price Shock	output gap shock	Exchange Rate Shock	Sectoral Price Shock
1	0.272373	2.081474	33.30838	1.487762	63.12238
2	0.275608	3.181947	26.13116	7.679518	63.00737
3	0.276262	3.383672	23.95242	10.80312	61.86079
4	0.276571	3.449646	23.15298	12.09071	61.30666
5	0.276724	3.475307	22.83309	12.61833	61.07327
6	0.276795	3.485921	22.70051	12.8375	60.97607
7	0.276826	3.490389	22.64479	12.92951	60.93531
8	0.276839	3.492281	22.62124	12.96837	60.91811

Source: Author's computations

5.4.4.4. Stability and Diagnostic Tests for Agriculture Sector Model

To be confidents of the results from the SVAR, several tests were conducted namely, the stability test, test for serial correlation, heteroscedasticity and normality test. The stability test was conducted to ensure that the estimated SVAR is well specified and stationary. The AR roots table and AR roots graph were used to test for stability of the SVAR for the agriculture sector. The AR roots table in table 5.6 and the AR roots graph in appendix C show that the SVAR for agriculture sector is well specified, stable and stationary. This is because the inverse roots of the characteristic polynomial have modulus value of less than one and lie within the circle.

The diagnostic tests in table 5.6 also shows that the SVAR model for agriculture sector does not have serial correlation and the residuals are normally distributed. The probability value of 0.0649 and 0.1375 for serial correlation and normality tests respectively show that the null hypothesis of no correlation and normality of residuals cannot be rejected. This implies that the residuals are normally distributed and serially uncorrelated. However, the homoscedasticity test indicates that there is heteroscedasticity in the SVAR, however, not severe because the probability value of 0.0496 for heteroscedasticity test statistics is almost 5%. When probability is slightly above 5%, it is an indication of the absence of heteroscedasticity. Thus, heteroscedasticity in this case is minor. In addition, Brooks (2006), asserts that estimators are still unbiased and consistent in the presence of heteroscedasticity except that they no longer have minimum variance.

Table 5.6: Stability and Diagnostic Tests for Agriculture Sector Model

AR Roots For SVAR Stability For Agriculture Sector Model	
Root	Modulus
0.651383	0.651383
0.205781 - 0.050422i	0.211868
0.205781 + 0.050422i	0.211868
-0.03956	0.03956
No root lies outside the unit circle; VAR satisfies the stability condition	

VAR Diagnostic Test for Agriculture Sector Model		
Test Type	LM-Stat/ Chi-square	Probability
Lagrange Multiplier test for Serial Correlation	25.29079	0.0649
White Test for Heteroscedasticity	124.3983	0.0496
VAR-Jarque Bera-Residual Normality test	12.31858	0.1375

Source: Author's computations

5.4.5. SVAR Results for Manufacturing Sector

The entire output for the SVAR model estimates for the exchange rate pass through in the manufacturing sector is presented in appendix C. The estimated SVAR is exactly identified. The short run restrictions were imposed to identify the SVAR through structural factorization.

Equations from 13 to 16 summarize the SVAR estimates for the manufacturing sector. These equations represent the system of shocks from the SVAR. The figures in parenthesis are p-values while figures which are not in the parenthesis are coefficients representing the impact of a shock on the variable of interest. Of great importance is equation 16, which shows the impact of exchange rate shock (*LNEXR*) to price inflation (*SPRICE*) in the manufacturing sector. The coefficient of exchange rate shock of 0.5897 is significant at 1% level. This result implies that a positive shock to exchange rate increases prices in the manufacturing sector. In more specific terms, when Kwacha depreciates by 1%, prices in the manufacturing sector will increase by 0.59%. In like manner, if the Kwacha depreciates by 10%, about 5.9 % of that depreciation in the Kwacha will be passed to prices in the manufacturing sector. Since the coefficient of the exchange rate pass through of 0.5897 is less than one, it means that the exchange rate pass through in the Zambian manufacturing sector is incomplete.

$$\varepsilon_{LNOIL} = \underset{(0.0000)}{0.2703}\ \mu_{LNOIL} \tag{13}$$

$$\varepsilon_{LNGAP} = \underset{(0.1563)}{-0.4599}\mu_{LNOIL} + \underset{(0.0000)}{0.5037}\ \mu_{GAP} \tag{14}$$

$$\varepsilon_{LNEXR} = \underset{(0.1605)}{-0.1491}\mu_{LNOIL} + \underset{(0.0000)}{0.3448}\ \mu_{GAP} + \underset{(0.0000)}{0.1601}\ \mu_{LNEXR} \tag{15}$$

$$\varepsilon_{SPRICE} = \underset{(0.6161)}{0.0502}\mu_{LNOIL} + \underset{(0.9914)}{0.0008}\ \mu_{GAP} + \underset{(0.0002)}{0.5897}\ \mu_{LNEXR} + \underset{(0.0000)}{0.1465}\ \mu_{SPRICE} \tag{16}$$

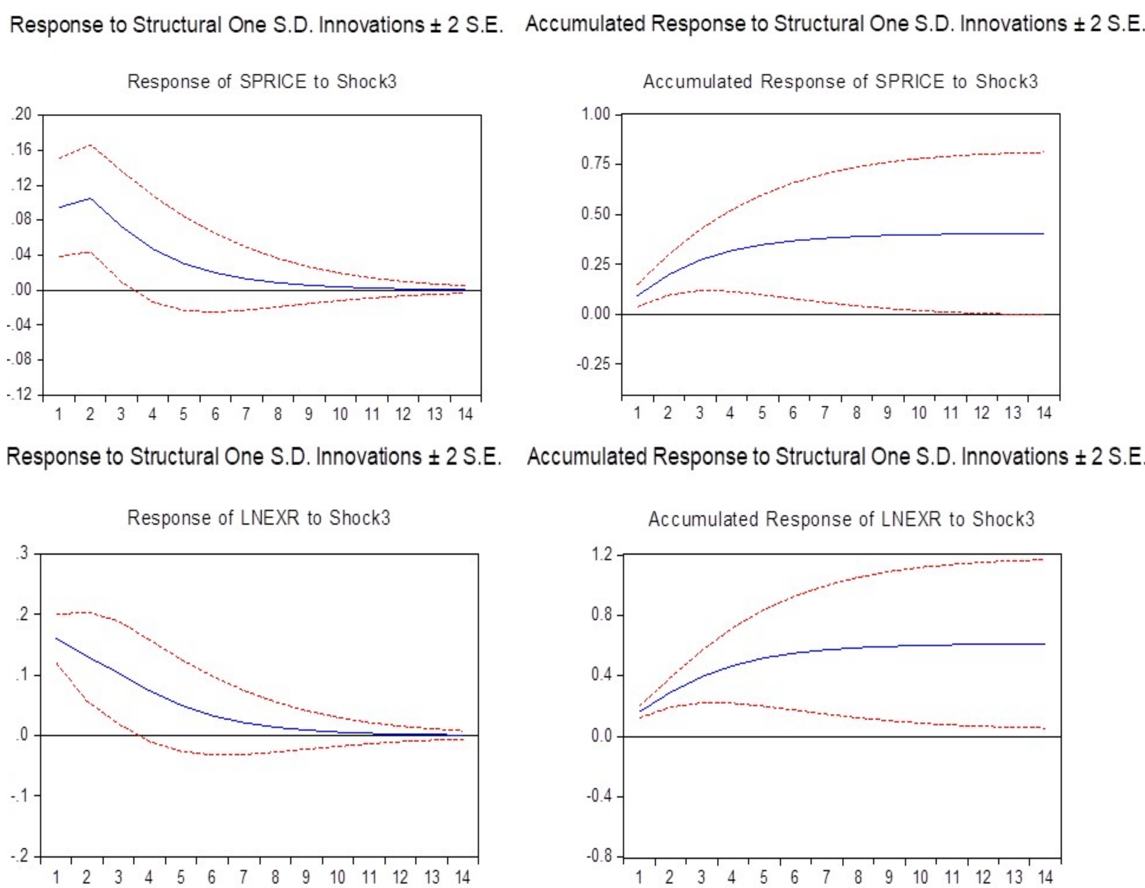
5.4.5.1. Impulse Response Function Analysis for Manufacturing Sector.

To have a clear picture of the magnitude and propagation of the exchange rate pass through to prices in the manufacturing sector, we computed the structural impulse response functions and accumulated structural impulse response functions.

Figure 5.3 displays the structural impulse response function and the accumulated impulse response of sectoral price and exchange rate due to the shock in exchange rate. The upper panel of figure 5.3 displays the non-cumulated and cumulated impulse response of sectoral prices to a shock in exchange rate. The lower panel of figure 5.3 shows the non-cumulated and cumulated impulse response of exchange rate to own shocks.

In the SVAR for manufacturing sector, shock 1, shock 2, shock 3 and shock 4 are oil price shock (*LNOIL*), output gap or demand Pressure (*GAP*) shock, exchange rate shock (*LNEXR*) and agricultural price (*SPRICE*) shocks respectively. Figure 4.3 presents the response of prices in the manufacturing sector *(SPRICE)* to the shock in exchange rate. It can be observed in figure 5.3 that the initial one standard deviation shock to exchange rate causes prices in the manufacturing sector to increase to a maximum of 10.5% in period two and thereafter begins to decline to insignificant level in period ten as shown in figure 5.3. Considering only the significant responses of sectoral prices to the shock in exchange rate, the cumulative maximum impact of the responses of sectoral price is 0.395 that is 39.5% in period nine (table 5.7). It should be noted here that in period nine the cumulative impulse response of exchange rate to the shock in exchange rate in period nine is 0.596 that is 59.6% as shown in figure 5.3 and table 5.7. When one compares the cumulative impulse response of sectoral price and the cumulative impulse response of exchange rate, it can be told that the exchange rate pass through is less than complete in the manufacturing sector.

Figure 5.3: Impulse Response Function Graph for Manufacturing Sector



Source: Author's computations

5.4.5.2 Exchange Rate Pass Through Elasticity to Manufacturing Sector Prices

To provide a better understanding of the evolution of exchange rate pass through, the study calculated the exchange rate pass through elasticity (ERPTE) of prices in the manufacturing sector. In estimating the exchange rate pass through elasticity, the study followed, Leigh and Rossi (2002), Capistran et. al (2011) and Guillermo et. al (2014) formulation. ERPTE is defined as the ratio of cumulative impulse response of manufacturing sector price inflation to cumulative impulse response of exchange rate to the shock in exchange rate.

Table 5.7 displays exchange rate pass through elasticity in the manufacturing sector. The table also displays the cumulative impulse response of manufacturing sector prices (*SPRICE*) and cumulative impulse response of exchange rate to the shock in exchange rate. It should be noted here that since the impulse responses are significant up to period nine as shown in figure 5.3, the exchange rate pass through elasticity was calculated up to period nine. Table 5.7 shows that one standard deviation shock of 0.1601 in exchange rate increases manufacturing sector price inflation by 0.0944, which corresponds to exchange rate pass through elasticity of 0.59 in the first period. This means that exchange rate appreciation (Kwacha depreciation) of 16.01% increases manufacturing sector prices by 9.4%. The maximum impact of initial one standard deviation shock in exchange rate on prices in the manufacturing sector is recorded in period three where the exchange rate pass through elasticity is 0.69. Beyond period three, the exchange rate pass through elasticity begins to decline until it reaches 0.66 in period nine. The average exchange rate pass through elasticity for the period under consideration is 0.67. For the entire period, the exchange rate pass through is less than complete. This is because the exchange rate pass through elasticity is less than one. Therefore, the pricing to market theory holds in the manufacturing sector. This means foreign exporters absorb part of exchange rate fluctuations in their profit margins to maintain their market share in the import nation (Zambia in this case). This finding in this chapter of incomplete pass through is similar to the findings by Marston (1990) and Otan et al (2003) who also found incomplete exchange rate pass through in the manufacturing sector in Japan. Otan et al (2003) for instance found exchange rate pass through elasticity to be around 0.5 in the 1980s for the case of Japan

Table 5.7: Exchange Rate Pass-through Elasticity for Manufacturing Sector

	Cumulative Response of Exchange Rate *(LNEXR)*	Cumulative Response of Sectoral Price *(SPRICE)*	Exchange Rate Pass Through Elasticity
Period	To Exchange Rate Shock (*LNEXR*=Shock 3)	To Exchange Rate Shock (*LNEXR*=Shock 3)	ERPTE
1	0.16012	0.09442	0.58967
2	0.29055	0.19942	0.68634
3	0.39435	0.27202	0.68979
4	0.46809	0.31887	0.68122
5	0.51782	0.34909	0.67415
6	0.55066	0.36870	0.66956
7	0.57221	0.38150	0.66671
8	0.58630	0.38985	0.66493
9	0.59552	0.39531	0.66381
Average Exchange Rate Pass Through			0.66513

Source: Author's computations

5.4.5.3. Variance Decomposition for Manufacturing Sector

To understand the relative importance of the shocks from endogenous variables in the system on manufacturing sector prices, the study computed the forecast error variance decomposition (FEVD). The variance decomposition was computed for the period up to period nine. This is because the impulse response function for sectoral prices in the manufacturing sector become insignificant in period ten as shown in figure 5.3. Table 5.8 presents variance decomposition of manufacturing sector price inflation (*SPRICE*). Table 5.8 shows that exchange rate shocks are an important determinant of fluctuations in prices in the manufacturing sector. Exchange rate fluctuations account between 21.1% to 42% variance in the manufacturing sector prices between period one and nine. The further we go into the future, the greater the impact of exchange rate fluctuation on prices in the manufacturing sector. It is also clear from table 5.8 that inflation inertia account between 39.9% to 50.8% variance on prices in the manufacturing sector. However, the effect of own price shocks (inflation inertia) in the manufacturing sector is greater in the initial period but declines with time. For instance, in period one, own price shocks explain 50.85% variation in the manufacturing sector prices and only explains 39.9% variation in period nine as shown in table 5.8. In the case of exchange rate shocks, the effect on prices in the manufacturing sector increases with time. In the first period, exchange rate shock, explains about 21.1% variation in manufacturing sector prices. In period nine, exchange rate shock explains 42.4% variation in manufacturing prices. Output gap shocks (Demand pressure) on the other hand accounts for 25%, 18.6% and 16.7% variation in prices in the first, second and third period. Beyond period three, demand pressure accounts for 15.6% variance in manufacturing price inflation. Oil price shocks account for 2 to 3% variance in the manufacturing price inflation for the entire period under consideration.

In conclusion, therefore, exchange rate fluctuations are an important determinant of variations in the prices in the manufacturing sector. This suggest that policy makers should closely monitor how external shocks such as exchange rate affect the manufacturing sector and design appropriate policies to caution the effects of international shocks in this sector.

Table 5.8: Variance Decomposition for Manufacturing Sector

Variance Decomposition of Sectoral Price					
Period	S.E.	Oil Price Shock	Output gap shock	Exchange Rate Shock	Sectoral Price Shock
1	0.270257	2.996101	25.03958	21.11449	50.84983
2	0.273904	2.314323	18.56202	34.73177	44.39189
3	0.274922	2.149147	16.69866	39.50525	41.64695
4	0.27531	2.093675	16.041	41.24939	40.61594
5	0.275461	2.072499	15.78405	41.93416	40.2093
6	0.275523	2.063854	15.6785	42.21545	40.0422
7	0.275549	2.060222	15.6341	42.3337	39.97198
8	0.27556	2.058679	15.61523	42.38393	39.94216
9	0.275565	2.058021	15.60718	42.40535	39.92945

Source: Author's computations

5.4.5.4. Stability and Diagnostic Tests for Manufacturing Sector Model

To be confidents of the results from the SVAR, the tests were conducted namely, the stability test, test for serial correlation, heteroscedasticity and normality. The stability test was conducted to ensure that the estimated SVAR is well specified and stationary.

Therefore, the AR roots table and AR roots graph were used to test for stability of the SVAR for the manufacturing sector. The AR roots table in table 5.9 and the AR roots graph in appendix C show that the SVAR for the manufacturing sector is well specified, stable and stationary. This is because the inverse roots of the characteristic polynomial have modulus value of less than one and lie within the circle.

Table 5.9: VAR Stability and Diagnostic Tests for Manufacturing Sector Model

AR Roots For VAR Stability for the Manufacturing Sector Model		
Root	Modulus	
0.653913	0.653913	
0.199773 - 0.077631i	0.214326	
0.199773 + 0.077631i	0.214326	
-0.039965	0.039965	
No root lies outside the unit circle; VAR satisfies the stability condition		
VAR Diagnostic Test for Manufacturing Sector Model		
Test Type	LM-Stat/ Chi-square	Probability
Lagrange Multiplier test for Serial Correlation	14.21927	0.5824
White Test for Heteroscedasticity	127.9181	0.0313
VAR-Jarque Bera-Residual Normality test	8.742925	0.3644

Source: Author's computations

The diagnostic tests in table 5.9 show that the SVAR model for the manufacturing sector does not have serial correlation and the residuals are normally distributed. The probability value of 0.5824 and 0.3644 for serial correlation and normality test respectively show that the null hypothesis of no correlation and normality of residuals cannot be rejected. This implies that the residuals are normally distributed and serially uncorrelated. However, the probability value of 0.0313 for heteroscedasticity is lower than 5%. This shows that there is heteroscedasticity in the SVAR, however, not severe.

5.4.6. SVAR Results for Services Sector

The entire SVAR output for exchange rate pass through in the services sector is presented in appendix C. The estimated SVAR is justified or exactly identified. The short run restrictions were imposed to identify the SVAR through structural factorization.

Equations from 17 to 20 summarize the SVAR estimates for services sector. These equations represent the system of shocks from the SVAR. The figures in parenthesis are p-values while figures which are not in the parenthesis are coefficients representing the impact of a shock on the variable of interest. Of great importance is equation 20, which shows the impact of exchange rate shock (*LNEXR*) to prices (*SPRICE*) in the services sector. The coefficient of exchange rate shock of 0.6031 is positive and significant at 1% level. It implies that a positive shock to exchange rate increases prices in the services sector in. If exchange rate shock increases by 1%, services sector price inflation will increase by 0.603%. By extension then, if the Zambian Kwacha depreciates by 10%, about 6.03 % of that depreciation in the Kwacha will be passed to prices in the services sector prices. Since the coefficient of the exchange rate pass through of 0.6031 is less than one, it means that exchange rate pass through to the services sector in Zambia is incomplete.

$$\varepsilon_{LNOIL} = \underset{(0.0000)}{0.2733}\mu_{LNOIL} \tag{17}$$

$$\varepsilon_{LNGAP} = \underset{(0.1212)}{-0.4912}\mu_{LNOIL} + \underset{(0.0000)}{0.5037}\ \mu_{GAP} \tag{18}$$

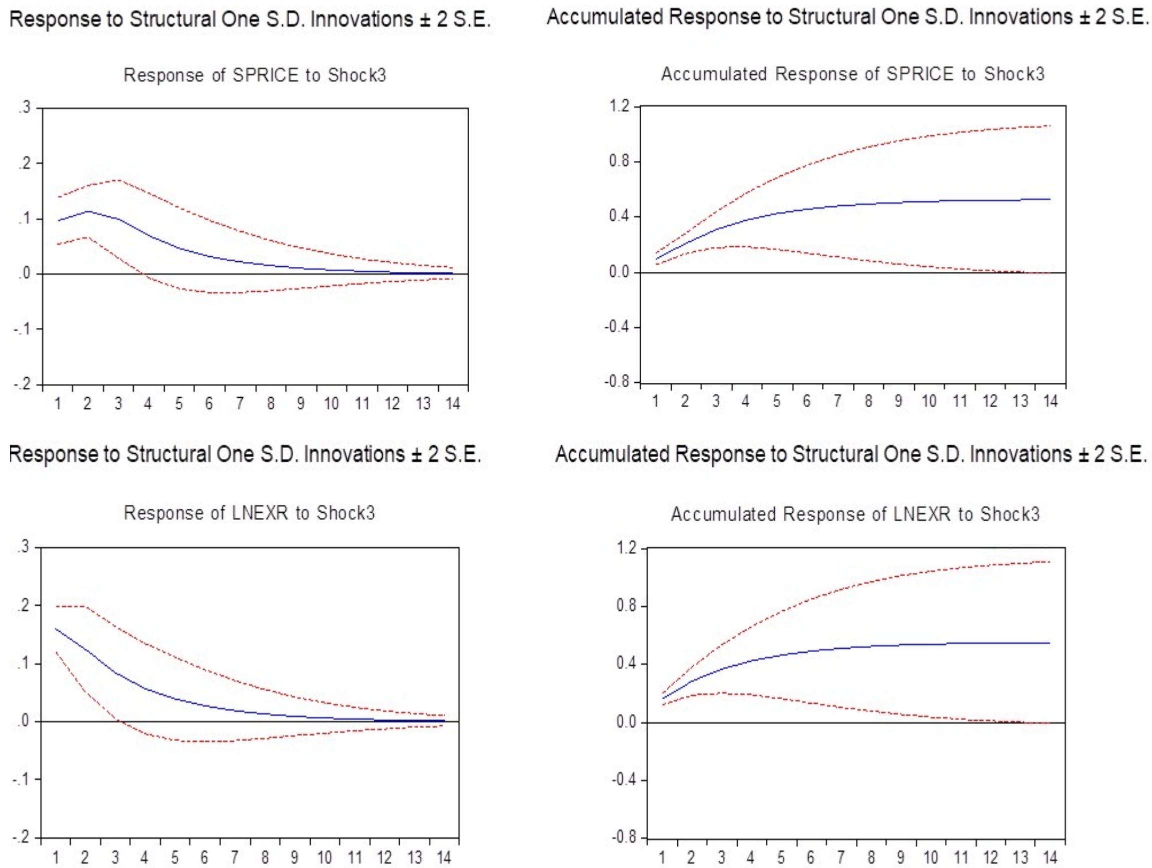
$$\varepsilon_{LNEXR} = \underset{(0.1195)}{-0.1643}\mu_{LNOIL} + \underset{(0.0000)}{0.3725}\ \mu_{GAP} + \underset{(0.0000)}{0.1560}\mu_{LNEXR} \tag{19}$$

$$\varepsilon_{SPRICE} = \underset{(0.0103)}{0.1762}\mu_{LNOIL} - \underset{(0.0160)}{0.1290}\mu_{LNGAP} + \underset{(0.0000)}{0.6031}\mu_{LNEXR} + \underset{(0.0000)}{0.1005}\mu_{SPRICE} \tag{20}$$

5.4.6.1. Impulse Response Function Analysis for Services Sector

To have a clear picture of the magnitude and propagation of the exchange rate pass through to prices in the services sector, the study computed the structural impulse response functions and cumulated structural impulse response functions. Figure 5.4 displays the impulse response function for sectoral prices and exchange rate to shock in exchange rate in the services sector. The upper part of figure 5.4 indicate the impulse response function and cumulated impulse response function of sectoral prices to shocks in exchange rate. The lower part of figure 5.4 shows the impulse response of function and cumulated impulse response function of exchange rate due to the shock in exchange rate. It should be noted that in the SVAR for services sector, shock 1, shock 2, shock 3 and shock 4 are oil price shock (*LNOIL*), output gap or demand Pressure (*GAP*) shock, exchange rate shock (*LNEXR*) and services sector price (*SPRICE*) shocks respectively.

Figure 5.4: Impulse Response Function Graph for Services Sector Model



Source: Author's computations

Figure 5.4 shows that the initial one standard deviation shock to exchange rate causes prices to increase to a maximum of 11.1% in period two and thereafter begins to decline up to period twelve when it becomes insignificant. The significant response of service sector prices to exchange rate shock last up to period eleven as shown in figure 5.4. Taking account of only the significant responses of service sector prices due to the shock in exchange rate, the maximum cumulative impulse response of sectoral prices due to a shock in exchange rate is estimated at 51.8% in period eleven as shown in figure 5.4 and table 5.10. On the other hand, the cumulative impulse response of exchange rate due to the shock in exchange rate in period eleven is 54.43%. Comparing the cumulative impulse response of exchange rate due to exchange rate shock and cumulative impulse response of sectoral prices at period eleven that is 54.43% and 51.8% respectively, one can tell that the exchange rate pass through in this sector is quiet high though incomplete (see figure 5.4 and table 5.10).

5.4.6.2. Exchange Rate Pass Through Elasticity to Sector Prices

To provide a better understanding of the evolution of the exchange rate pass through in the services sector, we computed the exchange rate pass through elasticity (ERPTE). In estimating the pass-through elasticity, we followed, Leigh and Rossi (2002), Capistran et al (2011) and Guillermo et. al (2014) formulation. ERPTE is defined as the ratio of cumulative response of services sector price inflation to cumulative exchange rate changes in response to its shock in exchange rate.

Table 5.10 displays the exchange rate pass through elasticity in the services sector. The table also displays the cumulative impulse response of services sector prices (*SPRICE*) and cumulative impulse response of exchange rate to shock in exchange rate. In table 5.10, one can observe that one standard deviation shock of 0.1600 in exchange rate increases services sector prices by 0.0965, which corresponds to exchange rate pass through elasticity of 0.60 in the first period. This means that exchange rate appreciation (Kwacha depreciation) of 16% increases services sector prices by 9.65%. It can be observed in table 4.10 that the exchange rate pass through elasticity in the services sector is an increasing function and very high. In the initial period, the exchange rate pass through elasticity is 0.60 and in period eleven, the exchange rate pass through elasticity increases to 0.95. It is worth to note that for the entire period, the exchange rate pass through to services sector price inflation is less than complete. This is because the exchange rate pass through elasticity is less than one. However, the exchange rate pass through elasticity in the services sector is very high getting closer to one. This implies that the services sector is very sensitives to changes in exchange rate in Zambia.

Table 5.10: Exchange Rate Pass-through Elasticity for Services Sector Model

Period	Cumulative Response of Exchange Rate (LNEXR) To Exchange Rate Shock (*LNEXR*=Shock 3)	Cumulative Response Sectoral Price (SPRICE) To Exchange Rate Shock (*LNEXR*=Shock 3)	Exchange Rate Pass Through Elasticity *ERPTE*
1	0.1600	0.0965	0.6031
2	0.2846	0.2103	0.7389
3	0.3688	0.3097	0.8396
4	0.4255	0.3793	0.8915
5	0.4646	0.4258	0.9164
6	0.4919	0.4575	0.9299
7	0.5110	0.4795	0.9384
8	0.5242	0.4949	0.9441
9	0.5335	0.5057	0.9479
10	0.5399	0.5131	0.9505
11	0.5443	0.5183	0.9523
Average Exchange Rate Pass Through			0.8775

Source: Author's computations

5.4.6.3. Variance Decomposition for Services Sector Model

To understand the relative importance of shocks from endogenous variables in the system on services sector prices, the study computed the forecast error variance decomposition (FEVD). Table 5.11 presents variance decomposition of services sector price inflation (*SPRICE*). Table 5.11 shows that exchange rate shocks and output gap are the vital determinants of fluctuations in prices in the services sector followed by own price shocks (*SPRICE*) and lastly oil price shocks (*LNOIL*). Exchange rate shocks account for more than between 41% and 43% variance in services sector prices. Output gap account between 10% to 47% variance in prices in the services sector. Own shock account for 46% variance in services sector prices in the initial period but drastically reduces beyond period one. For instance, own price shocks account for, 15.7% in period two and 10% from period four until period eleven. Oil price shocks on the other hand explain less variance in the sectoral prices in the services sector.

In conclusion, therefore, exchange rate fluctuations and output gap are the major determinants of variations in the prices in the services sector. This suggest that policy makers should closely monitor how external shocks such as exchange rate shocks are affecting the services sector and design appropriate policies to caution the effects of international shocks in this sector.

Table 5.11: Variance Decomposition for Services Sector Model

Variance Decomposition of Sectoral Price					
Period	S.E.	Oil Price Shock	Output Shock	Exchange Rate Shock	Sectoral Price Shock
1	0.273315	0.300461	10.64234	42.69222	46.36498
2	0.276299	1.519202	48.42470	34.33715	15.71894
3	0.276564	1.561503	49.13386	37.42394	11.8807
4	0.276639	1.569671	48.03444	39.50034	10.89554
5	0.276681	1.573869	47.51494	40.37832	10.53288
6	0.276705	1.576508	47.31966	40.73771	10.36612
7	0.276717	1.57785	47.23901	40.89878	10.28435
8	0.276723	1.578475	47.20048	40.97631	10.24474
9	0.276726	1.578767	47.18135	41.01412	10.22576
10	0.276727	1.578907	47.17202	41.03242	10.21665
11	0.276728	1.578975	47.16753	41.04124	10.21226
12	0.276728	1.579008	47.16536	41.0455	10.21013

Source: Author's computations

5.4.6.4. Stability and Diagnostic Tests for Services Sector Model

The stability test was conducted to ensure that the estimated SVAR is well specified and stationary. Therefore, the AR roots table and AR roots graph were used to test for stability of the SVAR for the services sector. The AR roots table in table 5.12 below and the AR roots graph in appendix C show that the SVAR for the services sector is well specified, stable and stationary. This is because the inverse roots of the characteristic polynomial have modulus value of less than one and lie within the circle.

The diagnostic tests results in table 5.12 also show that the residuals for SVAR model are normally distributed with the probability of 0.0589 which is above 5%. However, the model suffers from minor heteroscedasticity and serial correlation.

Table 5.12: SVAR Stability and Diagnostic Tests for Services Sector Model

AR Roots For VAR Stability for Services Sector Model

Root	Modulus
0.695207	0.695207
0.138848 - 0.294984i	0.326028
0.138848 + 0.294984i	0.326028
-0.060836	0.060836

No root lies outside the unit circle.

VAR Diagnostic Test for Services Sector Model

Test Type	LM-Stat/ Chi-square	Probability
Lagrange Multiplier test for Serial Correlation	41.36488	0.0005
White Test for Heteroscedasticity	124.8418	0.0469
VAR-Jarque Bera-Residual Normality test	14.9673	0.0598

Source: Author's computations

5.4.7. Comparative Analysis of Exchange Rate Pass Through in all Sectors

In this section, we compare the degree of the exchange rate pass through to sectoral prices in the three sectors under consideration. These are, the agriculture, manufacturing and the services sectors. The chapter compares the coefficients of the shocks of the SVAR, impulse response functions, the exchange rate pass through elasticity and the variance decomposition in all the three sectors up to period eleven.

5.4.7.1. Coefficients of The Shocks from The SVAR System for Each sector.

Table 5.13 below displays coefficients of the shocks obtained from the SVAR output for each of the three sectors. The SVAR output for each of the three sectors is presented in appendix C. Table 5.13 below shows that the exchange rate pass through coefficients for agriculture, manufacturing and services sectors are 0.2254, 0.5897 and 0.6031 respectively. These coefficients mean that 1% increase in exchange rate causes sectoral prices to increase by 0.23%, 0.58% and 0.60% in agriculture, manufacturing and services sectors respectively. The exchange rate pass through to sectoral prices is greatest in the services sector followed by the manufacturing sector and least in the agriculture sector. This entails that the most sensitive sector to changes in exchange rate is the services sector followed by the manufacturing sector. On the other hand, the agriculture sector prices are less sensitive to exchange rate movements.

Table 5.13: Coefficients of Shocks of the Sprice Equation for Each Sector

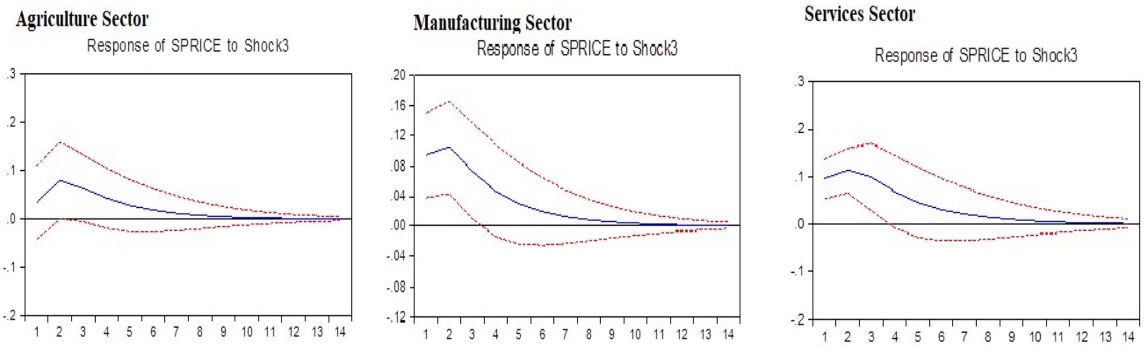
Target Variable is Sectoral Price			
Variable	Agriculture Sector Coefficient	Manufacturing Sector Coefficient	Services Sector Coefficient
Exchange Rate	0.2254	0.5897*	0.6031*
	(0.2556)	(0.1593)	(0.1094)
Price of Crude Oil	0.0882	0.5020	0.1762**
	(0.1572)	(0.1001)	(0.0687)
Output Gap	0.2554**	0.0008	-0.1290**
	(0.1127)	(0.0747)	(0.0536)
Sectoral Price	0.2201*	0.1465*	0.1005*
	0.0270	(0.0108)	(0.0124)

*, ** and ***show significance at 1%, 5% and 10% respectively.
Note: Figure not in parenthesis are shocks coefficients and in parenthesis are standard errors
Source: Author's computations

5.4.7.2. Impulse Response Function Analysis for all Sectors

Figure 5.5 presents impulse response of the sectoral prices to the shock in exchange rate for agriculture, manufacturing and services sectors. Figure 5.5 shows that there is a difference in the exchange rate pass through to sectoral prices both in terms of the impact and propagation among the sectors. Although in all the three sectors, one standard deviation shock to exchange rate causes sectoral prices to increase and reach maximum in period two; the impact is different. For instance, the impact of one standard deviation shock to exchange rate causes sectoral prices to rise to a maximum impact of 8%, 10.5% and 11.1% in period two in agriculture, manufacturing and services sectors respectively as shown in figure 5.5. Thus, the effect of the exchange rate pass through to sectoral prices is greater in the services sector followed by manufacturing sector and least in the agriculture sector. Furthermore, figure 5.5 shows that one standard deviation shock to exchange rate is more persistent in the services sector followed by manufacturing sector and less in the agriculture sector. For instance, the shock last for eight, nine and eleven periods in agriculture, manufacturing and services respectively. This implies that the effect of the shock is more persistent in the services sector followed by manufacturing and agriculture sectors respectively (see figure 5.5).

Figure 5.5: Impulse Response Functions for all Sectors



Source: Author's computations

5.4.7.3. Exchange Rate Pass Through to Price Elasticity for all Sectors

To have a more clarity on the degree of exchange rate pass through to sectoral prices among the three sectors, the study compares the calculated exchange rate pass through elasticities in the three sectors. The results of the exchange rate pass through elasticities are tabulated in table 5.14. In table 5.14, it can be seen clearly that the exchange rate pass through elasticity is greatest in the services sector followed by manufacturing sector and least in the agriculture sector for the entire period under consideration. The average exchange rate pass through elasticity for the whole period is 0.53832, 0.66472 and 0.8775 for agriculture, manufacturing and services sectors respectively as shown in table 5.14.

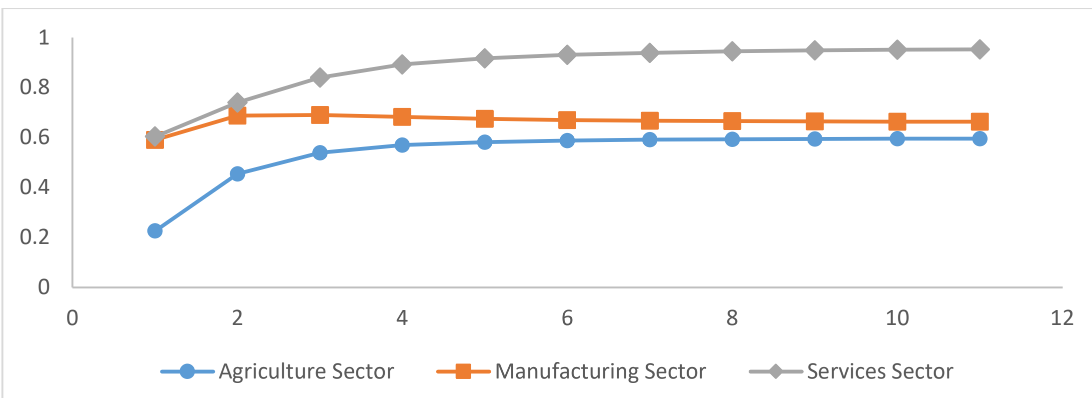
The exchange rate pass through elasticity for the agriculture, manufacturing and services sectors is also presented in figure 5.6. The middle graph in figure 5.6 represents the exchange rate pass through elasticity in the manufacturing sector while the graph above it is the exchange rate pass through elasticity graph for the services sector. Finally, the graph below that of the manufacturing sector elasticity graph represents the exchange rate pass through elasticity in the agriculture sector. These three graphs in figure 5.6 do show that exchange rate pass through is greatest in the services sector followed by the manufacturing sector. It can be concluded that the least affected sector by exchange rate movements is the agriculture sector while the most sensitive or most responsive sector is the services sector followed by the manufacturing sector.

Table 5.14: Exchange Rate Pass-through Elasticity for all Sectors

Period	Agriculture Sector	Manufacturing Sector	Services Sector
1	0.2254	0.58967	0.6031
2	0.45423	0.68634	0.7389
3	0.5389	0.68979	0.8396
4	0.56875	0.68122	0.8915
5	0.58106	0.67415	0.9164
6	0.5871	0.66956	0.9299
7	0.59045	0.66671	0.9384
8	0.59245	0.66493	0.9441
9	0.59369	0.66381	0.9479
10	0.59448	0.6631	0.9505
11	0.59499	0.66264	0.9523
Average Exchange Rate Pass Through	0.53832	0.66472	0.8775

Source: Author's computations

Figure 5.6: Exchange Rate Pass Through Elasticity for all Sectors



Source: Author's Computations

It is not surprising that the services sector is the most affected and sensitive sector to exchange rate movements. This is because the services sector is dominated by final consumer services which are sensitive to movements in exchange rate. Table 5.15 shows the composition of the services sector. The wholesale and retail sector accounts for 37.3% of the services. It should be mentioned that imports accounts for a bigger percentage in the wholesale and retail. Thus, movements in the exchange rate are easily transmitted to the service sector. Not only that, the other components of the services sector such as the tourism industry and financial sector are also sensitive to exchange rate movements. In addition, the tourism industry in Zambia is heavily dominated by foreign nationals such that external shocks such as exchange rate shocks heavily impact on the tourism industry in Zambia. Finally, the services sector accounts for a bigger portion in GDP (table 5:15). Therefore, it is expected that the services sector is the most affected sector by exchange rate movements. It is also expected for the manufacturing sectoral prices to be sensitive to exchange rate movements because the manufacturing sector depends on imported inputs which make this sector to be very sensitive to external shocks such as exchange rate.

Table 5:15: Share of Agriculture, Manufacturing and Services sectors in GDP

Sector	1994-2000	2001-2005	2006-2010	2011-2017
Agriculture, Forestry, Fishing	24%	26%	23%	10%
Manufacturing	14%	13%	12%	11%
Services	62%	61%	65%	78%
Share of Sub-Sectors in Services	1994-2000	2001-2005	2006-2010	2011-2017
Wholesale and Retail trade	36%	37%	35%	41%
Restaurants, Bars and Hotels	4%	5%	5%	3%
Transportation and storage	8%	6%	8%	9%
Communications	4%	4%	3%	5%
Financial Intermediaries and Insurance	19%	18%	15%	8%
Real Estate and Business services	13%	13%	11%	8%
Other	16%	16%	23%	26%

Note: Other=Public Admin and Defence, Education, Health and Recreation, Religious, Culture
Source: Zamstats

5.4.7.4. Variance Decomposition for all Sectors

To explore further the differences in the exchange rate pass through to agriculture, manufacturing and services sectors, the study compared the forecast error variance decomposition (FEVD) of sectoral prices in the three sectors. The FEVD may also enhance an understanding of the relative importance of exchange rate shocks in explaining the percentage variance in sectoral prices in the three sectors under consideration. The results of the forecast error variance of sectoral prices (*SPRICE*) for each sector are presented in table 5.14. In table 5.14, it can be observed that the exchange rate shocks in the services sector and manufacturing sector explain a bigger percentage of variance in sectoral prices as compared to the agriculture sectors. The computed FEVD is displayed in table 5.14 and show that exchange rate shock explains a bigger portion of variance in the sectoral prices in the manufacturing sector and services sectors. For instance, in the first period exchange rate explains 42.69%, 21.11% and 1.49% variance in sectoral prices in the services, manufacturing and agriculture sectors respectively. This shows that in the first period the most affected sector by exchange rate movements is services sector followed by the manufacturing sector and least in the agriculture sector. However, beyond period two, the exchange rate shock explains relatively almost the same variance of sectoral prices in the services and manufacturing sectors. However, table 5.14 shows clearly that exchange rate shock explains the smallest percentage variance in sectoral prices in the agriculture sector. This shows the agriculture sector is the least affected by exchange rate movements.

Table 5.14: Variance Decomposition for all Sectors

Variance Decomposition of Sectoral Price			
Period	Agriculture Sector Exchange Rate Shock	Manufacturing Sector Exchange Rate Shock	Service Sector Exchange Rate Shock
1	1.487762	21.11449	42.69222
2	7.679518	34.73177	34.33715
3	10.80312	39.50525	37.42394
4	12.09071	41.24939	39.50034
5	12.61833	41.93416	40.37832
6	12.8375	42.21545	40.73771
7	12.92951	42.33370	40.89878
8	12.96837	42.38393	40.97631
9	12.98482	42.40535	41.01412
10	12.99179	42.41450	41.03242
11	12.99475	42.41841	41.04124

Source: Author’s computations

5.5. Conclusion

In conclusion, the exchange rate pass through to sectoral prices is less than complete in the three sectors namely agriculture, manufacturing and services. However, the exchange rate pass through is very high in the services sectors. This is because the services sector is dominated by whole and retail trade which is import dependent hence its sensitivity to exchange rate changes. The sector also contains tourism and financial sector which are very sensitive to changes in exchange rate movements. After the services sector, the manufacturing sector also exhibited the high degree of exchange rate pass through among the sectors. This could be because most of the raw materials that are used in the manufacturing sector are imported. Thus, it is expected that changes in exchange rate should be able to affect a bigger percentage of the inputs in this sector. For this reason, exchange rate pass through is expected to be high in the manufacturing sector too. The findings in this study have shown that the effect of exchange rate movements on sectoral prices in the agriculture sector is least among all the sectors. This could be giving an indicator that there is less international trade in this sector. This might explain why prices in the agriculture sector are less affected by exchange rate movements.

CHAPTER 6

GLOBALISATION AND EXCHANGE RATE PASS THROUGH

6.1. Introduction

In the recent past, the impact of globalisation on the exchange rate pass through has received considerable attention by both researchers and policy makers. There is an intense debate on the impact of globalisation on the exchange rate pass through. There are two strands of literature, each giving plausible opposite outcomes. One end of the globalisation literature claims that globalisation is expected to positively impact the exchange rate pass through. The other end concludes that globalisation can produce a negative effect on the exchange rate pass through. This ambiguity entails that the debate on the impact of globalisation on the exchange rate pass through is not yet settled (Benigno and Faia, 2016).

The first strand of the globalisation literature contends that multilateral globalisation, proxied by trade openness, can be expected to have a positive effect on the exchange rate pass through. This is because the more trade has been liberalized in an economy, the larger the quantities of imports that enter the domestic economy. This means that exchange rate fluctuations impact a wider category of goods. This is especially so, if imported goods account for a bigger percentage of total goods purchased in the domestic economy. This may cause the overall price index in the domestic economy to be more responsive or sensitive to external factors such as changes in the exchange rate (Villavicencio and Mignon, 2017). Therefore, the more open an economy is, the easier it can transmit external shocks to the domestic variables through exchange rate movements. This means that the more open an economy is, the greater the degree of exchange rate pass through. In addition, the New open economy theory argues that a larger share of imports in total output means a lower substitution between foreign and domestic goods. This implies that exchange rate movements, easily pass through to domestic prices (Dornbusch, 1987; Menon, 1995; and Camp and Goldberg, 2002).

Villavicencio and Mignon (2017) examined whether multilateral and regional globalisation matter for the exchange rate pass through in three core Eurozone countries.

The study showed that globalisation indicators, such as trade openness and lower tariffs, pushed up the exchange rate pass through in some sectors. However, their study did show that regional globalisation, defined as the share of intra-EU imports in total imports, reduces the exchange rate pass through. Their finding also showed that the exchange rate pass through increases and becomes very high when the globalisation indicator (trade openness) is controlled for. Benigno and Faia (2016) applied the Dornbusch (1987) oligopolistic model to analyse the extent to which globalisation affects the exchange rate pass through. They defined globalisation as the number of foreign products in each destination market. Their finding did show that globalisation increases the exchange rate pass through (Benigno and Faia, 2016).

The second strand has argued that multilateral globalisation, measured by trade openness, may lead to higher international competition among multinational firms. This may result in pricing to market behaviour among exporters. This might reduce the exchange rate pass through (Ozkhan and Erden, 2015). Their argument is that foreign exporters may want to preserve their market share in the face of international competition in the export market. If this condition prevails, globalisation may negatively impact the exchange rate pass through to prices. Furthermore, the proponents of this strand claim that trade integration could also lower tariffs. This could lead to the reduction in the exchange rate pass through. To prove their argument, Ozkhan and Erden (2015) analysed the determinants of the exchange rate pass through for a group of countries. These were classified as developed, developing and less developed countries. Their findings showed that for all groups of countries, the coefficient of the globalisation variable was negative and significant. This implied that trade integration has a reducing effect on the exchange rate pass through. Gust, Leduc and Vigfusson, (2010) in their empirical study showed that the entry of foreign exporters in the domestic market raises the exchange rate pass through. However, when trade costs are reduced because of trade integration, the exchange rate pass through reduces.

It can be concluded from the foregoing discussion that the debate on the direction of the impact of globalisation on the exchange rate pass through is not yet settled. The empirical literature is divided on the direction of the effect of globalisation on the exchange rate pass through. One side of the literature proposes a positive effect of globalisation on the exchange rate pass through. The other side suggests a negative effect. On the other hand, the empirical literature on the effect of globalisation on the exchange rate pass through is scarce. Studies known to the author that analyse the impact of globalisation on the exchange rate pass through are Ozkhan and Erden (2015), Benigno and Faia (2016), and Villavicencio and Mignon (2017). In addition, reviewed literature by the author shows that there is no such evidence for Zambia. This creates a motivation to examine the impact of globalisation on the exchange rate pass through to consumer prices in Zambia. This study, therefore, has two objectives; first the study examines the effect of accounting for globalisation on the exchange rate passthrough to consumer price inflation in Zambia and second, the study goes beyond accounting for globalisation in the exchange rate passthrough and examines the impact of globalisation on the exchange rate passthrough to consumer price inflation in Zambia. The study defines globalisation in terms of Chinese presence (imports from China), regional globalisation or regional integration (imports from SADC countries) and multilateral globalisation defined by trade openness.

The current study contributes to the debate on the impact of globalisation on the exchange rate passthrough by examining the effect of accounting for Chinese presence, regional and multilateral globalisation on the exchange rate pass through to consumer prices in Zambia. Second this study goes beyond accounting for globalisation on the exchange rate passthrough to consumer price inflation by examining the impact of Chinese presence, regional and multilateral globalisation on the exchange rate passthrough to consumer price inflation in Zambia. It is also vital to note that, a large volume of empirical studies on the exchange rate pass through to consumer prices do not account for globalisation. Very few studies have taken globalisation into account. An example of such studies are studies by Ozkhan and Erden (2015), Benigno and Faia (2016), Villavicencio and Mignon (2017). Benigno and Faia (2016), Villavicencio and Mignon (2017) have concluded from the empirical findings that accounting for globalisation increases exchange rate pass through. If indeed accounting for the globalisation variables increase the exchange rate pass through, it could mean that the abundant mass of the empirical studies that have not accounted for the same have not correctly characterized the exchange rate pass through. In addition, even those studies that have accounted for globalisation have not examined the impact that globalisation has on the exchange rate passthrough to consumer price inflation. This necessitates the need to explore this realm to broaden literature on the exchange rate pass through. The study defines globalisation by three variables namely, Chinese presence (imports from China), regional globalisation (regional trade or imports from SADC) and multilateral globalisation (trade openness). In doing so the current study examines the impact of the Chinese presence, regional and multilateral globalisation on the exchange rate pass through to consumer prices in Zambia.

Second, by accounting for globalisation on the exchange rate pass through, this study contributes to the debate on whether the inclusion of globalisation variables in the exchange rate pass through equation affects the exchange rate pass through to consumer prices in Zambia. Such a finding is very important as a contribution to literature. This is because, it could give a signal that there could be need to adjust the exchange rate pass through models to include globalisation variables in modelling the exchange rate pass through. In addition, the study contributes to literature in Zambia in the sense that, in the same framework, the study seeks to investigate the influence of Chinese presence in Zambia. This is very important because the findings have a bearing on China-Zambia trade relations.

Third, the three studies done by Ozkhan and Erden (2015), Benigno and Faia (2016), Villavicencio and Mignon (2017) which examine the effect of globalisation on the exchange rate pass through use ordinary least squares method of estimation (OLS). The current study differs in that, it applies the VECM to examine the impact of globalisation on the exchange rate pass through to consumer price inflation in the short and long run. This is another contribution.

6.2. Methodology and Econometric Specification.

This study investigates the effect of accounting for globalisation on the exchange rate pass through to consumer price inflation. The study goes further and examines the impact of globalisation on the exchange rate pass through to consumer price inflation. To do so, the current study adopts the pricing to market framework developed in chapter 4 in the methodology section. Therefore, the model that is used in this study to account for the effect of globalisation, on the exchange rate passthrough to consumer price inflation is abstracted from the theoretical model specified in equation (9) in chapter 4 in the methodology section. It can be expressed in first difference as follows:

$$\Delta lncpi_t = \beta + \gamma\Delta lnexr_t + \rho\Delta lnoil_t + \pi\Delta gap_t + \sigma tbil_t + \mu \quad (1)$$

Where lncpi is log of consumer price index; lnexr is log of nominal exchange rate; lnoil is log of oil price in US Dollars; gap is output gap while tbil is treasury bills. Note that lnexr is the measure of the exchange rate pass through while lnoil is the proxy for foreign marginal cost. Output gap (gap) is the proxy for demand pressure. Output gap and treasury bills variables are not logged.

Since the first objective of this chapter is to investigate specifically the effect of accounting for Chinese presence (imports from China), regional globalisation (regional integration or imports from SADC) and multilateral globalisation on the exchange rate pass through to consumer prices in Zambia, the following four models were estimated.

$$\Delta lncpi_t = \beta + \gamma\Delta lnexr_t + \rho\Delta lnoil_t + \pi\Delta gap_t + \sigma\Delta tbil_t + \mu \quad (2)$$

$$\Delta lncpi_t = \beta + \gamma\Delta lnexr_t + \rho\Delta lnoil_t + \pi\Delta gap_t + \sigma\Delta tbil_t + \tau\Delta lnchina_t + \mu \quad (3)$$

$$\Delta lncpi_t = \beta + \gamma\Delta lnexr_t + \rho\Delta lnoil_t + \pi\Delta gap_t + \sigma\Delta tbil_t + \delta\Delta region_t + \mu \quad (4)$$

$$\Delta lncpi_t = \beta + \gamma\Delta lnexr_t + \rho\Delta lnoil_t + \pi\Delta gap_t + \sigma\Delta tbil_t + \Omega\Delta global + \mu \quad (6)$$

Where:

lnchina= Chinese presence in Zambia; region = regional globalisation; global = multilateral globalisation. The $\beta, \gamma, \rho, \pi, \sigma, \tau, \delta, \Omega$ are the coefficients to be estimated and γ measures the exchange rate pass through to domestic consumer prices. It is vital to mention here that there is a theoretical argument that macroeconomic variables such as exchange rate volatility, inflation volatility, money supply, average inflation (stable monetary policy) and treasury bills can influence the exchange rate passthrough (Taylor, 2000; Razafimahefa, 2012; Ozkhan and Erden, 2015; WU, 2017). New models of the exchange rate passthrough are now augmenting the pricing to market model with macroeconomic variables (Taylor, 2000; Razafimahefa, 2012; Ozkhan and Erden, 2015; WU, 2017). Broad money and the treasury bills rate are two major intermediary variables to capture the effects of the monetary policy stance and the market's response (WU, 2017). Therefore, in this study, the treasury bills variable is included in the exchange rate passthrough equation as a control variable and to capture the effects of monetary policy stance and market response.

It should be noted that equation 2 is the baseline model. Equation 3 is the model that captures Chinese presence in Zambia. Equations 4 and 5 are models of regional and multilateral globalisation respectively. To measure the effect of accounting for Chinese presence, regional and multilateral globalisation on the exchange rate pass through to consumer prices; the baseline model is estimated first followed by the other three models in sequence. The analysis proceeds as follows; if there is a change in the exchange rate pass through coefficient because of introducing Chinese presence, regional globalisation or multilateral globalisation variables respectively, it would be interpreted as the effect of accounting for Chinese presence, regional globalisation or multilateral globalisation on the exchange rate pass through to consumer prices.

To investigate the impact of globalisation on the exchange rate pass through to consumer price inflation in Zambia, all the globalisation variables namely Chinese presence (imports from China), regional globalisation (imports from SADC countries) and multilateral liberalization (trade openness) are interacted with nominal exchange rate by multiplying the globalisation variables with nominal exchange rate. In addition, imports from China and from SADC are weighted where the weight is the ratio of imports from China and SADC in total Zambia's imports respectively.

To examine the impact of globalisation on the exchange rate pass through to consumer price inflation, this study makes an extension of equation 1 above and expresses the impact of globalisation on the exchange rate passthrough to consumer price inflation as follows:

$$\Delta \mathrm{lncpi}_t = \beta + \gamma \Delta \mathrm{echina}_t + \rho \Delta \mathrm{lnoil}_t + \pi \Delta \mathrm{gap}_t + \sigma \Delta \mathrm{tbil}_t + \mu \quad (7)$$

$$\Delta \mathrm{lncpi}_t = \beta + \gamma \Delta \mathrm{eregion}_t + \rho \Delta \mathrm{lnoil}_t + \pi \Delta \mathrm{gap}_t + \sigma \Delta \mathrm{tbil}_t + \mu \quad (8)$$

$$\Delta lncpi_t = \beta + \gamma \Delta eglobal_t + \rho \Delta lnoil_t + \pi \Delta gap_t + \sigma \Delta tbil_t + \mu \qquad (9)$$

Where echina = the product of the weighted imports from China to Zambia and nominal exchange rate; eregion is the product of the weighted imports from SADC countries to Zambia and nominal exchange rate and finally, eglobal is the product of trade openness and normal exchange rate. eglobal is a proxy for multilateral trade or globalisation.

6.2.1. Econometric Model: Vector Error Correction Model (VECM)

The main objectives in this study were to examine the effect of accounting for globalisation on consumer price inflation and to examine the impact of globalisation on the exchange rate passthrough to consumer price inflation in Zambia. To achieve these two main objectives, the study employed the Vector error correction model (VECM). Recall that the VECM is a restricted Vector autoregression model (VAR). Therefore, the beginning point before arriving at the VECM is the VAR of order p given in equation 10 below.

$$X_t = \mu + A_1 X_{t-1} + A_2 X_{t-2} + \dots\dots\dots + A_p X_{t-p} + \varepsilon_t \qquad (10)$$

Where X_t is an n x 1 vector of variables $(lncpi_t, lnexr_t, lnoil_t, lngap_t, tbil_t, lnchina_t, region_t, global_t)$ for accounting for globalisation on the exchange rate pass through to consumer price inflation and $(lncpi_t, Xgrobal_t, lnoil_t, gap_t, tbil_t,)$ for examining the impact of globalisation on the exchange rate passthrough to consumer price inflation. Xglobal is a vector of globalisation variables namely echina, eregion and eglobal. All the variables in the vectors are integrated of order one written as I(1); ε_t is nx1 vector of innovations and A_1 up to A_P are *m* x *m* matrices and μ is an nx1 vector of deterministic variables. Equation (10) can be expressed in such a way that the short and long run terms are incorporated as follows.

$$\Delta X_t = \mu + \Pi X_{t-1} + \sum_{t=1}^{p-1} \Gamma_i \, \Delta X_{t-1} + \varepsilon_t \qquad (11)$$

Where $\Pi = \sum_{t=1}^{p} A_i - I$, $\Gamma_i = \sum_{t=1}^{p} A_j$ and ΠX_{t-1} captures the long run relationship among variables in X_t while $\Gamma_i \, \Delta X_{t-1}$ captures the short run relationship among variables in X_t. If variables in X_t are cointegrated, ΠX_{t-1} follows the I(0) process. Thus, equation (11) can be expressed in the error correction representation form as follows.

$$\Delta X_t = \mu + \alpha ecm_{t-1} + \sum_{t=1}^{p-1} \Gamma_i \Delta X_{t-1} + \varepsilon_t \quad (12)$$

Where $\alpha ecm_{t-1} = \beta' X_{t-1}$ is the error correction term representing long term relationships among the variables in X.

It should be noted that for error correction models, the cointegration test is a requirement. Johansen and Juselius (1990) cointegration test is a common test for cointegration in empirical studies. In this study the Johansen and Juselius (1990) cointegration test was adopted. Johansen and Juselius (1990) proposed two different likelihood ratio tests for cointegration namely the trace statistic and the maximum statistic. These are specified as follows.

$$Q_{trace}(r) = -T \sum_{i=r+1}^{n} \mathrm{In}(1 - \lambda_i) \quad (13)$$

$$Q_{max}(r, r+1) = -\mathrm{T}\ \mathrm{In}(1 - \lambda_{r+1}) \quad (14)$$

Where T is the sample size; λ_i is the estimated value of the i^{th} eigenvalue from the rank Π matrix. The larger the value of the eigenvalue λ_i the larger the $In(1 - \lambda_i)$ and the larger the test statistic. Each eigenvalue λ_i is associated with a different cointegrating vector. The trace test statistic in equation (13) tests the null hypothesis of *r* cointegrating vectors against the alternative that there are *n* number of cointegrating vectors. On the other hand, the maximum test statistic in equation (14) tests the null hypothesis of r cointegrating vectors against the alternative of (*r+1*) cointegrating vectors. If the test statistic from either the Q_{trace} or the Q_{max} is greater than the critical values provided by Johansen's table or Osteward-Lenaum (1992), the null hypothesis in both Q_{trace} or Q_{max} is rejected respectively which signifies the presence of cointegration at 5% level of significance.

The choice of the optimal lag length in both the VAR and VECM that guarantees residuals that are serially uncorrelated, can be done by information criteria such as the Akaike Information Criterion (AIC), Hannan and Quinn Criterion (HQ) and Final Prediction Error (FPE) information criterion. The inclusion of deterministic term in the VECM is empirical and thus, depends on the behaviour of data. To determine the adequacy of the estimated VECM or the VAR model, various diagnostic tests such as serial correlation, heteroscedasticity, normality, and stability tests are done after estimation. Finally, since the VECM is estimated upon establishing the order of integration of variables and co-integration among variables, unit root tests are done to establish the order of integration followed by Johansen test for co-integration.

6.3. Type of Data, Data Sources and Variable Description.

This study employed monthly data from January 2006 to December 2017. The data on the consumer price index (CPI) and exchange rates were obtained from the International Financial Statistics (IFS). The data on the Gross Domestic Product (GDP), trade openness and oil prices were obtained from the World Bank Development Indicators and the World Bank commodity Prices (World Bank pink sheet) respectively. The data on the three months treasury bills were obtained from the Bank of Zambia. The data on the imports from China, Southern African Development Community (SADC) and total imports were obtained from the Zambia Statistical Agency.

The consumer price index (lncpi) is calculated as the weighted average of prices of the basket of imported and domestically produced goods which are consumed in the domestic economy. It represents the aggregate consumer price level in the economy. Changes in the consumer price index from the reference year (base year) represents inflation. The base year for the consumer price index is in this study is 2010. The nominal exchange rate variable (lnexr) is measured as the units of the Zambia Kwacha over the units of US Dollars. It is a measure of the exchange rate pass through to domestic prices. The oil price variable (lnoil) is measured in US Dollars per barrel. It is a proxy for marginal cost facing the foreign exporters.

Output gap (lngap); a measure of demand pressure facing foreign firms in the export market is calculated using HP filter. Monthly GDP data is not available. Therefore, annual GDP data were decomposed into a monthly series using the Quadratic method. Thereafter, the Hodrick and Prescott (1997) filter also called the HP filter method as explained in chapter four was used to generate the output gap.

Finally, there are three globalisation variables in this study namely the Chinese presence (Chinese imports), representing bilateral trade, regional and the multilateral globalisation. These were used to account for the effect of globalisation on the exchange rate passthrough to consumer price inflation. The Chinese presence variable (lnchina) is measured as imports from China as a ratio of total imports in Zambia. On the other hand, regional globalisation (region) is measured as total imports from SADC countries as a ratio of total imports in Zambia. Finally, the multilateral globalisation variable (global) is proxied by trade openness which is measured as total exports plus total imports in Zambia as ratio of GDP. In like manner, trade openness variable which was used as the proxy for multilateral globalisation was also decomposed into monthly series using the quadratic method. This is because data on GDP; the denominator for the sum of exports and imports are not available on monthly frequency. Trade openness was chosen as a measure of multilateral globalisation because, in several empirical studies, it is taken as a proxy for multilateral trade liberalization. For instance, Ozkhan and Erden (2015), Benigno and Faia (2016) and Villavicencio and Mignon (2017), used trade openness as a proxy for multilateral globalisation in their respective studies on globalisation and exchange rate pass through. The variables for measuring the impact of globalisation on the exchange rate passthrough to consumer price inflation are echina, eregion and eglobal. These were obtained as a product with nominal exchange rate respectively. echina, eregion and global measure the impact of Chinese presence, regional and multilateral globalisation on the exchange rate passthrough to consumer price inflation respectively. echina and eregion are products of weighted imports from China and SADC countries with nominal exchange rate respectively while eglobal is the product of trade openness (global) and nominal exchange rate.

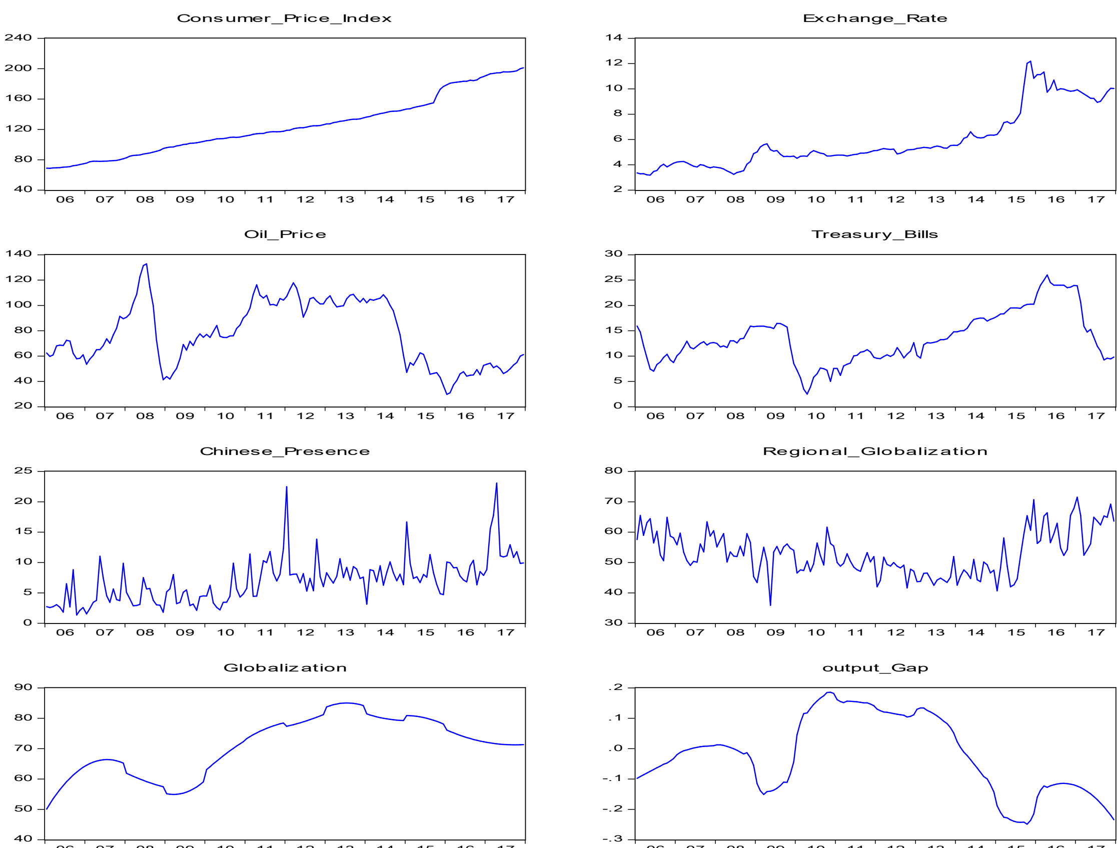
6.4. Results and Estimation for Globalisation

This section of the chapter presents results and estimation of the VECMs for the globalisation models.

6.4.1. Descriptive Analysis.

The graphical examination of the variables in figure 6.1 shows that the consumer price index displays an upward trend for the entire period. The exchange rate variable shows a downward trend from 2007 to 2008. This depicts the appreciation of the Kwacha. Beyond 2008 up to 2015 exchange rate trends upwards indicating depreciation of the Kwacha of course with minor appreciations. The depreciation of the Kwacha could be attributed to the reduction in the price of copper during this period. The oil price variable shows a sharp rise in 2006 but declines sharply in 2007. Beyond 2007 oil price rises steadily and declines beyond 2014. Treasury bills display a steady rise from 2006 to 2015 but declined sharply in 2009. The Chinese presence variable shows a cyclic pattern for the entire period. The regional globalisation variable shows downward swings from 2006 to 2016. After 2016 the regional globalisation variable displays an upward swing for the rest of the period. The globalisation and output gap variables show irregular swings for the entire period.

Figure 6.1: Graphical Presentation of Level Series of the Variables



Source: Author’s computations

The summary statistics displayed in table 6.1 show that the consumer price index (CPI) and oil price (Oil) are the most volatile of all the variables based on standard deviation. Treasury bills rate show more variability than exchange rate. All the variables are not normally distributed as confirmed by their respective skewness, kurtosis and the Jarque Bera statistics. This is expected for financial and price data. This is consistent with literature. Most financial and price data exhibit non normal distribution because they are generated from distributions which are characterised by fat tails (Chipili, 2010; Koay and Kwek, 2006; Hassan, 2009).

Table 6.1: Summary Statistics of Level Data-January-2006 to December-2017

Variable	cpi	exr	oil	gap	tbils	china	region	global
Mean	124.29	5.93	77.41	-0.02	13.53	7.01	52.99	71.03
Std. Dev.	38.13	2.29	24.92	0.13	5.03	3.70	7.20	9.39
Kewness	0.47	1.10	0.09	-0.02	0.51	1.32	0.41	-0.37
Kurtosis	2.22	3.02	1.79	1.83	2.83	6.44	2.57	1.94
J-B	8.83	28.91	8.98	8.25	6.37	112.48	5.11	9.97
P-Value	0.01	0.00	0.01	0.02	0.04	0.00	0.08	0.01
Obs	144	144	144	144	144	144	144	144

Note: cpi=Consumer price index; exr=exchange rate; oil=oil price in US Dollar per barrel; gap=output gap; tbills=three months treasury bills; china=Imports from China as% of Total Zambian Imports; region=imports from SADC countries as % of Total Zambia Imports; global=(imports plus exports) as a ration of GDP; J-B = Jarque-Bera; Std. Dev=Standard Deviation; Obs=observations

Source: Author's computations

6.4.2. Unit Root Test Results.

Unit root tests were conducted to establish the order of integration of the variables. Two-unit root tests were conducted namely, the Augmeted Dickey-Fuller (ADF) and the Philip Peron (PP) unit root tests. The null hypothesis of unit root is rejected if the calculated ADF and PP statistics are greater than their respective critical values. Table 6.2 displays the unit root tests results. The results show that all the variables are stationary at first difference since for all the variables, the ADF and PP test statistics are greater than the critical values at 1% and 5% respectively. This means that all the variables are integrated of order one.

Table 6.2: Unit Root Test

Variable	Level ADF	Level PP	First Difference ADF	First Difference PP	Mackinnon Critical Values: Critical value	Critical value
	t-stat	t-stat	t-stat	t-stat	1% Level	5% Level
lncpi	-0.6563	-0.4238	-6.8671*	-6.9429*	-3.4768	-2.8818
lnexr	-0.9394	-0.7606	-8.7605*	-8.7388*	-3.4768	-2.8818
lnoil	-2.4064	-2.1184	-7.7645*	-7.8382*	-3.4768	-2.8818
gap	-1.4538	-1.1680	-5.0825*	-4.3389*	-3.4768	-2.8818
tbil	-2.5106	-2.2499	-8.7397*	-8.6705*	-3.4768	-2.8818
lnchina	-2.3330	-1.0376	-9.0565*	-40.399*	-3.4768	-2.8818
echina	-1.1004	-2.5867	-8.8890*	-21.787	-3.4768	-2.8818
region	-2.2519	-0.2295	-12.788*	-24.861*	-3.4768	-2.8818
eregion	-0.6494	-0.6705	-5.4660*	-9.9977*	-3.4768	-2.8818
global	-2.0219	-1.6762	-5.3202*	-4.6387*	-3.4768	-2.8818
egrobal	-1.2314	-0.9886	-5.0113*	-7.8274*	-3.4768	-2.8818

* and ** denote variable is integrated at 1% and 5% respectively

Note: lncpi=log of consumer price index; lnexr=log of nominal exchange rate; lnoil=log of oil price in US Dollar per barrel; gap=output gap; tbils=three months treasury bills; lnchina=imports from China % of total imports in Zambia representing Chinese presence in Zambia; region=imports from SADC as % of total imports in Zambia representing regional globalisation; global=trade openness representing multilateral globalisation; echina=an interaction of exchange rate and imports from China; eregion=an interaction of imports from SADC and exchange rate; eglobal=an interaction of trade openness and exchange rate.

Source: Author's computations

6.4.3. Optimal Lag Selection Criteria for Globalisation Models

Table 6.3 displays the optimal lag length for all the models that account for globalisation in the exchange rate passthrough to consumer prices in Zambia. The information criteria namely the FPE, AIC, SIC and HQ indicated an optimal lag length of one for all the models of globalisation that examine the effect of accounting for globalisation on the exchange rate passthrough to consumer price inflation. To this effect all the models that account for globalisation in the exchange rate passthrough to consumer price inflation were estimated with lag one in the VECM setting.

Table 6.3: Optimal Lag for Accounting for Globalisation Models

Optimal Lag for Baseline Model Endogenous variables: lncpi lnexr lnoil gap tbil						
Lag	LogL	LR	FPE	AIC	SC	HQ
0	-16.683	NA	4.46e-0	1.334	2.519	1.5947
1	1.4294	30.382	3.94e-0*	1.198*	2.123*	1.4997*
2	7.5110	8.6320	7.91e-0	1.838	3.5033	2.3808
3	30.641	26.861*	5.81e-0	1.378	3.7834	2.1621
Optimal Lag for Accounting for Chinese Presence Model Endogenous variables: lncpi lnexr lnoil gap tbil lnchina						
Lag	LogL	LR	FPE	AIC	SC	HQ
0	-170.70	NA	0.834	11.17	11.54	11.290
1	-55.563	187.10*	0.002*	4.973*	6.072*	5.337*
2	-43.137	17.087	0.002	5.196	7.028	5.8030
Optimal Lag for Accounting for Regional Globalisation Presence Model Endogenous variables: lncpi lnexr lnoil gap tbil region						
Lag	LogL	LR	FPE	AIC	SC	HQ
0	-310.997	NA	5358.55	19.937	20.304	20.059
1	-195.475	187.723*	10.844*	13.717*	14.816*	14.082*
2	-180.388	20.7455	12.2950	13.7742	15.606	14.381
Optimal Lag for Accounting for Multilateral Globalisation Model Endogenous variables: lncpi lnexr lnoil gap tbil global						
Endogenous variables:						
Lag	LogL	LR	FPE	AIC	SC	HQ
0	-29.252	NA	9.39E-0	2.0782	2.2615	2.139
1	-7.9157	36.00*	6.80e-0*	1.7447*	2.1660*	2.0484*
2	6.0664	20.0992	8.12E-0	1.8708	3.5198	2.4174

Source: Author's computations

Table 6.4 displays the optimal lag length for all the models that examine the impact of globalisation on the exchange rate passthrough to consumer prices in Zambia. The information criteria namely the FPE, AIC, SIC and HQ indicated an optimal lag of two. Therefore, all the models that examine the impact of globalisation on the exchange rate passthrough to consumer price inflation were estimated with two lags in the VECM framework.

Table 6.4: Optimal lag: The Impact of Globalisation Models

Lag	LogL	LR	FPE	AIC	SC	HQ
Lag Length Determination for the Impact of Chinese Presence Model endogenous variables: lncpi echina lnexr lnoil gap tbil						
Lag	LogL	LR	FPE	AIC	SC	HQ
0	-77.13	NA	0.00	1.21	1.3100	1.25
1	977.09	2015.4	0.00	-13.930	-13.290	-13.67
2	1074.83	63.240*	1.99*	-15.080*	-13.820*	-14.52*
Lag Length Determination for the Impact of Regional Globalisation Model Endogenous variables: lncpi eregion lnoil gap tbil						
Lag	LogL	LR	FPE	AIC	SC	HQ
0	-1.24	NA	0.00	0.0900	0.2000	0.140
1	1125.13	2153.4	0.00	-16.100	-15.460	-15.84
2	1222.16	178.35	2.00*	-17.400*	-15.990*	-16.69*
Lag Length Determination for the Impact of Multilateral Globalisation endogenous variables: lncpi global lnoil gap tbil						
Lag	LogL	LR	FPE	AIC	SC	HQ
0	161.83	NA	0.00	-2.310	-2.2000	-2.260
1	1383.05	2334.6	0.00	-19.90	-19.260	-19.64
2	1500.90	64.80*	3.66*	-21.38*	-20.090*	-20.79*

Source: Author’s computation

6.5.1. Co-integration Test Results for Accounting for Globalisation Model

Table 6.5, 6.6, 6.7 and 6.8 display the cointegration tests for all the four models namely the baseline, Chinese presence, regional and the multilateral globalisation respectively. The co-integration test results showed that the baseline and globalisation models have one co-integrating equation. On the other hand, the Chinese presence and the regional globalisation models exhibit two co-integrating equations. This is because the maximum Eigen statistic and the Trace statistic are greater than their respective critical values at 5% in all cases. This means that there is co-integration among variables for each model. It should be noted here that, though the Johansen co-integration test showed that the baseline and multilateral globalisation models have one co-integrating equation while the Chinese presence and regional globalisation models have two co-integrating equations, all the models were estimated with one co-integrating equation for easy comparison among the models.

Table 6.5: Johansen Cointegration Test for Baseline Model

Cointegration Test [Trend assumption: Linear deterministic trend (in First Difference-1 lag)]

Unrestricted Cointegration Rank Test (Trace)

Ho	Ha	Egeinvalue	Trace Statistic	5% Critical value	Probability
None*	At most 1	0.283058	92.07928	69.81889	0.0003
At most 1	At most 2	0.137327	44.82735	47.85613	0.0937
At most 2	At most 3	0.092964	23.85123	29.79707	0.2068
At most 3	At most 4	0.067900	9.995807	15.49471	0.2811
At most 4	At most 5	7.81E-05	0.011084	3.841466	0.9159

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Ho	Ha	Eigenvalue	Max-Egein Statistic	5% Critical value	Probability
None*	At most 1	0.283058	47.25193	33.87687	0.0007
At most 1	At most 2	0.137327	20.97612	27.58434	0.2777
At most 2	At most 3	0.092964	13.85542	21.13162	0.377
At most 3	At most 4	0.0679	9.984723	14.2646	0.2129
At most 4	At most 5	7.81E-05	0.011084	3.841466	0.9159

* and ** denotes rejection of the hypothesis at the 0.05 and 0.10 level respectively.
Source: Author’s computation

Table 6.6: Johansen Co-integration Test for Accounting for Chinese Presence

Co-integration Test [Trend assumption: Linear deterministic trend (in First Difference-2 lags)]

Unrestricted Co-integration Rank Test (Trace)

Ho	Ha	Eigenvalue	Trace Statistic	5% Critical value	Probability
None*	At most 1	0.326582	142.5060	95.75366	0.0000
At most 1*	At most 2	0.249968	86.36081	69.81889	0.0014
At most 2	At most 3	0.134903	45.51602	47.85613	0.0816
At most 3	At most 4	0.099493	24.93835	29.79707	0.1637
At most 4	At most 5	0.06821	10.05708	15.49471	0.2764

Unrestricted Co-integration Rank Test (Maximum Eigenvalue)

Ho	Ha	Eigenvalue	Max-Eigen Statistic	5% Critical value	Probability
None*	At most 1	0.326582	56.1452	40.07757	0.0004
At most 1*	At most 2	0.249968	40.84479	33.87687	0.0063
At most 2	At most 3	0.134903	20.57767	27.58434	0.3026
At most 3	At most 4	0.099493	14.88127	21.13162	0.2973
At most 4	At most 5	0.068210	10.03194	14.2646	0.2098

* and ** denotes rejection of the hypothesis at the 0.05 and 0.10 level respectively.
Source: Author’s computation

Table 6.7: Co-integration Test for Accounting for Regional Globalisation

Co-integration Test [Trend assumption: Linear deterministic trend (in First Difference-2 lags)]
Unrestricted Co-integration Rank Test (Trace)

Ho	Ha	Eigenvalue	Trace Statistic	5% Critical value	Probability
None*	At most 1	0.251171	113.7775	95.75366	0.0016
At most 1*	At most 2	0.214824	72.99406	69.81889	0.0273
At most 2	At most 3	0.133807	38.89353	47.85613	0.2645
At most 3	At most 4	0.080775	18.63931	29.79707	0.5190
At most 4	At most 5	0.04678	6.763653	15.49471	0.6053
Unrestricted Co-integration Rank Test (Maximum Eigenvalue)					
Ho	Ha	Egeinvalue	Max-Egein Statistic	5% Critical value	Probability
None*	At most 1	0.251171	40.78345	40.07757	0.0416
At most 1*	At most 2	0.214824	34.10052	33.87687	0.0470
At most 2	At most 3	0.133807	20.25422	27.58434	0.3238
At most 3	At most 4	0.080775	11.87566	21.13162	0.5600
At most 4	At most 5	0.046780	6.755227	14.26460	0.5185

* and ** denotes rejection of the hypothesis at the 0.05 and 0.10 level respectively.
Source: Author's computation

Table 6.8: Co-integration Test for Accounting for Multilateral Globalisation

Co-integration Test [Trend assumption: Linear deterministic trend (in First Difference-1 lag)]
Unrestricted Co-integration Rank Test (Trace)

Ho	Ha	Eigenvalue	Trace Statistic	5% Critical value	Probability
None*	At most 1	0.295988	108.9600	95.75366	0.0045
At most 1	At most 2	0.165510	59.12363	69.81889	0.2633
At most 2	At most 3	0.103619	33.43095	47.85613	0.5331
At most 3	At most 4	0.075656	17.89765	29.79707	0.5737
At most 4	At most 5	0.044872	6.726352	15.49471	0.6097
Unrestricted Co-integration Rank Test (Maximum Eigenvalue)					
Ho	Ha	Eigenvalue	Max-Eigen Statistic	5% Critical value	Probability
None*	At most 1	0.295988	49.83639	40.07757	0.0030
At most 1	At most 2	0.16551	25.69268	33.87687	0.3398
At most 2	At most 3	0.103619	15.53330	27.58434	0.7050
At most 3	At most 4	0.075656	11.17130	21.13162	0.6302
At most 4	At most 5	0.044872	6.519179	14.26460	0.5475

* and ** denotes rejection of the hypothesis at the 0.05 and 0.10 level respectively.
Source: Author's computation

6.5.2. Co-integration Tests Results for the Impact of Globalisation Model

The co-integration test results displayed in table 6.9, 6.10 and 6.11 show that the impact of globalisation on exchange rate pass through to consumer inflation models have one co-integrating equation respectively. This is because the maximum Eigen statistic and the Trace statistic are greater than their respective critical values at 5% in all cases.

Table 6.9: Co-integration Test: The Impact of Chinese Presence

Co-integration Test [Trend assumption: Linear deterministic trend (In First Difference-2 lags)]

Unrestricted Co-integration Rank Test (Trace)

Ho	Ha	Eigenvalue	Statistic	5% Critical Value	Probability
None *	AT most 1	0.25441	87.2476	69.81889	0.0011
At most 1	AT most 2	0.169295	45.85295	47.85613	0.0762
At most 2	AT most 3	0.083355	19.70015	29.79707	0.4434
At most 3	AT most 4	0.051317	7.428283	15.49471	0.5284
At most 4	AT most 5	2.36E-06	0.000333	3.841466	0.9875

Unrestricted Co-integration Rank Test (Maximum Eigenvalue)

Ho	Ha	Eigenvalue	Statistic	5% Critical Value	Probability
None *	AT most 1	0.25441	41.39465	33.87687	0.0053
At most 1	AT most 2	0.169295	26.15279	27.58434	0.0753
At most 2	AT most 3	0.083355	12.27187	21.13162	0.5211
At most 3	AT most 4	0.051317	7.42795	14.2646	0.4398
At most 4	AT most 5	2.36E-06	0.000333	3.841466	0.9875

* and ** denotes rejection of the hypothesis at the 0.05 and 0.10 level respectively.
Source: Author's computation

Table 6.10: Co-integration Test: The Impact of Regional Globalisation

Co-integration Test [Trend assumption: Linear deterministic trend (In First Difference-2 lags)]

Unrestricted Co-integration Rank Test (Trace)

Ho	Ha	Eigenvalue	Statistic	5% Critical Value	Probability
None *	AT most 1	0.232892	81.56576	69.81889	0.0043
At most 1	AT most 2	0.149747	44.18273	47.85613	0.1062
At most 2	AT most 3	0.09586	21.30957	29.79707	0.3386
At most 3	AT most 4	0.048976	7.100915	15.49471	0.5659
At most 4	AT most 5	0.000145	0.020404	3.841466	0.8863

Table 6.10 Cont/d

Unrestricted Co-integration Rank Test (Maximum Eigenvalue)

Ho	Ha	Eigenvalue	Statistic	5% Critical Value	Probability
None *	AT most 1	0.232892	37.38303	33.87687	0.0183
At most 1	AT most 2	0.149747	22.87316	27.58434	0.1790
At most 2	AT most 3	0.095860	14.20865	21.13162	0.3482
At most 3	AT most 4	0.048976	7.080511	14.26460	0.4797
At most 4	AT most 5	0.000145	0.020404	3.841466	0.8863

* and ** denotes rejection of the hypothesis at the 0.05 and 0.10 level respectively.
Source: Author's computation

Table 6.11: Co-integration Test: The Impact of Multilateral Globalisation

Co-integration Test [Trend assumption: Linear deterministic trend (In First Difference-2 lags)]

Unrestricted Co-integration Rank Test (Trace)

Ho	Ha	Eigenvalue	Statistic	Critical Value	Probability
None *	AT most 1	0.229612	74.57356	69.81889	0.0198
At most 1	AT most 2	0.137434	37.79214	47.85613	0.3111
At most 2	AT most 3	0.072299	16.94625	29.79707	0.644
At most 3	AT most 4	0.044137	6.364855	15.49471	0.6524
At most 4	AT most 5	2.80E-07	3.94E-05	3.841466	0.9968

Unrestricted Co-integration Rank Test (Maximum Eigenvalue)

Ho	Ha	Eigenvalue	Statistic	Critical Value	Probability
None *	AT most 1	0.229612	36.78142	33.87687	0.0219
At most 1	AT most 2	0.137434	20.84589	27.58434	0.2856
At most 2	AT most 3	0.072299	10.58140	21.13162	0.6888
At most 3	AT most 4	0.044137	6.364816	14.2646	0.5669
At most 4	AT most 5	2.80E-07	3.94E-05	3.841466	0.9968

* and ** denotes rejection of the hypothesis at the 0.05 and 0.10 level respectively.
Source: Author's computation

6.5.3. VECM Results for Accounting for Globalisation in ERPT

6.5.3.1. Short run Results for Baseline VECM.

Table 6.12 presents the short run results of the exchange rate pass through to consumer prices from the baseline VECM model. The results presented in table 6.12 show that the exchange rate pass through variable is significant at 1% level. The coefficient of the exchange rate pass through is 0.055. This result means that exchange rate changes significantly influence consumer price inflation in the short run. When the exchange rate increases by 10% in a month, 0.55% of that increase will be passed across to domestic consumer price inflation. As can be observed from the results, the exchange rate pass through in the short run is incomplete in Zambia. This confirms that foreign exporters practice pricing to market in marketing their goods. In other words, foreign exporters absorb part of exchange rate movements into their mark-up to stabilize prices in the export market. This allows them to maintain their market share. This makes exchange rate pass through to be incomplete.

Table 6.12: Results of Short Run Equation for Baseline VECM Model

Target Variable: Consumer Price Index		
Variable	Coef.	Std. Err.
Cointegration Equation (1)	-0.02215	0.00949
Consumer Price Index (-1)	0.314**	0.07732
Lag of Exchange Rate (-1)	0.0551*	0.01315
Lag of Oil Price (-1)	-0.00451*	0.00673
Lag of Output Gap (-1)	0.01071	0.03486
Lag of treasury Bills (-1)	-0.00011	0.00422
Constant	0.0046*	0.00074
R-squared: 0.704; Chi2 (321.34-Prob:0.00)		

* and ** show significance at 1% and 5% respectively.
Source: Author’s computation

6.5.3.2. Long run Results for Baseline VECM.

Table 6.13 presents the results of the co-integrating equation of the long run equation of the baseline VECM. Recall that in interpreting the co-integrating equation, signs of the coefficients must be reversed. The co-integration equation results tabulated in table 6.13 indicate that the exchange rate pass through is significantly positive at 1% in the long run. The coefficient of the exchange rate pass through is 1.064. This shows that the exchange rate pass through is complete in the long run. This implies that when the Kwacha depreciates by 100%, domestic price inflation will also increase by 100% in the long run. This means there is a one-to-one relationship between exchange rate movements and consumer prices.

Table 6.13: Results for Long Run Equation for Baseline VECM Model

Target Variable: Consumer Price Index

Johansen normalization restriction imposed on Consumer Price Index

Variable	Coef.	Std. Err.
Exchange Rate	-1.06405*	0.02901
Oil Price	-0.37084*	0.03651
Output Gap	0.14872	0.11224
Treasury bills	0.06553*	0.02813
Constant	-1.53026	

R-squared: 0.7042; Chi2 (321.34-Prob:0.00)

* and ** show significance at 1% and 5% respectively.
Source: Author's computation

6.5.2.3. Accounting for Globalisation in Exchange Rate Passthrough

To examine the effect of accounting for globalisation on the exchange rate pass through, this study employed three variables of globalisation. These are the Chinese presence computed as imports from China over total imports; SADC presence as indicator of regional globalisation computed as imports from SADC countries over total imports and multilateral globalisation (trade openness). This is measured as total exports and imports as a ratio of GDP. The study estimated the VECM models by introducing these variables one by one in the baseline VECM model. The variables of globalisation could not be introduced in the exchange rate passthrough equation all at once for robustness check. But also introducing the globalisation variables all at once could have introduced multi-collinearity. First, the baseline VECM was estimated. Second, Chinese presence variable was introduced, followed by regional globalisation and last the multilateral globalisation variable. The coefficient of the exchange rate passthrough of the baseline VECM was compared with the coefficients of the exchange rate passthrough of the globalisation variables. Any change in the exchange rate passthrough due to the introduction of the globalisation variables was interpreted as the effect of accounting for globalisation on the exchange rate passthrough to consumer price inflation. Tables 6.14 and table 6.15 show the short and long run results for all the three models of globalisation respectively.

Table 6.14: VECM Short Run Results for Accounting for Globalisation

Target Variable is Consumer Price Index			
Variable	Chinese Presence Coefficient	Regional Globalisation Coefficient	Multilateral Globalisation Coefficient
Cointegration Equation (1)	-0.00736	-0.02275**	-0.02104**
	(0.00619)	(0.00893)	(0.00921)
Consumer Price Index (-1)	0.34006*	0.30952*	0.30445*
	(0.07984)	(0.07703)	(0.07794)
Exchange Rate (-1)	0.06249*	0.05481*	0.05729*
	(0.01257)	(0.01269)	(0.01304)
Oil Price (-1)	-0.00061	-0.00614	-0.00479
	(0.00637)	(0.00664)	(0.00679)
Output gap (-1)	0.01637	0.00961	0.01929
	(0.03583)	(0.03449)	(0.03576)
Treasury Bills (-1)	0.00022	-0.00081	-0.00022
	(0.00433)	(0.00416)	(0.00423)
Chinese Presence (-1)	-0.00173*		
	(0.00125)	-	-
Regional Globalization (-1)]	-	0.0075*	-
		(0.00486)	
Multilateral Globalisation (-1)	-	-	-0.05524*
			(0.06462)
Constant	0.00415*	0.00467*	0.00489*
	(0.00071)	(0.00074)	(0.00077)

* and ** show significance at 1% and 5% respectively.
Note: Standard errors are in parethesis and (-1) is lag 1.
Source: Author's computation

Results tabulated in table 6.14 and table 6.15 show that for the Chinese presence variable, the exchange rate pass through coefficient for the short and long run are 0.062 and 1.326 respectively. These are positively significant at the 1% level both in the short and long run. The results imply that accounting Chinese presence in the exchange rate pass through to consumer prices increases the exchange rate pass through. The exchange rate pass through coefficient for the short and long run for the multilateral globalisation are 0.057 and 1.127 respectively. These results imply that accounting for multilateral globalisation significantly increases the exchange rate pass through to consumer prices at 1% level in both the short and long run. Finally, table 6.14 and table 6.15 also show the results for regional globalisation VECM both in the short and long run respectively. For regional globalisation, the exchange rate pass through coefficients in the short and long run are 0.055 and 1.062 respectively. The coefficients are significant at the 1% level in both the short and long run. It should be noted that the exchange rate pass through for all the globalisation models is complete in the long run but incomplete in the short run when globalisation is accounted for.

Table 6.15: VECM Long Run Results for Accounting for Globalisation

Target Variable is Consumer Price Index (lncpi) Johansen normalization restriction imposed on lncpi			
Variable	Chinese Presence Coefficient	Regional Globalisation Coefficient	Multilateral Globalisation Coefficient
Exchange Rate	-1.32641*	-1.06208*	-1.12695*
	(0.06035)	(0.03031)	(0.04736)
Oil Price	-0.48655*	-0.39967*	-0.42044*
	(0.05596)	(0.04048)	(0.04282)
Output gap	-0.010190	0.105940	0.100240
	(0.15692)	(0.11758)	(0.11655)
Treasury Bills	0.037280	0.047160	0.037580
	(0.03943)	(0.02941)	(0.03072)
Chinese Presence	0.20446*	-	-
	(0.03466)		
Regional Globalisation	-	-0.14794***	-
		(0.07684)	
Multilateral Globalisation	-	-	0.25386***
			(0.15318)

*, ** and ***show significance at 1%, 5% and 10% respectively.
Note: Figures in parenthesis are standard errors.
Source: Author's computation

6.5.2.3. Accounting for Globalisation in the Exchange Rate Pass Through-Comparative Analysis.

To investigate the effect of accounting for globalisation on the exchange rate pass through to consumer prices in Zambia, the exchange rate pass through coefficients from the baseline and the globalisation VECMs are compared and analysed. These are shown in table 6.16. Table 6.16 shows the exchange rate pass through coefficients for the short and long run for the baseline and globalisation VECMs. The short and long run results for the baseline and globalisation models are tabulated in the second and third columns of table 6.16 respectively.

Table 6.16 shows that the short run exchange rate pass through coefficient from the baseline VECM is 0.055. This is significant at the 1% level. When the Chinese presence variable is introduced in the equation, the exchange rate pass through coefficient increases to 0.062. This is also significant at the 1% level in the short run. This is shown in the fourth row of table 6.16. This result means that Chinese presence significantly increases the exchange rate pass through to domestic consumer price inflation by 13.41% in the short run.

The fifth row of table 6.16 shows the short run exchange rate pass through coefficient when the regional globalisation variable is introduced. The regional globalisation coefficient is 0.054. It is significant at 1% level. This coefficient is slightly lower than the baseline exchange rate pass through coefficient of 0.055. This means that, in the short run, regional globalisation significantly reduces the exchange rate pass through from 0.055 to 0.054. In other words, regional globalisation reduces the exchange rate pass through by 1.7%,

The sixth row of table 6.16 displays the short run exchange rate pass through to consumer prices for multilateral globalisation. The short run exchange rate pass through coefficient for multilateral globalisation is 0.057. This is significant at the 1% level. It is higher than the short run exchange rate pass through coefficient of the baseline model. This means that when the multilateral globalisation variable is introduced in the baseline equation, the short run exchange rate pass through slightly increases. The increase in the exchange rate pass through is about 4%.

The findings in this study show that accounting for Chinese presence and multilateral globalisation in the baseline model increase the exchange rate pass through to consumer prices in the short run. The results have also shown that accounting for regional globalisation has a lower effect on the exchange rate pass through to consumer price inflation in the short run.

Table 6.16: Accounting for Globalisation and ERPT Coefficients

Model	Short run coefficient	Long run Coefficient
Baseline	0.05510*	-1.06405*
	(-4.1900)	(-36.670)
Chinese Presence	0.06249*	-1.32641*
	(-4.9700)	(-21.980)
Regional Globalisation	0.05418*	-1.06208*
	(-4.3200)	(-35.040)
Multilateral Globalisation	0.05700*	-1.12695*
	(-4.3900)	(-35.040)

* and ** show significance at 1% and 5% respectively.
Note: Standard Errors are in parenthesis
Source: Author's computation

Table 6.16 also displays the long run exchange rate pass through results for the baseline and globalisation models. Table 6.16 shows that the long run exchange rate pass through coefficient is 1.064 for the baseline model. This is significantly positive at the 1% level. When Chinese presence variable is accounted for in the baseline model, the exchange rate pass through coefficient increases from 1.064 to 1.326. This is shown in the fourth row and column three of table 6.16. It is clear that in the long run, Chinese presence significantly increases the exchange rate pass through to consumer price inflation by 24.66%.

The study also shows the long run exchange rate pass through coefficient when the regional globalisation variable is accounted for. The regional globalisation coefficient is estimated at 1.062. It is significant at the 1% level. The long run exchange rate pass through coefficient for regional globalisation is slightly lower than the baseline exchange rate pass through coefficient of 1.064. Thus, in the long run, when regional globalisation is accounted for, exchange rate pass through significantly reduces from 1.064 to 1.062. In other words, in the long run, accounting for regional globalisation reduces the exchange rate pass through by about 0.19 %.

Table 6.16 also shows the exchange rate pass through for multilateral globalisation. The long run exchange rate pass through coefficient for multilateral globalisation is 1.127. This is significant at the 1% level. It is also higher than the long run exchange rate pass through coefficient of the baseline model. This result means that accounting for multilateral globalisation increases the long run exchange rate pass through. The increase in the exchange rate pass through when multilateral globalisation is accounted for is about 5.91%.

It is, therefore, clear from the findings that accounting for Chinese presence and multilateral globalisation increase the exchange rate pass through to consumer prices in both the short and long run. Accounting for regional globalisation, on the other hand, has a negative effect on the exchange rate pass through to consumer prices. This is both in the short and long run. There could be reasons why accounting for Chinese presence and multilateral globalisation increase the exchange rate pass through while accounting for regional globalisation reduces exchange rate pass through. Accounting for Chinese presence and multilateral globalisation is likely to increase the exchange rate pass through to consumer prices because imported goods are quoted in US Dollars. Fluctuations in the US Dollar is likely to increase the price of imported goods. This in turn may increase the exchange rate pass through to consumer prices. This explanation is in line with globalisation theory. Globalisation theory argues that globalisation may lead to an increase in the exchange rate pass through because the more open an economy is, the larger the quantities of imports that enter the domestic economy. This means that exchange rate fluctuations impact a wider category of goods. This is especially so if the imported goods account for a bigger percentage of goods purchased in the domestic economy. This may cause the overall price index in the domestic economy to be more sensitive to external factors. One such external factor is the exchange rate (Villavicencio and Mignon, 2017).

This findings in this chapter also show that accounting for regional globalisation reduces exchange rate pass through to domestic consumer prices in both the short and long run. This maybe because regional trade may involve cross border trade in local regional currencies as opposed to global trade where vehicle currencies such as the US Dollar are used for trade. This may have a reducing effect on the exchange rate pass through, as has been observed, both in the short and long run. In addition, one stream of globalisation theory argues that globalisation can have a negative effect on the exchange rate pass through in the sense that trade integration may lead to higher international competition among multinational firms. This may result in pricing to market behaviour among exporters. If this condition prevails, trade integration may negatively impact on the exchange rate pass through (Ozkhan & Erden, 2015). Finally, when trade costs become low because of regional trade integration, exchange rate pass through may reduce (Ozkhan & Erden, 2015).

6.5.4. Results: The Impact of Globalisation on Exchange Rate Passthrough.

The purpose of this section was to analyse the impact of globalisation on exchange rate pass through to consumer price inflation in Zambia. As mentioned earlier, to determine the impact of globalisation on the exchange rate pass through to consumer price inflation, all the globalisation variables namely Chinese presence, regional globalisation and multilateral globalisation were interacted with nominal exchange rate. Below is an analysis of the results from the VECMs.

6.5.4.1. Short Run Results: The Impact of Globalisation on Exchange Rate Passthrough to Consumer Prices.

Table 6.17 displays the VECM short run results for the impact of globalisation on the exchange rate pass through to consumer price inflation in Zambia. Table 6.17 shows that in the short run the interactive term between Chinese presence and exchange rate is not significant. This shows that in the short run, Chinese presence does not influence exchange rate pass through to consumer price inflation. Regional and multilateral globalisation have a positive significant impact on the exchange rate pass through to consumer price inflation in the short run. Their respective coefficients are significant at 1%. The coefficient of regional globalisation (0.008) is smaller than that of multilateral globalisation (0.08). This means that multilateral globalisation has a greater impact on the exchange rate pass through to consumer price inflation more than regional globalisation.

Table 6.17: Short Run Results: The Impact of Globalisation on ERPT

Target Variable is Consumer Price Index						
	Chinese Presence		Regional Globalisation		Multilateral Globalisation	
CointEq1	-0.005	(0.004)	-0.016***	(0.005)	0.005**	(0.002)
D [lncpi(-1)]	0.553***	(0.086)	0.278***	(0.087)	0.362***	(0.089)
D [lncpi(-2)]	-0.091	(0.088)	-0.031	(0.079)	0.047	(0.087)
D [echina(-1)]	-0.002	(0.001)	-		-	
D [echina(-2)]	0.001	(0.001)	-			
D [eregion(-1)]	-		0.008*	(0.002)	-	
D [eregion(-2)]	-		0.005**	(0.002)	-	
D [eglobal(-1)]	-		-		0.080*	(0.018)
D [eglobal(-2)]	-		-		0.023	(0.018)
D [lnoil(-1)]	-0.004	(0.007)	-0.002	(0.006)	0.004	(0.007)
D [lnoil(-2)]	-0.011	(0.007)	-0.019***	(0.007)	-0.007	(0.007)
D [gap(-1)]	0.026	(0.056)	0.023	(0.049)	0.028	(0.053)
D [gap(-2)]	0.007	(0.056)	0.046	(0.049)	0.046	(0.054)
D [tbil(-1)]	0.003	(0.005)	0.0015	(0.004)	0.002	(0.004)
D [tbil(-2)]	0.0034	(0.005)	0.002	(0.004)	0.001	(0.004)
Constant	0.004***	(0.001)	0.006***	(0.001)	0.004***	(0.001)

* and ** show significance at 1% and 5% respectively.
Notes: (a). Standard Errors are in parethesis
(b). lncpi=log of consumer price index; lnexr=log of nominal exchange rate; lnoil=log of oil price in US Dollar per barrel; gap=output gap; tbil=three months treasury bills; echina=an interaction of exchange rate and imports from China; eregion=an interaction of imports from SADC and exchange rate; eglobal=an interaction of trade openness and exchange rate; (-1) and (-2) are lag 1 and 2 respectively.
Source: Author's computations

6.5.4.2. Long Run Results: The Impact of Globalisation on Exchange Rate Passthrough to Consumer Prices.

Table 6.18 displays the long run VECM results for the impact of globalisation on the exchange rate pass through to consumer price inflation in Zambia. The coefficient of Chinese presence is positive and significant at 1% in the long run. This implies that Chinese presence positively impacts the exchange rate passthrough to consumer price inflation in Zambia. Therefore, 1% increase in the interactive term between Chinese presence and exchange rate causes consumer price inflation to increase by 0.27% in the long run. The coefficient of regional globalisation is positive being 0.26 and is significant at 1%. This result implies that regional globalisation positively impacts the exchange rate pass through to consumer price inflation in the long run. Finally, the coefficient of multilateral globalisation is 0.97. It is positive and significant at 1%. This means that multilateral globalisation has a positive significant impact on the exchange rate pass through to consumer price inflation in Zambia. In terms of comparison, the coefficient of multilateral globalisation (eglobal) is bigger than that of regional globalisation (eregion) and Chinese presence (echina). This means that the impact of multilateral globalisation on the exchange rate pass through to consumer price inflation is greater than that of Chinese presence and regional globalisation respectively. This is expected, since multilateral trade accounts for a bigger percentage in total trade in Zambia as compared to imports from China and SADC. However, the coefficient of Chinese presence (Chinese imports) is 0.27 while that of regional globalisation is 0.26. This implies that Chinese presence (imports from China) has a greater impact on the exchange rate pass through to consumer price inflation in Zambia as compared to imports from SADC countries. It is expected that China has a greater impact on the exchange rate pass through to consumer price inflation in Zambia since it the largest bilateral trade partner of Zambia.

Table 6.18: Long Run Results for the Impact of Globalisation on ERPT

Target Variable is Consumer Price Index
Johansen normalization restriction imposed on lncpi

Variable	Chinese Presence Coefficient	Regional Globalisation Coefficient	Multilateral Globalisation Coefficient
Oil Price	-0.3308* (0.1034)	-0.7651* (0.0852)	0.6314* (0.1838)
Output Gap	0.6216***(0.338)	0.7225* (0.2562)	-1.1697 (0.6108)
Treasury Bills	0.02917 (0.083)	-0.0283 (0.0638)	0.5621* (0.1626)
echina	-0.274* (0.0195)	-	-
eregion	-	-0.26167* (0.0155)	-
eglobal	-	-	-.09766* (.1280)

*, ** and ***show significance at 1% and 5% respectively.
Note: Figures in parenthesis are standard errors.
Note: echina=an interaction of exchange rate and imports from China; eregion=an interaction of imports from SADC and exchange rate; eglobal=an interaction of trade openness and exchange rate
Source: Author’s computations

6.5.4.3. Diagnostic and Stability Tests for all VECM Models.

The estimated standard errors of the VECM output from STATA output are robust to heteroscedasticity. Therefore, the study only did serial correlation, normality and stability tests. The diagnostic and stability tests results are in appendix D. The test results for all the VECMs that account for the effect of accounting for globalisation on the exchange rate passthrough to consumer price inflation show that all the four VECMs do not suffer from serial correlation because in all the cases the probability of the LM test statistic is above 5%. In addition, all the VECMs that examine the impact of globalisation on the exchange rate passthrough to consumer price inflation do not suffer from serial correlation except for the model that examines the impact of regional globalisation on the consumer price inflation. However, all the models suffer from non-normality of residuals. In all cases the probability of the Jarque Bera test is less than 5%. However, non-normality is expected due to a few reasons. First, financial data such as price and exchange rate data normally come from a process with fat tails, which can cause residuals to be non-normal. Second, excessive appreciation or depreciation of the exchange rate can cause non-normality of residuals. Finally, rapid changes in the condition of an economy can also lead to non-normality of residuals.

The stability tests for all the VECM were also conducted. The condition for VECM stability is that if there are r co-integrating relations in a k variable model, the companion matrix will have k-r unit Eigenvalues. If the remaining r Eigenvalues are less than one, the VECM is stable (Johansen, 1995; Nikolic and Zoroja, 2016; Zou, 2018). The stability test results in his study show that all the VECMs are stable because they satisfy this condition.

6.6. Conclusion

The study had two main objectives namely accounting for the effect of globalisation on the exchange rate passthrough to consumer price inflation and examining the impact of globalisation on the exchange rate pass through to domestic consumer inflation. The study applied the VECMs using monthly data from 2006m1 to 2017m12. To estimate the effect of accounting for globalisation on the exchange rate passthrough to consumer price inflation, four VECMs were estimated for the baseline model and for Chinese presence, regional and multilateral globalisation respectively. The results from the other globalisation models were compared with the baseline model. The change in the exchange rate coefficient because of introducing the globalisation variable was interpreted as the effect of accounting for globalisation on the exchange rate pass through to consumer price inflation. To investigate the impact of globalisation on the exchange rate passthrough to consumer price inflation, the globalisation variables were interacted with nominal exchange rate and thus, three VECMs were estimated in series and coefficients of the exchange rate passthrough to consumer price inflation were compared.

The findings showed that accounting for Chinese presence and multilateral globalisation increase the exchange rate pass through to consumer prices in both the short and long run. However, in terms of impact, multilateral globalisation has greater impact on the exchange rate pass through to consumer prices followed by Chinese presence. Regional globalisation has the least impact on consumer price inflation. One might argue that multilateral globalisation and Chinese presence have greater impact on the exchange rate pass through to consumer prices in Zambia. This is because imported goods are quoted in the US Dollar. Consequently, fluctuations in the US Dollar are likely to increase the price of imported goods, which can subsequently increase the exchange rate pass through to consumer prices. Second, multilateral trade has a bigger weight in trade followed by Chinese imports. Thus, the influence of multilateral globalisation and Chinese presence in that order is felt on the exchange rate pass through to consumer prices in Zambia. Finally, results in this study have also shown that the impact of regional globalisation on the exchange rate pass through to consumer prices is lower. This is attributed to cross border trade in the region.

In addition, the findings showed that, accounting for the multilateral globalisation increases the exchange rate pass through. This indicates that ignoring globalisation in the exchange rate pass through models might be incorrect characterization of the exchange rate pass through.

CHAPTER 7

CONCLUSION AND POLICY RECOMMENDATIONS

7.1. Introduction

This study aimed at examining the exchange rate pass through to domestic prices in Zambia. In the first objective, the study examined the symmetric and asymmetric exchange rate pass through to consumer prices using quarterly data from 1985 to 2017. In the second objective, the study examined the exchange rate pass through to sectoral prices with focus on agriculture, manufacturing and services sector for the period from 1983 to 2017 using annual data. Finally, the study examined the impact of bilateral trade (Chinese presence), regional and multilateral globalisation on the exchange rate pass through to consumer prices in Zambia using monthly data from 2006 to 2017.

7.2. Summary of the Findings.

The first objective of the study aimed at investigating the exchange rate pass through to consumer prices in Zambia using the symmetric and asymmetric models for the period from 1985 to 2017 with quarterly data. In the asymmetric model the study investigated the exchange rate pass through to consumer prices due to Kwacha depreciation and appreciation. In the asymmetric approach, the study assumed that exchange rate appreciation and depreciation have different effects on consumer prices. Therefore, the exchange rate variable was decomposed into exchange rate depreciation and appreciation. On the other hand, in modelling the exchange rate pass through using the symmetry approach, it was assumed that exchange rate appreciation and depreciation have the same effects on consumer prices. Therefore, the exchange rate variable was not decomposed into depreciation and appreciation. To meet the first objective the study applied a combination of the pricing to market model as the theoretical framework and the SVAR as the econometric model.

Results from the symmetric and the asymmetric model of the exchange rate pass through to consumer prices revealed that the exchange rate pass through to consumer prices is incomplete thereby confirming the pricing to market behavior of exporters. This entails that exporters absorb part of the exchange rate movements to stabilize domestic consumer prices in the export market. Exporters do this in order to maintain their market share in the export market. This makes the exchange rate pass through to be incomplete. The summary results from the SVAR output for the asymmetric and symmetric models of the exchange rate pass through showed that exchange rate movements especially Kwacha depreciation increase consumer price inflation in Zambia. However, Kwacha appreciation has insignificant effect on consumer price inflation. The impulse response function analysis showed that consumer price inflation largely responds to shocks in Kwacha depreciation. On the other hand, consumer price inflation responds insignificantly and weakly to Kwacha appreciation. The response tails off within a short period of time. These findings indicate that consumer prices are very responsive or sensitive to Kwacha depreciation and insensitive to Kwacha appreciation. The variance decomposition of consumer price inflation showed that Kwacha depreciation shock explains a bigger percentage variance in consumer price inflation than does Kwacha appreciation. This suggests that shocks to Kwacha depreciation are one of the major determinants of consumer price inflation in Zambia. The findings in this study show that accounting for asymmetries in the exchange rate pass through to prices is very important to correctly characterize the exchange rate pass through phenomenon.

The second objective of this study aimed at investigating the exchange rate pass through to sectoral prices. The study specifically examined the exchange rate pass through to prices in the agriculture, manufacturing and the services sectors respectively. To achieve this objective, the study, employed the pricing to market model and the SVAR model using annual data spanning from 1983 to 2017. The SVAR was applied to each sector and results were compared to examine which of the three sectors is more sensitive to exchange rate movements. The summary results from the SVAR output for the sectoral exchange rate pass through study showed that the exchange rate pass through to sectoral prices is highest in the services sector followed by manufacturing sector and least in the agriculture sector. The impulse response function analysis showed that the exchange rate pass through is highest in the services and manufacturing sectors and least in the agriculture sector. The impulse response function analysis showed that the response of sectoral price inflation to the shock in exchange rate is more persistent in the services sector and the manufacturing sector and least in the agriculture sector. The exchange rate shock last for eight, nine and eleven periods in the agriculture, manufacturing and services sector respectively. The calculated exchange rate pass through elasticity is greatest in the services sector followed by manufacturing sector and least in the agriculture sector. The average exchange rate pass through elasticity for eleven periods is 0.88, 0.66 and 0.54 for services, manufacturing and agriculture sector respectively. This shows that the services sector is more sensitive to exchange rate exchange rate changes followed by manufacturing sector and least in agriculture sector. The variance decomposition analysis also showed that exchange rate shocks explain a bigger percentage variance in the services and manufacturing sectors and least in the agriculture sector. As explained earlier, the services sector is likely to be more affected because the sector is dominated by wholesale and retail sector which is import dependent. Hence, exchange rate changes are easily passed to the sector. The sector contains final consumer services such as tourism and financial sectors which are sensitive to exchange rate movements. The manufacturing industry is also likely to be affected by exchange rate movements. This is because it depends on imported inputs which are sensitive to exchange rate changes. The agriculture sector's less sensitivity to exchange rate could be attributed to less foreign trade in this sector. Hence, exchange rate movements seem to have less impact on the sector.

The final objective of this study was to investigate specifically the impact of bilateral trade (imports from China), regional globalisation (regional trade) and multilateral globalisation on the exchange rate pass through to consumer prices in Zambia in the short and long run. In addressing the final objective, the study accounted for globalisation in the exchange rate passthrough. The study used the pricing to market model as the theoretical framework and the VECM as the econometric model. To achieve the objective monthly data from 2006 to 2017 were used. In accounting for globalisation, the results showed that multilateral globalisation and Chinese presence (Chinese imports) have the effect of increasing the exchange rate pass through to consumer price inflation in Zambia as compared to regional globalisation. In terms of impact, multilateral globalisation has greater impact on the exchange rate passthrough to consumer price inflation followed by Chinese presence in the long run. Regional globalisation has less impact on the exchange rate passthrough to consumer price inflation in the long run. The low impact of regional globalisation on the exchange rate pass through to prices in Zambia is attributed to cross border trade due to less use of the US Dollar in trade. On the other hand, the increasing effect of multilateral globalisation and Chinese presence on the exchange rate pass through is attributed to the fact that imported goods from beyond the regional trading block are normally quoted in US Dollar thereby causing the imports to be very sensitive to fluctuations in the exchange rate. Finally, China is the largest bilateral trade partner with Zambia. This could contribute to its influence on the exchange rate passthrough.

7.3. Policy Implications and Recommendations

The results from the asymmetric and symmetric models have implication for inflation and exchange rate policies in Zambia. Since exchange rate fluctuations, especially Kwacha depreciation increase consumer price inflation in Zambia, it means that exchange rate movements have the capacity of impairing inflation targets in Zambia. Therefore, to achieve price stability, policy makers should not only focus on monetary stability but also on exchange rate stability. The central bank, therefore, should continue to intervene in the foreign exchange market to smoothen Kwacha fluctuation by engaging in open market operation if price stability is to be achieved. In addition, there is also need for the Government to implement policies whose efforts aim at stabilizing the Kwacha currency. For instance, the government should encourage investment by creating more properly defined economic zones. The purpose for creating economic zones is to increase output with the aim of increasing exports. Increase in export earnings has the effect of stabilizing the local currency.

The sectoral exchange rate pass through results have implications for macroeconomic and exchange rate policies as regards to these sectors. First, the findings from the sectoral models for the exchange rate pass through have shown that the services sector is more affected by exchange rate changes than other sectors under consideration. This is because the services sector is dominated by the whole and retail sector which is import dependent. Therefore, movements in the exchange rate are easily reflected in the sector. Second, the sector contains the tourism industry and financial sector which are sensitive to exchange rate changes. This sends a signal to boost our manufacturing sector to reduce on imports. This will reduce the sensitivity of the sector to external shocks. It is vital to mention that the tourism industry in Zambia is foreign nationals dominated. This makes the tourism industry to be extra sensitive to external shocks. The government should encourage local tourism. This will require aggressive advertising and sensitization so as to remove the notion that tourism is for foreign nationals only. Local City Councils should be encouraged to build lodges or recreation facilities around the country to encourage local tourism. Tourism services could then be sold at affordable prices to attract the locals. In addition, when services are sold at affordable prices; there could also be a multiplier effect. This is because even foreigners could be attracted to tourism services which were initially aimed at attracting the locals. This might bring in more forex which may in turn stabilize the Kwacha.

The results from the sectoral model of the exchange rate pass through showed that the manufacturing sector is sensitive to exchange rate changes. As explained earlier, the manufacturing sector is expected to be very sensitive to exchange rate movements. This is because this sector depends on the imported inputs, which are sensitive to exchange rate fluctuations. There could be need to reduce tariffs for imported inputs in the manufacturing sector. This may have the effect of reducing the exchange rate pass through to sectoral prices in the sector. However, this might be a short-term solution. A more long-term solution could be for the government to design policies to encourage firms to use local content in production. This will reduce dependence on imported inputs. This will also require developing local resources and skills. A good example of such is empowering trade schools for skills development. Increasing local content in production will reduce the use of imported input in production. This will consequently reduce pressure on the US Dollar which arises due to need to import these inputs. This will have the effect of stabilizing the Kwacha and consequently the prices in the long term.

Another suggestion is for the government to create more economic zones targeted at encouraging local production of manufactures. The focus for boosting production of the manufactures is to increase export in the region and beyond the region. Creating economic zones to boost manufactures and export of the same will increase forex earnings. This will consequently stabilize the Kwacha and prices in Zambia.

Finally, the findings in the sectoral exchange rate pass through have shown that the agriculture sector is less affected by exchange rate movements. This entails that exchange rate fluctuations may be less inflationary in the agriculture sector. However, this less sensitivity of the agriculture sector to exchange rate movement could mean that there is less foreign trade in the sector. This may mean that Zambia has not exploited the market within the region especially the surrounding neighbors such as Congo DRC. It could also mean that Zambia has not developed the agriculture to the level where she can export the produce within and outside the region. This is a signal for the government that there could be need for deliberate policies aimed at boosting the agriculture sector to increase production in this sector with the aim of increasing exports of agriculture produce. This will further bring forex and stabilize the Kwacha.

The results from the globalisation models have shown that Chinese presence (Chinese imports) has an increasing effect on the exchange rate pass through to consumer price inflation in Zambia. Results in this study have shown that the presence of China in Zambia just like in any other countries cannot be ignored. There is, therefore, need to increase trade ties or enter into trade agreements with China for two reasons. First, to reduce trade cost and trade tariffs on goods imported from China. This may have the reducing effect on the exchange rate pass through to consumer prices and consequently on inflation. Second, Zambia could start trading directly in Chinese Yuan (Chinese currency) when trading with China as opposed to the of US Dollar. Trading directly with Chinese currency may have the reducing effect on the exchange rate pass through to consumer prices in Zambia. It will also have a stabilizing effect on the Kwacha. It should be mentioned here that, trading directly with Chinese currency should be considered as a long-term plan as it cannot be implemented in the short term. Finally, the results in this study have also shown that regional globalisation has smaller effect on the exchange rate pass through to consumer prices in Zambia. This signals to policy makers that there could be need to strengthen and increase regional trade as a strategy for curbing inflation in Zambia.

7.4. Contribution of the Study

The study aimed at investigating the exchange rate pass through to prices in Zambia for the period covering 1983 to 2017. The study in its first objective investigated the exchange rate pass through to consumer prices using the symmetric and the asymmetric models. In the second objective, the thesis investigated the sectoral exchange rate pass through to agriculture, manufacturing and services sectors. In the third objective, this thesis investigated the impact of Chinese presence (bilateral trade), regional globalisation and multilateral globalisation on the exchange rate pass through to domestic consumer price inflation. From these objectives, the study made the following empirical contributions.

First, this study has taken another view of modelling exchange rate pass through to prices in that, it incorporated the globalisation variables thereby investigating the impact of globalisation (multilateral trade), Chinese imports (Chinese presence) and regional globalisation on consumer prices in Zambia. Very few studied have taken globalisation into account. An example of such studies are studies by Ozkhan and Erden (2015), Benigno and Faia (2016), Villavicencio and Mignon (2017). It is worthwhile to note that the exchange rate pass through studies which have accounted for globalisation on the exchange rate pass through have made use of ordinary least squares (OLS) method of estimation (Ozkhan and Erden, 2015; Benigno and Faia, 2016; Villavicencio and Mignon, 2017). The current study contributes to literature in that, it applies the VECM. Therefore, the current study was able to analyse the short and long run effects of globalisation on the exchange rate pass through which other studies have not done. Therefore, the current study contributes to the body of knowledge in terms of econometric methodology. In addition, the findings in this study indicate that by accounting for globalisation in the exchange rate pass through, the pass-through coefficients tend to be very high. It could be that the low and incomplete exchange rate pass through reported by a vast number of empirical studies could be attributed to not accounting for globalisation in the exchange rate pass through models. This finding is in line with the finding in the empirical study done by Villavicencio and Mignon (2017). They also found that when globalisation is accounted for, the exchange rate pass through becomes very high. Hence there could be need to adjust the exchange rate pass through models to account for globalisation to correctly characterize the exchange rate pass through. However, this will require more empirical studies that account for globalisation to be done to verify the findings in this study. Therefore, by accounting for globalisation, this study has contributed to the less explored realm of literature on the exchange rate pass through.

Second, the inclusion of Chinese presence in modelling the exchange rate pass through to consumer price inflation in Zambia is a contribution. This helps us to ascertain the influence of Chinese presence in Zambia. The results from the globalisation model have shown that Chinese presence positively influences or increases consumer price inflation in Zambia. This finding means that the influence of China on Zambia cannot be ignored. This finding is a contribution to trade policy. This is because the finding gives an idea to the government on how to strategically relate with China in terms of trade and other areas of cooperation.

Third, from the reviewed literature on the exchange rate pass through to prices, there has not been any study done in Zambia that investigates the exchange rate pass through to sectoral prices in Zambia. Empirical literature on the exchange rate pass through to various sectors of the economy is quite rare. From the reviewed literature, the author has not come across the exchange rate pass through studies that analyse the exchange rate pass through to various sectors of the economy as has been done in this study. This serves as a contribution to literature. Most studies have tended to explore exchange rate pass through to selected products especially the manufacturing sector. Most of these studies use ordinary least squares method of estimation for analysis. The current thesis applied the SVAR as an econometric technique. The study differs from the other sectoral exchange rate passthrough studies in this aspect. The SVAR econometric technique allows a researcher to assess the dynamic interactions among endogenous variables. It also allows the researcher to assess the dynamic path of the exchange rate pass through, the speed and magnitude of the exchange rate shocks on the prices. This serves as a contribution to literature.

7.5. Limitations of the Study.

The main limitation of this study was the non-availability of data. This is so especially for sectoral price data. Data for various sectors of the economy are not available for early years at least from 1964 to 1994. Except for few sectors such as services, agriculture and manufacturing whose data are available from 1983 to 2017. Therefore, the analysis for the exchange rate pass through to economic sectors was restricted to only a few sectors whose data are available from 1983 to 2017.

7.6. Areas for Further Research

One of the limitations faced in this thesis is lack of data as mentioned above. For instance, if data on a number of sectors and sub-sectors are available, exchange rate pass through studies that incorporate more sectors and subsectors could be done. Future studies on the exchange rate pass through, should endeavour to analyse how more sectors other than just services, agriculture and manufacturing sectors respond to changes in exchange rate. In addition, even within sectors, there could be need to see how various subsectors respond to exchange rate changes. This study, therefore, is a stepping-stone to such future studies.

Another possible area of future research in the exchange rate pass through is to study how prices respond to changes in exchange rate in various regions or cities in Zambia. This way, it would be easier to examine which region/ province or city is highly affected by changes in exchange rate. This might help the government to design regional/provincial or city specific policies that could cushion the impact of exchange rate fluctuations in such cities. Such studies maybe undertaken in the future as Zambia Statistical Agency expands its coverage of variables in data collection.

The last objective of this thesis was to examine the impact of globalisation on the exchange rate pass through to consumer prices. The results of this study have shown that accounting for globalisation increases passthrough. The study done by Villavicencio and Mignon (2017) also showed that multilateral globalisation increases exchange rate pass through in the Euro area countries. The suggestion from this study is that more exchange rate pass through studies that account for globalisation should be conducted to confirm if indeed accounting for different dimensions of globalisation increases exchange rate pass through. If the case be that accounting for globalisation increases exchange rate pass through as would be confirmed by more empirical studies, the models of exchange rate pass through might have to be adjusted accordingly to correctly characterize the exchange rate pass through phenomenon.

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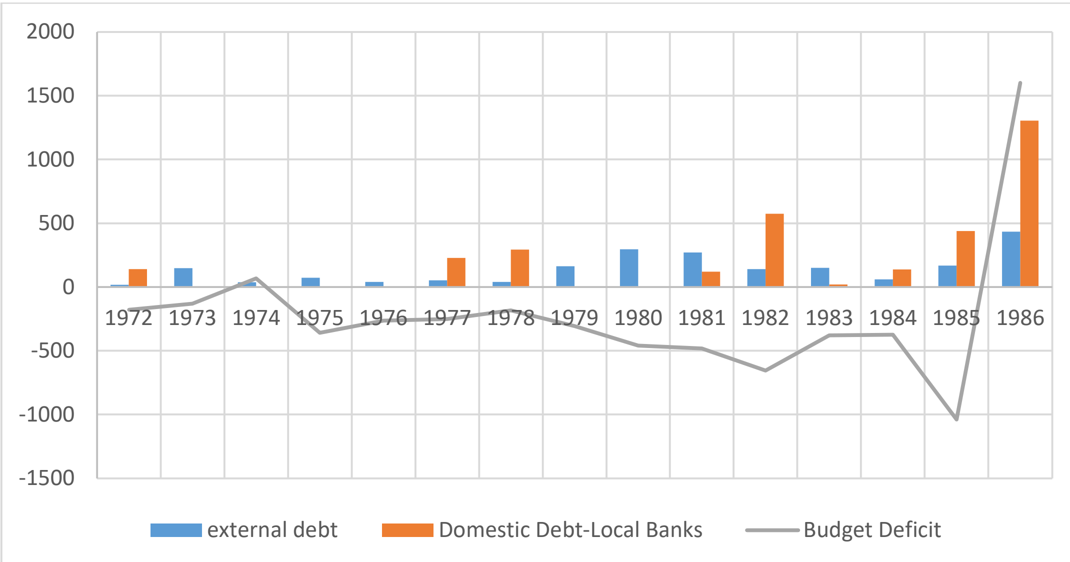
APPENDICES

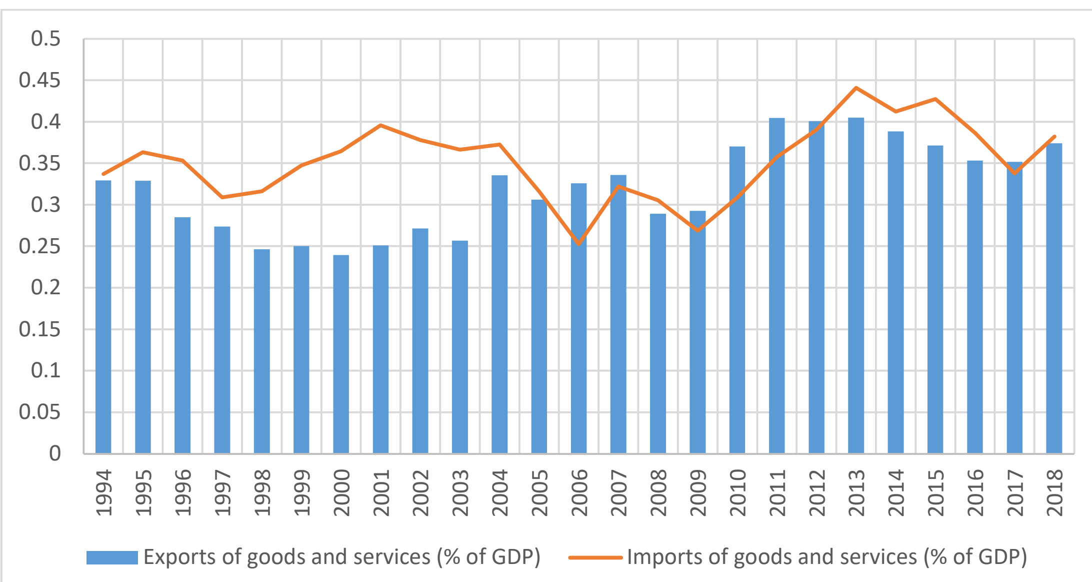
APPENDIX A: DESCRIPTIVE STATISTICS AND GRAPHS

Figure A1: Government Deficit Financing (K'Million)-1970-1986



Government Financial Statistics Yearbook, IMF (various year)

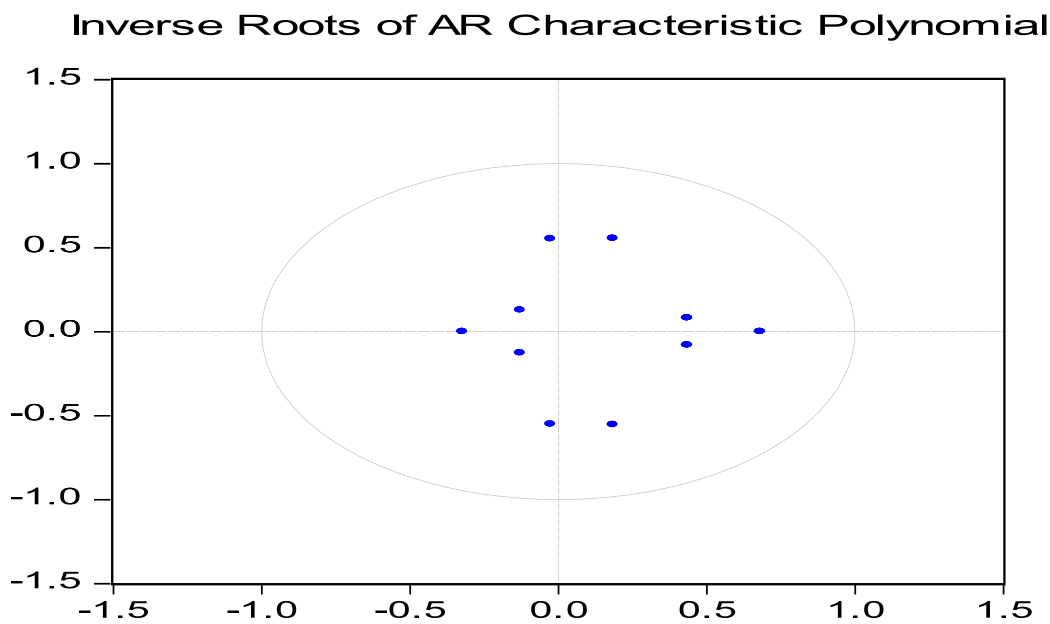
Figure A2: Export and Imports Trends (Annual % of GDP, 1994-2018)



Source: WDI

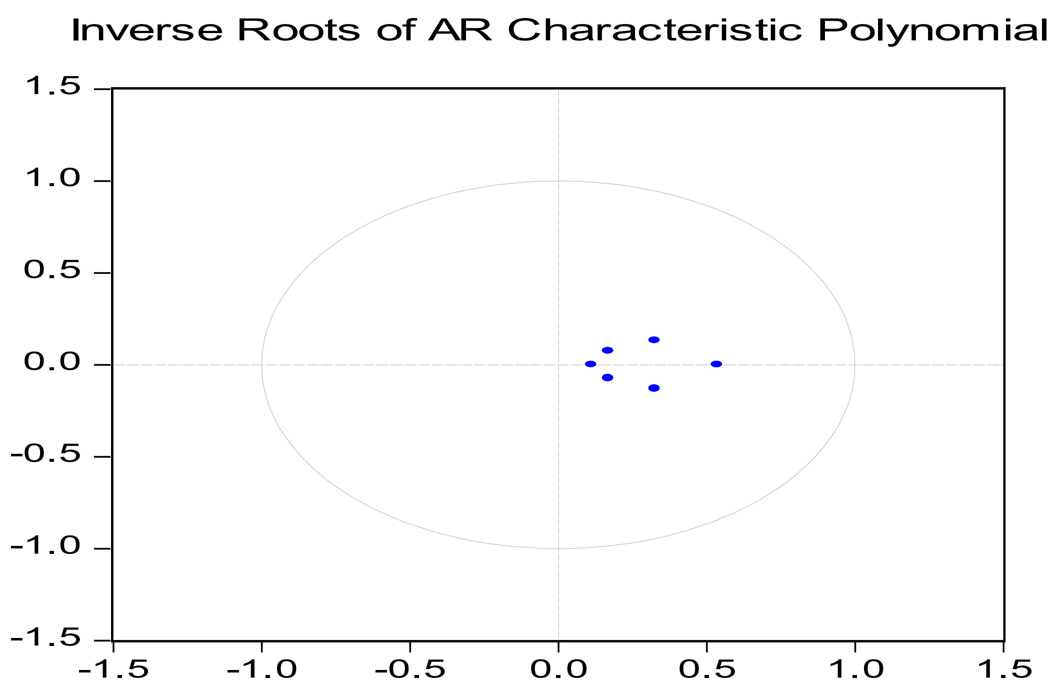
APPENDIX B: ESTIMATIONS: SYMMETRIC AND ASYMMETRIC SVAR

Figure B1: Symmetric SVAR: Stability Test



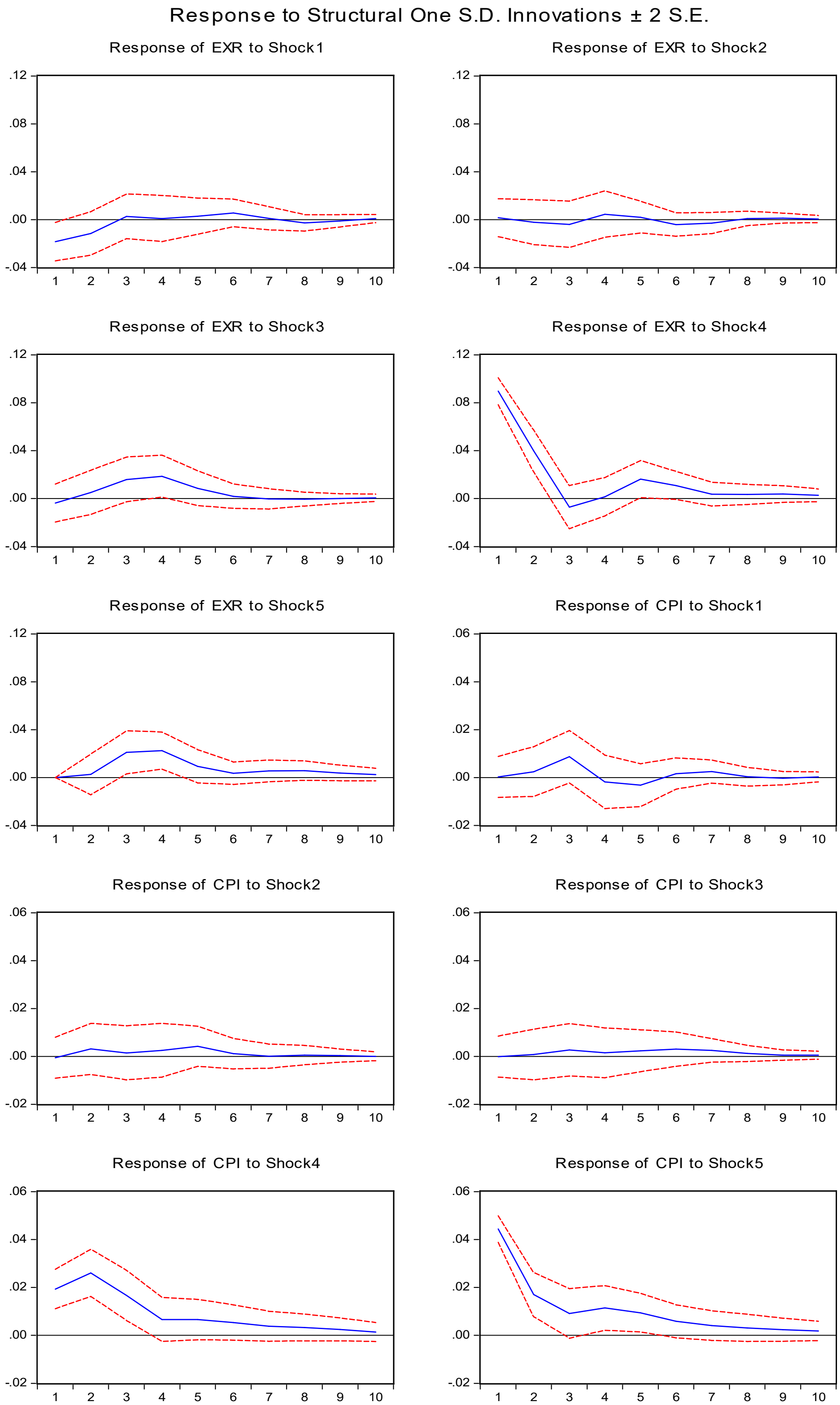
Source: Author's computations

Figure B2: Asymmetric Exchange Rate-Asymmetric SVAR graph



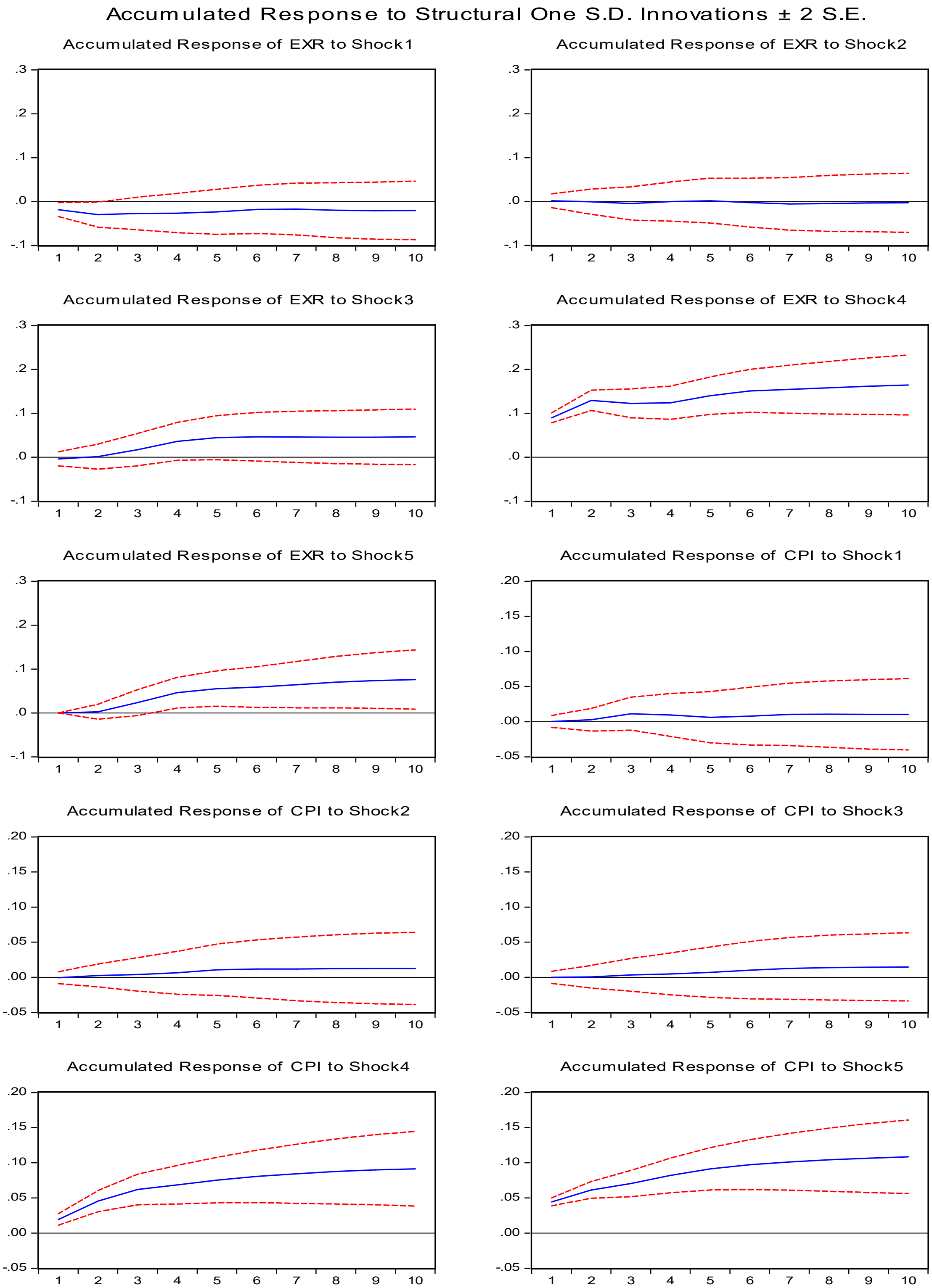
Source: Author's computations

Figure B3: Impulse Responses of CPI and EXR for Symmetric SVAR



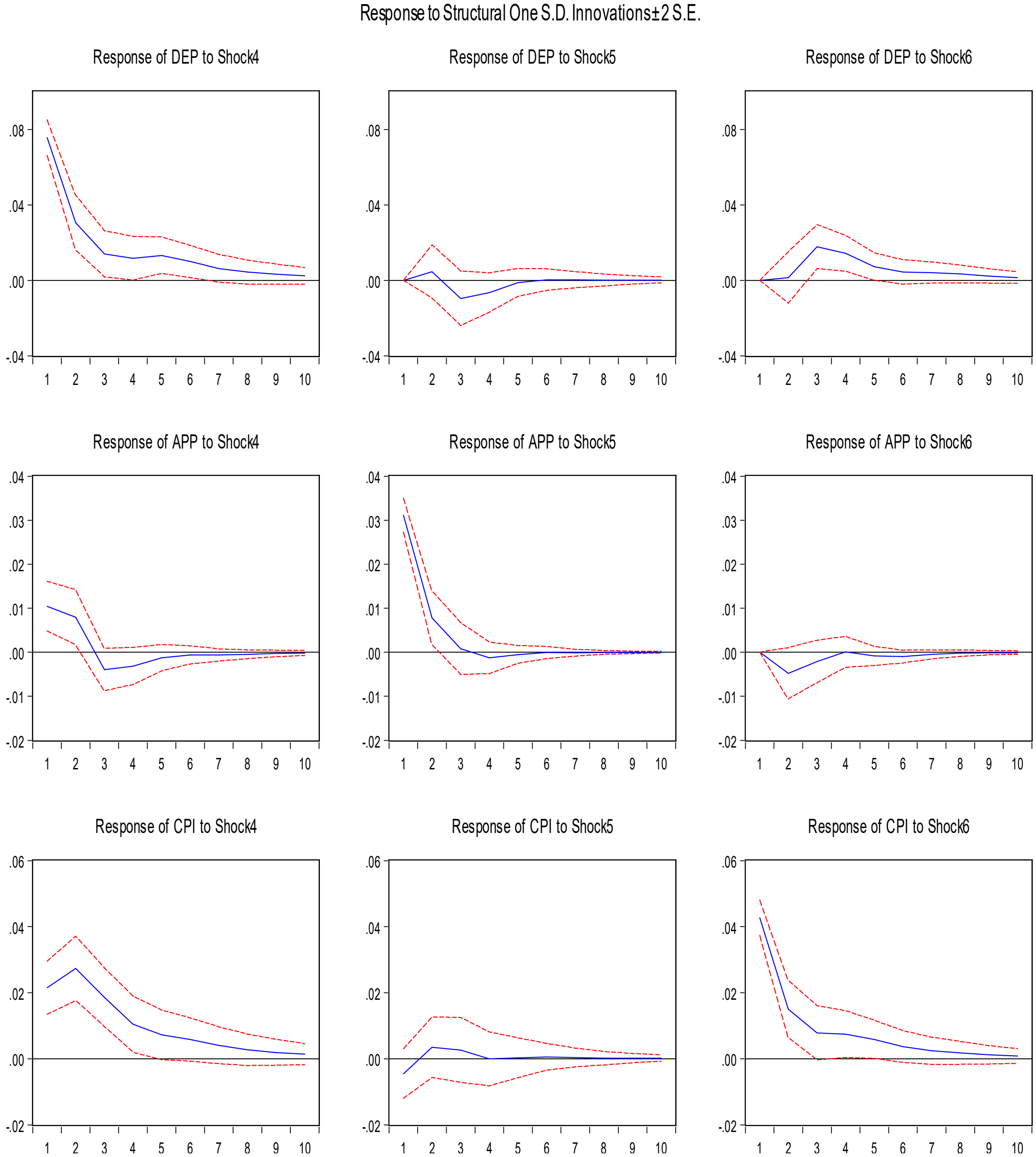
Source: Author’s computations

Figure B4: Cumulative Impulse Responses of CPI and EXR for Symmetric SVAR



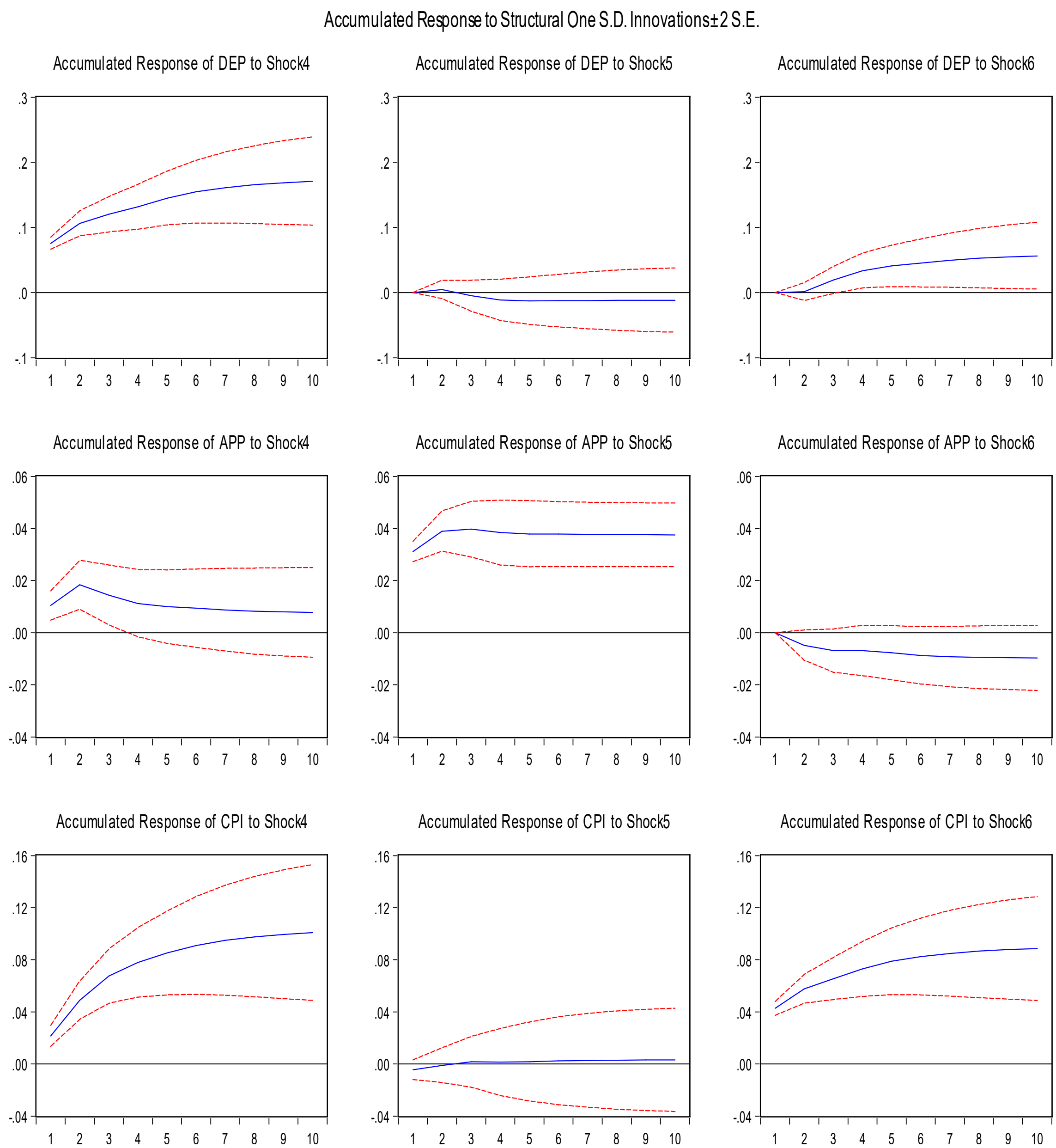
Source: Author's computations

Figure B5: Impulse Responses of CPI, DEP and APP for Asymmetric SVAR



Source: Author's computations

Figure B6: Cumulative Impulse Responses of CPI to DEP & APP for Asymmetric SVAR



Source: Author's computations

Table B1: Symmetric Structural VAR (SVAR) Estimates

Symmetric Model
Structural VAR Estimates
Date: 05/07/23 Time: 21:09
Sample (adjusted): 1986Q1 2017Q4
Included observations: 128 after adjustments
Estimation method: method of scoring (analytic derivatives)
Convergence achieved after 19 iterations
Structural VAR is just-identified

Model: Ae = Bu where E[uu']=I
Restriction Type: short-run text form
@e1 = C(1)*@u1
@e2 = C(2)*@e1 + C(3)*@u2
@e3 = C(4)*@e1 + C(5)*@e2 + C(6)*@u3
@e4 = C(7)*@e1 + C(8)*@e2 + C(9)*@e3 + C(10)*@u4
@e5 = C(11)*@e1 + C(12)*@e2 + C(13)*@e3 + C(14)*@e4 + C(15)*@u5

where
@e1 represents OIL residuals; @e2 represents GAP residuals; @e3 represents MSG residuals
@e4 represents EXR residuals; @e5 represents CPI residuals

	Coefficient	Std. Error	z-Statistic	Prob.
C(2)	0.0440	0.0237	1.8572	0.0633
C(4)	1.4495	5.4712	0.2649	0.7911
C(5)	20.2941	20.1480	1.0072	0.3138
C(7)	-0.1242	0.0534	-2.3259	0.0200
C(8)	0.0476	0.1973	0.2412	0.8094
C(9)	-0.0004	0.0009	-0.4733	0.6360
C(11)	0.0290	0.0270	1.0757	0.2820
C(12)	-0.0242	0.0977	-0.2474	0.8046
C(13)	0.0001	0.0004	0.1747	0.8613
C(14)	0.2155	0.0437	4.9268	0.0000
C(1)	0.1504	0.0094	16.0000	0.0000
C(3)	0.0403	0.0025	16.0000	0.0000
C(6)	9.1856	0.5741	16.0000	0.0000
C(10)	0.0896	0.0056	16.0000	0.0000
C(15)	0.0444	0.0028	16.0000	0.0000
Log likelihood	169.1673			

Estimated A matrix:

1.0000	0.0000	0.0000	0.0000	0.0000
-0.0440	1.0000	0.0000	0.0000	0.0000
-1.4495	-20.2941	1.0000	0.0000	0.0000
0.1242	-0.0476	0.0004	1.0000	0.0000
-0.0290	0.0242	-0.0001	-0.2155	1.0000

Table B1: Symmetric Structural VAR (SVAR) Estimates

Estimated B matrix:

0.1504	0.0000	0.0000	0.0000	0.0000
0.0000	0.0403	0.0000	0.0000	0.0000
0.0000	0.0000	9.1856	0.0000	0.0000
0.0000	0.0000	0.0000	0.0896	0.0000
0.0000	0.0000	0.0000	0.0000	0.0444

Source: Author's computations

Table B2: Asymmetrical Structural VAR Estimates

Structural VAR Estimates
Date: 04/08/23 Time: 19:21
Sample (adjusted): 1985Q3 2017Q4
Included observations: 130 after adjustments
Estimation method: method of scoring (analytic derivatives)
Convergence achieved after 20 iterations
Structural VAR is just-identified

Model: Ae = Bu where E[uu']=I
Restriction Type: short-run text form

@e1 = C(1)*@u1
@e2 = C(2)*@e1 + C(3)*@u2
@e3 = C(4)*@e1 + C(5)*@e2 + C(6)*@u3
@e4 = C(7)*@e1 + C(8)*@e2 + C(9)*@e3 + C(10)*@u4
@e5 = C(11)*@e1 + C(12)*@e2 + C(13)*@e3 + C(14)*@e4 + C(15)*@u5
@e6 = C(16)*@e1 + C(17)*@e2 + C(18)*@e3 + C(19)*@e4 + C(20)*@e5 + C(21)*@u6

where
@e1 represents OIL residuals
@e2 represents GAP residuals
@e3 represents MSG residuals
@e4 represents DEP residuals
@e5 represents APP residuals
@e6 represents CPI residuals

	Coefficient	Std. Error	z-Statistic	Prob.
C(2)	0.0233	0.02174	1.0725	0.2835
C(4)	-7.2753	3.06539	-2.3734	0.0176
C(5)	-8.5439	12.3093	-0.6941	0.4876
C(7)	-0.1598	0.04409	-3.6239	0.0003
C(8)	0.0739	0.17365	0.4254	0.6705
C(9)	-0.0013	0.00123	-1.0549	0.2914
C(11)	0.0076	0.01880	0.4057	0.685

Table B2: Asymmetrical Structural VAR Estimates Cont/d

C(12)	-0.0709	0.07060	-1.0039	0.3154
C(13)	-0.0010	0.00050	-1.9593	0.0501
C(14)	0.1298	0.03563	3.6433	0.0003
C(16)	0.0126	0.02657	0.4751	0.6347
C(17)	-0.0793	0.10013	-0.7924	0.4282
C(18)	-0.0012	0.00072	-1.6617	0.0966
C(19)	0.2796	0.05285	5.2909	0.0000
C(20)	-0.0939	0.12390	-0.7581	0.4484
C(1)	0.1573	0.00976	16.125	0.0000
C(3)	0.0390	0.00242	16.124	0.0000
C(6)	5.4732	0.33943	16.124	0.0000
C(10)	0.0770	0.0047	16.124	0.0000
C(15)	0.0313	0.0019	16.124	0.0000
C(21)	0.0442	0.0027	16.124	0.0000
Log likelihood	523.2993			

Estimated A Matrix

1	0.0000	0.0000	0.0000	0.0000	0.000
-0.023321	1	0.0000	0.0000	0.0000	0.000
7.275331	8.543939	1	0.0000	0.0000	0.000
0.159778	-0.073877	0.0013	1	0.0000	0.000
-0.007625	0.070882	0.0009	-0.1298	1	0.000
-0.012623	0.079337	0.0012	-0.2796	0.0939	1

Estimated B matrix:

0.157288	0.0000	0.00000	0.0000	0.0000	0.000
0.000000	0.0390	0.00000	0.0000	0.0000	0.000
0.000000	0.0000	5.47320	0.0000	0.0000	0.000
0.000000	0.0000	0.00000	0.0771	0.0000	0.000
0.000000	0.0000	0.00000	0.0000	0.0313	0.000
0.000000	0.0000	0.00000	0.0000	0.0444	0.000

Source: Author's computations

Table B3: Accumulated Response of CPI (Symmetric Model)

Period	Shock1	Shock2	Shock3	Shock4	Shock5
1	0.0002	-0.0006	-0.0001	0.0193	0.0444
2	0.0027	0.0025	0.0006	0.0454	0.0614
3	0.0113	0.0039	0.0033	0.0620	0.0705
4	0.0095	0.0064	0.0048	0.0686	0.0819
5	0.0063	0.0106	0.0071	0.0751	0.0913
6	0.0079	0.0117	0.0101	0.0805	0.0972
7	0.0103	0.0118	0.0125	0.0843	0.1012
8	0.0106	0.0123	0.0137	0.0875	0.1043
9	0.0103	0.0126	0.0142	0.0899	0.1066
10	0.0105	0.0125	0.0147	0.0913	0.1085

Note: Shock1=OIL, Shock2=GAP; Shock3=MSG; Shock4=EXR; Shock5=CPI
Source: Author’s computations

Table B4: Accumulated Response of EXR (Symmetric Model)

Period	Shock1	Shock2	Shock3	Shock4	Shock5
1	-0.0185	0.0016	-0.0037	0.0896	0.0000
2	-0.0301	-0.0007	0.0014	0.1294	0.0025
3	-0.0274	-0.0047	0.0174	0.1223	0.0235
4	-0.0266	-0.0002	0.0360	0.1238	0.0460
5	-0.0238	0.0017	0.0446	0.1401	0.0553
6	-0.0183	-0.0025	0.0465	0.1509	0.0588
7	-0.0173	-0.0055	0.0462	0.1546	0.0642
8	-0.0200	-0.0046	0.0457	0.1579	0.0699
9	-0.0212	-0.0035	0.0457	0.1617	0.0735
10	-0.0204	-0.0031	0.0463	0.1643	0.0760

Note: Shock1=OIL, Shock2=GAP; Shock3=MSG; Shock4=EXR; Shock5=CPI
Source: Author’s computations

Table B5: Accumulated Response of CPI (Asymmetric Model)

Period	Shock1	Shock2	Shock3	Shock4	Shock5	Shock6
1	-0.0033	-0.0016	-0.0080	0.0206	-0.0029	0.0442
2	-0.0002	0.0000	-0.0153	0.0395	0.0029	0.0673
3	0.0020	0.0009	-0.0191	0.0518	0.0081	0.0790
4	0.0031	0.0012	-0.0209	0.0591	0.0114	0.0849
5	0.0035	0.0013	-0.0216	0.0631	0.0132	0.0878
6	0.0036	0.0013	-0.0220	0.0654	0.0141	0.0892
7	0.0036	0.0013	-0.0221	0.0666	0.0145	0.0900
8	0.0036	0.0012	-0.0222	0.0672	0.0148	0.0904
9	0.0035	0.0012	-0.0222	0.0676	0.0149	0.0906
10	0.0035	0.0012	-0.0223	0.0677	0.0149	0.0907

Note: Shock1=OIL, Shock2=GAP; Shock3=MSG; Shock4=DEP; Shock5=APP; Shock=CPI

Source: Author's computations

Table B6: Accumulated Response of DEP (Asymmetric Model)

Period	Shock1	Shock2	Shock3	Shock4	Shock5	Shock6
1	-0.00069	-0.0017	-0.0035	0.01044	0.03114	0.0000
2	-4.75E-06	-0.002	-0.0003	0.01835	0.03894	-0.0048
3	-0.002123	-0.0042	0.00238	0.0144	0.03971	-0.0069
4	-0.003532	-0.0044	0.00387	0.01123	0.03843	-0.0069
5	-0.003658	-0.0049	0.00389	0.00996	0.0379	-0.0077
6	-0.003325	-0.0052	0.00383	0.00936	0.03781	-0.0088
7	-0.00355	-0.0053	0.00379	0.00873	0.03769	-0.0093
8	-0.00392	-0.0052	0.00375	0.00825	0.03763	-0.0095
9	-0.004029	-0.0052	0.00375	0.00796	0.03759	-0.0096
10	-0.003991	-0.0053	0.00377	0.00777	0.03756	-0.0097
11	-0.003991	-0.0054	0.00377	0.00764	0.03754	-0.0098
12	-0.00403	-0.0054	0.00376	0.00755	0.03753	-0.0099

Note: Shock1=OIL, Shock2=GAP; Shock3=MSG; Shock4=DEP; Shock5=APP; Shock=CPI

Source: Author's computations

Table B7: Accumulated Response of APP (Asymmetric Model)

Period	Shock1	Shock2	Shock3	Shock4	Shock5	Shock6
1	-0.0009	-0.0020	-0.0063	0.0100	0.0313	0.0000
2	-0.0004	-0.0019	-0.0038	0.0116	0.0397	-0.0038
3	-0.0007	-0.0023	-0.0018	0.0113	0.0412	-0.0071
4	-0.0012	-0.0027	-0.0009	0.0105	0.0411	-0.0091
5	-0.0016	-0.0028	-0.0004	0.0099	0.0407	-0.0101
6	-0.0018	-0.0029	-0.0003	0.0095	0.0404	-0.0106
7	-0.0019	-0.0029	-0.0002	0.0092	0.0403	-0.0108
8	-0.0019	-0.0029	-0.0002	0.0091	0.0402	-0.0109
9	-0.0019	-0.0029	-0.0001	0.0090	0.0402	-0.0109
10	-0.0019	-0.0029	-0.0001	0.0089	0.0401	-0.0110

Note: Shock1=OIL, Shock2=GAP; Shock3=MSG; Shock4=DEP; Shock5=APP; Shock=CPI

Source: Author's computations

Table B8: Test for Serial Correlation for Symmetric Model

VAR Residual Serial Correlation LM Tests
Null Hypothesis: no serial correlation at lag order h
Date: 05/07/23 Time: 21:42
Sample: 1985Q2 2017Q4
Included observations: 129

Lags	LM-Stat	Prob
1	35.59145	0.078
2	46.8219	0.0051
3	13.28103	0.9729

Probs from chi-square with 25 df.

Source: Author's computations

Table B9: Test for Serial Correlation for Asymmetric Model

VAR Residual Serial Correlation LM Tests
Null Hypothesis: no serial correlation at lag order h
Date: 04/08/23 Time: 22:00
Sample: 1985Q2 2017Q4
Included observations: 130

Lags	LM-Stat	Prob
1	63.5920	0.0031
2	44.46787	0.1572
3	24.72299	0.9221
4	108.836	0.0000

Probs from chi-square with 36 df.

Source: Author's computations

Table B10: VAR Residual Heteroskedasticity Tests for Symmetric Model

VAR Residual Heteroskedasticity Tests: No Cross Terms (only levels and squares)

Date: 05/07/23 Time: 21:44

Sample: 1985Q2 2017Q4

Included observations: 129

Joint test:

Chi-sq	df	Prob.
372.6094	330	0.0529

Individual components:

Dependent	R-squared	F(22,106)	Prob.	Chi-sq(22)	Prob.
res1*res1	0.100983	0.54121	0.9504	13.02687	0.9324
res2*res2	0.352125	2.618715	0.0006	45.42409	0.0023
res3*res3	0.195957	1.174264	0.2865	25.2785	0.2839
res4*res4	0.262129	1.711661	0.0375	33.81463	0.0513
res5*res5	0.246333	1.5748	0.0664	31.77692	0.0813
res2*res1	0.247451	1.584299	0.0639	31.92115	0.0788
res3*res1	0.173834	1.013798	0.4546	22.42462	0.4348
res3*res2	0.238906	1.512415	0.0852	30.81882	0.0999
res4*res1	0.130544	0.723425	0.8065	16.8402	0.7721
res4*res2	0.260604	1.698192	0.0397	33.61789	0.0537
res4*res3	0.134037	0.745773	0.7823	17.29071	0.7471
res5*res1	0.205404	1.245503	0.2273	26.49707	0.231
res5*res2	0.139432	0.78066	0.7424	17.98677	0.7068
res5*res3	0.091483	0.485164	0.9732	11.80126	0.9613
res5*res4	0.188561	1.119643	0.3386	24.32439	0.3305

Source: Author's computations

Table B11: VAR Residual Heteroskedasticity Test for Asymmetric Model

VAR Residual Heteroskedasticity Tests: Includes Cross Terms

Date: 04/08/23 Time: 22:15

Sample: 1985Q2 2017Q4

Included observations: 130

Joint test:

Chi-sq	df	Prob.
1016.792	903	0.0048

Individual components:

Dependent	R-squared	F(43,86)	Prob.	Chi-sq(43)	Prob.
res1*res1	0.1684	0.4051	0.9992	21.8978	0.9969
res2*res2	0.4668	1.7509	0.0141	60.6833	0.0388
res3*res3	0.1913	0.4731	0.9960	24.8689	0.9878

Table B11: VAR Residual Heteroskedasticity Test for Asymmetric Model Cont/d

res4*res4	0.6821	4.2908	0.0000	88.6701	0.0001
res5*res5	0.2243	0.5784	0.9753	29.1606	0.9471
res6*res6	0.3203	0.9426	0.5764	41.6432	0.5302
res2*res1	0.2970	0.8450	0.7256	38.6104	0.6620
res3*res1	0.2367	0.6203	0.9571	30.7744	0.9186
res3*res2	0.3507	1.0802	0.3739	45.5895	0.3649
res4*res1	0.1763	0.4282	0.9986	22.9240	0.9948
res4*res2	0.4174	1.4326	0.0794	54.2567	0.1166
res4*res3	0.2842	0.7940	0.7964	36.9421	0.7303
res5*res1	0.2748	0.7579	0.8410	35.7258	0.7765
res5*res2	0.4507	1.6410	0.0262	58.5920	0.0568
res5*res3	0.2074	0.5234	0.9896	26.9635	0.9734
res5*res4	0.4254	1.4806	0.0621	55.2994	0.0989
res6*res1	0.3019	0.8649	0.6962	39.2448	0.6349
res6*res2	0.2648	0.7202	0.8817	34.4198	0.8217

Source: Author's computations

Table B12: VAR Residual Normality Tests for Symmetric Model

VAR Residual Normality Tests
Orthogonalization: Cholesky (Lutkepohl)
Null Hypothesis: residuals are multivariate normal
Date: 05/07/23 Time: 21:45
Sample: 1985Q2 2017Q4
Included observations: 129

Component	Skewness	Chi-sq	df	Prob.
1	-0.7651	12.5871	1	0.0004
2	-0.3173	2.1642	1	0.1413
3	-0.1592	0.5448	1	0.4605
4	0.2367	1.2041	1	0.2725
5	1.4886	47.6447	1	0.0000
Joint		64.14485	5	0.0000
Component	Kurtosis	Chi-sq	df	Prob.
1	5.8995	45.1873	1	0.0000
2	6.2918	58.2426	1	0.0000
3	7.3754	102.9015	1	0.0000
4	6.8708	80.5332	1	0.0000
5	9.5550	230.9542	1	0.0000
Joint		517.8188	5	0.0000
Component	Jarque-Bera	df	Prob.	

Table B12: VAR Residual Normality Tests for Symmetric Model cont/d

1	57.7744	2	0.0000
2	60.4068	2	0.0000
3	103.4463	2	0.0000
4	81.7373	2	0.0000
5	278.5989	2	0.0000
Joint	581.9636	10	0.0000

Source: Author's computations

Table B13: VAR Residual Normality Tests for Asymmetric Model)

VAR Residual Normality Tests
Orthogonalization: Cholesky (Lutkepohl)
Null Hypothesis: residuals are multivariate normal
Date: 04/08/23 Time: 22:30
Sample: 1985Q2 2017Q4
Included observations: 130

Component	Skewness	Chi-sq	df	Prob.
1	-0.972085	20.47389	1	0.0000
2	-0.100061	0.216932	1	0.6414
3	-0.976582	20.66377	1	0.0000
4	1.493399	48.3219	1	0.0000
5	-2.690412	156.8302	1	0.0000
6	1.219902	32.24351	1	0.0000
Joint		278.7502	6	0.0000

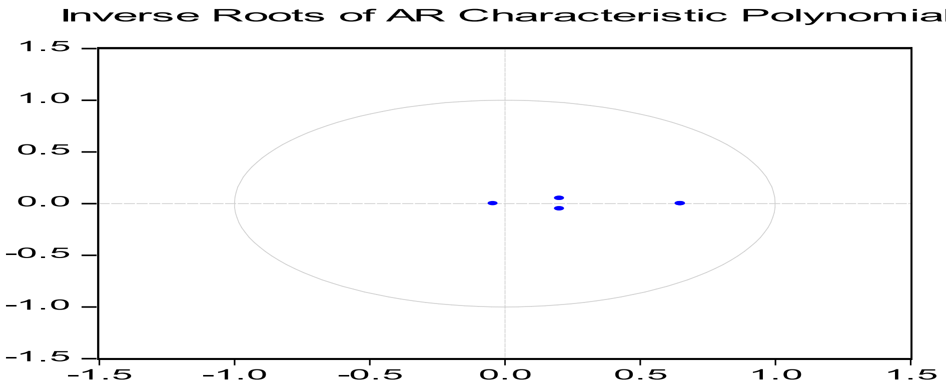
Component	Kurtosis	Chi-sq	df	Prob.
1	7.049609	88.82971	1	0.0000
2	5.682537	38.97835	1	0.0000
3	19.96855	1559.63	1	0.0000
4	9.915233	259.0274	1	0.0000
5	14.18796	678.0063	1	0.0000
6	9.390065	221.1784	1	0.0000
Joint		2845.65	6	0.0000

Component	Jarque-Bera	df	Prob.
1	109.3036	2	0.0000
2	39.19528	2	0.0000
3	1580.294	2	0.0000
4	307.3493	2	0.0000
5	834.8365	2	0.0000
Joint	3124.401	12	0.0000

Source: Author's computations

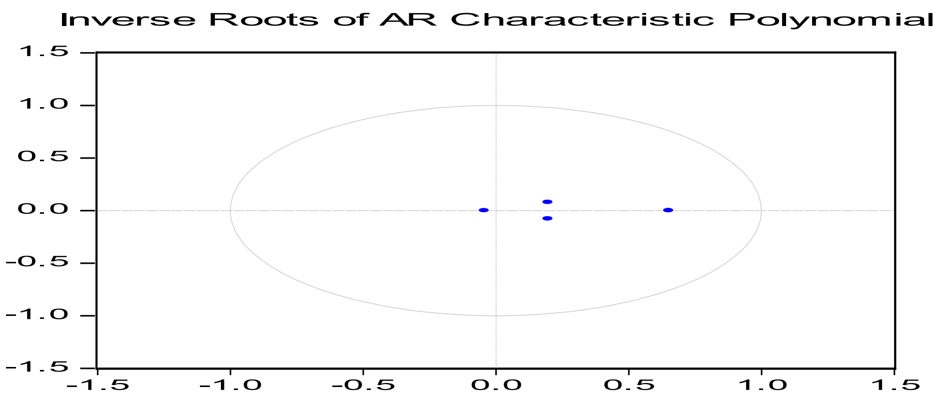
APPENDIX C: ESTIMATIONS FROM SECTORAL ERPT MODELS

Figure C1: AR Roots For Agriculture Sector SVAR



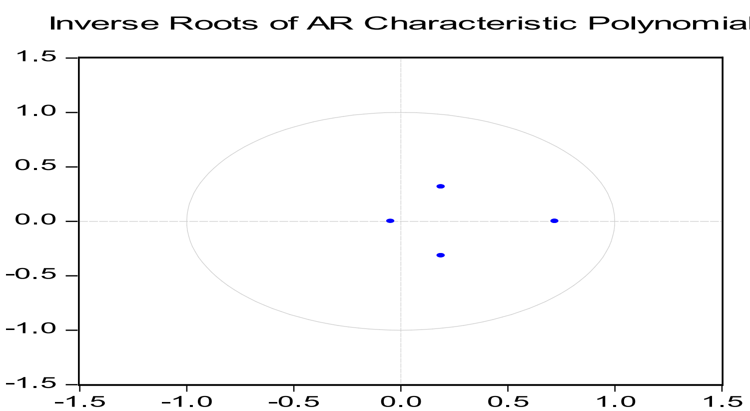
Source: Author's computations

Figure C2: AR Roots for Manufacturing Sector SVAR



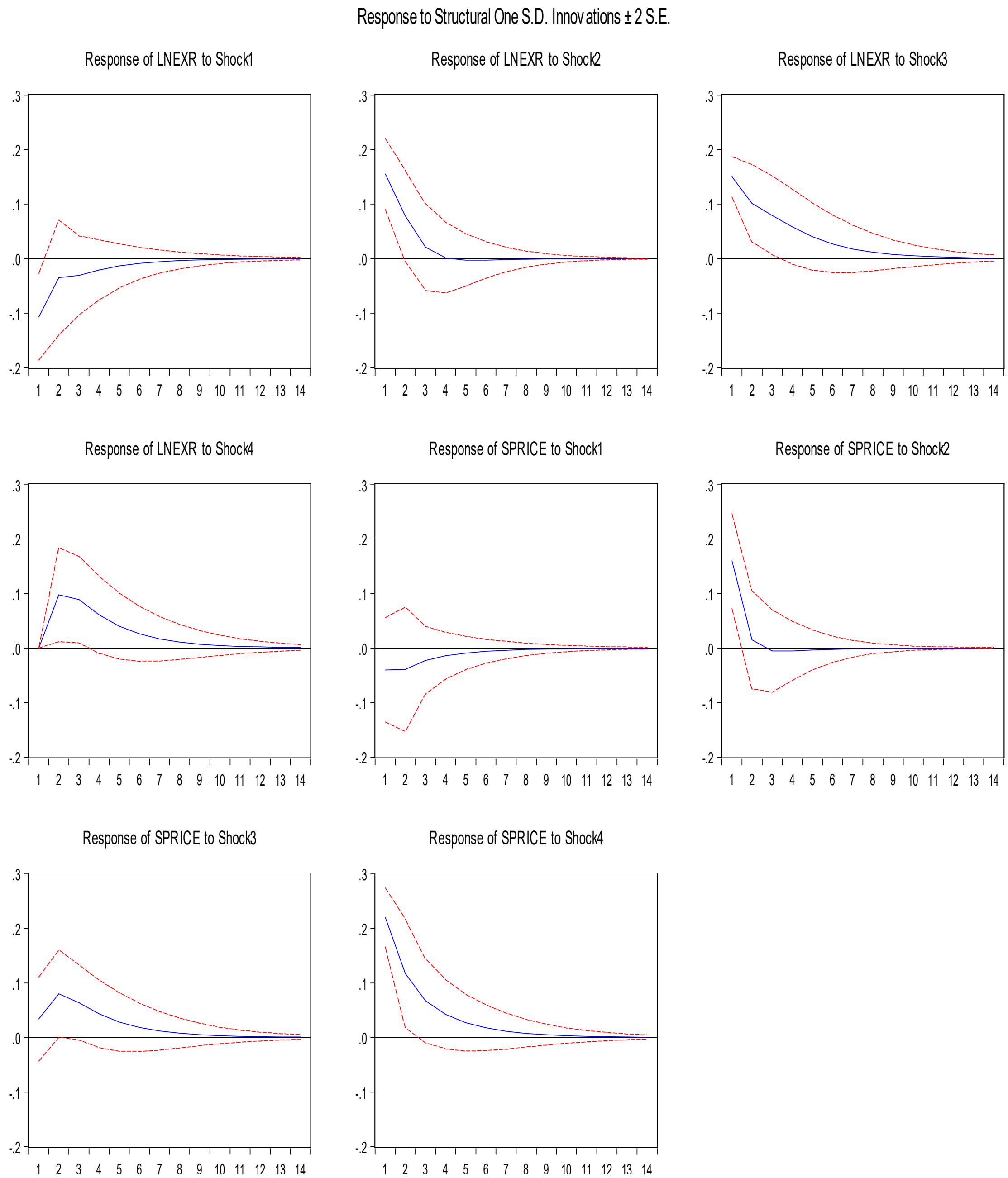
Source: Author's computations

Figure C3: AR Roots For Services Sector SVAR



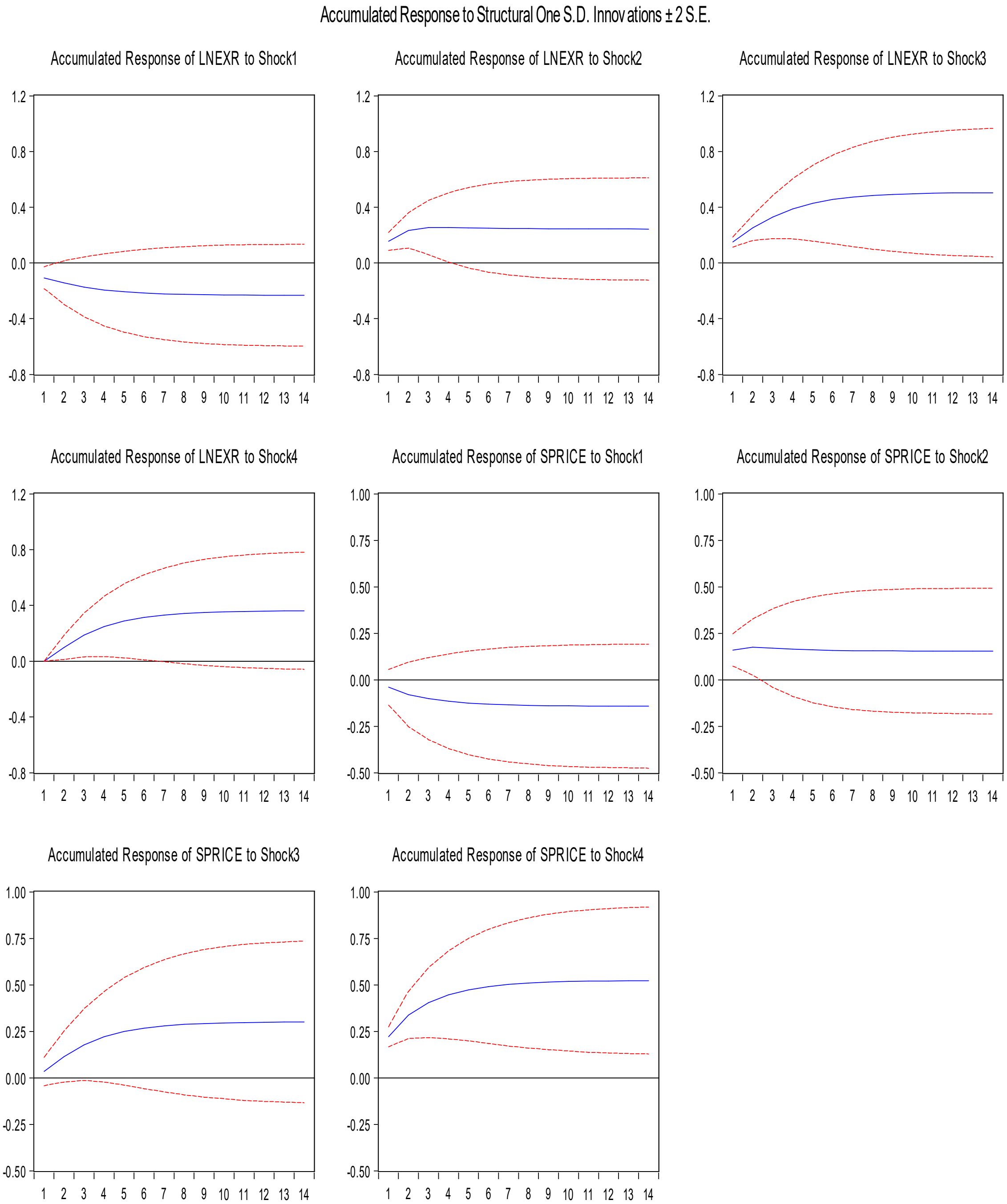
Source: Authors' computations

Figure C4: Impulse Response of SPRICE and LNEXR for Agriculture Sector



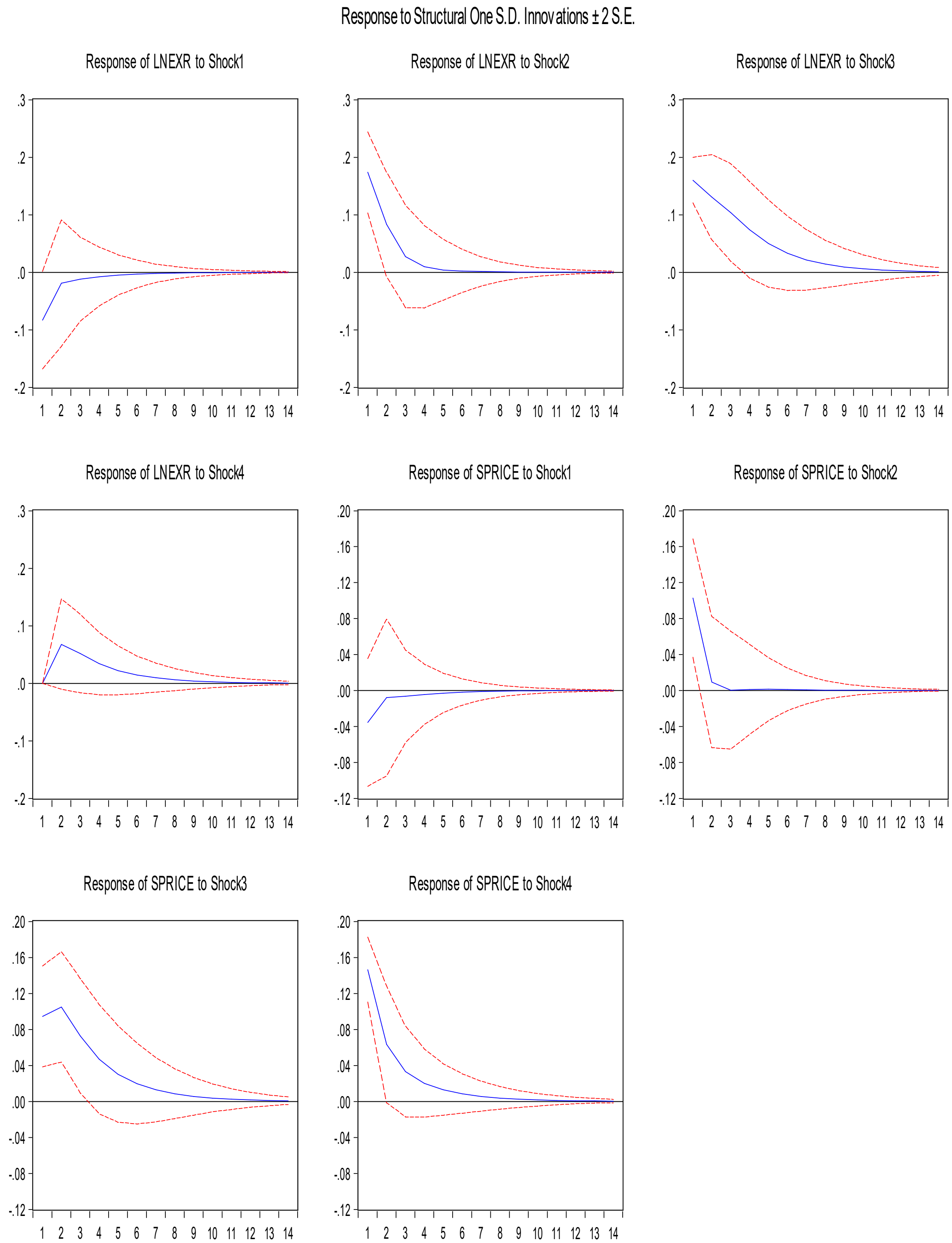
Source: Author's computations

Figure C5: Cumulative Impulse Response of SPRICE and LNEXR for Agriculture Sector



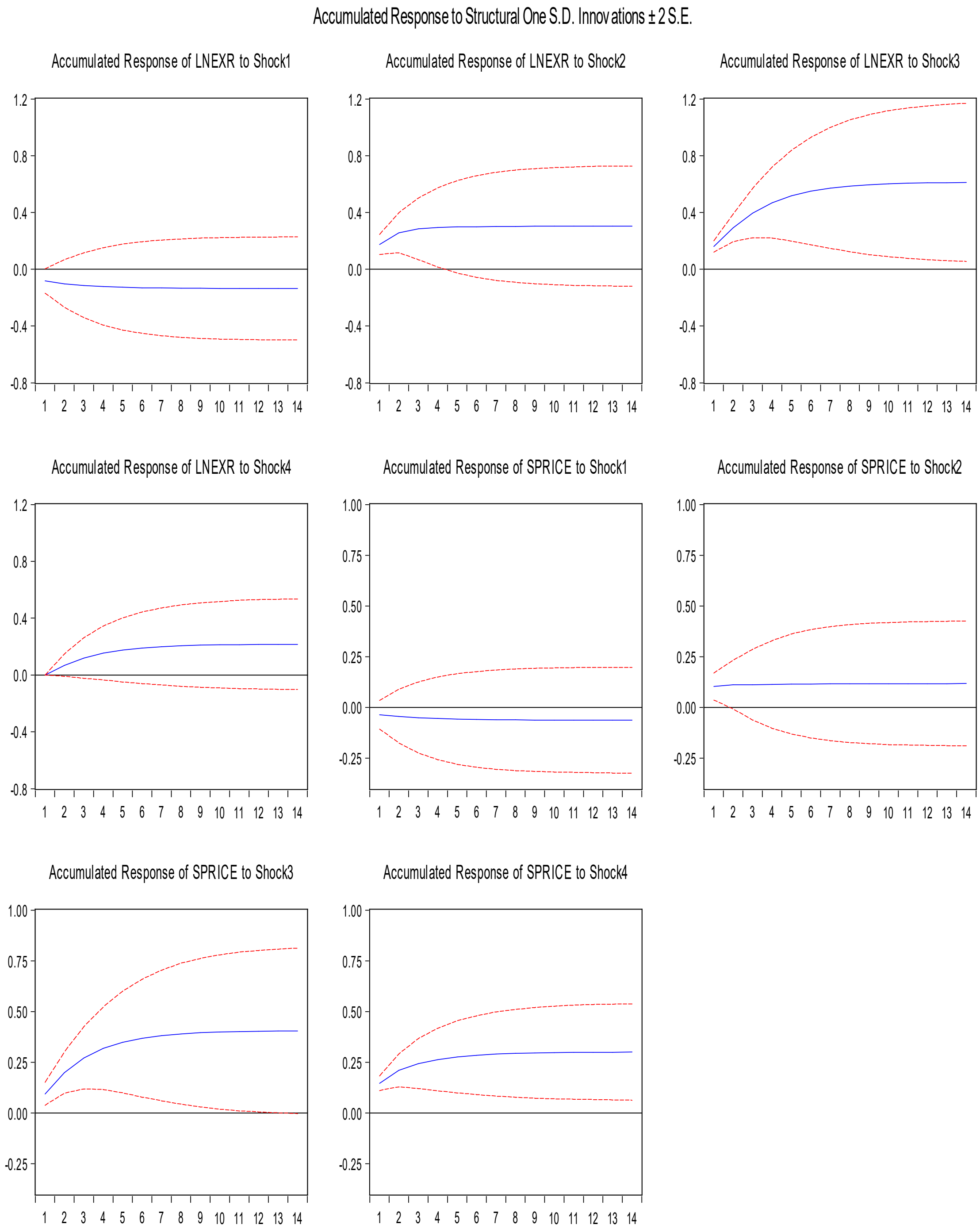
Source: Author's computations

Figure C6: Impulse Response of SPRICE and LNEXR for Manufacturing Sector



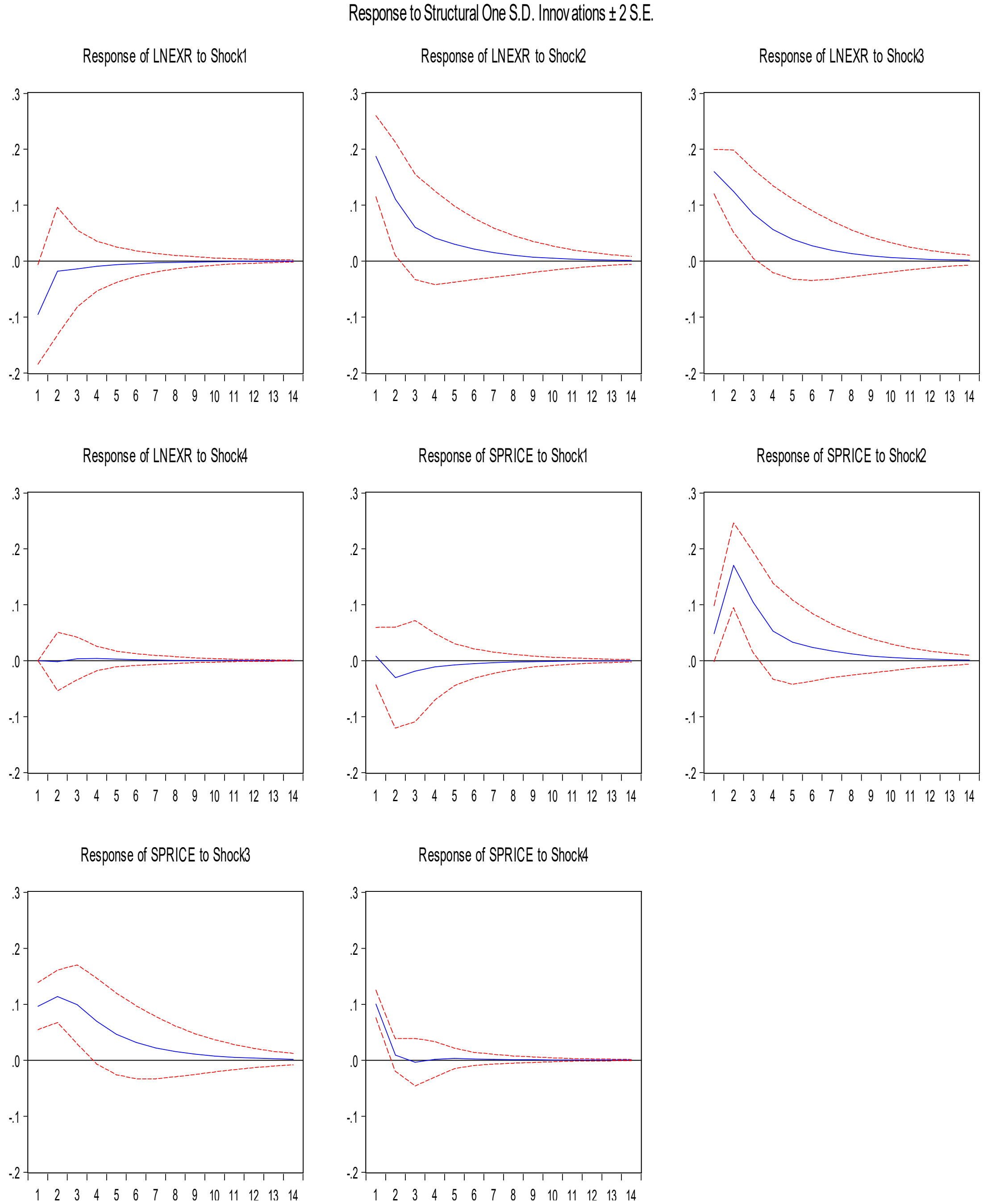
Source: Author's computations

Figure C7: Cumulative Impulse Response of SPRICE and LNEXR for Manufacturing Sector



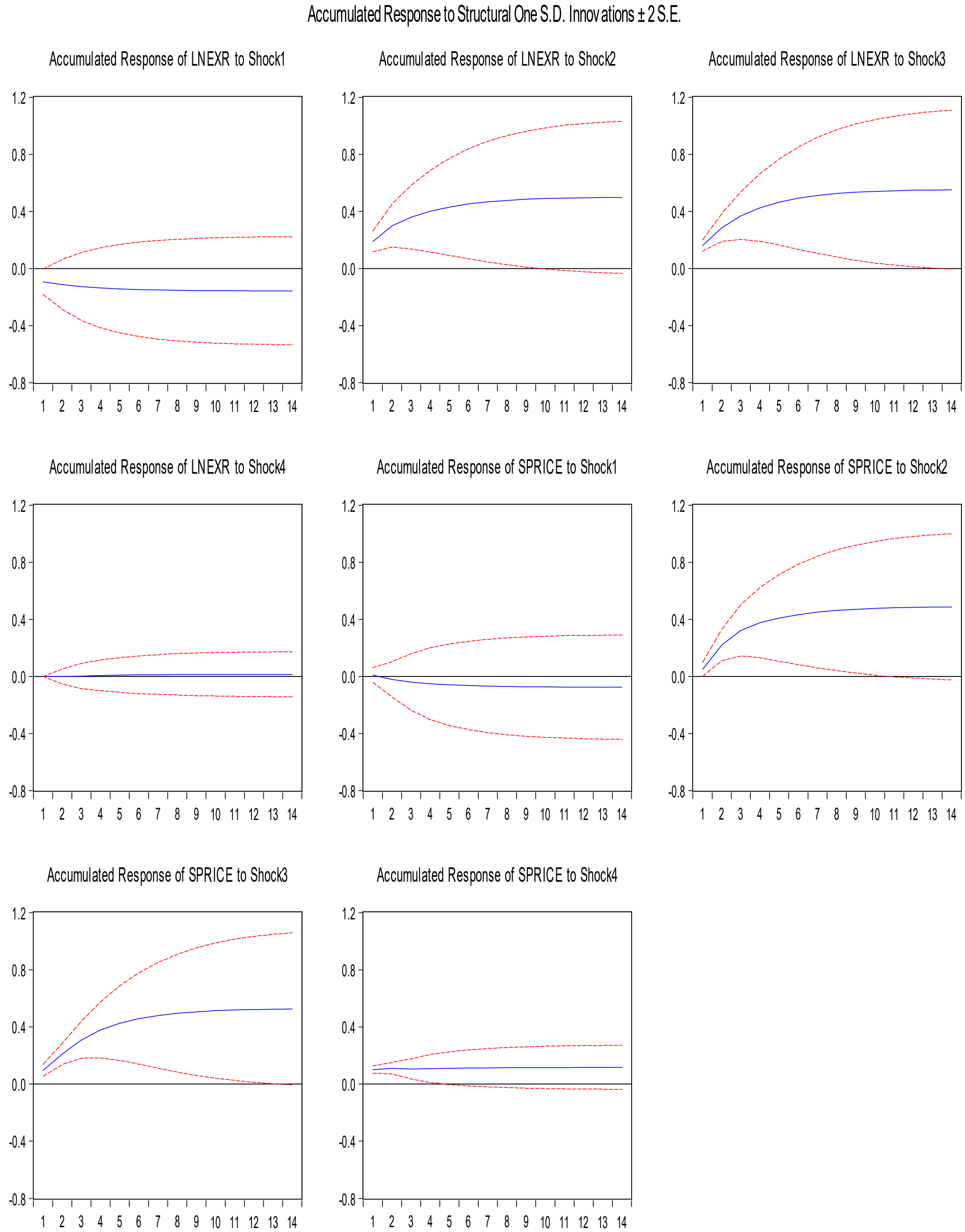
Source: Author's computations

Figure C8: Impulse Response of SPRICE and LNXER for Services Sector



Source: Author's computations

Figure C9: Cumulative Impulse Response of SPRICE and LNXER for Services Sector



Source: Author's computations

Table C1: Structural VAR (SVAR) Estimates for Agriculture Sector

Structural VAR Estimates
Date: 04/27/21 Time: 21:41
Sample (adjusted): 1985 2017
Included observations: 33 after adjustments
Estimation method: method of scoring (analytic derivatives)
Convergence achieved after 6 iterations
Structural VAR is just-identified

Model: Ae = Bu where E[uu']=I
Restriction Type: short-run text form
@e1 = C(1)*@u1
@e2 = C(2)*@e1 + C(3)*@u2
@e3 = C(4)*@e1 + C(5)*@e2 + C(6)*@u3
@e4 = C(7)*@e1 + C(8)*@e2 + C(9)*@e3 + C(10)*@u4
where
@e1 represents LNOIL residuals; @e2 represents LNGAP residuals
@e3 represents LNEXR residuals; @e4 represents SPRICE residuals

	Coefficient	Std. Error	z-Statistic	Prob.
C(2)	-0.57321	0.312594	-1.833724	0.0667
C(4)	-0.210948	0.100575	-2.09742	0.0360
C(5)	0.317135	0.053356	5.943780	0.0000
C(7)	0.088185	0.157197	0.560985	0.5748
C(8)	0.255410	0.112722	2.265847	0.0235
C(9)	0.225401	0.255579	0.881926	0.3778
C(1)	0.272373	0.033527	8.124038	0.0000
C(3)	0.489104	0.060204	8.124038	0.0000
C(6)	0.149913	0.018453	8.124038	0.0000
C(10)	0.220101	0.027093	8.124038	0.0000
Log likelihood	-8.204428			

Estimated A matrix:

1.000000	0.000000	0.000000	0.000000
0.573210	1.000000	0.000000	0.000000
0.210948	-0.317135	1.000000	0.000000
-0.088185	-0.25541	-0.225401	1.000000

Estimated B matrix:

0.272373	0.000000	0.000000	0.000000
0.000000	0.489104	0.000000	0.000000
0.000000	0.000000	0.149913	0.000000
0.000000	0.000000	0.000000	0.220101

Source: Author's computations

Table C2: Structural VAR Estimates for Manufacturing Sector

Structural VAR Estimates
Date: 04/27/21 Time: 22:20
Sample (adjusted): 1985 2017
Included observations: 33 after adjustments
Estimation method: method of scoring (analytic derivatives)
Convergence achieved after 6 iterations
Structural VAR is just-identified

Model: Ae = Bu where E[uu']=I
Restriction Type: short-run text form
@e1 = C(1)*@u1
@e2 = C(2)*@e1 + C(3)*@u2
@e3 = C(4)*@e1 + C(5)*@e2 + C(6)*@u3
@e4 = C(7)*@e1 + C(8)*@e2 + C(9)*@e3 + C(10)*@u4
where
@e1 represents LNOIL residuals; @e2 represents LNGAP residuals
@e3 represents LNEXR residuals; @e4 represents SPRICE residuals

	Coefficient	Std. Error	z-Statistic	Prob.
C(2)	-0.459943	0.324472	-1.417511	0.1563
C(4)	-0.149068	0.106232	-1.403233	0.1605
C(5)	0.344789	0.055333	6.231130	0.0000
C(7)	0.050176	0.100069	0.501416	0.6161
C(8)	0.000804	0.074702	0.010759	0.9914
C(9)	0.589666	0.159296	3.701711	0.0002
C(1)	0.270257	0.033266	8.124038	0.0000
C(3)	0.503745	0.062007	8.124038	0.0000
C(6)	0.160123	0.019710	8.124038	0.0000
C(10)	0.146526	0.018036	8.124038	0.0000
Log likelihood	2.332359			

Estimated A matrix:

1.000000	0.000000	0.000000	0.000000
0.459943	1.000000	0.000000	0.000000
0.149068	-0.344789	1.000000	0.000000
-0.050176	-0.000804	-0.589666	1.000000

Estimated B matrix:

0.270257	0.000000	0.000000	0.000000
0.000000	0.503745	0.000000	0.000000
0.000000	0.000000	0.160123	0.000000
0.000000	0.000000	0.000000	0.146526

Source: Author's computations

Table C3: Structural VAR Estimates for Services Sector

Structural VAR Estimates
Date: 04/28/21 Time: 19:58
Sample (adjusted): 1985 2017
Included observations: 33 after adjustments
Estimation method: method of scoring (analytic derivatives)
Convergence achieved after 7 iterations
Structural VAR is just-identified

Model: Ae = Bu where E[uu']=I
Restriction Type: short-run text form

@e1 = C(1)*@u1
@e2 = C(2)*@e1 + C(3)*@u2
@e3 = C(4)*@e1 + C(5)*@e2 + C(6)*@u3
@e4 = C(7)*@e1 + C(8)*@e2 + C(9)*@e3 + C(10)*@u4
where
@e1 represents LNOIL residuals; @e2 represents LNGAP residuals
@e3 represents LNEXR residuals; @e4 represents SPRICE residuals

	Coefficient	Std. Error	z-Statistic	Prob.
C(2)	-0.49719	0.32079	-1.54990	0.12120
C(4)	-0.16429	0.10552	-1.55687	0.11950
C(5)	0.37249	0.05529	6.73738	0.00000
C(7)	0.17624	0.06872	2.56481	0.01030
C(8)	-0.12902	0.05356	-2.40893	0.01600
C(9)	0.60311	0.10941	5.51234	0.00000
C(1)	0.27332	0.03364	8.12404	0.00000
C(3)	0.50366	0.06200	8.12404	0.00000
C(6)	0.15996	0.01969	8.12404	0.00000
C(10)	0.10054	0.01238	8.12404	0.00000
Log likelihood	14.43033			

Estimated A matrix:

1.00000	0.00000	0.00000	0.00000
0.49719	1.00000	0.00000	0.00000
0.16429	-0.37249	1.00000	0.00000
-0.17624	0.12902	-0.60311	1.00000

Estimated B matrix:

0.27332	0.00000	0.00000	0.00000
0.00000	0.50366	0.00000	0.00000
0.00000	0.00000	0.15996	0.00000
0.00000	0.00000	0.00000	0.10054

Source: Authors computations

Table C4: Accumulated Response of SPRICE for Agriculture Sector

Structural One Standard Deviation Shock to:				
Period	Shock1	Shock2	Shock3	Shock4
1	-0.03997	0.15988	0.03379	0.22010
2	-0.07924	0.17473	0.11401	0.33725
3	-0.10175	0.16933	0.17777	0.40431
4	-0.11603	0.16396	0.22081	0.44626
5	-0.12524	0.16037	0.24898	0.47326
6	-0.13123	0.15807	0.26731	0.49079
7	-0.13513	0.15660	0.27924	0.50220
8	-0.13767	0.15565	0.28700	0.50963
9	-0.13933	0.15503	0.29206	0.51448
10	-0.14040	0.15463	0.29535	0.51763
11	-0.14111	0.15437	0.29750	0.51968
12	-0.14156	0.15419	0.29890	0.52102
13	-0.14186	0.15408	0.29981	0.52189
14	-0.14206	0.15401	0.30040	0.52246

Note: Shock1=LNOIL; Shock2=LNGAP; Shock3=LNEXR; Shock4=SPRICE
Source: Author's computations

Table C5: Accumulated Response of LNEXR for Agriculture Sector

Structural One Standard Deviation Shock to:				
Period	Shock1	Shock2	Shock3	Shock4
1	-0.10697	0.15511	0.14991	0.00000
2	-0.14195	0.23279	0.25100	0.09775
3	-0.17303	0.25360	0.32987	0.18646
4	-0.19393	0.25491	0.38824	0.24748
5	-0.20762	0.25210	0.42848	0.28754
6	-0.21652	0.24932	0.45530	0.31361
7	-0.22232	0.24727	0.47292	0.33057
8	-0.22609	0.24589	0.48443	0.34161
9	-0.22855	0.24498	0.49193	0.34880
10	-0.23015	0.24438	0.49682	0.35349
11	-0.23119	0.24399	0.50001	0.35654
12	-0.23187	0.24374	0.50208	0.35852
13	-0.23231	0.24358	0.50344	0.35982
14	-0.23260	0.24347	0.50432	0.36066

Note: Shock1=LNOIL; Shock2=LNGAP; Shock3=LNEXR; Shock4=SPRICE
Source: Author's computations

Table C6: Accumulated Response of SPRICE for Manufacturing Sector

Structural One Standard Deviation Shock to:				
Period	Shock1	Shock2	Shock3	Shock4
1	-0.03557	0.10282	0.09442	0.14653
2	-0.04355	0.11200	0.19942	0.20990
3	-0.05009	0.11218	0.27202	0.24294
4	-0.05451	0.11321	0.31887	0.26313
5	-0.05744	0.11449	0.34909	0.27613
6	-0.05936	0.11554	0.36870	0.28461
7	-0.06061	0.11627	0.38150	0.29016
8	-0.06144	0.11676	0.38985	0.29379
9	-0.06197	0.11709	0.39531	0.29617
10	-0.06232	0.11730	0.39889	0.29772
11	-0.06255	0.11744	0.40122	0.29874
12	-0.06270	0.11753	0.40275	0.29940
13	-0.06280	0.11759	0.40375	0.29984
14	-0.06287	0.11763	0.40440	0.30012

Note: Shock1=LNOIL; Shock2=LNGAP; Shock3=LNEXR; Shock4=SPRICE
Source: Author's computations

Table C7: Accumulated Response of LNEXR for Manufacturing Sector

Structural One Standard Deviation Shock to:				
Period	Shock1	Shock2	Shock3	Shock4
1	-0.08315	0.17369	0.16012	0.00000
2	-0.10231	0.25684	0.29055	0.06779
3	-0.11451	0.28420	0.39435	0.11931
4	-0.12217	0.29364	0.46809	0.15347
5	-0.12714	0.29764	0.51782	0.17564
6	-0.13038	0.29978	0.55066	0.19005
7	-0.13250	0.30109	0.57221	0.19945
8	-0.13389	0.30193	0.58630	0.20558
9	-0.13480	0.30248	0.59552	0.20959
10	-0.13539	0.30284	0.60155	0.21222
11	-0.13578	0.30307	0.60549	0.21393
12	-0.13603	0.30322	0.60807	0.21505
13	-0.13620	0.30332	0.60976	0.21579
14	-0.13631	0.30339	0.61086	0.21627

Note: Shock1=LNOIL; Shock2=LNGAP; Shock3=LNEXR; Shock4=SPRICE
Source: Author's computations

Table C8: Accumulated Response of SPRICE for Services Sector

Structural One Standard Deviation Shock to:				
Period	Shock1	Shock2	Shock3	Shock4
1	0.00809	0.04817	0.09647	0.10054
2	-0.02222	0.21865	0.21026	0.10947
3	-0.04110	0.32260	0.30966	0.10575
4	-0.05246	0.37543	0.37934	0.10697
5	-0.05994	0.40837	0.42578	0.10993
6	-0.06522	0.43228	0.45746	0.11216
7	-0.06896	0.44958	0.47952	0.11354
8	-0.07157	0.46169	0.49494	0.11444
9	-0.07338	0.47006	0.50567	0.11506
10	-0.07464	0.47586	0.51313	0.11549
11	-0.07551	0.47989	0.51831	0.11580
12	-0.07612	0.48269	0.52192	0.11601
13	-0.07654	0.48464	0.52442	0.11616
14	-0.07683	0.48600	0.52616	0.11626

Note: Shock1=LNOIL; Shock2=LNGAP; Shock3=LNEXR; Shock4=SPRICE
Source: Author's computations

Table C9: Accumulated Response of LNEXR for Services Sector

Structural One Standard Deviation Shock to:				
Period	Shock1	Shock2	Shock3	Shock4
1	-0.09552	0.18761	0.15996	0.00000
2	-0.11355	0.29828	0.28458	-0.00179
3	-0.12731	0.35881	0.36882	0.00190
4	-0.13658	0.40020	0.42549	0.00584
5	-0.14317	0.43041	0.46461	0.00845
6	-0.14780	0.45189	0.49193	0.01008
7	-0.15102	0.46681	0.51099	0.01118
8	-0.15325	0.47712	0.52424	0.01195
9	-0.15480	0.48428	0.53345	0.01249
10	-0.15588	0.48926	0.53985	0.01287
11	-0.15663	0.49272	0.54430	0.01313
12	-0.15715	0.49513	0.54739	0.01331
13	-0.15751	0.49680	0.54954	0.01344
14	-0.15777	0.49796	0.55104	0.01353

Note: Shock1=LNOIL; Shock2=LNGAP; Shock3=LNEXR; Shock4=SPRICE
Source: Author's computations

Table C10: Test Serial Correlation Test for Agriculture Sector

VAR Residual Serial Correlation LM Tests

Null Hypothesis: no serial correlation at lag order h

Date: 04/27/21   Time: 22:01

Sample: 1983 2017

Included observations: 33

Lags	LM-Stat	Prob
1	25.29079	0.0649
2	18.89931	0.2739

Probs from chi-square with 16 df.

Source: Author's computations

Table C11: Serial Correlation for Manufacturing Sector

VAR Residual Serial Correlation LM Tests

Null Hypothesis: no serial correlation at lag order h

Date: 04/27/21   Time: 22:44

Sample: 1983 2017

Included observations: 33

Lags	LM-Stat	Prob
1	14.21927	0.5824
2	22.54854	0.1263

Probs from chi-square with 16 df.

Source: Author's computations

Table C12: Serial Correlation Test for Services Sector

VAR Residual Serial Correlation LM Tests

Null Hypothesis: no serial correlation at lag order h

Date: 04/28/21   Time: 19:58

Sample: 1983 2017

Included observations: 33

Lags	LM-Stat	Prob
1	41.36488	0.0005
2	24.03812	0.0887
3	16.80088	0.3986

Probs from chi-square with 16 df.

Source: Author's computations

Table C13: VAR Residual Heteroskedasticity Tests for Agriculture Sector

VAR Residual Heteroskedasticity Tests: No Cross Terms (only levels and squares)

Date: 04/27/21 Time: 22:03

Sample: 1983 2017

Included observations: 33

Joint test:

Chi-sq	df	Prob.
124.3983	100	0.0496

Individual components:

Dependent	R-squared	F(10,22)	Prob.	Chi-sq(10)	Prob.
res1*res1	0.240942	0.698328	0.716	7.951075	0.6336
res2*res2	0.618196	3.562123	0.0062	20.40048	0.0257
res3*res3	0.39041	1.408984	0.2403	12.88354	0.2303
res4*res4	0.388634	1.398497	0.2447	12.82491	0.2336
res2*res1	0.359182	1.233111	0.3246	11.853	0.295
res3*res1	0.215386	0.603927	0.7939	7.107745	0.7152
res3*res2	0.453158	1.823101	0.1155	14.95422	0.1337
res4*res1	0.391441	1.415097	0.2377	12.91755	0.2283
res4*res2	0.399254	1.462111	0.219	13.17537	0.214
res4*res3	0.393474	1.427217	0.2328	12.98465	0.2245

Source: Author's computations

Table C14: VAR Residual Heteroskedasticity Test for Manufacturing Sector

VAR Residual Heteroskedasticity Tests: No Cross Terms (only levels and squares)

Date: 04/27/21 Time: 22:47

Sample: 1983 2017

Included observations: 33

Joint test:

Chi-sq	df	Prob.
127.9181	100	0.0313

Individual components:

Dependent	R-squared	F(10,22)	Prob.	Chi-sq(10)	Prob.
res1*res1	0.363987	1.259048	0.3107	12.01157	0.2843
res2*res2	0.670814	4.483161	0.0016	22.13688	0.0144
res3*res3	0.506485	2.257818	0.0535	16.71401	0.0809
res4*res4	0.616816	3.541367	0.0064	20.35493	0.0261
res2*res1	0.34062	1.13647	0.3809	11.24048	0.3391
res3*res1	0.564	2.845866	0.0196	18.61198	0.0455
res3*res2	0.509341	2.283761	0.0511	16.80824	0.0787
res4*res1	0.555673	2.751309	0.0229	18.33721	0.0495
res4*res2	0.598463	3.278941	0.0097	19.74926	0.0317
res4*res3	0.544256	2.627272	0.0283	17.96045	0.0556

Source: Author's computations

Table C15: VAR Residual Heteroskedasticity Tests for Services

VAR Residual Heteroskedasticity Tests: No Cross Terms (only levels and squares)
Date: 04/28/21 Time: 19:55
Sample: 1983 2017; Included observations: 33

Joint test:

Chi-sq	df	Prob.
124.8418	100	0.0469

Individual components:

Dependent	R-squared	F(10,22)	Prob.	Chi-sq(10)	Prob.
res1*res1	0.34289	1.14799	0.37380	11.31532	0.33350
res2*res2	0.66122	4.29379	0.00210	21.82009	0.01600
res3*res3	0.43043	1.66259	0.15370	14.20432	0.16390
res4*res4	0.18918	0.51331	0.86250	6.24298	0.79450
res2*res1	0.32899	1.07866	0.41810	10.85678	0.36880
res3*res1	0.32181	1.04391	0.44170	10.61960	0.38790
res3*res2	0.60049	3.30672	0.00920	19.81610	0.03100
res4*res1	0.18701	0.50605	0.86760	6.17122	0.80070
res4*res2	0.82649	10.47917	0.00000	27.27407	0.00240
res4*res3	0.50755	2.26744	0.05260	16.74908	0.08010

Source: Author's computations

Table C16: Normality Test for Agriculture Sector

VAR Residual Normality Tests
Orthogonalization: Cholesky (Lutkepohl)
Null Hypothesis: residuals are multivariate normal
Date: 04/27/21 Time: 22:09; Sample: 1983 2017; Included observations: 33

Component	Skewness	Chi-sq	df	Prob.
1	-0.5025	1.3889	1	0.2386
2	0.5319	1.5561	1	0.2122
3	0.1100	0.0666	1	0.7964
4	0.8491	3.9649	1	0.0465
Joint		6.9765	4	0.1371
Component	Kurtosis	Chi-sq	df	Prob.
1	3.5210	0.3732	1	0.5413
2	4.2268	2.0693	1	0.1503
3	2.9204	0.0087	1	0.9256
4	4.4500	2.8909	1	0.0891
Joint		5.3421	4	0.2540
Component	Jarque-Bera	df	Prob.	
1	1.7621	2	0.4143	
2	3.6254	2	0.1632	
3	0.0753	2	0.9630	
4	6.8558	2	0.0325	
Joint	12.3186	8	0.1375	

Source: Author's computations

Table C17: VAR Residual Normality Tests for Manufacturing Sector

VAR Residual Normality Tests

Orthogonalization: Cholesky (Lutkepohl)

Null Hypothesis: residuals are multivariate normal

Date: 04/27/21 Time: 22:46

Sample: 1983 2017

Included observations: 33

Component	Skewness	Chi-sq	df	Prob.
1	-0.528754	1.537695	1	0.215
2	0.230223	0.291515	1	0.5893
3	0.507135	1.414524	1	0.2343
4	-0.488122	1.310445	1	0.2523
Joint		4.554179	4	0.3362
Component	Kurtosis	Chi-sq	df	Prob.
1	3.894108	1.099216	1	0.2944
2	3.560475	0.431932	1	0.511
3	3.464633	0.296841	1	0.5859
4	4.310311	2.360757	1	0.1244
Joint		4.188746	4	0.3811
Component	Jarque-Bera	df	Prob.	
1	2.636911	2	0.2675	
2	0.723448	2	0.6965	
3	1.711365	2	0.425	
4	3.671202	2	0.1595	
Joint	8.742925	8	0.3644	

Source: Author’s computations

Table C18: VAR Residual Normality Tests for Services Sector

VAR Residual Normality Tests

Orthogonalization: Cholesky (Lutkepohl)

Null Hypothesis: residuals are multivariate normal

Date: 04/28/21 Time: 19:56

Sample: 1983 2017

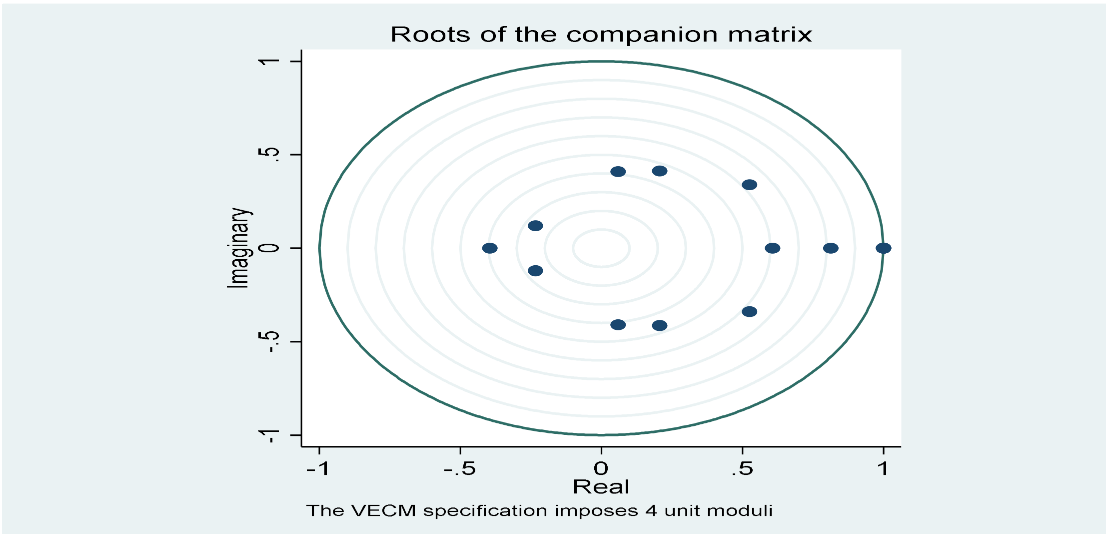
Included observations: 33

Component	Skewness	Chi-sq	df	Prob.
1	-0.4646	1.1873	1	0.2759
2	0.5999	1.9796	1	0.1594
3	0.8015	3.5335	1	0.0601
4	0.3234	0.5752	1	0.4482
Joint		7.2756	4	0.1220
Component	Kurtosis	Chi-sq	df	Prob.
1	3.7384	0.7497	1	0.3866
2	4.2071	2.0034	1	0.1569
3	4.1153	1.7103	1	0.1909
4	4.5323	3.2283	1	0.0724
Joint		7.6917	4	0.1035
Component	Jarque-Bera	df	Prob.	
1	1.9370	2	0.3797	
2	3.9830	2	0.1365	
3	5.2438	2	0.0727	
4	3.8035	2	0.1493	
Joint	14.9673	8	0.0598	

Source: Author's computations

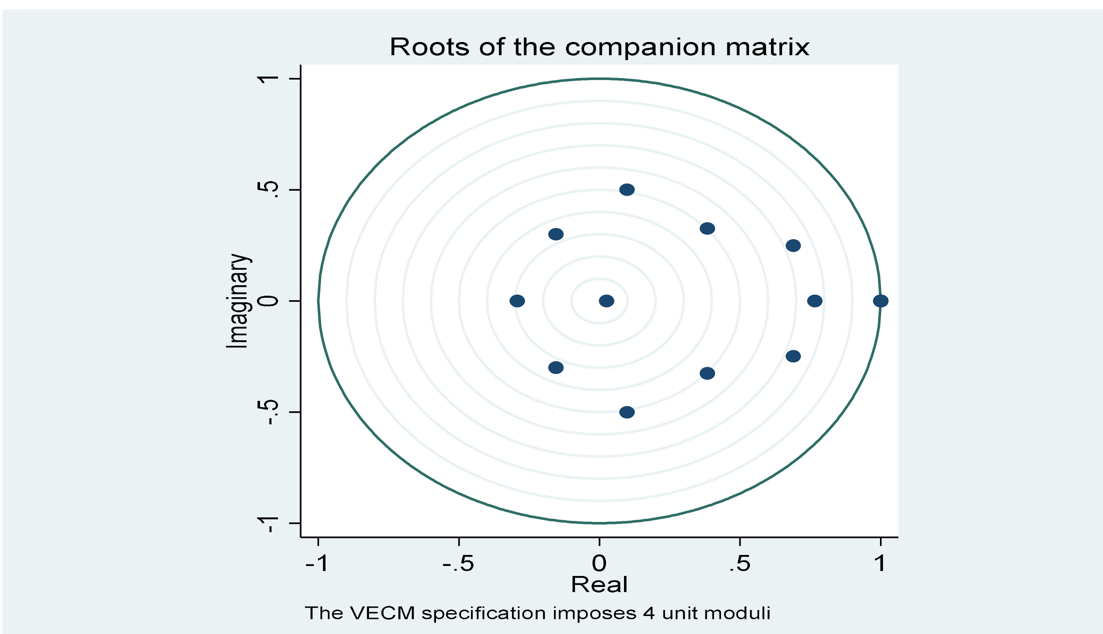
APPENDIX D: ESTIMATIONS FROM GLOBALISATION MODELS

Figure D1: Stability Condition for the Impact of Chinese Presence on ERPT to Consumer Prices



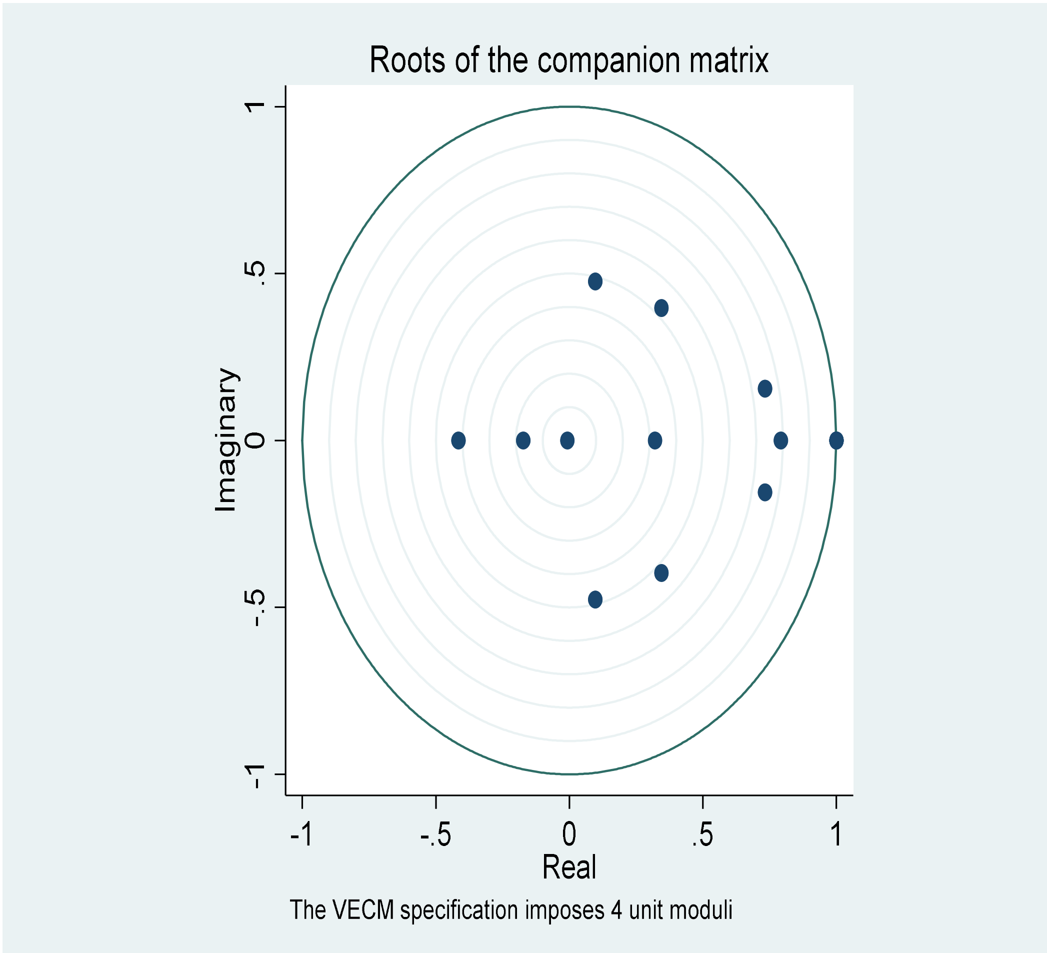
Source: Author's computations

Figure D2: Stability Condition for the Impact of Regional Globalisation on ERPT to Consumer Prices



Source: Author's computations

Figure D3: Stability Condition for the Impact of Multilateral Globalisation on ERPT to Consumer Prices



Source: Author’s computations

Table D1: VECM Output for Baseline VECM Model

Results For Long Run or Co-integration Equation for Baseline Model

Target Variable: lncpi

Johansen normalization restriction imposed on lncpi

Variable	Coef.	Std. Err.	Z	P>|z|	[95% Conf. Interval]	
lncpi	1.00000					
lnexr	-1.06405	0.02901	-36.67	0.000	-1.120917	-1.007184
lnoil	-0.37084	0.03651	-10.16	0.000	-.4424054	-.2992701
gap	0.14872	0.11224	1.330	0.185	-.0712681	.3687177
tbil	0.06553	0.02813	2.330	0.020	.0104012	.1206679
_Cons	-1.53026					

Results For Short Run Equation for Baseline Model

Target Variable: *lncpi* [D(*lncpi*)]

Variable	Coef.	Std. Err.	z	P>|z|	[95% Conf. Interval]	
CointEq1	-0.0222	0.0095	-2.33	0.02	-.0407527	-.0035421
D [lncpi(-1)]	0.3141	0.0773	4.06	0	.1625629	.465632
D [lnexr(-1)]	0.0551	0.0132	4.19	0	.029324	.080885
D [lnoil(-1)]	-0.0045	0.0067	-0.67	0.503	-.0177086	.0086859
D [gap(-1)]	0.0107	0.0349	0.31	0.759	-.0576252	.0790407
D [tbil(-1)]	-0.0001	0.0042	-0.03	0.979	-.0083837	.0081627
_Cons	0.0046	0.0007	6.21	0	.0031284	.0060162

R-squared: 0.7042; Chi2 (321.3385-Prob:0.00); AIC:-21.0231; SBIC:-20.211; HQIC:-20.693

Note: Reported standard errors are robust to heteroscedasticity

Source: Authors computations

Table D2: VECM Output for Accounting for Chinese Presence

Results For Long Run or Co-integration Equation for Chinese Presence Model

Target Variable: lncpi

Johansen normalization restriction imposed on lncpi

Variable	Coef.	Std. Err.	z	P>|z|	[95% Conf. Interval]	
lncpi	1.0000					
lnexr	-1.326	0.06035	-21.98	0.000	-1.4446	-1.20812
lnoil	-0.487	0.05596	-8.690	0.000	-.5962363	-.3768614
gap	-0.010	0.15692	-0.060	0.948	-.3177426	.297366
tbil	0.037	0.03943	0.950	0.344	-.0399999	.1145567
lnchina	0.204	0.03466	5.900	0.000	.1365218	.2723882
_cons	-0.931					

Results For Short Run Equation for Accounting for Chinese Presence

Target Variable: lncpi [D(lncpi)]

Variable	Coef.	Std. Err.	z	P>|z|	[95% Conf. Interval]	
CointEq1	-0.0074	0.0062	-1.19	0.234	-.019496	.00477
D [lncpi(-1)]	0.3401	0.0798	4.26	0.000	.1835906	.49654
D [lnexr(-1)]	0.0625	0.0126	4.97	0.000	.0378511	.08712
D [lnoil(-1)]	-0.0006	0.0064	-0.10	0.923	-.013107	.01188
D [gap(-1)]	0.0164	0.0358	0.46	0.648	-.053847	.08659
D [tbil(-1)]	0.0002	0.0043	0.05	0.959	-.008271	.008717
D [lnchina(-1)]	-0.0017	0.0013	-1.38	0.166	-.00417	.000717
_Cons	0.0042	0.0007	5.820	0.000	.002751	.005544

R-squared: 0.7067; Chi2 (322.8855-Prob:0.00); AIC:-19.8649; SBIC:-18.7617; HQIC:-19.4166

Note: Reported standard errors are robust to heteroscedasticity

Source: Author's computations

Table D3: VECM Output for Accounting for Regional Globalisation

Results For Long Run or Co-integration Equation for Regional Globalisation Model

Target Variable: lncpi

Johansen normalization restriction imposed on lncpi

Variable	Coef.	Std. Err.	z	P>|z|	[95% Conf. Interval]	
lncpi	1.0000					
lnexr	-1.0621	0.0303	-35.0400	0.0000	-1.121488	-1.002673
lnoil	-0.3997	0.0405	-9.8700	0.0000	-.4790112	-.3203271
lngap	0.1059	0.1176	0.9000	0.3680	-.1245013	.3363899
tbil	0.0472	0.0294	1.6000	0.1090	-.0104908	.1048053
region	-0.1479	0.0768	-1.9300	0.0540	-.2985309	.0026568
_cons	-0.7748					

Results For Short Run Equation for Accounting for Regional Globalisation Model

Target Variable: lncpi [D(lncpi)]

Variable	Coef.	Std. Err.	z	P>|z|	[95% Conf. Interval]	
CointEq1	-0.0228	0.0089	-2.5500	0.0110	-.04026	-.005249
D [lncpi(-1)]	0.3095	0.0770	4.0200	0.0000	.15854	.4605003
D [lnexr(-1)]	0.0548	0.0127	4.3200	0.0000	.02993	.0796902
D [lnoil(-1)]	-0.0061	0.0066	-0.9200	0.3560	-.01915	.006881
D [gap(-1)]	0.0096	0.0345	0.2800	0.7810	-.05799	.077212
D [tbil(-1)]	-0.0008	0.0042	-0.1900	0.8460	-.00896	.0073453
D [region (-1)]	0.0075	0.0049	1.5400	0.1230	-.00202	.017024
_Cons	0.0047	0.0007	6.3200	0.0000	.00322	.0061195

R-squared: 0.706; Chi2 (322.2815-Prob:0.00); AIC:-28.5297; SBIC:-27.427; HQIC:-28.0814

Note: Reported standard errors are robust to heteroscedasticity

Source: Author's computations

Table D4: VECM Output for Accounting for Multilateral Globalisation Model

Results For Long Run or Co-integration Equation for Globalisation VECM Model

Target Variable: lncpi

Johansen normalization restriction imposed on lncpi

Variable	Coef.	Std. Err.	z	P>|z|	[95% Conf. Interval]	
lncpi	1.0000					
lnexr	-1.1270	0.0474	-23.7900	0.0000	-1.219779	-1.034116
lnoil	-0.4204	0.0428	-9.8200	0.0000	-.5043663	-.3365179
gap	0.1002	0.1166	0.8600	0.3900	-.1281967	.3286753
tbil	0.0376	0.0307	1.2200	0.2210	-.0226400	.0977957
global	0.2539	0.1532	1.6600	0.0970	-.0463658	.5540768
_cons	-1.3159					

Results For Short Run Equation for Accounting for Multilateral Globalisation VECM Model

Target Variable: lncpi [D(lncpi)]

Variable	Coef.	Std. Err.	z	P>|z|	[95% Conf. Interval]	
CointEq1	-0.0210	0.0092	-2.2900	0.0220	-.03908	-.002996
D [lncpi(-1)]	0.3045	0.0779	3.9100	0.0000	.15169	.457209
D [lnexr(-1)]	0.0573	0.0130	4.3900	0.0000	.03173	.082853
D [lnoil(-1)]	-0.0048	0.0068	-0.7100	0.4800	-.01810	.008518
D [gap(-1)]	0.0193	0.0358	0.5400	0.5900	-.05080	.089389
D [tbil(-1)]	-0.0002	0.0042	-0.0500	0.9590	-.00850	.00807
D [global(-1)]	-0.0552	0.0646	-0.8500	0.3930	-.18189	.071425
_Cons	0.0049	0.0008	6.3200	0.0000	.00337	.006406

R-squared: 0.706; Chi2 (322.2815-Prob:0.00); AIC:-28.5297; SBIC:-27.427; HQIC:-28.0814

Note: Reported standard errors are robust to heteroscedasticity

Source: Author's computations

Table 5D: VECM Output for Impact of Chinese Presence on ERPT to Consumer Prices

Results For Long Run Equation for Chinese Presence Impact on ERPT to Consumer Prices

Target Variable: lncpi [lncpi]

Johansen normalization restriction imposed on lncpi

Variable	Coef.	Std. Err.	z	P>z	95% Conf. Interval	
lncpi	1.0000					
echina	-0.2740	0.0195	-14.0600	0.0000	-0.3122	-0.2358
lnoil	-0.3308	0.1034	-3.2000	0.0010	-0.5335	-0.1281
gap	0.6216	0.3380	1.8400	0.0660	-0.0409	1.2841
tbil	0.0292	0.0834	0.3500	0.7260	-0.1342	0.1926
_Const	-2.5053					

Results For Short Run Equation for Chinese Presence Impact ERPT to Consumer Prices

Target Variable: lncpi [D(lncpi)]

Variable	Coef.	Std. Err.	z	P>z	95% Interval	Conf.
CointEq1	-0.0045	0.0041	-1.1	0.2710	-0.0126	0.0035
D [lncpi(-1)]	0.5534	0.0862	6.42	0.0000	0.3845	0.7224
D [lncpi(-2)]	-0.0910	0.0877	-1.04	0.3000	-0.2629	0.0809
D [echina(-1)]	-0.0015	0.0011	-1.41	0.1580	-0.0036	0.0006
D [echina(-2)]	0.0010	0.0009	1.14	0.2530	-0.0007	0.0028
D [lnoil(-1)]	-0.0041	0.0070	-0.59	0.5580	-0.0178	0.0096
D [lnoil(-2)]	-0.0107	0.0072	-1.48	0.1390	-0.0248	0.0035
D [gap(-1)]	0.0264	0.0561	0.47	0.6380	-0.0835	0.1363
D [gap(-2)]	0.0071	0.0558	0.13	0.8990	-0.1023	0.1165
D [tbil(-1)]	0.0034	0.0048	0.71	0.4800	-0.0060	0.0127
D [tbil(-2)]	-0.0002	0.0048	-0.04	0.9680	-0.0095	0.0091
_Const	0.0042	0.0009	4.87	0.0000	0.0025	0.0059

R-squared: 0.659; Chi2 (249.327-Prob:0.00); AIC:-14.862; SBIC:-13.524; HQIC:-14.318

Note: Reported standard errors are robust to heteroscedasticity

Source: Author's computations

Table D6: VECM: The Impact of Regional Globalisation on ERPT
Long Run Results: Impact of Regional globalisation on ERPT to Consumer Prices

Target Variable: lncpi [lncpi]

Johansen normalization restriction imposed on lncpi

Variable	Coef.	Std. Err.	z	P>z	95% Conf. Interval	
lncpi	1.0000					
eregion	-0.2617	0.0155	-16.85	0.0000	-0.2921	-0.231
lnoil	-0.7651	0.0852	-8.98	0.0000	-0.9322	-0.598
gap	0.7225	0.2562	2.82	0.0050	0.2204	1.224
tbil	-0.0283	0.0638	-0.44	0.6570	-0.1533	0.096
_Const	0.4368					

Short Run Results: Impact of Regional Globalisation on ERPT

Target Variable: lncpi [D(lncpi)]

Variable	Coef.	Std. Err.	z	P>z	95% Conf. Interval	
CointEq1	-0.0159	0.0051	-3.08	0.002	-0.0259	-0.005
D [lncpi(-1)]	0.2785	0.0869	3.2	0.0010	0.1081	0.4488
D [lncpi(-2)]	-0.0314	0.0788	-0.4	0.6900	-0.1858	0.1229
D [ergion(-1)]	0.0080	0.0021	3.91	0.0000	0.0040	0.0121
D [ergion(-2)]	0.0048	0.0021	2.27	0.0230	0.0007	0.0090
D [lnoil(-1)]	-0.0019	0.0064	-0.29	0.7680	-0.0144	0.0107
D [lnoil(-2)]	-0.0188	0.0069	-2.71	0.0070	-0.0324	-0.0052
D [gap(-1)]	0.0229	0.0494	0.46	0.6430	-0.0740	0.1198
D [gap(-2)]	0.0461	0.0495	0.93	0.3510	-0.0509	0.1431
D [tbil(-1)]	-0.0001	0.0042	-0.04	0.9720	-0.0084	0.0081
D [tbil(-2)]	-0.0020	0.0042	-0.47	0.6390	-0.0102	0.0063
_Const	0.0062	0.0010	6.51	0.0000	0.0044	0.0081

R-squared: 0.732; Chi2 (351.463-Prob:0.00); AIC-17.148:-; SBIC:-15.810; HQIC:-16.604

Note: Reported standard errors are robust to heteroscedasticity

Source: Author's computations

Table 7D: VECM: Impact of Multilateral Globalization on ERPT to Consumer Prices

Results For Long Run Equation for Globalisation Impact on ERPT to Consumer Prices

Target Variable: lncpi [lncpi]

Johansen normalization restriction imposed on lncpi

Variable	Coef.	Std. Err.	z	P>z	95% Conf. Interval	
lncpi	1.0000					
eglobal	-0.9766	0.1280	-7.630	0.0000	-1.2274	-0.7257
lnoil	0.6315	0.1838	3.4400	0.0010	0.2713	0.9916
gap	-1.169	0.6108	-1.920	0.0550	-2.3669	0.0275
tbil	0.5621	0.1626	3.4600	0.0010	0.2434	0.8807
_Const	-7.645					

Results For Short Run Equation for Globalisation Impact on ERPT to Consumer Prices

Target Variable: lncpi [D(lncpi)]

Variable	Coef.	Std. Err.	z	P>z	95% Conf. Interval	
CointEq1	0.0046	0.0023	1.97	0.0490	0.0000	0.0091
D [lncpi(-1)]	0.3620	0.0886	4.08	0.0000	0.1882	0.5357
D [lncpi(-2)]	0.0469	0.0869	0.54	0.5890	-0.1234	0.2172
D [eglobal(-1)]	0.0803	0.0178	4.52	0.0000	0.0455	0.1151
D [eglobal(-2)]	0.0229	0.0181	1.26	0.2060	-0.0126	0.0583
D [lnoil(-1)]	0.0044	0.0066	0.68	0.4990	-0.0084	0.0173
D [lnoil(-2)]	-0.0075	0.0066	-1.13	0.2590	-0.0205	0.0055
D [gap(-1)]	0.0284	0.0532	0.53	0.5940	-0.0760	0.1327
D [gap(-2)]	0.0462	0.0543	0.85	0.3950	-0.0602	0.1525
D [tbil(-1)]	0.0021	0.0044	0.48	0.6330	-0.0066	0.0108
D [tbil(-2)]	0.0007	0.0044	0.16	0.8760	-0.0080	0.0094
_Const	0.0035	0.0008	4.2	0.0000	0.0019	0.0052

R-squared: 0.701; Chi2 (303.726-Prob:0.00); AIC:-21.296; SBIC:-19.958; HQIC:-20.752

Note: Reported standard errors are robust to heteroscedasticity

Source: Author's computations

Table D8: VECM Diagnostic Tests for all VECM Models for Accounting for Globalisation

VECM Diagnostic Tests for Baseline Model

Test Type	LM-Stat/ Chi-square	Probability
Lagrange Multiplier test for Serial Correlation	1 18.3844	0.8256
VECM-Jarque Bera-Residual Normality test	555.3140	0.0000

VECM Diagnostic Tests for Accounting for Regional Globalisation Model

Test Type	LM-Stat/ Chi-square	Probability
Lagrange Multiplier test for Serial Correlation	33.67200	0.5798
VECM-Jarque Bera-Residual Normality test	1756.4610	0.0000

VECM Diagnostic Tests for Accounting for Chinese Presence Model

Test Type	LM-Stat/ Chi-square	Probability
Lagrange Multiplier test for Serial Correlation	38.43780	0.3597
VECM-Jarque Bera-Residual Normality test	1673.8920	0.0000

VECM Diagnostic Tests for Accounting for Globalisation Model

Test Type	LM-Stat/ Chi-square	Probability
Lagrange Multiplier test for Serial Correlation	30.78590	0.7147
VECM-Jarque Bera-Residual Normality test	2037.6650	0.0000

Source: Author's computations

Table D9: VECM Diagnostic Tests for the Impact of Globalisation on ERPT to Consumer Prices

VECM Diagnostic Tests for the Impact of Regional Globalisation Model on ERPT to Consumer Prices		
Test Type	LM-Stat/ Chi-square	Probability
Lagrange Multiplier test for Serial Correlation	33.0586	0.0000
VECM-Jarque Bera-Residual Normality test	1157.26	0.0000

VECM Diagnostic Tests for the Impact of Chinese Presence on ERPT to Consumer Prices		
Test Type	LM-Stat/ Chi-square	Probability
Lagrange Multiplier test for Serial Correlation	36.6572	0.0622
VECM-Jarque Bera-Residual Normality test	1673.8920	0.0000

VECM Diagnostic Tests for the Impact of Multilateral Globalisation on ERPT to Consumer Prices		
Test Type	LM-Stat/ Chi-square	Probability
Lagrange Multiplier test for Serial Correlation	27.9572	0.3098
VECM-Jarque Bera-Residual Normality test	673.861	0.0000

Source: Author's computations

Table D10: AR Roots for VECM Stability for Baseline Model

Root	Modulus
1	1
1	1
1	1
1	1
0.7476525	0.747652
.5030407 + .3037406i	0.587629
.5030407 - .3037406i	0.587629
0.4806224	0.480622
.211496 + .1057451i	0.236458
.211496 - .1057451i	0.236458
The VECM specification imposes 4 unit moduli.	

Source: Author's computations

Table D11: AR Roots for VECM Stability- Accounting for Chinese Presence Model

Root	Modulus
1	1
1	1
1	1
1	1
1	1
0.7692258	0.769226
0.4962187	0.496219
.4014327 + .2799581i	0.489413
.4014327 - .2799581i	0.489413
-0.3315018	0.331502
.2029378 + .09583388i	0.224428
.2029378 - .09583388i	0.224428

The VECM specification imposes 5 unit moduli.

Source: Author’s computations

Table D12: AR Roots for VECM Stability- Accounting for Regional Globalisation Model

Root	Modulus
1	1
1	1
1	1
1	1
1	1
0.7491668	0.749167
.4881949 + .3268922i	0.587531
.4881949 - .3268922i	0.587531
0.518195	0.518195
-0.2279055	0.227905
.19657 + .06834572i	0.208113
.19657 - .06834572i	0.208113

The VECM specification imposes 5 unit moduli.

Source: Author’s computations

Table D13: AR Roots for VECM Stability- Accounting for Multilateral Globalisation Model

Root	Modulus
1	1
1	1
1	1
1	1
1	1
0.7811515	0.781152
0.6751313	0.675131
.4950766 + .3334227i	0.596885
.4950766 - .3334227i	0.596885
0.4589189	0.458919
.214564 + .07248171i	0.226476
.214564 - .07248171i	0.226476
The VECM specification imposes 5 unit moduli.	

Source: Author's computations