EXCHANGE RATE PASS-THROUGH TO DOMESTIC CONSUMER PRICES IN ZAMBIA

BY

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DECLARATION

I, Kaumba Chinyemba do declare that:

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CERTIFICATE OF APPROVAL

This dissertation of Kaumba Chinyemba has been approved as partial fulfilment of the requirements for the award of the degree of Master of Arts in Economics by the University of Zambia.

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ABSTRACT

This study investigated the exchange rate pass-through to domestic consumer prices in Zambia, using quarterly data for the period 1994: q1-2019: q4. To estimate the pass-through of exchange rate changes on domestic consumer prices, a structural vector autoregressive (SVAR) approach was used. The impulse response functions traced the effect of exchange rate shocks on the domestic consumer prices over time. The key findings of the study suggest that the exchange rate pass-through is low and incomplete, but persistent. The pass-through declined and was less persistent between the period 2006: q2-2019: q4, largely attributed to improvements in the macroeconomic environment. Although the exchange rate pass-through is low and incomplete, exchange rate shocks are a potential source of inflation in Zambia based on the variance decomposition results. One policy implication from the study is that the central bank should continue to monitor developments in the exchange rate and take necessary policy measures to dampen excessive depreciation of the Kwacha.

Keywords: Exchange Rate Pass-Through; Domestic Consumer Prices; Structural Vector Autoregressive.

DEDICATION

This piece of work is dedicated to all road traffic accident victims. Globally, road traffic accidents are reported to be among the leading cause of death among young people, with Zambia ranking number 29 in road traffic injuries in the world. I have dedicated this paper to this group of people, considering that I am a victim of a road traffic accident. The accident happened while pursuing studies leading to this piece of work.

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ABBREVIATIONS AND ACRONYMS

BoZ	Bank of Zambia
CPI	Consumer Price Index
ECM	Error Correction Model
ERPT	Exchange rate Pass-Through
HIPC	Highly Indebted Poor Countries
IMF	International Monetary Fund
IRF	Impulse Response Function
OLS	Ordinary Least Squares
PPP	Purchasing Power Parity
SAPs	Structural Adjustment Programs
SSA	Sub-Saharan Africa
SVAR	Structural Vector Auto-Regressive
USA	United States of America
VAR	Vector Auto-Regressive
VD	Variance Decomposition
VECM	Vector Error Correction Model

CHAPTER ONE

INTRODUCTION AND BACKGROUND TO THE STUDY

Introduction

Globally, commercial banks, central banks, and financial centres are continuously tracking and reporting statistics on exchange rates. At a national level, exchange rate changes dominate debate in the mainstream media. Its interaction with other macroeconomic variables, particularly prices is an issue of concern to every economic agent. To households, exchange rate changes influence the choice of whether to consume locally produced or imported goods. Similarly, firms experience changes in operating costs following exchange rate changes.

This chapter contains six sections: Section 1.1 outlines background information on the interlinkages between exchange rates and prices. Section 1.2 presents the problem statement in the Zambian context and the objective of the study is highlighted in 1.3. Further, the chapter contains the research hypotheses in section 1.4, the significance of the study in section 1.5, and the organisation of the study in section 1.6.

1.1 Background to the Study

An economy is linked to the rest of the world through two broad channels, i.e., trade in goods and services and finance. Through trade, an economic agent who wishes to buy goods and services from another country must acquire that country's currency on the foreign exchange market to pay for the purchases. Similarly, through finance, a foreign investor wishing to hold Zambian bonds, for example, must acquire the Zambian currency on the foreign exchange market by giving an equivalent amount of his or her home currency. The exchange rate is crucial in facilitating these linkages.

Zambia is a small open economy with a large share of imports. Imports in Zambia comprise consumer and capital goods. The consumer goods component is chiefly dominated by manufactured and a few agricultural goods whereas the capital goods component can be disaggregated into intermediate and machinery goods. The influx of imports in Zambia arises from the limited industrial capacity and unfavorable climatic conditions for certain crops to grow.

The country's narrow industrial base is inherent and can be traced as far as 1964. At independence in 1964, Zambia inherited an economy that was anchored on mining, with copper being the leading mineral, accounting for 90 percent of foreign exchange earnings and 40 percent of gross domestic product (GDP) (Mudenda, 2009; Ndulo *et al.*, 2019). The agriculture and manufacturing sectors were largely underdeveloped partly because of the colonial masters' deliberate strategy to reserve the country's labour force for mining activities and use the mining resource to develop their preferred territories South Africa and Southern Rhodesia (Andersson *et al.* 2000; Mudenda, 2009).

Soon after independence, the new government embarked on an industrialisation strategy based on import substitution. The import substitution strategy was supplemented by a change from a private enterprise-oriented strategy towards state-ownership (Andersson *et al.*, 2000). The government's economic reforms helped to revamp the manufacturing sector with manufacturing value-added increasing by 12.7 percent on average per year, while industrial growth for low-income countries was 5.4 percent (Andersson *et al.*, 2000). Ndulo *et al.* (2019) record that the GDP share of manufacturing increased from 6 percent in 1964 to 18 percent in 1975 respectively. It averaged 15 percent between 1964 and 1991 and manufactured goods were also diversified.

Following the structural adjustment programmes (SAPs) of the international monetary fund (IMF) and world bank (WB) in the 1990s, Zambia could not continue with its import substitution industrialisation programme. The structural adjustment programme set, among other conditions, a liberalisation of the economy and implementation of market-based mechanisms of governance (Mudenda, 2009). The liberalisation of the economy ensured that trade tariffs were significantly reduced, price controls eliminated, freeing the exchange rate and interest rates. The liberalisation of the internal and external sectors exacerbated an increase in inflation and rapid depreciation of the exchange rate. The inflation rate in the economy rose from 99.3 percent in 1991 to 162.3 percent in 1992 and then to 185.9 percent in 1993. It only fell to 61.9 percent in 1994 (Zombe *et al.*, 2017). Despite the increase in inflation, the government maintained an open trade regime with Zambia putting into effect the Common Market for East and Southern Africa (COMESA) Free Trade Agreement in October 2000 as one of the first countries in the region to do so (Rakner, 2003).

Pilbeam (2005) and Ca' Zorzi *et al.* (2007) have highlighted some of the risks associated with trade openness. They argue that if an economy is open to trade with the rest of the world, the

likelihood that movements in exchange rates are transmitted to domestic consumer prices is very high. Given that Zambia is an import-dependent country and pursues a flexible exchange rate regime, such interactions between exchange rates and domestic consumer prices are inevitable.

The question of how exchange rate changes affect the price level is once again a popular question of research. Typically, this process is called exchange rate pass-through (ERPT), which refers to the degree to which changes in the exchange rate are passed through to domestic prices i.e. import prices, producer prices, and consumer prices (Barhoumi, 2005; Pilbeam, 2006; Ocran, 2010). Thus, if a unit change in the exchange rate leads to a proportionate change in a domestic price, the pass-through is said to be complete. Whereas if the effect of a unit change in the exchange rate leads to less than a unit change in a given domestic price, pass-through is considered to be incomplete. Bhundia (2002) and Campa and Goldberg (2005) note that the extent to which currency variations are passed through to domestic prices is dependent on the weight of imported goods and services that enter the production process, pricing behaviour of exporters in the producing country, sensitivity of mark-ups to competitive conditions and existence of distribution costs. Further, Bhundia (2002) adds that the monetary policy regime pursued by the central bank plays a role in influencing pass-through. It is contended that policy credibility reinforces agents' expectations about the commitment of the authorities to reduce the second-round impacts of currency depreciation on inflation.

There has been vast literature documenting the effect of exchange rate fluctuations on domestic prices. Ca' Zorzi *et al.* (2007) note that over the past three decades, the economic literature on ERPT has been growing. The empirical literature has uncovered the role played by ERPT in both small and large economies. There is also burgeoning literature applied to emerging market economies, including cross-country comparisons as in Choudhri and Hakura (2001), Barhoumi (2005) as well as Ca' Zorzi *et al.* (2007). The recent interest in investigating ERPT in emerging economies has set new dawn in the scope of the economic literature on ERPT, although Barhoumi (2005), as well as Rahimov *et al.* (2017), have bemoaned the scanty literature on developing countries. In Africa, Choudhri and Hakura (2001), Barhoumi (2005), and Razafimahefa (2012) have explored this case in group country cases that included Zambia.

Given that the exchange rate is an instrument for managing the trade balance, the pass-through to import prices and producer prices may influence expenditure switching, while high pass-through to consumer prices can bring pressure to bear on inflation levels (Ocran, 2010).

Inflation is generally considered to be injurious to the growth of an economy. Moreover, central banks have explicitly emphasised the attainment of low inflation and stable prices as a core objective in the conduct of their monetary policy. In Zambia, the sole responsibility of maintaining a stable price level has been charged to the Bank of Zambia through the Bank of Zambia Act No.43 of 1996 in Section 4 (Phiri, 2012 and Chipili, 2015). The emphasis on inflation is inspired by the costs it imposes on the economy, which eventually translate into lower long-run reduced economic growth (Chipili, 2015). The costs associated with rising inflation include lost opportunity of earning interest on interest-bearing assets as economic agents convert them to currency, uncertainty on firms to invest and consumers to spend, re-distribution of income, menu costs of frequent price adjustments, and the erosion of competitiveness (Romer, 2012; Chipili, 2015). Of the drivers of inflation, exchange rate variation has been identified as one of the leading sources of inflation in economies that pursue a flexible exchange rate regime.

Since exchange rate fluctuations have both inflation and trade implications, increased awareness of exchange rate pass-through in the economy can aid both trade and monetary policy formulations (Ocran, 2010; Peóna Guillermo and Brindis Rodríguez, 2014). It remains an obligation of the central bank to pursue policies that sustain the stability of the exchange rate to promote economic growth. Thus, monetary policy that is aimed at reducing excessive depreciation of a currency is synonymous with reducing inflation. The two are complementary.

1.2 Statement of the Problem

Zambia is a small economy with a larger percentage share of the import of its consumer and industrial input goods (Zgambo, 2015). In such an economy, changes in the exchange rate will have adverse effects on prices faced by both producers and consumers. Since Zambia pursues a flexible exchange rate regime, the role played by ERPT becomes crucial in evaluating the potential contribution of exchange rate variations on domestic prices. The correct determination of the ERPT is a key asset for central banks in the formulation of

monetary policy decisions. Thus, the extent to which exchange rates influence domestic consumer prices is of major concern for monetary policy decisions (McCarthy, 2007). To be precise, the estimation of ERPT to domestic prices is of great importance for obtaining better inflation forecast output for the adoption of adequate and timely monetary decisions. Although it is theoretically acknowledged that exchange rate pass-through affects inflation, little is known about its impact in Zambia. If policymakers can have precise knowledge about the magnitude of the impact, it would be easier to formulate policies that result in reduction of excessive depreciation of the currency.

While studies on inflation are popular in the country, especially with the Bank of Zambia, their focus is mainly on inflation forecasting as exemplified by Phiri (2012) and Chipili (2015). To the researcher's knowledge, case-specific studies on ERPT include Simuchile (2003), Zgambo (2015), and Morrissey *et al*. (2017). Although Simuchile and Zgambo applied similar methodologies, their results are poles apart. Simuchile (2003) shows that ERPT is complete, while Zgambo (2015) and Morrissey *et al.* (2017) argue that ERPT is incomplete in Zambia. While Zgambo and Morrissey *et al.* arrived at the same consensus, their estimated ERPT values in the fourth quarter, for example, differ by a wide margin despite the similarities exhibited in the sample periods studied. Zgambo (2015) estimates ERPT elasticity of 37 percent after four quarters and 41 percent after twenty-six quarters. On the contrary Morrissey *et al.* (2017) estimate even a smaller ERPT of 7 percent in the fourth quarter. While the findings of these studies are derived from uncomparable methodologies, the variations and departures in their results raise questions. The mixed results on ERPT motivate this study to interrogate and provide further understanding on exchange rate pass-through in Zambia.

1.3 Objectives of the Study

The main objective was to estimate the exchange rate pass-through to domestic consumer prices in Zambia. The specific objectives were to:

i. Estimate the exchange rate pass-through to domestic consumer prices in Zambia.
ii. Determine how inflation regimes affect exchange rate pass-through in Zambia.

1.4 Research Hypotheses

H_1: Exchange rate pass-through to domestic consumer prices is incomplete in Zambia.

H_2: Inflation regimes influence exchange rate pass-through in Zambia.

1.5 Significance of the Study

The growing interest by economists to investigate ERPT to consumer prices is of great importance, particularly to countries like Zambia, pursuing inflation-targeting monetary policy strategy. Broad knowledge of ERPT to inflation provides a chance for monetary policymakers to conduct their monetary policy from an informed perspective. This study, like others present, will estimate ERPT to inflation in Zambia and gain further understanding on whether ERPT is incomplete. If so, what is the speed of the pass-through? The findings will contribute to the existing reservoir of knowledge on ERPT.

1.6 Organisation of the Study

The study is comprised of six chapters. Chapter two presents an overview of the movements in inflation and exchange rates in Zambia. A review of the theoretical and empirical literature is presented in chapter three. Chapter four presents the methodology utilised in the study, while chapter five presents the analysis and findings of the study. Chapter six concludes and provides some policy implications and recommendations.

CHAPTER TWO

Introduction

This chapter gives a brief overview of inflation and its association with movements in exchange rates in Zambia.

Brief Overview of Inflation and the Movements in Exchange rates in Zambia

Zambia experienced relatively low inflation rates from independence in 1964 to 1974. During this period, the economy was characterised by annual inflation rates of less than 10 percent and a fixed exchange rate that averaged K0.714/US$ (Bowa, 1994; Chipili, 2009; Chileshe, 2015). The years that followed proved chaotic for the country. There were disruptions in key sectors of the economy following the global recession of the 1970s.

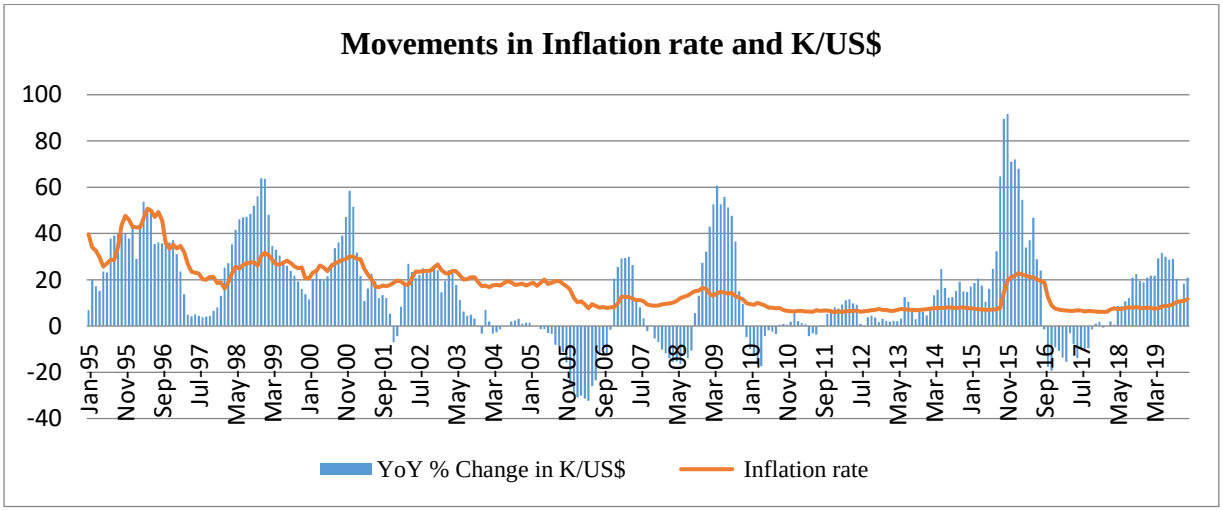
Zambia's major export commodity, copper, experienced a price shock in the international market. At the same time, oil prices began to surge (Andersson et al., 2000; Mungule, 2004). These two factors, coupled with inconsistencies in exchange rate regimes and administrative controls, hampered economic growth. This led to widening fiscal deficits and an increase in the money supply. The result was accelerated inflation rates over the years. For example, the inflation rate hit 51.8 percent in 1986 and 128 percent in 1989. It was noted that the main drivers of inflation during this period were a combination of multiple factors that include an increase in money supply, higher oil import prices, widening fiscal deficits, civil service wage increments, and depreciation of the currency where it was made to float against major convertible currencies (Aron and Elbadawi, 1992; Mungule, 2004). However, since fixed exchange rates dominated most of the pre-liberalised era, ERPT to inflation was limited. Because of low volatility during this period estimating ERPT using nominal exchange rates is impossible.

After the transition to a market-based economy that began in the 1990s and the adoption of a fully flexible exchange rate regime in 1994, Zambia experienced higher volatility in the exchange rate. The high volatility in exchange rates subsequently triggered a rise in inflation. In 1992, for example, the inflation rate was recorded at 197.8 percent. Andersson *et al.* (2000), as well as Mungule (2004), note that it was during this time that the Kwacha recorded a real depreciation. This was an adjustment of the price level to its equilibrium given that prices had been suppressed through price controls.

It took more than a decade to renew and establish new economic infrastructure in all areas of the economy. State guaranteed activity in the financial sector, and to some extent, enhanced credibility of the central bank helped overcome inflationary pressures and achieve lower and stable inflation rates in the mid-2000s.

From theory, it is well documented that nominal exchange rate depreciation/appreciation causes increases/decreases in inflation. This inverse relationship can be discerned in figure 2. A simple correlation between the two variables yielded a moderate strong coefficient of 54.5percent. The relationship could have been stronger than observed had the central bank not intervened in the foreign exchange market to dampen depreciation pressures. Thus, the sharp appreciation of the currency observed in the 2000s might be linked to disinflation activities by the central bank aimed at dampening inflationary pressures.

Figure 2: Co-Movements in Inflation Rates and K/US$ Exchange Rates



Source: Author's computation

Between 1995 and 2003 the two variables exhibited a strong interdependence with upward/downward movements in the exchange rate associated with increases/decreases in the inflation rate. The relationship seems weakly linked between 2004 and 2006 when a currency appreciation averaging about 8 percent was associated with an average inflation rate of about 15 percent. This observation suggests that factors other than exchange rate variations were responsible for driving inflation upwards and that exchange rate pass-through was characterised by asymmetries. Precisely, currency depreciation has a more impact on driving inflation up than an appreciation does on reducing it.

The inflation rate however declined remarkably in 2005, although still recorded with a double-digit. During the same period, the exchange rate appreciation was about 20 percent. The appreciation in the currency was largely attributed to an increase in foreign direct investment, particularly in the mining sector, and the attainment of HIPC[1] completion which entailed a reduced burden on the country's commitment towards repayments of foreign debts. Collectively, these events, coupled with increased inflows of foreign exchange from the higher copper earnings of that time, accounted for the sharp appreciation of the currency observed in the mid-2000s and subsequent decline in consumer prices that followed.

In 2008, the economic meltdown ensured that commodity prices declined in the international market. Copper, Zambia's major foreign exchange earner, was no exception. The price of copper plummeted by half of its value. As a result, the currency depreciated, triggering a rise in inflation in 2009. Generally, between 2006 and 2014 inflation remained low and below 10 percent with moderate swings in the exchange rate.

The exchange rate and inflation relationship were reinforced in 2015. The Kwacha experienced unusual exchange rate volatility. The Kwacha lost about 21 percent of its value against the US dollar between January and August 2015. The weakness of the currency was abruptly transmitted to consumer prices and the annual inflation rate jumped to 21.1percent in December 2015 from 7.9 percent recorded in December 2014. It reached a high of 22.9 percent in February 2016 before declining to about 7 percent in January 2017. The increase in inflation was due to a combination of several factors. Among them were a significant depreciation in the exchange rate, an upward adjustment of fuel pump prices, increased power rationing in the second half of 2015, and reduced supply of some food items due to draught. These factors combined raised both food and non-food inflation. Non-food inflation rose to 17.1 percent in December 2015 from 8.4 percent in December 2014, while food inflation was recorded at 24.8 percent at the end-2015, up from 7.4 percent at the close of 2014.

Inflation was contained and remained relatively low at about 7 percent in 2017 and the third quarter of 2018, with an exchange rate appreciation of about 15 percent on average. The major drivers of the decline in inflation were, among other factors, a bumper harvest recorded during that period and appreciation of the currency resulting from improvement in exports of

[1] HIPC program was designed to ensure that the poorest countries in the world are not overwhelmed by unmanageable or unsustainable debt burdens under the International Monetary fund (IMF) and the World Bank

traditional and non-traditional exports. However, in 2019 inflation steadily increased. The Kwacha depreciated by 16.9 percent between the fourth quarter of 2018 and that of 2019, and the inflation rate was up from 7.8 percent in December 2018 to 11.7 percent in December 2019. Exchange rate pass-through, poor crop harvest due to severe droughts, increases in fuel prices, erratic power supply were some of the major drivers of inflation.

The above underscores how fluctuations in exchange rates are associated with consumer prices in Zambia. The evidence from the graph supports the popular view that exchange rate appreciation/depreciation is accompanied by decreases/increases in consumer prices. Although this observation has empirical support in many countries, its validity has attracted mixed findings in Zambia.

CHAPTER THREE

LITERATURE REVIEW

Introduction

Estimation of the pass-through from exchange rates to domestic prices has increasingly gained prominence in both developed and developing countries. Since its emergency, researchers have investigated the exchange rate pass-through to domestic prices in many countries. As a result, several economic theories have emerged to explain complete/incomplete pass-through. This chapter contains two sections; section 3.1 lays the theoretical foundation and section 3.2 documents the empirical literature, especially those conducted in sub-Saharan Africa (SSA) and Zambia.

3.1 Theoretical Literature

The traditional definition of exchange rate pass-through refers to the percentage change in import prices in domestic currency in response to a 1 percent change in the exchange rate. This is also referred to as stage one ERPT (Kumar, 2008; Aron et al., 2014). Traditional studies on ERPT have endeavoured to provide more evidence on the influence of exchange rates on import prices than the overall consumer prices. Among them are Zietz (1993) and Campa and Goldberg (2005). Rahimov *et al*. (2017) observe that it is the import price that transmits exchange rate shocks to the domestic economy through imported goods. Since the interaction between imported prices and the domestic economy is inevitable, recent work on ERPT has shown that researchers have increasingly taken interest in exploring this case (McCarthy, 2007). Moreover, the definition of ERPT has since extended to address the effect of exchange rate movements on producer and consumer prices. The effect of a change in import price on producer or consumer price is known as stage two ERPT (Aron et al., 2014). The stage two approach is popular primarily because the disaggregated data on import prices and composition is generally unavailable, especially in developing countries (Sanusi, 2018).

Broadly, there exist two channels through which exchange rate fluctuations affect domestic consumer prices.ie direct and indirect. Lafleche (1997) and Pilbeam (2005) note that a direct channel operates through a cost and consumption sub-channel. Through the cost channel, shocks from the exchange rate are first transmitted to the price of imported intermediate

goods, then to prices faced by producers, and subsequently to the final price of domestic goods. The consumption sub-channel is more direct than the cost channel. The price of imported final goods (food and non-food) changes after the exchange rate shock has hit the economy, which in turn influences the overall price level. Depending on the direction of the exchange rate movement, depreciation leads to more expensive imported final goods and vice-versa (Rahimov *et al*.2017). The change in the overall consumer price index (CPI) basket will depend on the import substitutability, price rigidities, and the degree of competition in the market.

Through the indirect channel, a weaker local currency results in increased demand for locally produced goods in the export and domestic markets. In the export market, a depreciated currency tends to make locally produced goods competitive, while through expenditure switching, domestic consumers may switch from consuming imported goods to locally produced ones. Because of the desire by firms to satisfy both markets, aggregate demand in the domestic economy may increase following the desire by producers to adjust their capacity upwards. Since nominal wage contracts are fixed in the short run, real wages decrease and output increases. Over time real wages increase, pushing up production costs. The increase in the cost of production has to be passed on to the consumer in form of price hikes, whilst output decreases. Therefore, a depreciation of the exchange rate results in a temporary increase in output with a permanent increase in the overall price level in developing countries (Kandil, 2008).

The orthodox literature on price adjustments in open economies has historically leaned on one of two extreme assumptions. Purchasing power parity (PPP) or the Keynesian fix-price idea incorporated in the IS-LM model (Zietz, 1993). The basic concept underlining PPP theory is that arbitrage forces will lead to the equalization of goods prices internationally once the prices of the goods are measured in the same currency (Pilbeam, 2006). As such, PPP represents an application of the law of one price. Zietz (1993) notes that these two assumptions give rise to two polar cases of exchange rate pass-through.

3.1.1 Purchasing Power Parity Model

Starting from a simple supply-demand model where the law of one price is assumed to hold, there can be cross-country differences in the pass-through of exchange rate fluctuations to

domestic prices (McCarthy, 2007). To illustrate this analogy the study demonstrates a case where the law of one price is assumed to hold.

The starting point is to assume that the basket of goods entering the consumer price index (CPI) is composed of traded and non-traded goods.

$$P_{t=(P_t^T)^{\alpha}(P_t^{NT})^{1-\alpha}} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 1$$

Where, $p_t$denotes the CPI in period t, p_t^T and p_t^{NT} are the price indexes for traded and non-traded goods, and α is the weight assigned to traded goods. The price of traded goods in the home country can be causally linked to the price of foreign traded goods adjusted for the exchange rate. The model assumes that traded goods are produced under competitive conditions. This assumption implies that in the absence of trade barriers, prices of traded goods expressed in a particular currency will be the same in each country. The following relation can thus be deduced.

$$P_t^T = S_t \; P_t^{T*} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 2$$

Where S_t is the exchange rate converted to foreign price P_t^{T*} expressed in domestic currency per unit of foreign currency, so that a rise in the exchange rate signifies depreciation of the currency. Expressing the relation in logarithms and writing it in lower case:

$$p_t^T = s_t + p_t^{T*} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 2a$$

Equilibrium in the non-traded goods section will be determined by the demand and supply functions for this sector. These functions would depend on the ratio of non-traded goods to traded goods prices. Let δ denote the price ratio that clears the non-traded goods. The equilibrium condition is:

$$P_t^{NT} = \delta P_t^T \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 3$$

Equation (3) provides an indirect link through which exchange rates enter the non-traded goods price index.

Relation (3) will hold in the short run if the price of non-traded goods is flexible and adjusts quickly to changes in the exchange rate. In this respect, pass-through to both traded and non-traded goods will be complete in the short run through (2) and (3), hence to CPI. However, the short-run impact of the exchange rate on CPI would be dampened if the prices of non-

traded goods are sticky. Exchange rate variations would now affect only traded goods in the short run and pass-through to CPI would be equivalent to the share of traded goods α. The failure of PPP to yield better results has led to several studies to investigate the firm's adjustment of mark-ups in response to exchange rate fluctuations (Zietz, 1993; McCarthy, 2007)

3.1.2 Purchasing Power Parity Model with Mark-up Over Cost

A point of variation in the recent literature that could limit the pass-through in the PPP model is the relaxation of the perfect competition assumption. Under perfect competition conditions, there is no mark-up. Thus, the pass-through will be complete (Choudhri and Hakura, 2001, 2015; Choudhri and Khan, 2002). To explain the partial pass through it is reasonable to assume imperfect competition. Under imperfect competition, firms will charge a mark-up over costs in their pricing. Incorporating the ideas in Choudhri and Khan (2002), Campa and Goldberg (2005) as well as Aron *et al*. (2014), foreign prices include a mark-up ($mkup^{*}$) over marginal cost (mc^{T*}). Substituting these facts into 2a,

$$p_t^T = S_t + mkup^{T*} + mc^{T*} \quad \ldots\ldots 4$$

These costs induce a push between the home price and foreign price. If the costs are determined independently of the exchange rate, ERPT to traded goods would be complete (Choudhri and Khan, 2002). To avoid losing market share, producers have the discretion to vary the mark-up across countries. Hence the pass-through is expected to be incomplete in this model.

The explanation behind this strategic mechanism is that when the exchange rate depreciates, the demand curve faced by consumers becomes more elastic, and foreign competitors would lower their price in domestic currency terms, implying that import prices increase by less than the size of the exchange rate fall (Bussière, 2006). The theoretical basis for this strategic interaction is Dornbusch (1987), who applied industrial organisation principles to open-economy price responses.

A similar argument that has received an appeal in observed incomplete pass-through is that imperfect competition producers are less likely to change prices frequently in the presence of small menu costs. However, decisions by producers to adjust prices frequently would tend to make domestic currency price of foreign goods move one-on-one with variations in the

nominal exchange rate if the one exporting fixes the price in his/her currency (Engel, 2002; Kumar, 2008). This phenomenon is known as producer currency pricing (PCP). Whereas, if the price is set in the importer's currency, also known as local currency pricing (LCP), and is sticky, the pass-through would be incomplete (Campa and Goldberg, 2005). Local currency pricing can therefore play a big role in insulating the impact of exchange rate fluctuations on traded goods in the short run. Devereux *et al.* (2003) has explored the role of price setting in determining exchange rate pass-through. While local currency pricing has been found to hold in some industrialized countries, such as the United States (see, Choudhri and Khan 2002; Campa and Goldberg, 2006) it is not clear whether this practice finds support in developing countries such as Zambia. Bacchetta and Wincoop (2002) add that if the final products sold to consumers incorporate a significant share of local value-added, consumer prices will not be so sensitive to exchange rate changes.

A mild response of the traded goods component of the CPI may also be explained by the fact that some imported goods are used as inputs in the production process of final goods. If prices of the final product are not adjusted frequently, changes in the cost of inputs emanating from exchange rate variations will not be quickly passed on to consumers. It is also worth noting that non-intermediate import goods also go through distribution channels such as transportation, marketing, and retailing before they are delivered to consumers. The channels incorporate the use of a mixture of non-traded services, which can account for a large fraction of consumer price. The price component represented by local services would not be affected by exchange rate movements in the short run.

Home currency depreciation has equally been known to elicit a substitution effect, also known as flying from quality. The reason for this is that domestically produced goods are a close substitute for imported goods. If the currency is depreciating, domestic consumers may consider switching to cheaper lower-quality local goods for imported brands. In that case, the exchange rate pass-through will be incomplete (Engel, 2002).

Feinberg and Kaplan (1992) consider a mechanism in which profit maximising firms fix prices with an eye on existing market share and the implication on future profits. A larger market share today implies greater demand and more profit tomorrow. They consider, for instance, an adverse demand shock expected in the future to the domestic industry following an appreciation of the domestic currency. Firms will increase prices today, as the future rewards from sacrificing short-run profits to gain market share are reduced. Conversely,

expected depreciation will elicit price reductions in an effort by firms to increase market share and future profits, following an expected positive demand shock. They argued that the observed incomplete pass-through might be a reaction by firms to expected exchange rates. However, this issue has received little attention in empirical work, for most studies have concentrated on actual exchange rates.

The foregoing discussion has highlighted short-run reasons that may explain the partial pass-through of exchange rates to traded goods. It does not explain the observed long-run incomplete pass-through to traded and non-traded goods prices. To appreciate the long-term association between exchange rates and consumer prices, Choudhri and Khan (2002) highlight that it is important to understand that these two variables are determined endogenously and may respond differently to various shocks. First, there are permanent shocks to the money stock. These shocks would fully be passed on to the exchange rate and consumer price in the long run. For example, suppose that domestic money stock increases permanently by 10 percent. Assuming that the long-run money demand is constant, monetary equilibrium requires that CPI rise by 10 percent. Riding on the same argument Devereux *et al.* (2003) have noted that pass-through is related to the stability of money growth. It is acknowledged that countries with relatively low volatility of money supply growth experience relatively low rates of exchange rate pass-through, while those with the relatively high volatility of money growth have relatively high pass-through rates. Moreover, in a country that follows a prudent policy of monetary stabilization reducing the variance of its money growth leads to a price-stability 'bonuses'. The reason being that foreign firms will find it easy to bargain more and to set their prices in that country's currency (LCP). By so doing they contribute to the reduction of the impact of exchange variation on the country's CPI.

Another macroeconomic aspect that has attracted attention from economists in this area of research is the much celebrated Taylor hypothesis. Taylor (2000) argued that the low ERPT observed in the 1990s in developed countries, particularly the USA, is not a coincidence, but a fruit of attainment of a stable inflationary environment. This finding is clearly understood through the behaviour of firms. Firms set their price for several periods ahead and adjust the prices on the cost expected to be incurred in the future. If cost variations are expected to continue, firms adjust prices more hastily and more intensively. The general point here is that if an increase in costs is expected to persist then the increase will be matched to a greater extent. Hence, measured pricing power is heavily dependent on expectations (Taylor, 2000).

It is assumed that in a high-inflation environment the additional inflation induced by the exchange rate changes is expected to persistently increase price levels and costs. Thus, the pass-through would be high. Similarly, low inflation economies should have low pass-through or less matching of price changes.

Despite the observed incomplete pass-through, there is a consensus that the sensitivity of the exchange rate will decline along the distribution chain from import prices at the border in the destination country, through to wholesale and retail networks to final consumer prices in the domestic economy (McCarthy, 2007; Aron *et al*. 2014). This implies that the pass-through is highest for import prices, followed by producer prices, and lowest for consumer prices in most economies. An exception to this phenomenon is large country cases such as the USA, where the inflationary pressures arising from currency depreciation are counteracted by a decline in the world price. This is as a result of its economic influence on global trade. Thus, reducing the measured passed through (Campa and Goldberg, 2006). In small countries like Zambia, depreciation of the exchange rate would not affect world prices.

3.2 Empirical Literature

There has been growing interest from researchers to understand the impact of the variations in exchange rates on consumer prices. However, the bulk of studies have been dedicated mostly to advanced economies. Huge though they may be, the findings and conclusions in most cases have been similar: Exchange pass-through is higher on import prices but declines along the distribution chain.

In Africa, the pioneering work on ERPT is that of Choudhri and Hakura (2001) who studied a sample of 71 countries that comprise industrial and developing countries. The study confirms a strong correlation between the exchange rate pass-through and a high inflationary environment. The study reports an average ERPT of 0.04 percent in the short run and 0.14 percent in the long run for low inflation countries and 0.22 percent and 0.50 percent respectively for high inflation countries. In that study, Zambia was included, and it was categorised as a high inflation country.

Razafimahefa (2012) investigated ERPT to CPI in Sub-Saharan Africa countries using a recursive VAR and single equation approaches. The findings of the study showed that ERPT is incomplete in SSA. The pass-through is large following depreciation than after an

appreciation of the local currency. The average ERPT elasticities in SSA are 0.19 percent in the first quarter and 0.416 percent after four quarters.

Mwase (2006) studied the exchange rate pass-through into consumer prices in Tanzania, using a structural vector autoregressive (SVAR) model to capture the impact of exchange rate shocks on inflation. To ensure the reliability of the results he applied Vector Error Correction Model (VECM) and Granger Causality Tests to evaluate the importance of exchange rate movements. He found that the pass-through was low and incomplete for the period 1990 to 2005 in Tanzania. His estimates showed that a 10 percent depreciation was associated with a 0.05 percent increase in inflation after a two-quarter lag. To assess the relationship between pass-through and inflation, he subdivided the full sample into two distinct periods: one before 1995 and the other after 1995. He found that a 10 percent depreciation was associated with a 0.03 percent decrease in inflation in the period 1995 to 2005. This was in contrast with the period 1990 to 1995 when a 10 percent depreciation of the currency was associated with a 0.17 percent increase in inflation. He attributed the decline in pass-through recorded during the period 1995 to 2005 to a low inflationary environment following sound monetary policies by the central bank.

In Ghana, Sanusi (2018) estimated the exchange rate pass-through to consumer prices using a structural vector autoregressive (SVAR) for the period 1983:q3 to 2006:q3. His findings show that the pass-through was high but incomplete in Ghana. His estimates showed that a 0.061 percent depreciation of the currency was associated with a 0.34 percent increase in inflation after a four-quarter lag. It increases to 0.79 percent after a twenty-four-quarter lag.

Mushendami and Namakalu (2016), using a model of pricing along the distribution chain and applying the recursive VAR approach estimated ERPT in Namibia. The findings showed that the exchange rate pass-through to inflation is low and incomplete. After a 10 percent depreciation of the nominal effective exchange rate, the pass-through to consumer and import prices were found to be 0.01 percent and 0.04 percent respectively, in the first quarter. After eight quarters, the exchange rate pass-through to consumer price increases by 0.02 percent, while imported inflation declined by the same magnitude.

Using the Philips curve equation and recursive VAR approaches, Jombo *et al.* (2014) established that ERPT was modest and incomplete in Malawi. They estimated a dynamic pass-through elasticity of 0.20 percent in the fourth quarter, after a 7.1 percent depreciation of the exchange rate.

Bhundia (2002) assessed the degree of pass-through to consumer prices in South Africa for the period 1976: q2 to 2000: q3. The channel of effects was modelled using a vector autoregression (VAR) like used by McCarthy (1999). He found that at the full impact of an exchange rate shock, consumer price increased by 8.3 percent in four quarters and 12.3 percent in eight-quarter lags.

More recently, Ocran (2010) studied ERPT in South Africa using monthly data from 2000 to 2009 in an unrestricted VAR approach. He showed that ERPT into consumer prices was 11.5 percent after 12 months (four quarters) and 12.5 percent after two years (eight quarters) into producer prices was 18 percent, and into import prices was 20 percent.

The results for the two studies show that exchange rate pass-through to consumer prices has not significantly changed in South Africa.

In Zambia, the first specific case study on ERPT is that of Simuchile (2003), using a recursive VAR framework on monthly data for the period Janaury1994 to July 2001. The results suggest that ERPT to domestic consumer prices is complete. The pass-through was complete within four months of an initial exchange rate shock and died out after 13 to 15 months. On the contrary, Zgambo (2015) employed a similar approach to estimate the magnitude and timing of exchange rate pass-through to domestic prices. His evidence suggests an incomplete, persistent, and moderate exchange rate pass-through. The estimated dynamic pass-through elasticity was 37 percent after four quarters. A recent study by Morrissey et al. (2017), using a Bayesian VAR approach report an incomplete and very low ERPT. The study found no evidence of an increase in consumer prices in the first quarter. However, they estimated a 0.07 or 7 percent elasticity at the full impact of an exchange shock in four quarters.

The empirical literature surveyed shows that the results for SSA countries are mixed with some studies reporting low pass-through, while others reporting moderate to high pass-through. This is naturally expected considering that the economic structure and the monetary policy strategy perused in each country may be unique from others. However, it raises concerns if studies on a country report mixed results as is the case for Zambia.

Further, the study contends that the utilisation of the recursive VAR framework in most of these studies has the possibility of producing unreliable findings. With n variables, a recursive VAR results in n! ordering, with each order giving rise to different results.

Moreover, a recursive VAR is purely based on statistical principles. As such, the innovations have no economic interpretations. Proper estimation of ERPT would arise from a model that considers the structure of the economy. This study, therefore, re-examines this issue by estimating the exchange rate pass-through using an SVAR approach.

CHAPTER FOUR

METHODOLOGY

Introduction

This chapter presents the methodology that was used to investigate the exchange rate pass-through to domestic consumer prices to achieve the study objectives. Section 4.1 outlines the theoretical underpinnings for the analysis, while section 4.2 highlights the variables used in the study. The model specification and estimation technique are presented in section 4.3 followed by data type and sources in section 4.4.

4.1 Theoretical Model

To analyse the exchange rate pass-through to consumer prices in Zambia, the study utilised the Purchasing Power Parity theory as applied in similar studies (see, McCarthy, 2007; Mushendami and Namakalu, 2016; Rahimov, Jafarova and Ganbarov, 2017). According to the PPP theory, arbitrage forces will lead to the equalization of goods prices internationally once the prices of the goods are measured in the same currency. If PPP for traded goods held pass-through would be complete, one can then draw a parallel between the failure of PPP to hold and the general conclusion that pass-through is incomplete.

The continued enthusiasm exhibited by economists to investigate ERPT over the years has led to the development of several econometric procedures. The econometric techniques have evolved from simple to highly sophisticated ones. Earlier studies leaned heavily on the ordinary least squares method (OLS) technique. However, the OLS method has flaws when applied to time series data. Campa and Goldberg (2005, 2006) and McCarthy (2007) recognised the weakness of the OLS method and employed alternative robust methods that include cointegration, error correction models (ECM), and vector autoregressive (VAR) approaches. The weakness of the OLS method mainly arises from its failure to recognise the properties of time series data. By nature, time-series data is non-stationary. A series is non-stationary if the mean and variance are time-variant. Stationarity is achieved by differencing.

Single equation techniques that use differenced variables have equally been criticised for assuming the exogeneity of exchange rates (Aron *et al*. 2014). On the contrary, floating exchange rates and prices are determined simultaneously in a general equilibrium setting

(Choudhri and Khan, 2002; (Aron *et al.* 2014). Forgetting the channels through which the exchange rate is influenced by other economic variables may lead to biased and inconsistent estimates. There is an existing pattern in the conduct of monetary policy from countries that follow a flexible exchange rate regime. If policymakers anticipate a rise in inflation, after the depreciation of the exchange rate, they may consider raising interest rates. This counters the original depreciation by appreciating the currency and the net shock becomes smaller. Aron *et al.* (2014) are of the view that imposing the assumption of exogenous exchange rate produces ERPT measures for a gross exchange rate shock without correcting for such possible negative feedback from monetary policy.

Therefore, it is appropriate to assume that exchange rates and prices are determined endogenously. To this effect, the study adopts a model that allows for feedback interaction between exchange rates and consumer prices. Vector autoregressive (VAR) technique has been found desirable for this purpose. A VAR model is an extension of the autoregressive process (AR) but contains a mixture of current and lagged values of its own and other endogenous variables. Within the VAR framework, there is a choice between unrestricted and restricted VARs such as VEC that focus on the long-run relationship between variables. Since the intent of the study is to investigate the short-run dynamics of exchange rate pass-through, as opposed to long-run equilibrium relationships among variables or measuring gross coefficients, the study utilised the unrestricted VAR model.

Several studies use variants of the VAR model to analyse ERPT. Common is the recursive VAR used by McCarthy (2007) as well as Ca' Zorzi et al. (2007). The framework of a recursive VAR is to decompose the residuals in a triangular fashion by assuming a particular ordering scheme. It thus places variables in order of exogeneity with the most exogenous variable ordered first. Decomposing the residuals in this fashion is called Cholesky decomposition (Enders, 2015).

While the Cholesky decomposition demands that $(n^2 - n)/2$ restrictions be placed on the relationship between the regressions' residuals and the structural innovations where *n* is the number of variables, the restrictions are purely statistical and lack any economic interpretation. It is, therefore, feasible to impose restrictions on the errors to fully identify the structural shocks in a way that is consistent with an underlying economic model. In this regard, the study followed the recent empirical literature and utilised the structural vector autoregressive (SVAR) approach (see Mwase, 2006; Sanusi, 2018) to impose

contemporaneous structural restrictions consistent with a priori theoretical expectations. SVAR uses structural decomposition instead of Cholesky's in identifying structural shocks.

4.2 Variables

The variables entering the SVAR model include crude oil prices (p_t^{oil}) to capture supply-side shocks, US consumer price index (π_t^{fpi}) as a proxy of world prices. By PPP theory, price differences between trade partners determine the exchange rate in the long run. By including this variable, one can net out the influence of trade partners' CPI on the exchange rate. The exchange rate is the K/US$ (s_t) nominal exchange rate (increase indicates depreciation). The use of the K/US dollar instead of the nominal effective exchange rate reflects the fact that most international transactions are transacted in the US dollar.

The price level is measured by the consumer price index (π_t^{cpi}) and the real output gap (y_t) is extracted from real GDP. The output gap is intended to capture the impact of the stage of the business cycle on the price level. Since real GDP is mostly available on annual basis the Denton method was used to decompose annual series data into quarterly frequency. An output gap is defined as the difference between actual and potential output.

$$gap(y_t) = y_t^A - y_t^T \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (5)$$

where $gap(y_t)$ is the output gap, y_t^A is the actual output and y_t^T is the potential output. Since the potential output is not observed, it has to be estimated (Brouwer, 1998). The Hodrick-Prescott filter was used to estimate potential output from actual, and successively compute the gap. In this form, a positive number for the gap indicates excess demand, and a negative indicates excess capacity. Thus, domestic consumer prices are expected to increase during periods of excess demand.

It would have been insightful to incorporate import and producer price indexes as a way of capturing ERPT along the distribution chain. However, data on these variables are not readily available.

4.3 Empirical Model Specification and Estimation Technique

In the SVAR framework, the study proposes the following specification without any form of ordering assumed.

$\boldsymbol{X} = (\boldsymbol{p_t^{oil}}\ \ \boldsymbol{\pi}_{\boldsymbol{t}}^{\boldsymbol{fpi}}\ \ \boldsymbol{y_t^{gap}}\ \ \boldsymbol{\pi_t^{cpi}}\ \ \boldsymbol{s_t})'$……..……. …….. (6)

More compactly, the dynamic behaviour of this system of equations can be represented in matrix notation as:

$Ay_t = C(L)y_{t-1} + D(L)x_t + \boldsymbol{\mathcal{E}_t}$ …….....(7)

where *y* is a vector of endogenous variables, x is an *n x 1* vector of exogenous variables, and ε is an *n x* 1 vector of structural disturbances with a zero mean and constant variance. In the specification given in equation (7), *A* is an *n x n* matrix of contemporaneous coefficients of the interaction of variables in y, while *C* is the matrix of lagged coefficients of interactions in *y*.

Multiplying equation (7) above by *A* inverse we obtain a reduced VAR.

$y_t = A^{-1}C(L)y_{t-1} + A^{-1}D(L)x_t + A^{-1}\varepsilon_{tt}$ …….. (8)

or

$y_t = E(L)y_{t-1} + \delta x_t + e_t; e_t \sim iid(0, \sigma)$ …….. (9)

where, $E(L) = A^{-1}C(L); \delta = A^{-1}D(L); e_t = A^{-1}\varepsilon_{tt}$

The structural and reduced-form equations can be related by

$E(L) = A^{-1}C(L)\ and\ \delta = A^{-1}D(L)$…….....(10)

$e_t = A^{-1}\varepsilon_t$ or $A^{-1}e_t = \varepsilon_t$ .....……..……..……... (11)

Following Mwase(2006), the structural shocks (ε_t) in each period *t* are determined by expectations conditional on available information at the end of period *t-1*, ($E_{t-1}(.)$), and forecast errors (e_t). It is straightforward to demonstrate that the one period ahead error made in forecasting $\pi_t^{cpi}$is equivalent to e_t, since $e_t = A^{-1}\varepsilon_t$, so that inflation forecasting is given by:

$e\pi_t^{cpi} = \alpha\varepsilon p_t^{oil} + \gamma\varepsilon\pi_t^{fpi} + \emptyset\varepsilon y_t + \varepsilon\pi_t^{cpi} + \rho_{10}\varepsilon s_t$. These errors are influenced by exchange rate shocks and the other variables in the system. Evoking equation 9 the system of equations with no order can be written as:

$$
\begin{pmatrix} e_t^{poil} \\ e\pi_t^{fpi} \\ ey_t \\ e\pi_t^{cpi} \\ es_t \end{pmatrix} = \begin{pmatrix} 1 & \rho_1 & \rho_2 & \rho_3 & \rho_4 \\ \propto & 1 & \rho_5 & \rho_6 & \rho_7 \\ \varphi & \sigma & 1 & \rho_8 & \rho_9 \\ \alpha & \gamma & \emptyset & 1 & \rho_{10} \\ \beta_1 & \beta_2 & \beta_3 & \beta_4 & 1 \end{pmatrix} \begin{pmatrix} \varepsilon_t^{poil} \\ \varepsilon\pi_t^{fpi} \\ \varepsilon y_t \\ \varepsilon\pi_t^{cpi} \\ \varepsilon s_t \end{pmatrix} \quad \ldots\ldots\ldots\ldots\ldots\ldots (12)
$$

To determine the role of exchange rate changes in influencing movements in consumer prices, there is a need to estimate the effect of exogenous shocks on the exchange rate, s_t, on the shocks $\varepsilon\pi_t^{cpi}$, by estimating (12). However, (12) is not identified in the sense that as long as β_1 , $\beta_{2,}$ β_3 and β_4 are not each equal to zero, the observed innovation in the variable s_t will depend both on the shock to the exchange rate and the shocks ε_t^{poil}, ε_t^{fpi}, εy_t and $\varepsilon\pi_t^{cpi}$

The study, therefore, imposed some restrictions to extract $s_t$from the other innovations while allowing for contemporaneous feedback effects and adjustment of parameters to the exchange rate innovations using structural decompositions. Further, impulse response functions (IRF) are used to trace the effects of a shock originating from an endogenous variable to other variables through the dynamic structure of the VAR, and subsequently applying the variance decomposition (VD) to measure the percentage of the forecast variance in domestic prices that is attributed to various shocks.

4.3.1 Identification Procedure

The first restriction is to assume that oil prices are exogenous. This is plausible given that oil prices are determined in the international market by cartels of oil-producing countries, which decide on the quantity to produce. However, oil prices affect the domestic economy, given its importance as one of the major sources of energy. Therefore, oil prices are modelled as being free of the influence of shocks from other variables. This assumption is equivalent to

$$
e_t^{poil} = \varepsilon_t^{poil} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (13)
$$

since it imposes zero restrictions on the 2nd, 3rd, 4th, and 5th elements in the A matrix.

Secondly, it is assumed that foreign price shocks are affected by oil prices and have no contemporaneous effect on oil prices. This assumption is equivalent to

$$e\pi_t^{fcpi} = \propto \varepsilon_t^{poil} + \varepsilon\pi_t^{fcpi} \quad \text{(14)}$$

given (13) above, (14) can be written as

$$e\pi_t^{fcpi} - \propto e_t^{poil} = \varepsilon\pi_t^{fcpi} \quad \text{(15)}$$

Further, the study considers the assumption that shocks to y-gap are influenced by shocks to oil prices, considering the relative importance of crude oil as a source of energy. However, y-gap shocks have no contemporaneous effect on oil prices considering the small country argument case. Thus, shocks to the y-gap can be modelled as follows:

$$e_t\, y_t = \varphi\varepsilon_t^{poil} + \varepsilon_{yt} \quad \text{(16)}$$

or

$$e\, y_t - \varphi e_t^{poil} = \varepsilon_{yt} \quad \text{(17)}$$

Shocks to domestic consumer prices are assumed to be affected contemporaneously by lagged shocks of exchange rates and current shocks of the other variables in the system. Domestic consumer price shocks are therefore modelled as:

$$e\pi_t^{cpi} = \alpha\, \varepsilon p_t^{oil} + \gamma\varepsilon\pi_t^{fcpi} + \emptyset\varepsilon y_t + \varepsilon\pi_t^{cpi} \quad \text{(18)}$$

or

$$e\pi_t^{cpi} - \alpha e_t^{poil} - \gamma\left(e\pi_t^{fcpi} - \propto e_t^{poil}\right) - \emptyset\left(e\, y_t - \varphi e_t^{poil}\right) = \varepsilon\pi_t^{cpi} \quad \text{(19)}$$

Finally, it is assumed that shocks to exchange rates are influenced by shocks to all the variables in the system.

Thus,

$$es_t = \beta_1\varepsilon_t^{poil} + \beta_2\varepsilon\pi_t^{fcpi} + \beta_3\varepsilon y_t + \beta_4\pi_t^{cpi} + \varepsilon s_t \quad \text{(20)}$$

or

$$es_t - \beta_1 e_t^{poil} - \beta_2\left(e\pi_t^{fcpi} - \propto e_t^{poil}\right) - \beta_3\left(e\,y_t - \varphi e_t^{poil}\right) - \beta_4[e\pi_t^{cpi} - \alpha e_t^{poil} - \gamma\left(e\pi_t^{fcpi} - \propto e_t^{poil}\right) - \emptyset\left(e\,y_t - \varphi e_t^{poil}\right)] = \varepsilon s_t \quad \ldots\ldots (21)$$

The full system of shocks can be estimated as:

$$\begin{pmatrix} e_t^{poil} \\ e\pi_t^{fcpi} \\ ey_t \\ e\pi_t^{cpi} \\ es_t \end{pmatrix} = \begin{pmatrix} 1 & 0 & 0 & 0 & 0 \\ \propto & 1 & 0 & 0 & 0 \\ \varphi & 0 & 1 & 0 & 0 \\ \alpha & \sigma & \emptyset & 1 & 0 \\ \beta_1 & \beta_2 & \beta_3 & \beta_4 & 1 \end{pmatrix} \begin{pmatrix} \varepsilon_t^{poil} \\ \varepsilon\pi_t^{fcpi} \\ \varepsilon y_t \\ \varepsilon\pi_t^{cpi} \\ \varepsilon s_t \end{pmatrix} \quad \ldots\ldots (22)$$

This SVAR model is over-identified by one additional restriction.

4.3.2 Unit Root and Stability Test

A starting point to multivariate time series modelling is the test of the stationarity of the variables. Each of the variables was subjected to unit root tests using the traditional augmented Dickey-Fuller (ADF) and Philip-Perron (PP) tests. A VAR is stationary if all characteristic roots lie within a unit circle.

4.4 Data Type and Sources

The study utilised quarterly secondary time series data collected over the period 1994: q1-2019: q4. The choice of the period coincides with the beginning of a fully flexible exchange rate regime in 1994. Unlike previous studies, it is contended that the study period is well suited, comprising both relative macroeconomic stability and instability in the Zambian economy. For example, no study has yet incorporated the unusual depreciation of the currency and subsequent increase in inflation experienced in 2015.

Data on K/US$ nominal exchange rate, foreign price index, and consumer price index was sourced from the Bank of Zambia's Fortnightly statistics, while real GDP data was obtained from the International Monetary Fund (IMF) database. Similarly, crude oil prices were obtained from the IMF's primary commodity database. Since Zambia imports its crude oil from the Middle East, it was incumbent on the researcher to use the Dubai crude oil prices. All the variables are transformed to the natural logarithm.

CHAPTER FIVE

DATA ANALYSIS AND DISCUSSION OF RESULTS

Introduction

This chapter presents the results of the study and their corresponding discussion. It contains two sections: Section 5.1 is unit root and diagnostic tests, while section 5.2 is the model estimation and discussion of results.

5.1. Unit root and Diagnostic tests

Before estimating the structural VAR, the study began by establishing the properties of the data. Two-unit root tests were performed i.e., the augmented Dickey-Fuller (ADF) and Philip -Perron (PP) unit root tests. The unit root test results are presented in Table 5.1. The results reveal that the variables are non-stationary in level but stationary at the first difference, apart from the output gap.

Table 5.1 Unit Root Test Results

Variable	Level		First difference		Comment
	ADF	P-Perron	ADF	P-Perron	
cpi	-2.5237 (0.3163)[2]	-3.4576 (0.0496)	-5.0447 (0.0004)	8.5855 (0.0000)	I (1)
fcpi	-0.9910 (0.9399)	-1.1133 (0.9212)	-7.3784 (0.0000)	-8.0045 (0.0000)	I (1)
K/US	-2.5270 (0.3148)	-2.2106 (0.4784)	-7.1394 (0.0000)	-6.4102 (0.0000)	I (1)
oil prices	-1.5913 (0.7898)	-1.7854 (0.7050)	-7.7719 (0.0000)	-8.2466 (0.0000)	I (1)
output gap	-2.8834 (0.0043)	-3.5028 (0.0006)			I (0)

Source: Author's computations

[2] Note: values in parathesis indicate p-values

The implication is that the first level difference variables are integrated of order one I (1).

There is an unsettled debate in econometrics concerning the treatment of variables in a VAR, whether they should be in difference or levels. Sims (1980) and Sims, Stock, and Watson (1990) as cited by Brooks (2008) and Enders (2015) recommend against differencing even if the variables contain a unit root. They argued that since the purpose of a VAR is to establish the relationship that exists between or among variables, differencing would result in the loss of important information. Relying on this argument, the variables in the SVAR are treated in their level form.

The VAR was estimated with six lags as suggested by the Akaike information criterion (AIC) lag selection criteria (see table below).

Table 5.2 VAR Lag Order Selection Criteria

Lag	LogL	LR	FPE	AIC	SC	HQ
0	455.9924	NA	5.72e-11	-9.395674	-9.262114	-9.341687
1	1259.077	1505.784	5.22e-18	-25.60578	-24.80442*	-25.28185
2	1298.988	70.67464	3.84e-18	-25.91641	-24.44725	-25.32255*
3	1330.966	53.29688	3.36e-18*	-26.06179	-23.92483	-25.19799
4	1343.708	19.90924	4.42e-18	-25.80641	-23.00165	-24.67268
5	1378.873	51.28248	3.70e-18	-26.01818	-22.54563	-24.61452
6	1408.771	40.48709*	3.51e-18	-26.12023*	-21.97987	-24.44663
7	1430.094	26.65338	4.08e-18	-26.04362	-21.23546	-24.10008
8	1455.494	29.10439	4.47e-18	-26.05196	-20.57600	-23.83849

Source: Author's computation

* Indicates lag order selected by the criterion

LR: sequential modified LR test statistic (each test at 5% level)

FPE: Final prediction error

AIC: Akaike information criterion

SC: Schwarz information criterion

HQ: Hannan-Quinn information criterion

The stability test was conducted (see Table 5.3 below). The test revealed that all characteristic roots of the VAR are within the unit circle. Accordingly, the VAR stratifies the stability condition and is stable and stationary.

Table 5.3 SVAR Stability Test

Root	Modulus
0.996792	0.996792
0.975475 - 0.043921i	0.976464
0.975475 + 0.043921i	0.976464
0.010284 - 0.910519i	0.910577
0.010284 + 0.910519i	0.910577
0.808301 + 0.381628i	0.893863
0.808301 - 0.381628i	0.893863
0.851975 - 0.264174i	0.891992
0.851975 + 0.264174i	0.891992
-0.653808 + 0.597432i	0.885658
-0.653808 - 0.597432i	0.885658
-0.203182 + 0.820279i	0.845068
-0.203182 - 0.820279i	0.845068
0.567725 - 0.622776i	0.842711
0.567725 + 0.622776i	0.842711
-0.583196 + 0.582558i	0.824313
-0.583196 - 0.582558i	0.824313
-0.755452	0.755452
0.305965 + 0.679579i	0.745280
0.305965 - 0.679579i	0.745280
-0.731290	0.731290
0.482184 + 0.523155i	0.711472
0.482184 - 0.523155i	0.711472
0.660978	0.660978
-0.049129 + 0.573982i	0.576081
-0.049129 - 0.573982i	0.576081
0.430501 + 0.214972i	0.481190
0.430501 - 0.214972i	0.481190
-0.382678 + 0.158455i	0.414186
-0.382678 - 0.158455i	0.414186

No root lies outside the unit circle.
VAR satisfies the stability condition.

Source: Author's computations

The multivariate test for residuals serial correlation was conducted using the Lagrange multiplier (LM) criterion. The test failed to reject the null hypothesis of no autocorrelation at lag six (see table 5.4 below). A visual inspection of the residual plots in figure A1in

Appendix II shows several outliers. Moreover, the Jarque-Bera test rejected the hypothesis of normality due to excess kurtosis in the data. Equally, the White Heteroskedasticity test failed to reject the hypothesis of homoscedasticity at the 5 percent critical value. Since the variables were entered in their level form normality of residuals is considered less of a problem (Lutkepohl, 2017).

Table 5.4 Results from the VAR Multivariate Diagnostic Tests

Lag	1	2	3	4	5	6
LM test	33.857	52.457	28.273	31.567	31.1752	19.358
	(0.111)	(0.001)	(0.295)	(0.171)	(0.165)	(0.779)
Skewness						40.4355[c3]
						(0.0000)
Kurtosis						178.141[c]
						(0.0000)
Jarque-Bera						218.576
						(0.0000)
White Heteroskedasticity						959.949[c]
						(0.081)

Source: Authors' computations

The calculated off-diagonal elements of the residual covariance matrix in Table A1, in Appendix 1 are close to zero, implying that no contemporaneous correlation is being ignored. The finding further supports the choice of the VAR in modelling ERPT (Mwase,2006; Sanusi, 2018). Additionally, the SVAR chi-square in Table A2 of Appendix 1 failed to reject the hypothesis of over-identification. This means that the restrictions on the variables were correctly imposed.

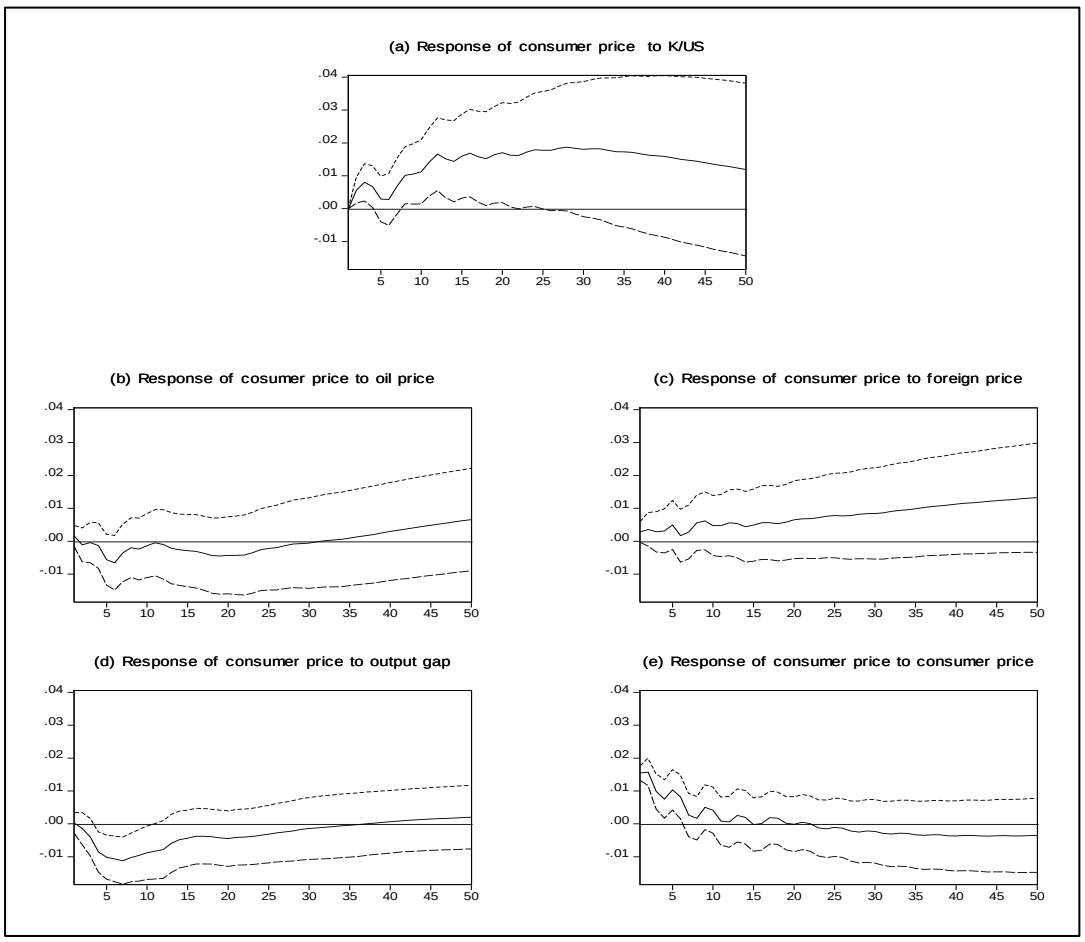
[3] Indicates joint chi-square of the variables.

5.2 Model Estimation and Discussion of Results

The goal of the SVAR is to recover structural innovations in the Hessian matrix and use them to estimate the impact of shocks on the system. The full estimated results of the structural factorization are presented in Table A2, in Appendix I. To trace the effects of a shock originating from an endogenous variable to other variables impulse response functions were used. Using the IRF, the study traced the effect of a shock originating from other variables to consumer prices in the dynamic structure of the VAR.

Figure 5.1 shows the response of consumer prices to a structural innovation to each of the variables. A complete plot of the contemporaneous shocks to all the variables in the system is shown in figure A1 in appendix II. In figure 5.1, the solid dashed lines show the 95 percent confidence interval two error bands around the estimate, while the thick line traces the response of consumer price to structural factors.

Figure 5.1 Impulse Response of CPI to Structural Innovations ± 2 S.E



Source: Author's computation

The noticeable evidence from the impulse response functions generated is that consumer prices do not react intensely to other variables, at least based on the short-run dynamics. The most evident effect is that exerted by exchange rates, in line with theoretical postulations. Since the data was entered at the level of the natural logarithm the impulse response functions may be regarded as measuring a proportional change in consumer price in each period.

Panel (a) reports the response of consumer prices to one standard (SD) innovation to the exchange rate. The impulse response function reveals no increase in consumer prices at impact. Consumer prices, however, rise beginning in the second quarter and reach their peak at a twenty-quarter lag and remain at an elevated level. Between the fifth and eighth quarter lags, exchange rate depreciation does not seem to have a significant impact on consumer prices. The general picture observed here is that the exchange rate shock tends to have a permanent positive impact on consumer prices.

Panel (d) shows the response of consumer prices to a shock in output-gap. At impact, there is no noticeable effect of the output gap on consumer prices. However, there is an observed decline in consumer prices that starts in the second quarter through to the sixth quarter. Thereafter, consumer price begins to rise but the rise in prices is insignificant after a ten-quarter lag. The decline in consumer prices following a shock to output gap indicates the excess capacity that exists in the Zambian economy. Partly, this phenomenon reflects output uncertainty which might elicit reactions from policy authorities. A close explanation leading to this result may be that actual output in the economy has consistently been lower than potential output, thus failing to boost employment and stimulate expenditure on goods and services. Zambia's real GDP has been declining, with 2019 recording a 1.4 percent growth rate, the lowest recorded since 1998. The unemployment rate has equally been high, averaging 12.9 percent. The implication is that real wages are sticky upwards, even when the output is expanding.

Panel (e) shows a one standard deviation shock to CPI on itself. Consumer prices increase sharply in the first quarter, after a shock in CPI. Gradually, prices decline, and the shock dies off after a six-quarter lag. The message here is that CPI own shocks tend to increase consumer prices. The fact that inflation reacts to its shocks reflects inflation inertia.

From the foregoing, it is evident that the most salient drivers of consumer prices are own shocks and exchange rate depreciation.

5.2.1 Exchange Rate Pass-through to Consumer Prices

Following Mwase (2006), the exchange rate pass-through to consumer prices over **T** periods can be defined as the accumulated partial effects of a one-unit increase in exchange rates, in period t on consumer prices, in period $t + T - 1$. The short-run and medium-term pass-through was examined over *T*=1, 4… and 20 periods/quarters.

To examine the impact of exchange rate shocks on consumer prices and subsequently determine the ERPT, it is appropriate to use the accumulated impulse response function. Table 5.3 below shows the accumulated impulse of consumer prices to structural shocks from other variables.

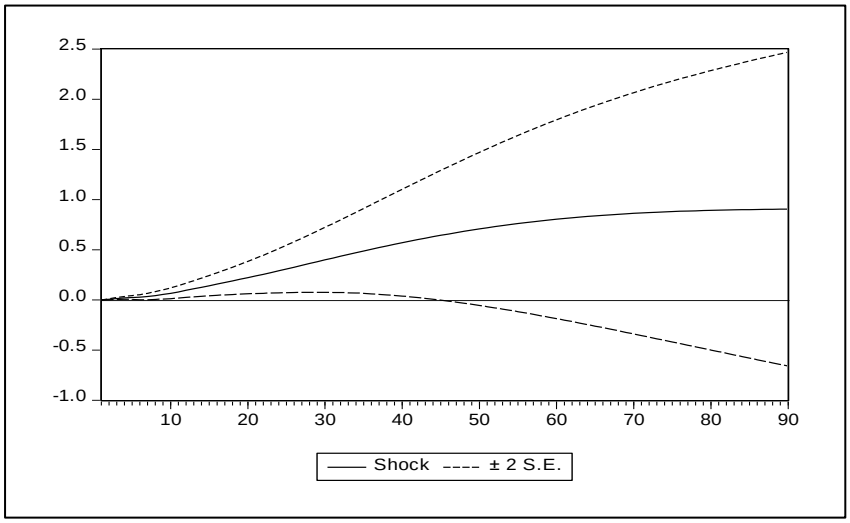
Table 5.3 Accumulated Impulse Response of CPI to Structural Shocks

Period (1)	Oil prices (2)	Foreign price (3)	Output gap (4)	Consumer price (5)	Exchange rate (6)
T= 1	0.0016	0.0029	0.0003	0.0155	0.0000
T= 2	0.0006	0.0065	-0.0012	0.0312	0.0056
T=4	-0.0012	0.0125	-0.0138	0.0486	0.0203
T=20	-0.0513	0.0926	-0.1258	0.0902	0.2223

Source: Author's computations

Column six results highlight that a depreciation of the exchange has no immediate effect on consumer prices at impact. Inflation tends to rise gradually in subsequent periods with ERPT elasticity in quarter two estimated at 0.0056 and 0.0203 recorded in the fourth quarter. This result implies that a 10 percent depreciation of the exchange rate increases consumer prices by 0.056 percent after a two-quarter lag and 0.203 percent after a four-quarter lag. The ERPT elasticity, however, increases to 2.2 percent or 22 percent at the full impact of the shock in twenty-quarters or five years. The pass-through is observed to accumulate further, reaching 0.57 percent or 57 percent at the full impact of the shock, which occurs in fort quarters. The prolonged pass-through reflects adaptive expectations. Since the model is based on short-run dynamics, the study will not preoccupy itself with the long-run estimates.

Figure 5.2 Accumulated Impulse Response of CPI to shocks to Nominal Exchange Rates



Source: Author's computation

Based on the short-run estimated results, the evidence uncovered shows that ERPT is low and incomplete. The result is comparable to the findings on other SSA countries. For example, the study finds a 0.056 percent pass-through in the second quarter. This is similar to the 0.05 percent result estimated by Mwase (2006) in Tanzania. In Malawi, Jombo *et al.* (2014) estimated a pass-through elasticity of 0.20 percent in the fourth quarter, similar to the 0.203 percent pass-through result obtained by this study. The result of this study is however much lower than the 0.34 or 34 pass-through elasticity estimated by Sanusi (2018) in Ghana and the 8.3 percent and 11.5 percent result estimated by Bhundia (2002) and Ocran (2010) respectively in South Africa.

The comparison with South Africa is thought-provoking when analysed from an industrial standpoint. The size of the manufacturing sector in a country plays a critical role when evaluating exchange rate pass-through to domestic prices. It is argued that the lesser the weight of imports in the production process, the smaller the influence of exchange rate fluctuations on domestic prices. South Africa boasts of a larger industrial base than any other country in southern Africa. Moreover, it is the largest source of imports into Zambia, whose industrial base is narrow. From the theoretical standpoint, it is expected that ERPT in South Africa would be lower than one obtainable in Zambia. On the contrary, the study finds a lower pass-through in Zambia compared to South Africa. However, the speed of pass-through is faster, less persistent in South Africa than in Zambia.

To explain the higher pass-through in South Africa, the study draws some insights from Bhundia (2002). He shows that the pass-through of producer prices to the consumer price is reasonably high and almost complete in South Africa, reaching 75 percent in eight quarters, although it reduced to 20 percent in a recent study by Ocran (2010).

One of the drivers of producer costs is growth in unit labour costs. Growth in labour unit cost account for a significant share of producer costs. Bhundia (2002) demonstrates that labour unit cost is highly correlated with producer price inflation. To remain profitable, firms would have to pass on the increased costs to the consumer in form of price hikes. The high cost of production Partly explains the relatively high pass-through observed in South Africa.

Group country studies by Choudhri and Hakura (2001) and Barhoumi (2005) reported ERPT elasticities of 41percent and 42 percent respectively for Zambia, after a four-quarter lag. This result is higher than the 0.2 or 2 percent estimated by this study. The departure in the results is attributed to the macroeconomic environments that prevailed during the two study periods. The sample periods for the two pieces of work were marked with turbulences in the economy, mostly characterized by the fixed exchange rate regime and higher inflation rates. Choudhri and Hakura's (2001) study (1979-2000) and Barhoumi's (2005) (1980-2003) cover periods of high inflation, with a mean inflation rate of about 40 percent. This can be contrasted with an average inflation rate of 15 percent per annum between 1994 and 2019. Their results are consistent with Choudhri and Hakura's (2001) main point of investigation; a high inflation environment is associated with high pass-through.

Similarly, the ERPT obtained by Simuchile (2003) and Zgambo (2015) is 100 percent and 37 percent respectively in the fourth quarter. Zgambo’s result, however, reduces to 20 percent in the third quarter when forecasted in a recent period (2004-2014) characterized by a relatively stable macroeconomic environment. Generally, both study results remain higher than the 2 percent and 22 percent estimated by this paper in the fourth and twenty quarters, respectively.

The difference in the two study results and this one arises from the methodological and the type of impulse response function used. The two studies utilised a recursive VAR, which is sensitive to the order of variables. Additionally, their ERPT elasticities are estimated using ordinary impulse response functions, while this study used accumulated structural impulse response functions as per SVAR requirements.

Furthermore, the decision to leave the initial impact of consumer prices on the exchange rate unrestricted in the model seems plausible. Estimating the same set of equations with full identification in a recursive VAR framework leads to higher ERPT. This is certainly what many of the previous studies have done.

To explore the relative contribution of the structural shocks to consumer prices, variance decompositions are utilized. The variance decomposition in column 6 of Table 5.4 highlights that changes in consumer prices are predominantly driven by own innovations. Consumer price shocks account for about 96 percent of the variation in the first quarter, however, this declines slowly to about 16 percent in twenty quarters. Exchange rate innovations, on the other hand, accounted for zero percent of the volatility in the first quarter. This rises to about 6 percent after a two-quarter lag and gradually increased to 54 percent in twenty quarters (see Table 5.4 below).

Table 5.4. Variance Decomposition of CPI to Structural Factors

Period (1)	S.E. (2)	Oil price (3)	Foreign price (4)	Output gap (5)	Consumer price (6)	Exchange rate (7)
1	0.1368	1.0663	3.2805	0.0308	95.6224	0.0000
2	0.2094	0.6979	3.8812	0.3899	89.2255	5.8055
4	0.2610	0.6296	4.2965	10.0235	69.7783	15.2721
20	0.3729	3.6542	8.2866	17.8469	15.8592	54.3531

Source: Author's computations

5.2.2 Sub-Sample Estimates

While the magnitude and speed of pass-through are vital, it might be interesting to understand how the pass-through may have changed in the last decade. In this regard, the full sample was split into two distinct samples, inspired by macroeconomic conditions that prevailed in each period. Specifically, the model was re-estimated over the sample period 1994: q1 to 2006: q1 and 2006: q2 to 2019: q4. Sample 1, the period 1994: q1 to 2006: q1 was mainly characterized by high inflation, with a year-on-year inflation rate averaging 22.34 percent and

a depreciated and volatile K/US exchange rate of about 16 percent and 33.5 percent respectively (see figure 5.5).

Table 5.5 Average percentage changes and volatilities of inflation and exchange rate

Sample Period	CPI average growth (%)	CPI volatility	K/US average growth (%)	K/US volatility[4]
Full sample	14.99	16.71	11.83	35.73
1994: q1-2006: q1	22.34	12.98	16.05	33.49
2006: q2-2019: q4	8.99	6.90	8.38	36.31

Source: Author's computation

The sharp depreciation and volatility in the exchange rate were a result of the adoption of a floating exchange rate regime, which replaced the fixed exchange rate system that dominated the pre-liberalized era. It was during this time the currency recorded a real depreciation, considering that the currency's real value was suppressed during the fixed exchange rate regime.

Similarly, the breakpoint 2006: q2 reflects the beginning of key developments in the domestic economy. In particular, the inflation rate dropped to a single digit of 8.5 percent after many years of rising. Between 2006: q2 to 2019: q4 inflation rate averaged about 9 percent. The exchange rate too appreciated by about 91 percent from the depreciation of 16 percent at end of sample 1 to about 8 percent at end of sample 2. The appreciation of the currency was supported by inflows of foreign exchange from foreign direct investment and increased tax revenue, following a boom in the mining sector. Additionally, the attainment of the High Indebted Poor Countries (HIPC) condition resulted in the cancellation of Zambia's huge debts. The debt cancellation served the country of its debt repayment obligations.

Adherence to the structural adjustment programs (SAPs) and the HIPC completion campaign was seen to have started paying off dividends, beginning this period. For instance, inflation declined to its lowest after three decades of registering unprecedented levels. According to Choudhri and Hakura (2001), economies that record an average inflation rate of less than 10 percent are regarded as low inflation economies. During this period, the average inflation rate

[4] Volatility is calculated as the standard deviation of the growth rate of the variable. Annual growth is utilised as a measure.

was about 9 percent. Thus, Zambia qualified to be considered as a low inflation economy between 2006: q2 to 2019: q4.

After analysing the two samples, the study found that there has been a significant decline in the pass-through of exchange rate depreciation to domestic consumer prices in sample two, from that recorded in sample one. Both sample models' structural factorization and impulse response functions are shown in Appendix 1 and II, respectively. In the first sample, the accumulated impulse response function shows that a 10 percent depreciation of the exchange rate causes a 0.12 percent increase in consumer prices beginning in the second quarter, with the pass-through increasing to about 0.31 percent in the fourth quarter. This can be contrasted with the period 2006: q2, where depreciation of the same size causes a 0.05 percent increase in consumer prices, with pass-through rising to about 0.14 percent in the fourth quarter (see Table 5.6 and 5.7, respectively).

Table 5.6 Accumulated Impulse Response of CPI to Structural Shocks (1994: q1 to 2006: q1)

Period (1)	Oil price (2)	Foreign price (3)	Output gap (4)	Consumer price (5)	K/US (6)
1	0.0010	-0.0009	0.0039	0.0222	0.0000
2	-0.0021	-0.0078	0.0073	0.0399	0.0119
3	0.0001	-0.0166	0.0057	0.0496	0.0217
4	0.0070	-0.0228	-0.0010	0.0646	0.0312

Source: Author's computation

Table 5.7 Accumulated Impulse Response of CPI to shocks to Exchange Rates (2006: q2 to 2019: q4)

Period (1)	Oil price (2)	Foreign price (3)	Output gap (4)	Consumer price (5)	K/US (6)
1	-0.0016	0.0033	0.0006	0.0125	0.0000
2	-0.0054	0.0112	0.0012	0.0249	0.0047
3	-0.0099	0.0204	-0.0004	0.0336	0.0102
4	-0.0139	0.0304	-0.0050	0.0396	0.0144

Source: Author's computation

The findings underscore that both the speed of pass-through and persistence have declined since 2006: q2. Of interest to note, however, is that foreign prices emerged stronger as a significant source of inflation between 2006: q2 to 2019: q4. The results show that at impact, a 10 percent increase in foreign price increase consumer prices by 0.033 percent. The pass-through increases to 0.304 percent in the fourth quarter and remains persistent.

The variance decompositions of the first sample model indicate that exchange rate innovations accounted for 0 to 19 percent of the volatility in consumer prices between the first and fourth quarters (see Table 5.8 below). On the other hand, own shocks accounted for about 97 percent of the volatility in consumer prices at impact, although this declined to about 64 percent in the fourth quarter.

Table 5.8. Variance Decomposition of CPI to Structural Factors (1994: q1 to 2006: q1)

Period (1)	S.E (2)	Foreign price (3)	Oil price (4)	Output gap (5)	Consumer price (6)	K/US (7)
1	0.1041	0.1932	0.1400	2.9725	96.6943	0.0000
2	0.1474	0.9903	4.7352	2.5509	77.9546	13.7689
3	0.1621	1.1472	9.6584	2.1931	68.7463	18.2551
4	0.1782	3.5617	9.3939	4.1875	64.1741	18.6829

Source: Author's computation

Contrasted with the period since 2006: q2 in Table 5.9, own shocks accounted for about 92 percent of the volatility in consumer price in the first quarter and declined to about 51 percent in the fourth quarter. The decline in volatility is faster than in the previous case. Exchange rate innovations maintained the zero-volatility contribution to inflation in the first quarter, with variation in inflation gaining momentum in subsequent periods, beginning in the second quarter. However, the volatility in inflation was less than 10 percent and tended to decline much faster than in the latter case.

Table 5.9. Variance Decomposition of CPI to Structural Factors (2006: q2 to 2019: q4)

Period (1)	S.E. (2)	Oil price (3)	FCPI (4)	Y gap (5)	CPI (6)	Exchange rate (7)
1	0.153085	1.423487	6.395892	0.243274	91.93735	0.000000
2	0.217950	4.149588	17.48472	0.159227	72.98480	5.221669
3	0.248324	5.866053	24.89934	0.458289	60.53815	8.238170
4	0.266990	6.480581	31.47169	2.068028	51.47927	8.500435

Source: Author's computation

As highlighted earlier, since 2006: q2, foreign prices (column 4) contributed significantly to inflation. Its innovations accounted for about 6.4 percent to about 31.5 percent of the volatility in consumer prices, dominating exchange rates. Moreover, of the factors that affected consumer prices in the second sample, the foreign price was the second driver, after consumer price own shocks. The growing contribution of foreign prices to domestic consumer prices as reflected in the variance decomposition highlights the dependence of the economy on imports of manufactured, agricultural, and intermediate goods. Ndulo *et al.* (2019) note that Zambia's manufacturing value-added as a percentage of GDP collapsed to 9.2 percent between 1994 and 2013 from 21.6 percent between 1977-1993. The collapse of the manufacturing sector was a result of the abolition of the import substitution industrialization strategy and the adoption of trade liberalization policies of the 1990s. Since then, the country's manufacturing sector output has not been able to compete favorably with imports, leading to the underperformance of the sector. As a result, the country has continued to rely heavily on the manufacturing sector of other countries to satisfy its consumer and industrial needs.

Commenting on the pass-through results of both full sample and sub-samples, the results are puzzling given that the exchange rate depreciation and volatility were substantial as indicated in Table 5.5. The low pass-through may be attributed to several factors. These include flexibility by firms to absorb costs to avoid losing market share, an improvement in the macroeconomic environment, SAPs reforms administered under the supervision of the IMF and the World Bank in the 1990s, and other factors. The structural reforms meant that

Zambia had to abide by strict fiscal management and liberalize the economy to qualify for financial assistance. This resulted in the removal of barriers to competition through the privatization of various state-owned institutions, foreign exchange decontrol, trade, and financial sector liberalization. As a result, the reforms helped the country to gain both local and foreign investors' confidence. Foreign direct investment surged from 2.5 percent of GDP in 1988 to 6.17 percent of GDP in 1990 and about 9 percent of GDP in 1993.

The liberalization of the capital account that came with the financial reforms implied a shift from a fixed exchange rate regime to a flexible one. A flexible exchange rate regime is often associated with a low pass-through as opposed to a fixed one. In the former, economic agents consider devaluations of the currency as permanent and induce long-term impact on the costs of production. This implies a rapid adjustment of the prices of goods and services. In a flexible regime, firms perceive a depreciation of the exchange rate as a temporal setback. Accordingly, firms are hesitant to adjust prices immediately.

The result of this study, compared with earlier studies of Choudhri and Hakura (2001) and Barhoumi (2005) indicates that pass-through has considerably reduced after the shift from fixed to floating exchange rate regime. Razafimahefa (2012) shows that the exchange rate pass-through was higher in countries that follow fixed exchange regimes compared with floating exchange rate regimes. In particular, he noted that the average elasticities in countries that pursued a flexible exchange rate regime range from 0.13 in the first quarter to 0.3 in the fourth quarter. The 0.3 elasticity is comparable to the 0.2 percent elasticity estimated by this study.

The decline in inflation over the years has significantly played a crucial role in reducing the pass-through of the exchange rate to consumer prices. Precisely, low inflation environments are associated with low pass-through in countries that pursue a flexible exchange rate regime. The hypothesis is consistent with the sub-sample experiment in Table 5.5 with results recorded in Table 5.6 and 5.7. Further, the finding is consistent with empirical evidence from other studies (Taylor, 2000; Choudhri and Hakura, 2001; Mwase, 2006) that show that exchange rate pass-through correlates with the initial inflation rate, with the degree of pass-through declining as inflation decreases.

The decline in pass-through may also be linked to interventions by the central bank in the foreign exchange market. Occasionally, the Bank of Zambia intervenes in the foreign exchange market through monetary policy, whenever the currency is under the pressure of

depreciating. Interventions in the foreign exchange market counter the original depreciation by appreciating the currency, thereby dampening the pass-through.

5.3 Limitations

Firstly, it could be enlightening to policymakers to understand the pass-through of the exchange rate along the distribution chain, from imports to the producer and ultimately the consumer. However, due to the non-availability of data, the latter cases could not be explored. Secondly, consumer price data collection in Zambia is quite poor, as such, it may not be reflective of the true prices prevailing in the economy. Thus, the actual CPI could be much higher than recorded.

CHAPTER SIX

CONCLUSION, POLICY IMPLICATIONS AND RECOMMENDATIONS

Introduction

This chapter presents a summary of the key findings of the study in section 6.1. Section 6.2 outlines the policy implications and recommendations, while section 6.3 highlights area(s) for future research.

6.1 Conclusion

The study sought to estimate the exchange rate pass-through to consumer prices in Zambia over the period 1994: q1 to 2019: q4. The analysis was based on a structural VAR model with overidentified restrictions. The model incorporated both supply and demand factors as potential drivers of consumer prices. The degree of exchange rate pass-through was estimated using structural accumulated impulse response functions, and variance decomposition to measure the relative importance of exchange rate shocks in explaining variations in consumer prices.

The analysis of the results in chapter five shows that a 10 percent depreciation of the exchange rate is associated with a 0.05 percent increase in consumer prices in the first quarter and 0.2 percent in the fourth quarter (one year). At the full impact of the shock, the pass-through increases steadily to 22 percent in twenty quarters (five years). The estimated results imply that the exchange rate pass-through to consumer prices is low and incomplete in Zambia. The estimated pass-through is much lower than found by earlier studies (Simuchile, 2003; Zgambo, 2015) whose results show a complete and moderate pass-through respectively. The speed of pass-through is also found to be low and persistent during the study period.

The results of the study are similar to those obtained by Mwase (2006) in Tanzania and Jombo *et al.* (2014) in Malawi. However, when compared with studies on South Africa (Bhundia, 2002; Ocran, 2010) with a well-established manufacturing sector, this study's result remains lower than the findings of the two papers. The result is puzzling considering that Zambia has a narrow manufacturing base compared to South Africa. The difference in

pass-through may be attributable to higher labour unit costs which increase the cost of production in South Africa.

To understand how inflation regimes affect pass-through in Zambia, the study found support for the existence of the interdependence between pass-through and the level of inflation. Specifically, the result from sub-sample experiments shows that periods of low/high inflation are associated with low/higher pass-through. It was shown that the pass-through had remarkably declined during the period 2006: q2 to 2019: q4 when inflation averaged 9 percent per annum compared with the period 1994: q1 to 2006: q1 with 22.34 average inflation.

Drawing from the foregoing, the study contends that the low pass-through observed during the sample period 1994: q1 to 2019: q4 may be linked to a combination of multiple factors. At a micro level, the reasons are more theoretical than empirical. The low pass-through may seem to suggest that there is an inability by importers of finished goods and intermediate processing firms to fully pass on the costs to consumers. This reflects the ability to absorb costs by firms. The ability to absorb costs may suggest that Zambian firms have a considerable degree of flexibility. One may speculate whether this flexibility is due to the availability of substitutes of expensive imported goods, or the ability to temporarily absorb cost increases out of profits.

At the macro level, there is enough evidence that suggests the adoption of a flexible exchange rate regime, interventions by the central bank, and a decline in inflation that characterised most of the sample period as some of the factors that may have substantially contributed to the observed low and incomplete pass-through.

6.2 Policy Implications and Recommendations

Several policy implications can be drawn from the study. Firstly, the fact that the exchange rate pass-through is low and incomplete despite Zambia being an import dependant country should raise some concerns to policymakers. From a trade point of view, the decreasing pass-through may suggest the existence of dumping practices, where foreign producers sell goods below market value in foreign markets. The aim is to thwart the growth of the domestic manufacturing base and secure a market for their products. Therefore, policymakers should be on the lookout for the possibility of such practices to protect local industries.

Secondly, the significant contribution of foreign inflation to domestic consumer prices as observed should call for the government to enact policy measures that strengthen the local manufacturing base. This would make the country self-reliant and increase its resilience to absorb external shocks.

To the central bank, the low ERPT would mean that exchange rate shocks have less impact on inflation so that monetary policy should not be counteractive by raising interest rates. However, the central bank may leave from this commitment due to a foreseen situation. For example, the nominal kwacha depreciated by 16.9 percent between the fourth quarter of 2018 and that of 2019. A pass-through into consumer prices of 10 percent implies that this shock would add 1.69 percent more to the quarterly inflation rate or an added 6.76 percent per annum over the next year. This was sufficient to worry the central bank, which raised the policy interest rate by 0.25 percent from 10.25 percent to 11.5 percent in November 2019. The message here is that a higher ERPT might have led to an even higher expected inflation and hence a higher rise in the policy interest rate. Thus, it may be justifiable to recommend that the central bank should continue monitoring exchange rates and enacting appropriate monetary policy measures to help dampen inflationary pressures. This is on the account that exchange rate depreciation still poses a threat as one of the major sources of inflation judged from the variance decomposition.

6.3 Area for future Research

As an opportunity for future research, exchange rate pass-through can be a measure of market power in industries. In this regard, further research should address the extent to which exchange rate pass-through determines the market concentration of certain firms in their respective industries in the economy.

APPENDICES:

Appendix I

Table A1. VAR Residual Covariance Matrix

	Oil price	Foreign price	Output gap	Consumer price	Exchange rate
Oil prices	0.018712	0.000497	8.44E-05	0.000223	-0.003327
Foreign price	0.000497	2.21E-05	1.69E-06	1.44E-05	-9.97E-05
Output gap	8.44E-05	1.69E-06	9.11E-06	1.29E-06	-2.25E-05
Consumer price	0.000223	1.44E-05	1.29E-06	0.000250	0.000221
Exchange rate	-0.003327	-9.97E-05	-2.25E-05	0.000221	0.004532

Table A2. Structural VAR Estimates (1994: q1 -2019: q4)

Sample (adjusted): 1995Q3 2019Q4
Included observations: 98 after adjustments
Estimation method: Maximum likelihood via Newton-Raphson (analytic derivatives)
Convergence achieved after 12 iterations
Structural VAR is over-identified

Model: Ae = Bu where E[uu']=I

A =

1	0	0	0	0
C(1)	1	0	0	0
C(2)	0	1	0	0
C(3)	C(5)	C(7)	1	0
C(4)	C(6)	C(8)	C(9)	1

B =

C(10)	0	0	0	0
0	C(11)	0	0	0
0	0	C(12)	0	0
0	0	0	C(13)	0
0	0	0	0	C(14)

	Coefficient	Std. Error	z-Statistic	Prob.
C(1)	-0.026570	0.002206	-12.04223	0.0000
C(2)	-0.004511	0.002182	-2.067460	0.0387
C(3)	0.013945	0.018260	0.763672	0.4451
C(4)	0.122550	0.071206	1.721055	0.0852
C(5)	-0.957765	0.523382	-1.829955	0.0673
C(6)	2.413588	2.069402	1.166322	0.2435
C(7)	-0.093917	0.529277	-0.177444	0.8592
C(8)	1.049640	2.058180	0.509984	0.6101
C(9)	-1.139157	0.392751	-2.900457	0.0037
C(10)	0.136792	0.009771	14.00000	0.0000
C(11)	0.002988	0.000213	14.00000	0.0000
C(12)	0.002955	0.000211	14.00000	0.0000
C(13)	0.015450	0.001104	14.00000	0.0000
C(14)	0.060069	0.004291	14.00000	0.0000

Log likelihood	1324.436			
LR test for over-identification:				
Chi-square(1)	0.388920		Probability	0.5329

Estimated A matrix:

1.000000	0.000000	0.000000	0.000000	0.000000
-0.026570	1.000000	0.000000	0.000000	0.000000
-0.004511	0.000000	1.000000	0.000000	0.000000
0.013945	-0.957765	-0.093917	1.000000	0.000000
0.122550	2.413588	1.049640	-1.139157	1.000000

Estimated B matrix:

0.136792	0.000000	0.000000	0.000000	0.000000
0.000000	0.002988	0.000000	0.000000	0.000000
0.000000	0.000000	0.002955	0.000000	0.000000
0.000000	0.000000	0.000000	0.015450	0.000000
0.000000	0.000000	0.000000	0.000000	0.060069

Estimated S matrix:

0.136792	0.000000	0.000000	0.000000	0.000000
0.003635	0.002988	0.000000	0.000000	0.000000
0.000617	0.000000	0.002955	0.000000	0.000000
0.001631	0.002862	0.000277	0.015450	0.000000
-0.024325	-0.003952	-0.002785	0.017600	0.060069

Estimated F matrix:

-0.589415	-1.513439	-0.497846	0.458578	-0.540208
0.521806	0.729710	0.032696	-0.002472	0.193396
-0.018022	-0.045237	0.002276	0.008836	-0.021457
3.096635	4.774315	0.198078	-0.123606	1.842286
3.491112	5.558057	0.475368	-0.491210	2.603099

Table A3. Structural VAR Estimates (1994: q1 -2006: q1)

Sample (adjusted): 1995Q1 2006Q1
Included observations: 45 after adjustments
Estimation method: Maximum likelihood via Newton-Raphson (analytic derivatives)
Convergence achieved after 18 iterations
Structural VAR is over-identified

Model: Ae = Bu where E[uu']=I

A =

C(1)	0	0	0	0
C(2)	C(6)	0	0	0
C(3)	0	C(9)	0	0
C(4)	C(7)	C(10)	C(12)	0
C(5)	C(8)	C(11)	C(13)	C(14)

B =

1	0	0	0	0
0	1	0	0	0
0	0	1	0	0
0	0	0	1	0
0	0	0	0	1

	Coefficient	Std. Error	z-Statistic	Prob.
C(1)	9.605988	1.012560	9.486833	0.0000
C(2)	-8.663276	1.698373	-5.100926	0.0000
C(3)	-0.041347	1.431983	-0.028874	0.9770
C(4)	-0.751812	1.930976	-0.389343	0.6970
C(5)	1.034649	1.935677	0.534515	0.5930
C(6)	523.7936	55.21269	9.486833	0.0000
C(7)	19.93046	78.22355	0.254789	0.7989
C(8)	68.61628	78.58531	0.873144	0.3826
C(9)	245.4394	25.87159	9.486833	0.0000
C(10)	-43.03346	36.92052	-1.165570	0.2438
C(11)	79.24323	38.12444	2.078541	0.0377
C(12)	44.97691	4.740982	9.486833	0.0000
C(13)	-31.50027	7.481913	-4.210190	0.0000
C(14)	24.86535	2.621038	9.486833	0.0000

Log likelihood	627.8160			
LR test for over-identification:				
Chi-square(1)	0.129916		Probability	0.7185

Estimated A matrix:

9.605988	0.000000	0.000000	0.000000	0.000000
-8.663276	523.7936	0.000000	0.000000	0.000000
-0.041347	0.000000	245.4394	0.000000	0.000000
-0.751812	19.93046	-43.03346	44.97691	0.000000
1.034649	68.61628	79.24323	-31.50027	24.86535

Estimated B matrix:

1.000000	0.000000	0.000000	0.000000	0.000000
0.000000	1.000000	0.000000	0.000000	0.000000
0.000000	0.000000	1.000000	0.000000	0.000000
0.000000	0.000000	0.000000	1.000000	0.000000
0.000000	0.000000	0.000000	0.000000	1.000000

Estimated S matrix:

0.104102	0.000000	0.000000	0.000000	0.000000
0.001722	0.001909	0.000000	0.000000	0.000000
1.75E-05	0.000000	0.004074	0.000000	0.000000
0.000994	-0.000846	0.003898	0.022234	0.000000
-0.007880	-0.006340	-0.008046	0.028166	0.040217

Estimated F matrix:

0.319440	-0.093172	-0.302795	0.273862	0.188301
0.045812	-0.008492	-0.061981	0.071466	0.040836
0.000319	-0.002226	0.011237	0.002280	0.003202
0.386816	-0.087966	-0.521419	0.684191	0.331477
0.525012	-0.035979	-0.601205	0.655553	0.242160

Table A4. Structural VAR Estimates (2006: q2 -2019: q4)

Sample (adjusted): 2006Q4 2019Q4
Included observations: 53 after adjustments
Estimation method: Maximum likelihood via Newton-Raphson (analytic derivatives)
Convergence achieved after 17 iterations
Structural VAR is over-identified

Model: Ae = Bu where E[uu']=I

A =

1	0	0	0	0
C(1)	1	0	0	0
C(2)	0	1	0	0
C(3)	C(5)	C(7)	1	0
C(4)	C(6)	C(8)	C(9)	1

B =

C(10)	0	0	0	0
0	C(11)	0	0	0
0	0	C(12)	0	0
0	0	0	C(13)	0
0	0	0	0	C(14)

	Coefficient	Std. Error	z-Statistic	Prob.
C(1)	-0.027519	0.002535	-10.85535	0.0000
C(2)	-0.001098	0.002762	-0.397627	0.6909
C(3)	0.046357	0.020373	2.275370	0.0229
C(4)	0.216052	0.072711	2.971396	0.0030
C(5)	-1.295267	0.614675	-2.107239	0.0351
C(6)	-1.529563	2.179768	-0.701709	0.4829
C(7)	-0.217643	0.564121	-0.385809	0.6996
C(8)	1.411119	1.924310	0.733312	0.4634
C(9)	-2.222797	0.467903	-4.750550	0.0000
C(10)	0.155187	0.015073	10.29563	0.0000
C(11)	0.002864	0.000278	10.29563	0.0000
C(12)	0.003121	0.000303	10.29563	0.0000
C(13)	0.012633	0.001227	10.29563	0.0000
C(14)	0.043032	0.004180	10.29563	0.0000

Log likelihood	737.2767			
LR test for over-identification:				
Chi-square(1)	1.530555		Probability	0.2160

Estimated A matrix:

1.000000	0.000000	0.000000	0.000000	0.000000
-0.027519	1.000000	0.000000	0.000000	0.000000
-0.001098	0.000000	1.000000	0.000000	0.000000
0.046357	-1.295267	-0.217643	1.000000	0.000000
0.216052	-1.529563	1.411119	-2.222797	1.000000

Estimated B matrix:

0.155187	0.000000	0.000000	0.000000	0.000000
0.000000	0.002864	0.000000	0.000000	0.000000
0.000000	0.000000	0.003121	0.000000	0.000000
0.000000	0.000000	0.000000	0.012633	0.000000
0.000000	0.000000	0.000000	0.000000	0.043032

Estimated S matrix:

0.155187	0.000000	0.000000	0.000000	0.000000
0.004271	0.002864	0.000000	0.000000	0.000000
0.000170	0.000000	0.003121	0.000000	0.000000
-0.001625	0.003710	0.000679	0.012633	0.000000
-0.030850	0.012627	-0.002894	0.028080	0.043032

Estimated F matrix:

6.249191	9.417433	-0.579318	-0.028904	5.979688
-2.260508	-3.724644	0.254522	0.172818	-2.320122
0.089242	0.146492	-0.001601	0.003995	0.089554
-12.41567	-20.22356	1.358566	0.924404	-12.61519
-15.35337	-24.82220	1.621326	0.986706	-15.37952

Appendix II

Figure A1, VAR Residuals

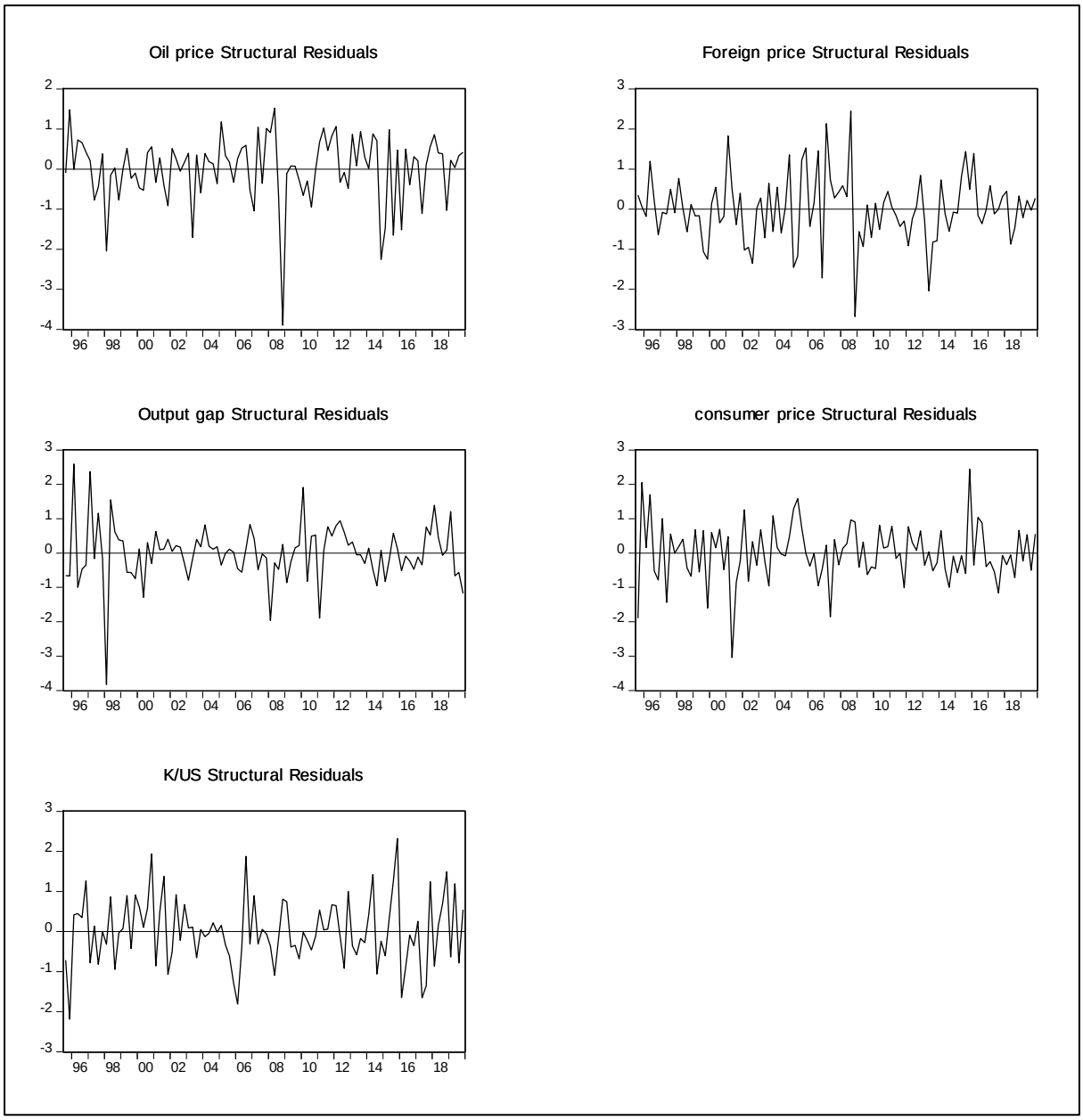


Figure A2 Response to Structural VAR Innovations ± 2 S.E(1994:q1 to 2019:q4)

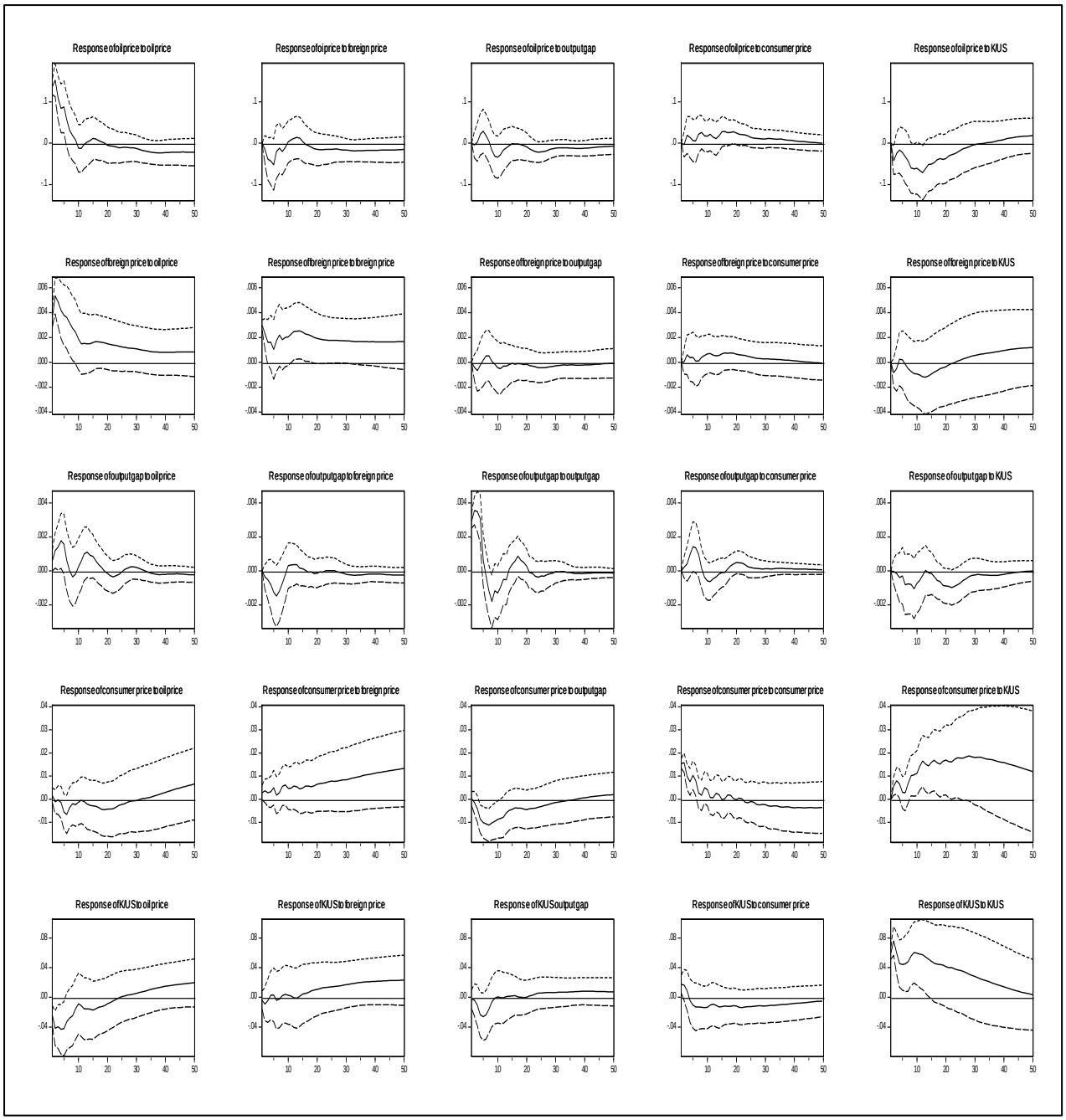


Figure A3 Response to Structural VAR Innovations ± 2 S.E(1994:q1 to 2006:q1)

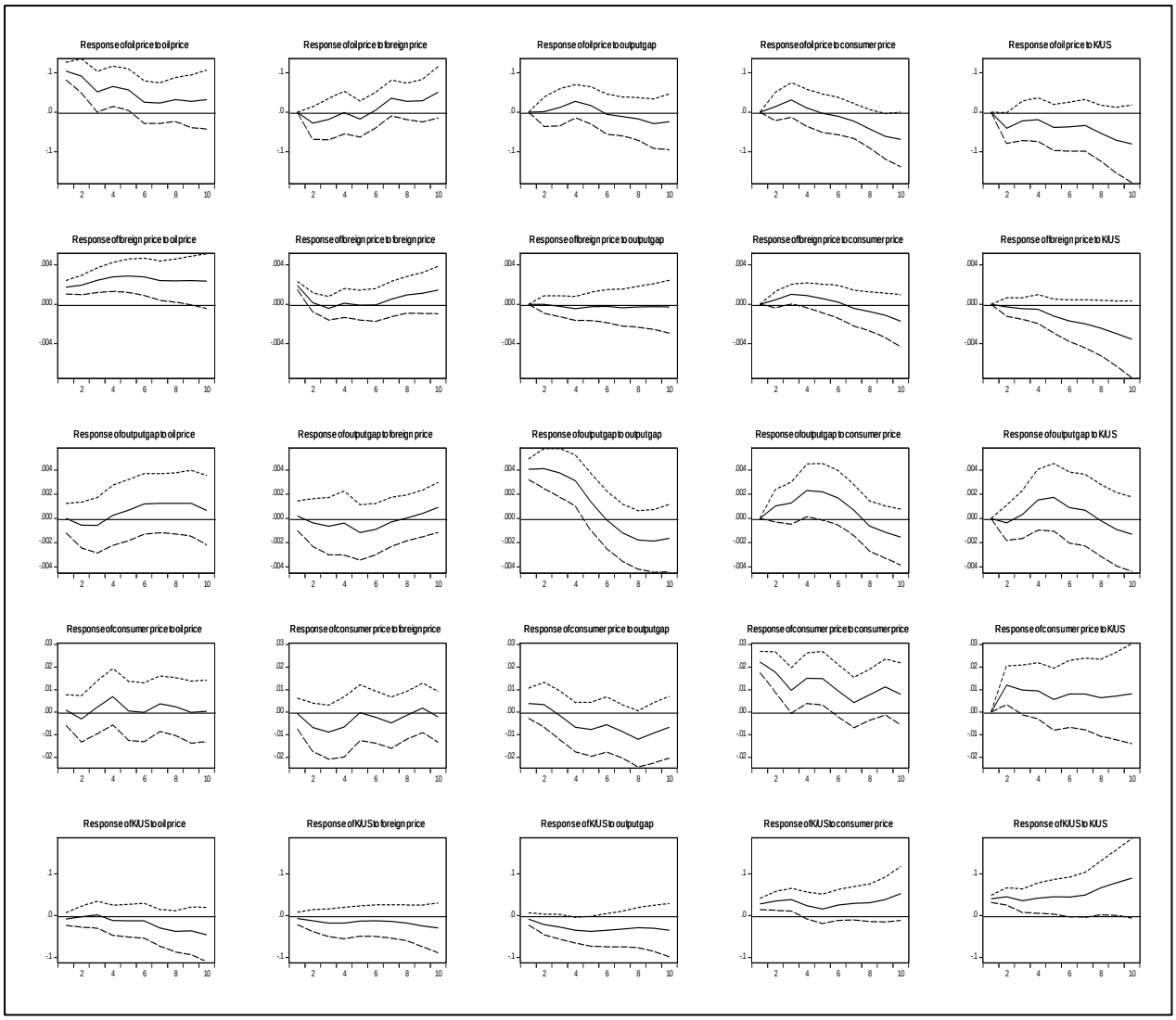
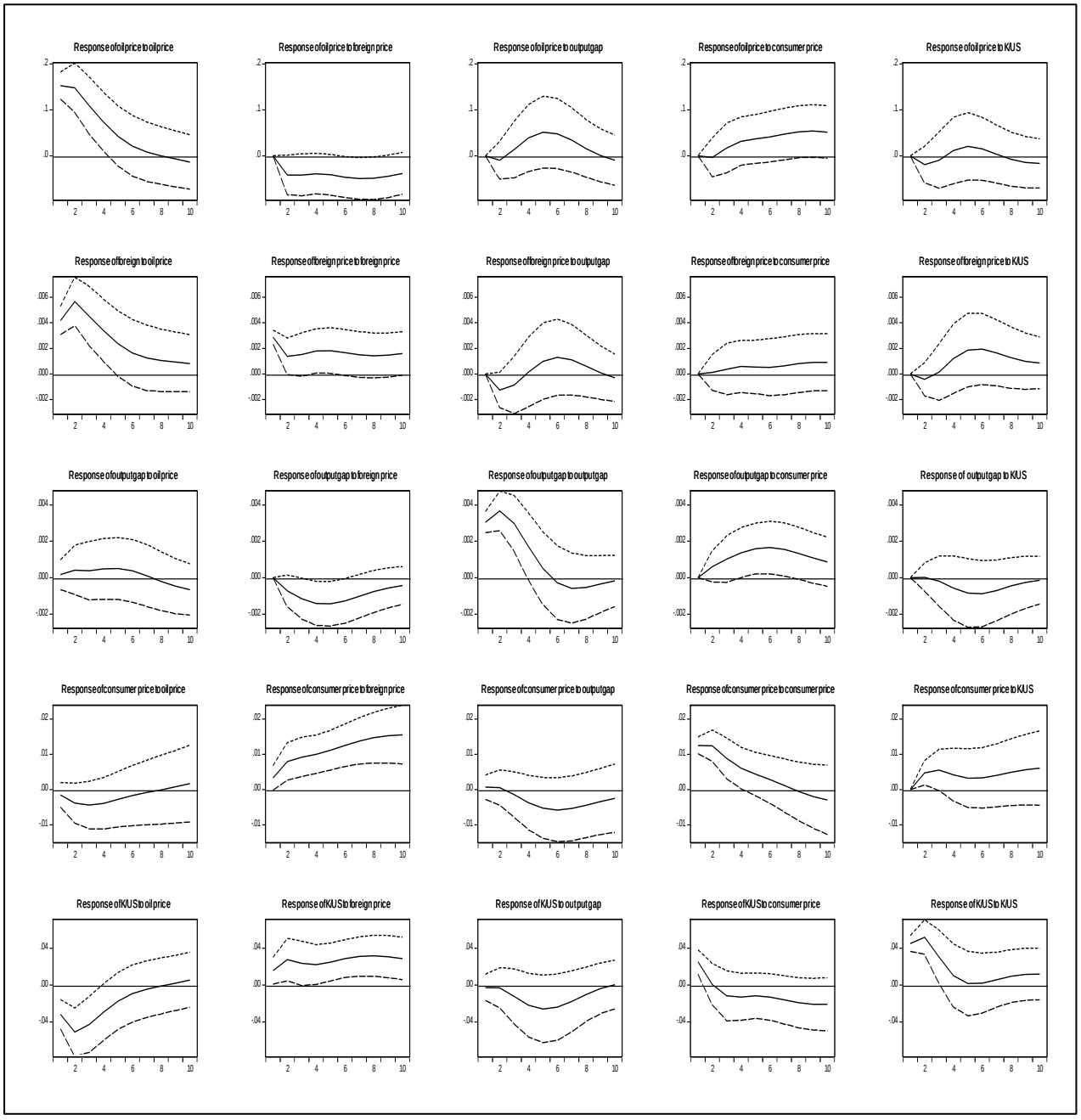


Figure A4 Response to Structural VAR Innovations ± 2 S.E(2006:q2 to 2019:q4)



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