



The Reaction of Inflation to Macroeconomic Shocks: The Case of Zimbabwe (2009 – 2012)

William Kavila and Pierre Le Roux

ERSA working paper 707

September 2017

Economic Research Southern Africa (ERSA) is a research programme funded by the National Treasury of South Africa.

The views expressed are those of the author(s) and do not necessarily represent those of the funder, ERSA or the author's affiliated institution(s). ERSA shall not be liable to any person for inaccurate information or opinions contained herein.

The Reaction of Inflation to Macroeconomic Shocks: The Case of Zimbabwe (2009-2012)*

William Kavila,[†] and Professor Pierre Le Roux,[‡]

September 1, 2017

Abstract

This paper empirically investigates the reaction of inflation to macroeconomic shocks using the Vector Error Correction modelling approach (VECM) with monthly data from 2009:01 to 2012:12. The Zimbabwean economy was dollarised during this period, after having abandoned its own currency in 2009, following the hyperinflation episode of 2007-2008. The empirical findings show that the reaction of price formation in Zimbabwe to external shocks, such as the appreciation or depreciation of the South African rand against the US dollar and the increase in international food and oil prices is immediate with permanent effects. Specifically, the study found that an appreciation of the South African rand against the US dollar, results in a sharp increase in inflation during the first 6 months and the effects are permanent. Similarly, a positive shock to international oil prices also results in a sharp increase in inflation, during the first 6 months, remaining high over the forecast period. The impact of a positive shock to food prices, is however, transitory, only felt during the first 4 months, before declining during the next 4 months and remaining at a moderately high level over the forecast period. The policy implication from this analysis is a need for Zimbabwean authorities to put in place measures to mitigate the negative impact of external shocks on inflation, given that the country lost its monetary policy autonomy when it dollarised in 2009.

Keywords: Inflation; Dollarised economy, Macro-economic shocks, Vector Error Correction Model, Impulse responses, Variance decomposition.

***Disclaimer:** The views expressed in this paper are those of the authors and do not necessarily coincide with those of the Reserve Bank of Zimbabwe or Nelson Mandela Metropolitan University.

[†]Deputy Director, Economic Research Division, Reserve Bank of Zimbabwe. Contact: wkavila@rbz.co.zw/ Mobile: 263 772 102 737

[‡]Lecturer, Department of Economics, Nelson Mandela Metropolitan University, Port Elizabeth

1 INTRODUCTION

This paper empirically investigates the reaction of inflation to macroeconomic shocks during the period from January 2009 to December 2012. The variables of interest include the consumer price index, the US dollar/South African rand exchange rate, international food and oil prices, money supply and South African inflation rate. The analysis is undertaken by applying the Vector Error Correction Model (VECM) approach, a variant of the unrestricted Vector Autoregressive (VAR) modelling approach. Monthly data is used because of its desirable characteristic of low correlations among contemporaneous variables and also for the sake of having a bigger sample. The VECM approach is applied to determine impulse responses of inflation to shocks as well as for the analysis of the variance decomposition of inflation. Granger causality tests are also carried out to determine the direction of causality between inflation and the other variables of interest. The VECM is used firstly because the variables were found to be integrated of order one $I(1)$. Secondly, cointegration test results confirmed the existence of a long run relationship between the variables.

The high import dependence of the Zimbabwean economy, on the back of attendant supply gaps, has exposed the country to vulnerabilities associated with fluctuations in the US dollar/South African rand exchange rate, international oil and food prices. It is thus important for policy makers in Zimbabwe to understand the reaction of inflation to macroeconomic shocks, in order to be better prepared to respond to the incidence of the shocks. For example, fluctuations of the US dollar/South African rand exchange rate have direct effects on the country's external competitiveness, as well as domestic price developments, transmitted through imports.

To the knowledge of the researchers, there is no published work on the reaction of Zimbabwean inflation to macroeconomic shocks. This presents a gap which this study attempts to bridge. Furthermore, existing empirical literature on the reaction of inflation to macroeconomic shocks in developing countries, for example, Ocran (2010); Bhattacharya (2013); Bahmani-Oskee and Domac (2002), used the VAR modelling approach. They all do not take into account the possibility that the variables in the analysis could have long run relationships, which would make the use of the VECM approach more appropriate.

The findings of this study have some interesting connotations for theoretical research on the reaction to external shocks, of inflation in a dollarised economy. First, a small open dollarized economy is prone to macroeconomic shocks, which are largely external, and these influence price formation as well as explain a large proportion of the variation of inflation. Second, inflation expectations continue to influence price formation well after the end of high inflation episodes, implying that the maintenance of price stability can be successful only if long run inflation expectations are kept at the desired level (Mohanty 2012). As Woodford (2005) observes, the active management of the public's perceptions about future inflation trends should take centre stage in the quest for central banks to control inflation. Inflation expectations have an influence on actual inflation outturns, as well as on the ability of the central bank to achieve its

primary objective of price stability (Bernanke 2007).

Third, the impact of external shocks on inflation in a dollarized economy takes a long time to dissipate, due to the absence of monetary policy autonomy. A country whose central bank has monetary policy autonomy would ordinarily use monetary policy instruments at its disposal to respond to the impact of external shocks. Lastly, in a dollarised economy, there is a unidirectional causality that runs from external factors to inflation. Inflation in the dollarised economy itself cannot influence the external factors.

The rest of this paper is organised as follows: Section two describes historical economic developments to put the study into context. Section three reviews theoretical literature and empirical literature. The data, model and estimation methodology are discussed in section four. Section five presents the empirical results and analysis. Section six gives the summary and policy recommendations.

2 ECONOMIC DEVELOPMENTS

A protracted economic crisis that occurred in Zimbabwe for over a decade (1998 - 2008) culminated in the hyperinflation episode of 2007-2008 (IMF, 2009; Kamniski and Ng, 2011; Kairiza, 2012; Pindiriri, 2012). This led to the abandonment of the local currency as a medium of exchange (IMF, 2009; Pindiriri, 2012). Informal dollarisation of the economy manifested itself during the second half of 2008, as economic agents responded to the failure of the local currency to fulfil the basic functions of money. In response to this development, the central bank sought to formalise the use of foreign currencies by the transacting public. In this regard, selected wholesalers and retailers were issued with licenses to sell goods in foreign currency in September 2008, under the Foreign Currency Licensed Warehouses and Retail Shops (FOLIWARS) programme (RBZ, 2008). This arrangement was, however, unsuccessful as unlicensed economic agents continued to engage in the “illegal” use of foreign currency in the settlement of transactions.

The political crisis that was occasioned by the disputed June 2008 presidential elections ended when the two major political parties signed a Global Political Agreement on 15 September 2008 and formed a Government of National Unity (GNU) (Dodo et al., 2012; Sikwila, 2013). In 2009, the GNU formally adopted a multicurrency system, after realising the futility of compelling some economic agents to settle transactions using the largely worthless local currency, while licensed traders were allowed to settle transactions using foreign currencies.

The formal adoption of the multicurrency system brought an abrupt end to hyperinflation (IMF, 2009; RBZ, 2010). In addition, the new government adopted an economic stabilisation programme; the Short Term Emergency Recovery Programme (STERP) in March 2009 (GOZ, 2009; RBZ, 2010). STERP was implemented over a period of nine months, from March 2009 to December 2009 (Kavila and Le Roux, 2015). The focus of the programme was to address political and governance issues, social protection, the supply side and

macro-economic reforms (GOZ, 2009).

The peaceful political environment that prevailed after the inception of the GNU, coupled with the implementation of economic reforms resulted in a remarkable improvement in economic activity. Real gross domestic product significantly rose, increasing from 5.4 per cent in 2009 to 9.6 per cent in 2010 and 10.3 per cent in 2011, before falling to 4.4 per cent in 2012 (RBZ, 2013; ZIMSTAT, 2013) as shown in Figure 1.

In line with the STERP, Zimbabwe adopted a cash budgeting fiscal system to ensure that government expenditure was in line with actual revenue inflows. As a result of the implementation of the cash budgeting system, expenditure overruns were curtailed and thus promoting fiscal austerity. Significant gains were also realised in respect of inflation, with year-on-year inflation recorded at -7.7 per cent by the end of December 2009 (ZIMSTAT, 2010) as shown in Figure 2. The year-on-year inflation took an upward trend, ending the years 2010 and 2011 at 3.2 per cent and 4.9 per cent, respectively, before declining to 2.9 per cent by the end of 2012 (ZIMSTAT, 2013).

Despite the remarkable stabilisation of the economy, the country's balance of payments position remained precarious, largely due to subdued capital inflows and a decline in export earnings, on the back of adverse macroeconomic conditions. The country posted a current account deficit of 11.3 per cent of GDP in 2009, which worsened to deficits of 15.2 per cent of GDP in 2010; and 22.1 per cent of GDP in 2011 (RBZ, 2013). A lower deficit of 14.7 per cent of GDP was, however, recorded in 2012 (RBZ, 2013).

In the dollarised environment, the lack of balance of payments support, coupled with low external capital inflows worsened an already problematic domestic liquidity situation. This resulted in a decline in capacity utilisation as productive entities could not access funds for working capital purposes. Capacity utilisation had risen from 40 per cent in 2009 to 57.2 per cent in 2011 but declined to 44.2 per cent in 2012 (CZI, 2012). Consequently, real growth in GDP declined from 5.4 per cent in 2011 to 4.4 per cent in 2012 (RBZ, 2013).

The study period was also characterised by the build-up of arrears on external payments, due to the lack of balance of payments support. Total external payment arrears averaged 45.1 per cent of GDP between 2009 and 2012, undermining the country's creditworthiness (RBZ, 2010). Benchmarked against the international sustainability ratio of 50 per cent, the country's external debt to GDP ratio at 81.3 per cent in December 2012, was clearly not sustainable (RBZ, 2013).

Notwithstanding the relative stability ushered in by the multiple currency system, there were growing concerns over the effects of adverse external shocks on the economy, particularly emanating from the fluctuations in the US dollar/South African rand exchange rate. The US dollar became the predominant currency for all transactions and in this regard, fluctuations in the US dollar/South African rand exchange rate are likely to have influenced inflation dynamics in Zimbabwe, because of the country's heavy reliance on imports from South Africa.

3 THEORETICAL AND EMPIRICAL LITERATURE REVIEW

3.1 Theoretical Review

Inflation is broadly defined as a sustained increase in the general price level and has, conceptually, two main sides namely demand pull and cost push. This phenomenon has largely been studied in the context of Monetarism; Keynesian; Structuralist and Expectations theories.

3.1.1 Demand pull inflation

Demand pull theorists agree that the primary cause of inflation is the persistent increase in the aggregate demand for goods against a relatively fixed supply of goods (Addison and Burton 1979). The source of inflation emanates from changes to the demand side of the aggregate goods market. An increase in aggregate demand without a corresponding increase in aggregate supply, results in an inflationary gap which induces an increase in prices.

Keynes (1936) and Smithies (1942) noted that inflation is generated by the pressures of excess demand as an economy approaches and exceeds the full employment level of output. If the economy is operating at full employment output and aggregate demand rises, the output level cannot respond automatically because of full employment constraints. Consequently, the only way to clear the goods market is by raising the money prices for goods.

The proponents of demand pull inflation argue that the inflationary gap in the goods market results from a disequilibrium in the money market. In this regard, inflation is caused by an expansionary monetary policy (Friedman 1956; Brunner 1978; Bordo and Schwartz, 2004), where the rate of expansion in the quantity of money is more than the rate of increase in output.

3.2 Cost push inflation

Cost push theories of inflation cite non-monetary supply-oriented influences that raise costs and hence prices. While recognising the significance of monetary expansion as a source of inflation, proponents of cost push theory view monetary growth as playing the accommodating or passive role (Humphrey 1977). Cost push inflation theories emphasise the increase of production costs instead of excess aggregate demand.

The huge increase in membership of trade unions that followed the end of World War II led to the revival of cost push theories of inflation (Takami 2014; Majumder 2006). In this regard, the aggressive and powerful labour unions pushed for higher wages, resulting in an increase in the costs of production which were passed on to consumers in the form of higher prices, often creating a wage-inflation spiral (Javed *et al.* 2010; Majumder 2006). This was exacerbated by the failure of labour unions to appreciate that when they demanded wage

increases, that were higher than the increase in labour productivity, the result would be inflation.

The proponents of cost-push inflation also believed that inflation was a result of non-monetary factors such as shocks induced by poor crop harvests. Barzdarich (1979) and Humphrey (1977) cited the 1973 and 1974 increase in oil prices by the Organisation of Petroleum Exporting Countries (OPEC), which led to an unprecedented increase in inflation to double digit levels as a classic case of cost-push inflation.

3.2.1 Monetarism

Monetarism is the term often used to describe a view or a body of work in which changes in the growth rates of monetary aggregates play a central role in explaining economic activity, including changes in nominal and real income and prices (Hafer 2001). Brunner and Meltzer (1964); Laidler (1982); and Meltzer (2004) demonstrated the stability of the demand for money function, a result which implies that variations in money supply growth primarily determined changes in nominal income. Hafer (2001) linked this postulation directly to the Quantity Theory of Money as follows:

$$M = kY \tag{1}$$

Where:

M is nominal stock of money

k is the ratio of money holdings by the public to nominal income

Y is nominal income

Assuming that k is constant, a change in M brings about a proportionate change in Y . If M is assumed to be the nominal stock of money balances the public would like to hold, the relationship $M = kY$ is a simple money demand function because the demand for money is a function of nominal income. When an economy is in equilibrium, money demand is equal to money supply, implying that an increase in the nominal stock of money results in an increase in ‘ k ’ or ‘ Y ’. Equation (1) can also be interpreted as implying that changes in money supply can affect both real income and prices differently as follows:

$$\text{Nominal income } Y = y(P) \tag{2}$$

Where: y is real income and P is the price.

Equation (1) can be rewritten as follows: $M = k(yP)$. In this case, if nominal money stock changes while k and y are constant, the result is an increase in prices (Hafer 2001).

The Quantity Theory of Money, which is the basis of monetarism, was pioneered by Hume (1752) and Fisher (1911). According to Dimand (2003) both Hume and Fisher believed in the long run neutrality and short run non-neutrality of money. Friedman’s monetary economics was in turn influenced by Irving Fisher (Bordo and Rockoff 2011). In the modern quantity theory of

money, Friedman (1956) held that inflation is always and everywhere a monetary phenomenon, which arises from a more rapid expansion in the quantity of money than in total output.

The building block and theoretical foundation of monetarism or the Quantity Theory of Money is the Equation of Exchange, propounded by Fisher (1911). The Fisher (1911) Equation of Exchange is expressed as follows:

$$MV = PT \tag{3}$$

Where:

M is the quantity of money

V is the velocity of circulation of money

P is the price level

T is real output

If the Monetarist view is taken, the Equation of Exchange ($MV=PT$) transforms into the Quantity Theory of Money. Any increase in money supply will impact on the price level given that the velocity of circulation of money (V) and the volume of transactions (T) are assumed to constant. In the long run, changes in the money supply leads to an increase in prices. In this regard, the rate of growth in money supply will be equal to the rate of increase in inflation. Monetarists believe that money supply is the primary determinant of nominal gross domestic product in the short run and the level of prices in the long run. The validity of the equation of exchange is not in dispute to both Keynesians and Monetarists. Keynesians, however, disagree with Monetarists on the assumption that velocity is stable and predictable in the short run.

While the Quantity Theory of Money may no longer be appealing to many economists, some important aspects of monetarism still remain important in modern non-monetarist analyses today. In this regard, the control of money supply growth remains a priority for central banks in the fight against inflation (Bordo and Schwatz 2004; Jahan *et al.* 2014).

3.2.2 Keynesianism

While Monetarism gained prominence in the 1970's, it was criticised by Keynesians such as Samuelson (1971) and Modigliani (1977). According to Samuelson (1971), money creation does not have a direct impact on aggregate demand but rather through interest rates, which themselves have a minimal impact on aggregate demand. Keynesians also disagreed with the monetarist notion that the velocity of circulation of money is stable but that it is inherently unstable. Modigliani (1977) dismissed the monetarist notion of following monetary policy rules, which is based on the constant money growth dictum, and advocates for the use of stabilisation policies in dealing with inflation.

Keynesians also disagreed with the view of the ability of markets to adjust freely to disruptions and the return to full employment level of output. Keynesianism was prominent during the first quarter century after World War II (Jahan *et al.* 2014) but lost sway to monetarism during the 1970's.

3.2.3 Structuralist theory of inflation

Structuralism asserts that there are factors peculiar to a country's institutional structures that explain a country's predisposition to inflation. According to the structuralist school of thought, the root cause of inflation can be found in bottlenecks in the economy. The bottlenecks can take the form of inefficiencies and inelastic supply, poor distribution networks, inflexibility in labour, monopoly tendencies, asymmetric information, and many others.

The structuralist school of thought is premised on the notion that the supply of most things is generally inelastic, especially in developing countries (Little 1982). In addition, the world is inflexible to such an extent that the price mechanism tends to fail to help the market achieve equilibrium (Little 1982). The structuralist view of Latin America, as summarised by Campos (1961) is that supply rigidities and the instability of export proceeds make it difficult to control inflation in the short run.

Noyola (1956) advanced the first formal statement of the structuralist theory by postulating that inflation pressures emanate from structural rigidities and escalates due to monetary expansion brought about by competing income claims (Arndt 1985), Danby (2005) also credits Noyola (1956) as the pioneer of the structuralist theory of inflation. The structuralist view of inflation was also corroborated by the Economic Commission of Latin America (1957) which attributed basic inflationary pressures to structural limitations and hence inflexibility of the economic system. In this regard, some productive sectors fail to adjust to fluctuations in demand because of their inelasticity leading to build-up in inflationary pressures (Fischer and Mayer, 1980). The importance of structural factors as causes of inflation is also attributed to Sunkel (1958); and Kaldor (1959). The United Nations World Economic Survey (1956) also postulated that the high degree of immobility of resources in underdeveloped countries inhibits production structures from adapting to changes in demand, generating acute inflationary pressures.

3.2.4 Expectations theory of inflation

Mohanty (2012) defined inflation expectations as the perceptions or views of economic agents about future inflation trends. Gali (2008) and Sims (2009) posited that inflation expectations are a basic building block in today's macro-economic theory and monetary policy. The ability of central banks to achieve price stability is greatly influenced by economic agents' inflation expectations and in this regard, the management of the perceptions is a critical component in the enhancement of price stability (Bomfin and Rudebusch 2000; Loley and Gurov 2010). Netsunajev and Winkelmann (2014) and the ECB (2013) observed that the Fed Res and the European Central Bank (ECB) showed the significance they attach to inflation expectations in macro-economic management by taking them into account in their decisions on the key policy rate strategy. The underlying difference between traditional and modern inflation theories is thus invariably defined by inflation expectations.

There are two broad theories on how expectations are formed, namely adaptive and rational expectations. Under adaptive expectations, economic agents form their expectations about future inflation trends by looking at what happened in the past, together with their current experience with inflation. In this regard, adaptive inflation expectations are largely backward-looking, with the origins of the hypothesis attributed to the works of Irving Fisher. The adaptive expectations hypothesis was formally propounded by Phillip Cagan, Milton Friedman, and Marc Nerlove in the 1950's (Evans and Honkapohja 2001). Adaptive expectations can be illustrated as follows:

$$\pi_t^e = \pi_{t-1}^e + \gamma(\pi_{t-1} - \pi_{t-1}^e) \quad (4)$$

Where: π_t^e stands for the expectation of current inflation, π_{t-1}^e is the previous period expectation of inflation. The actual inflation in the previous period is represented by π_{t-1} and γ is the adaptive coefficient with a value of between 0 and 1. This implies that current expectations of future inflation trends are a combination of past inflation and an error-adjustment term. Thus, current inflation expectations will depend on the difference between actual inflation and previous expectation of inflation.

Taking into account all the past periods, inflation expectations of the current period under adaptive expectations can be represented as follows:

$$\pi^e = (1 - \gamma) \sum_{j=0}^{\infty} (\gamma^j \pi_j) \quad (5)$$

Where π_j is actual inflation and j represents past years. The current expected inflation is thus a weighted average of past inflations.

The adaptive expectations theory was heavily criticised on the basis of its backward looking approach, giving rise to the rational expectations theory first developed by Muth (1961). Rational expectations theory was popularised by Lucas Jr and Sargent in the early 1970's (Evans and Honkapohja 2001). The formation of rational expectations occurs when economic agents take into account all the available information about inflation and then factor in the central banks' monetary policy reaction function (Mohanty 2012). After applying all accessible information about the economy, economic agents come up with an optimal forecast, similar to the market equilibrium (Wikipedia.org).

Rational expectations theory also advances the bold assumption that economic agents predict the future without making systematic errors, which implies that they have perfect foresight in making the predictions (Wikipedia.org; Evans and Honkapohja 2001). Where expectations are deemed rational, long run inflation expectations trends and inflation itself become an equilibrium outcome which is strongly influenced by the public's perception about the policy direction of the central bank (van der Klaauw *et al.* 2008).

Taylor (1983) argued that under rational expectations, economic agents make use of all the information at their disposable in addition to learning from the past, in making decisions. An additional observation by Taylor (1983) is the extensive use of rational expectations theory in macro-economic research

as well as its use as a theory in explaining economic phenomena such as business cycles and inflation persistence. The Phillips curve relationship is now expectations augmented, further signifying the importance of expectations in macro-economic theory (Elhers and Steinbach 2007). The rational expectations rule can be specified as follows:

$$\pi_t = \pi_t^e + \varepsilon_t \quad (6)$$

Where, π_t represents current period inflation rate, π_t^e is the expectation for current inflation and ε_t is the error term.

3.3 Empirical Literature Review

The reaction of inflation to macroeconomic shocks has largely been analysed in the context of Vector Autoregressive (VAR) models. A number of studies have been carried out to determine the reaction of inflation to macroeconomic shocks in developing economies, for example, Agenor and Hoffmaister (1997); Loungani and Swagel (2001); Bahmani-Oskooee and Domac (2002); Bailey (2007); Ocran (2010); Bhattacharya (2013) and Harvey and Cushing (2014). This section concentrates on empirical research conducted in developing countries, to contextualise the analysis.

Using a generalised VAR analysis, Agenor and Hoffmaister (1997) investigated short run relationships between growth in money supply, depreciation in the exchange rate, growth in nominal wage, the output gap and inflation in middle income developing countries, which included Chile, Korea, Mexico and Turkey. Shocks in nominal wage were found to have had a significant impact on the variation of inflation in Mexico. In all the four countries, inflation increased, following a shock to the growth in nominal wages. Shocks to money growth generated fluctuations in inflation over a long period in all the four countries. In Mexico, shocks to the output gap significantly determined inflation over a medium to long term period. Over a short-term horizon, shocks to inflation itself significantly explained its own variations. Lower rates of exchange rate depreciation were found to cause a fall in inflation in the countries under investigation, with the exception of Mexico.

Loungani and Swagel (2001) estimated Vector Autoregressive (VAR) models with pooled data to empirically determine sources of inflation in developing countries. The investigation showed that money growth and fluctuation in exchange rates as well as shocks to prices of oil and other non-oil commodities and the output gap, explained inflation in African and Asian countries. Inflation inertia was, however, found to be dominant in explaining the variation of inflation in these countries. In this regard, the authors urge authorities in African and Asian countries to address factors which influence inflation expectations, in dealing with the inflation problem in their countries.

Bahmani-Oskooee and Domac (2002) investigated the link between dollarisation and inflation in Turkey using the Vector Autoregressive (VAR) modelling approach. The endogenous variables in the analysis included the consumer price

index; base money; exchange rate; dollarisation ratio and public prices. Empirical results showed that higher levels of dollarisation resulted in higher prices in Turkey. Conversely, a reduction in the level of dollarisation would result in a reduction in inflation. Results from impulse responses indicated that shocks to dollarisation impacted positively on the consumer price index, exchange rate and public prices. A shock to dollarisation also resulted in an initial negative impact on monetary growth during the first five months, but thereafter the impact becomes positive leading to an increase in inflation. In terms of variance decompositions, dollarisation accounted for 38.8 per cent of the forecast error variance of the consumer price index. The other variables, namely inflation inertia, exchange rate, administered prices and base money accounted for 62.1 per cent; 46 per cent; 28.8 per cent and 2.3 per cent, respectively, of the variation in the consumer price index.

Bailey (2007) studied the relationship between financial dollarisation and inflation in Jamaica using the VAR modelling approach. The empirical results confirmed that financial dollarisation influenced the inflation process in Jamaica. In addition, given the high exchange rate pass through to inflation, depreciation in the exchange rate resulted in an increase in the consumer price index. Conversely, a fall in the consumer price index followed an exchange rate appreciation. Inflation inertia also accounted for a large portion of the variation in inflation over the study period.

Ocran (2010) used an unrestricted VAR framework to analyse the exchange rate pass-through to consumer price inflation and to import and producer prices in South Africa for the period 2000:01 to 2009:05. Results indicated that consumer price inflation increases by 0.125 per cent, following a 1 per cent shock to the nominal effective exchange rate. In general, the study finds that consumer price inflation is linked to external factors, despite the modesty of the impact of an exchange rate shock on the domestic price level. Oil price shocks were also found to be significant in explaining the variations in consumer price inflation.

In an empirical analysis of inflation dynamics and monetary policy transmission in Vietnam and other emerging Asian economies, Bhattacharya (2013) found that inflation is driven by fluctuations in the nominal exchange rate in the short term. Growth in credit influences inflation significantly in the medium term (2-10 quarters). A positive shock to growth, in real output, induces inflation after 4 quarters, with the impact dissipating during the next five quarters. Positive shocks on interest rates impact significantly on real growth in output and credit growth for a period spanning the short to medium term. The study also shows that the variation in inflation explained by inflation inertia is significant, compared to other emerging Asian economies. The insignificant impact of nominal interest rates on headline inflation in Vietnam points to the weakness of the country's monetary policy transmission mechanism.

Harvey and Cushing (2014) used a structural VAR to empirically determine the impact of shocks to real output, increase in money supply and exchange rate depreciation on inflation in Ghana. They found that a combination of both monetary growth and structural bottlenecks explained inflation. The dominance of structural factors in explaining inflation in Ghana was evidenced by the rel-

atively large portion of the variation in inflation accounted for by structural shocks, compared to monetary shocks. Impulse responses indicated that an increase in real output leads to a reduction in inflation in the long term. The response of inflation to monetary growth shocks was an initial rise, which dissipated within a six month period. A shock to the exchange rate in the form of a depreciation resulted in an initial reduction in inflation; a trend that reversed in the next two months. The response of the inflation to shocks in the growth of output was, however, found to be long lasting.

The general conclusion from the empirical literature reviewed is that inflation in developing countries is prone to macroeconomic shocks. Shocks to prices of oil, money supply growth, output and nominal wages were found to have generated fluctuations in inflation in some developing countries.

4 DATA, MODEL AND METHODOLOGY

4.1 Data

The study uses monthly data obtained from the Zimbabwe Statistical Agency (ZIMSTAT); the RBZ; IMF World Economic Outlook and the South African Reserve Bank. The data are used in log format.

4.2 Model and Estimation Methodology

The response of inflation to macroeconomic shocks is analysed using the Vector Error Correction Model (VECM), a variant of the Vector autoregressive (VAR) model. The VAR represents a system of equations in which each variable is expressed a function of its own lag and the lags of the other variables in the system. It is a general framework that facilitates the analysis of impulse response functions and forecast error variance decompositions as proposed by Sims (1980). The problem of simultaneity among economic variables is dealt with by treating all variables equally (Sims, 1980).

In this regard, the *a priori* distinction of variables as endogenous and exogenous is avoided given that economic theory does not make such a distinction. According to (Sims, 1980), interpretations made from models which group variables into endogenous and exogenous variable might not be robust (Sims, 1980).

A variable's response to shocks is shown by the impulse response function which uses the VAR's moving average characterisation. On the other hand, the relative contribution of each variable is analysed by the VAR's variance decomposition, which shows the proportion of the variance of each variable over time following a shock. In the case of inflation, the variance decomposition would show the magnitude of the fluctuations of inflation attributed to various shocks. The VAR framework allows for the identification of structural shocks through the Choleski decomposition and is useful in forecasting for the short term.

The general representation of a VAR system can be as follows:

$$Y_t = \beta_1 Y_{t-1} + \beta_2 Y_{t-2} + \dots + \beta_p Y_{t-p} + \varepsilon_t \quad (7)$$

Where:

Y_t is a vector of endogenous variables at time t

$\beta_i (i=1 \dots)$ are coefficient vectors

p is the number of lags included in the system

ε_t is a vector of residuals, representing the unexplained fluctuations in the variables due to the impact of exogenous shocks.

Studies by Pindiriri (2012) and Kavila and Le Roux (2016) found that inflation in the dollarised Zimbabwean economy is determined by inflation expectations, money supply, US dollar/South African rand exchange rate, South African inflation as well as international oil and food prices. This study extends this empirical work by examining how Zimbabwean inflation would respond to shocks on its determinants. In the process, the impulse responses of Zimbabwean inflation to the shocks are determined. The forecast error variance of inflation attributed to each of the variables is also analysed.

All the variables of interest in this study were found to be stationary in their first differences and had cointegrating relationships. This led to the modification of the general VAR framework and use of a VECM in the analysis, to allow for the consistent estimation of the relationships among the variables.

A VECM for two variables might be represented as follows:

$$\begin{aligned} \Delta Y_t = & \alpha_{yo} + \alpha_{y1} \Delta Y_{t-1} + \dots + \alpha_{yp} \Delta Y_{t-p} + \beta_{y1} \Delta X_{t-1} \\ & + \dots + \beta_{yp} \Delta X_{t-p} - \gamma_y (Y_{t-1} - \alpha_o - \alpha_1 X_{t-1}) + \varepsilon_t^y \end{aligned} \quad (8)$$

$$\begin{aligned} \Delta X_t = & \alpha_{xo} + \alpha_{x1} \Delta Y_{t-1} + \dots + \alpha_{xp} \Delta Y_{t-p} + \beta_{x1} \Delta X_{t-1} \\ & + \dots + \beta_{xp} \Delta X_{t-p} - \gamma_x (Y_{t-1} - \alpha_o - \alpha_1 X_{t-1}) + \varepsilon_t^x \end{aligned} \quad (9)$$

Where: $Y_t = \alpha_o + \alpha_1 X_t$ is the long run cointegrating relationship between Y and X and γ_y and γ_x are error correction parameters. The error correction parameters measure the reaction of Y and X to deviations from long run equilibrium.

The Augmented Dickey Fuller (ADF) and Phillips Peron tests were used to test for the order of integration of the dependent and independent variables and the Johansen test was used to test for cointegrating relationships in the variables of interest.

5 EMPIRICAL RESULTS AND ANALYSIS

This section discusses the empirical results and their analysis. The analysis starts by discussing the time series properties of the data in the form of unit root tests and cointegration and granger causality. After that the reaction of inflation

to shocks is analysed in the form of impulse response functions and variance decomposition. Stability tests are also discussed to assess the parsimonious attributes of the model.

5.1 Unit Root Tests

Results from unit root tests, suggest that all variables became stationary after differencing once, that is, they are integrated of order 1, as shown in Table 1. Both the ADF and Phillips Perron test results indicate that all the variables are non-stationary in levels, whether with the intercept, or trend and intercept or with none. All variables become stationary after differencing once, with the intercept, or trend and intercept or with none.

5.2 Cointegration Tests

Trace tests and Max- eigenvalue tests conducted using the Johansen cointegration test, indicated 3 cointegrating equations at the 5 per cent level of significance as shown in Table 2.

5.3 Determination of Lag Length

The results in Table 3 show that all the test criteria applied suggested a maximum lag length of 1. In this regard, the optimal lag length chosen according to the popular Schwarz Information Criterion (SIC) and Akaike Information Criterion (AIC) tests for the model is 1.

5.4 VEC Granger Causality Tests

The analysis also involved testing for the VEC Granger causality exogeneity tests to determine whether the lagged value of a variable explains the variation in another variable. To test the null hypothesis of no Granger causality, Wald statistics are used. The null hypothesis of no Granger causality is rejected when the probability values (p -values) are small and accepted in the case where the p -values are large. The results of the VEC Granger exogeneity tests are shown in Table 4.

The results in Table 4 show that money supply, South African inflation and international oil and food prices predict Zimbabwean inflation at the 5 per cent level of significance with p -values of 0.0518; 0.0399; 0.0015 and 0.0013, respectively. The South African rand/US\$ exchange predicts Zimbabwean inflation at the 1 per cent level of significance with a p -value of 0.0984. These results confirm the case of unidirectional causality, consistent with the position of Zimbabwe as a small, open and dollarised economy. For example, price formation in Zimbabwe cannot influence the variations in money supply as the country has no influence over the quantity of money supply in the economy. The country lost monetary policy autonomy when it adopted the multicurrency system in

2009. As a price taker in the international market, price variations in the country cannot help predict international oil and food prices. Zimbabwe is also a net importer of goods and services from international markets including South Africa and in this regard, the behaviour of prices in the country does not have any influence on the US dollar/South African rand exchange rate.

5.5 Impulse Responses

This is the response of current and future values of each of the variables to a unit increase in the current value of the VAR errors based on the assumption that the error returns to zero in future periods. Figure 3 plots the impulse responses of Zimbabwean inflation (LZCPI) with respect to one standard deviation in money supply (LMS); international oil (LOIL) and food (LFOOD) prices, US\$/South African rand exchange rate (LSEXC), and South African inflation (LSCPI).

A positive shock to international oil prices results in a steep increase in inflation in Zimbabwe, within the first six months and remaining at a high level, over the forecast horizon. A one standard deviation in international food prices also results in an increase in inflation in Zimbabwe within the first 4 months, before declining in the next 4 months and remaining at a moderately high level over the forecast horizon.

The strong positive response of LZCPI to a shock in LSEXC, within the first three months is consistent with a-prior expectations that an appreciation of the South African rand against the US\$ results in an increase in Zimbabwean inflation. This would be the case because Zimbabwe sources more than 40 per cent of its imports from South Africa, implying that the country would spend more dollars in importing the same quantity of goods, if the rand appreciates against the US\$. In this regard, the increased costs are passed on to Zimbabwean consumers in the form of higher prices.

The response of LZCPI to a shock to money supply would be a moderate increase within the first 6 months, before tapering off to a lower level over the forecast horizon.

A positive shock to South African inflation results in a moderate increase in Zimbabwean inflation in the first 3 months, before falling in the next 3 months and staying constant there-on. South Africa is on an inflation targeting monetary policy framework, where inflation is kept within a 3-6 per cent range. This implies that the South African Reserve Bank intervenes in cases where this range is violated.

5.6 Variance Decomposition

The results from the variance decomposition in Table 5 indicate that the lagged Zimbabwe consumer price index, US dollar/South African rand exchange rate and international oil and food prices contributed significantly to inflation dynamics during the study period. Together, these variables explained about 98.8 per cent of the standard error variation in inflation. The lagged consumer price index itself explained 39.1 per cent of the variation in inflation. The relatively

high explanation of the variation in inflation by its lagged values signifies the importance of inflation expectations, especially in a country that had a recent experience of hyperinflation.

International oil prices have a significant bearing in explaining the variation of inflation in Zimbabwe, stemming from the fact that the country is a net importer of oil. Any variations in oil prices would, therefore, have an impact on the variation in price formation in Zimbabwe. While South Africa is a major source of Zimbabwe's imports, South African inflation explains only 0.22 per cent of the variance of inflation in Zimbabwe, indicating a low pass through effect.

5.7 Stability Tests

The stability of the model was tested using the lag structure Inverse Roots of the Autoregressive Characteristic Polynomial shown in Figure 4. All the roots are within the one unit band, showing that the model is stable. In this regard, the model can be used for policy inference.

6 SUMMARY AND POLICY RECOMMENDATIONS

The empirical analysis in this paper used the VECM approach to analyse the reaction of inflation to macroeconomic shocks in the dollarised Zimbabwean economy during the period 2009:01-2012:12. Results from the analysis indicate that inflation in the dollarised economy is prone to external shocks.

The response of inflation to a shock in the US dollar/South African rand exchange rate is strong and positive, in line with the a-prior expectation that the appreciation of the South African rand against the US dollar would result in an increase in Zimbabwe's inflation. Conversely, a depreciation of the South African rand against the US dollar would result in a decrease in Zimbabwe's inflation. A positive shock to money supply results in a moderate increase in inflation, while an increase in food prices would result in higher inflation, peaking at 4 months and remaining in positive territory over the forecast horizon. In addition, an increase in the international price of oil would lead to a steep increase in inflation, within the first six months and remaining high over the forecast horizon. Zimbabwe's inflation increases moderately in response to a shock to South African inflation, in the first 3 months, before falling in the next 3 months and staying constant over the forecast horizon.

The variance decompositions put the portion of the variance in inflation explained by the lagged consumer price index at 39.1 per cent. The US dollar/South African rand exchange rate, international oil prices and international food prices, money supply and South African inflation accounted for 32.3 per cent; 21.3 per cent; 5.9 per cent; 1.1 per cent; and 0.2 per cent of the variation in inflation, respectively. Results from Granger causality proved that causality is unidirectional, that is, running from money supply, international oil prices

and the US dollar/South Africa rand exchange rate to inflation, signifying that Zimbabwe is a small and open dollarised economy.

The empirical findings show that price formation in Zimbabwe is prone to the influence of external shocks. In this regard, the country should increase production and reduce its reliance on imported products, particularly from South Africa. Furthermore, there is a need for the GOZ to work on building confidence in the economy through the pursuance of consistent and well coordinated policies, to deal with the problem of negative inflation expectations. There is also a need for the GOZ to build a track-record of sound macroeconomic policies to convince the Zimbabwean population that the country will not slip into hyperinflation again.

References

- [1] Addison, J.T and Burton, J (1979), “The Demise of Demand Pull and Cost Push in Inflation Theory”. Published by Birmingham, 1979.
- [2] Agenor, P.R. and Hoffmaister, A.W. (1997). “Money, wages and inflation in middle income developing countries”. *IMF Working Paper WP/97/174*.
- [3] Arndt, H. W (1985), “The Origins of Structuralism”. *World Development, Volume 13, Number 2, pp 151-159, 1985*.
- [4] Bahmani-Oskooee, M. and Domac, I. (2002). “*On the link between dollarisation and inflation: Evidence from Turkey*”. [Online]. Available: <http://www.tcmb.gov>
- [5] Bailey, S.A. (2007). “*Investigating the link between financial dollarisation and inflation: Evidence from Jamaica*”. *Business, Finance and Economics in Emerging Economies, volume 2, number 1, 2007*.
- [6] Bazdarich M (1979), “The Phenomenon of Inflation and the Prospects for Anti-inflation Policy - Alternate Strategies towards Inflation”. *Federal Reserve Bank of San Francisco Economic Review*.
- [7] Bhattacharya, R. (2013). “Inflation dynamics and monetary policy transmission in Vietnam and Emerging Asia”. *IMF Working Paper, WP/13/155*.
- [8] Bernanke, B. S. (2007); “Inflation Expectations and Inflation Forecasting”, *Speech delivered at the Monetary Economics Workshop of the National Bureau of Economic Research Summer Institute, Cambridge, Massachusetts, July 10, 2007*.
- [9] Bomfin, A and Rudenbusch (2000), “Opportunistic and Deliberate Disinflation under Imperfect Credibility”. *Journal of Money, Credit and Banking* 32, 707-721.

- [10] Bordo, M.D. and Schwatz, A. J. (2004). "IS-LM and monetarism". *History of Political Economy*, volume 36, annual supplement, 2004, pp 217-239. Duke University Press.
- [11] Bordo, M.D and Rockoff, H (2011), "The Influence of Irving Fisher on Milton Friedman". *Paper prepared for the AEA Session on Irving Fisher and Modern Economics: 100 years after the Purchasing Power of Money, Denver*.
- [12] Brunner, K and Meltzer, A.H (1964), "Some Further investigations of Demand and Supply Functions of Money". *Journal of Finance, Volume 19, pp 240-283*.
- [13] Campos, Roberto de. Oliviera (1961). "Two Views of inflation in Latin America". in: Hirschman, A. O, ed. Latin American Issues. New York: Twentieth Century Fund, 1961, 69-73.
- [14] Confederation of Zimbabwe Industries (2012). "2012 manufacturing sector survey"
- [15] Danby, C (2005), "Noyola's Institutional Approach to Inflation". *Journal of the History of Economic Thought*, March 2005.
- [16] Dimand, R.W (2003), "Irving Fisher on the International Transmission of Booms and Depressions through Monetary Standards. *Journal of Money, Credit and Banking, Volume 35, Number 1 (Feb): pp 49-90*.
- [17] Dodo, O.; Chipaika, R.; Ngwerume, E.T. and Chigondo, E.E. (2012). "Four years into Zimbabwe's Government of National Unity: assessing the challenges and successes from the civil society's perspective" *LWATI: A Journal of Contemporary Research, 9(3), 202-215, 2012*.
- [18] Economic Commission for Latin America. "*Economic Surveys of Latin America 1957*". United Nations, Department of Economic and Social Affairs (1959).
- [19] Elhler, N and Steinbach, M.R (2007), "The formation of inflation expectations in South Africa". *South African Reserve Bank, Working Paper, WP/07/06*.
- [20] European Central Bank (2013). Annual Report, 2013.
- [21] Evans, G.W and Honkapohja, S (2001), *Learning and Expectations in Macroeconomics*. Princeton University Press.
- [22] Fischer, B. and Mayer, T. (1980). "On the structuralist view of inflation in some Latin American countries: A reassessment". *Kiel Working Papers, Number 103*.
- [23] Fisher, I (1911). "The Purchasing Power of Money: Its Determination and Relation to Credit, Interest and Crises". Macmillan Company. New York.

- [24] Friedman, M (1956), “The Quantity Theory of Money: a restatement”. In Friedman, M (Ed), *Studies in the Quantity Theory of Money*. University of Chicago Press, Chicago.
- [25] Government of Zimbabwe (2009). “Short term emergency recovery programme: getting Zimbabwe moving again”.
- [26] Gali, J. (2008), “Monetary Policy, Inflation and the Business Cycle: An Introduction to the New Keynesian Framework”. *Princeton University Press*.
- [27] Hafer, R.W (2001), “What Remains of Monetarism?” *Federal Reserve Bank of Atlanta Economic Review, Fourth Quarter 2001*.
- [28] Harvey, S.K and Cushing, M.J. (2014). “Separating monetary and structural causes of inflation”. *Journal of Finance and Economics, 2(3):16-30*.
- [29] Hume, D (1752). *Political Discourses*. Edinburgh.
- [30] Humphrey, T.M (1977), “On Cost Push Theories in the Pre-war Monetary Literature”. *Federal Reserve Bank of Richmond, Economic Review, May/June 1977*.
- [31] International Monetary Fund (2009). “Country Report No 09/139: Zimbabwe: 2009 Article IV Consultation—Staff Report.
- [32] Jahan, S; Mahmud, A.S and Papageorgious, C (2014), “What is Keynesian Economics?” *Finance and Development, September 2014, pp53-54*.
- [33] Javed, Z.H; Farooq, M and Akram, S (2010), “Cost Push Shocks and Inflation: An Empirical Analysis from the economy of Pakistan”. *Journal of Economics and International Finance, Volume 2, Number 12, pp 308-312, December 2010*.
- [34] Kaldor, N (1959), “Economic Problems of Chile”. In: *Essays in Economic Policy, Volume II*. Duckworth, 1964, pp 232-287.
- [35] Kairiza, T. (2012). “Unbundling Zimbabwe’s journey to hyperinflation and official dollarisation”. *GRIPS Policy Information Centre. Discussion Paper 09-12*.
- [36] Kavila, W and Le Roux, P (2015). “Inflation dynamics in a dollarised economy: the case of Zimbabwe” *ERSA working paper 606, May 2016*.
- [37] Kaminski, B and Ng, F. (2011). “Zimbabwe’s foreign trade performance during the decade of economic turmoil: will exports recover?” *A revised version of a background paper prepared for Zimbabwe’s Diagnostic Trade Integration Study in Africa Region (AFTP1)*
- [38] Keynes, J.M (1936), “The General Theory of Employment, Interest and Money”. London: Macmillan Cambridge University Press.

- [39] Laidler, D (1982). *Monetarist Perspectives*. Cambridge Mass: Harvard University Press.
- [40] Loleyt, A and Gurov, I (2010), “The Process of Inflation Expectations Formation”. *General Economic Department, Bank of Russia and Faculty of Economics, Lomonosov Moscow State University, Russia*.
- [41] Loungani, P. and Swagel, P. (2001). “Sources of inflation in developing countries”. *IMF Working Paper WP/01/198*.
- [42] Majumder, Md. A (2006), “Inflation in Bangladesh: Supply side Perspective”. Policy Notes Series: PN9705, pp 1-10. Policy Analysis Unit, Research Department, Bangladesh Bank.
- [43] Meltzer, A. H (2004), “Monetarism Revisited”. Research Showcase @ CMU. Carnegie Mellon University. Tepper School of Business, 7-2004.
- [44] Modigliani, F. (1977). The monetarist controversy or should we forsake stabilisation policies. *American Economic Review*, 67.
- [45] Mohanty, D (2012), “The Importance of Inflation Expectations”. *Speech by Mr Deepak Mohanty, Executive Director of the Reserve Bank of India, at the S P Jain Institute of Management & Research, Mumbai, 9 November 2012*.
- [46] Muth, J (1961), “Rational Expectations and the Theory of Price Movements.” *Econometrica* 29 (July) pp 315-35.
- [47] Netsunajev, A. and Winklemann, L. (2014). “Expectations spill-overs between the United States and Euro Area”. SFB 649 Discussion paper 2014-023.
- [48] Noyola, V (1956), “El Desarrollo Economico y la Inflacion en Mexico y otros Paises Latinoamericanos”. *Investigacion Economica. XVI: 4*.
- [49] Ocran, M. K (2010). “Exchange rate pass-through to domestic prices: the case of South Africa”. *Prague Economic Papers, 4, 2010*.
- [50] Pindiriri, C. (2012). “Monetary reforms and inflation dynamics in Zimbabwe”. *International Research Journal of Finance and Economics, Issue 90, May 2012*.
- [51] Reserve Bank of Zimbabwe: *Quarterly Statistical and Economic Review, Various Issues*.
- [52] Reserve Bank of Zimbabwe: *Monthly Review, Various Issues*.
- [53] Reserve Bank of Zimbabwe: *Annual Reports, Various Issues*.

- [54] Samuelson, P.A (1971), “Reflections on the Merits and Demerits of Monetarism,” in *Issues in Fiscal and Monetary Policy: The Eclectic Economist Views the Controversy*, ed. James J. Diamond. De Paul University, 1971, pp 7-21.
- [55] Sikwila, M.N. (2013). “Dollarisation and Zimbabwe’s economy”. *Journal of Economic and Behavioural Studies*, volume 6, number 6, pp 398-405, June 2013.
- [56] Sims, C. A (1980), “Macroeconomics and Reality”. *Econometrica*, 48(6), pp 1-48.
- [57] Sims, C. A (2009), “Inflation Expectations, Uncertainty and Monetary Policy”. *BIS Working Paper Number 275*.
- [58] Smithies, A (1942), “The Behaviour of Money, National Income under Inflationary Conditions”, *Quarterly Journal of Economics*, Volume 57, Issue 1, pp 113-128.
- [59] Sunkel, O. (1958). Inflation in Chile: An unorthodox approach. *International Economic Papers*, No. 10(1960):107-131.
- [60] Takami, N (2014), “Baffling Inflation: Cost-push Inflation Theories in the Late 1950s.” *United States Discussion Paper Series A, Number 604 April, 2014*.
- [61] Taylor, J.B (1983), “Rational Expectations Models in Macroeconomics”. *National Bureau of Economic Research, Working Paper, Number 1224*.
- [62] United Nations, *World Economic Surveys 1956*. New York, 1957.
- [63] van der Klaauw, W; de Bruin, W. B; Topa, G; Potter,S and Bryan, M (2008), Rethinking the Measurement of Household Inflation Expectations: Preliminary Findings”. *Federal Reserve Bank of New York Staff Report Number 359, December 2008*.
- [64] Woodford M. (2005): “Central Bank Communication and Policy Effectiveness,” *Proceedings, Federal Reserve Bank of Kansas City*.
- [65] Zimbabwe Statistical Agency (ZIMSTAT). *Quarterly Digest of Statistics. Various Issues*.

Table 1: Stationarity Test Results

Augmented Dickey –Fuller Test Results						
Levels				1st Difference		
Variable	Intercept	Trend and Intercept	None	Intercept	Trend and intercept	None
LZCPI	0.0150669	-2.128753	0.921567	-5.167083**	-4.820468**	-6.093424**
LMS	-2.025646	-1.247217	0.758581	-3.196089**	-9.058695**	-4.194732**
LOIL	-2.199369	-1.578232	1.677753	-6.239955**	-6.726976**	-5.857592**
LFOOD	-1352098	-1.403803	1.470087	-4.932633**	-4.972977**	-4.758280**
LSEXC	-2.343162	-2.043006	-0.700651	-4.782503**	-5461728**	-4.79830**
LSCPI	-1.919350	-2.158109	1.386336	-6.766744**	-7.036089**	-5.041339**
Phillips-Perron Test Results						
Levels				1st Difference		
Variable	Intercept	Trend and Intercept	None	Intercept	Trend and intercept	None
LZCPI	-0.424879	-1.275089	0.635098	-10.60804**	-8.495956**	-5.140483**
LMS	-1.970040	-1.074880	3.048381	-6.095628**	-8.639828**	-4.526750**
LOIL	-2.303872	-1.468009	1.607649	-6.239955**	-6.799970**	-5.885965**
LFOOD	-1.399150	-1.403803	1.264282	-4.862132**	-4.89986**	-4.714481**
LSEXC	-2.359887	-2.044426	-0.587365	-4.773641**	-5.461728**	-4.787873**
LSCPI	-2.540697	-2.008917	1.689888	-6778310**	-7.397007**	-5.113148**

*Note: * significant at 10%, ** significant at 5%, *** significant at 1%*

Table 2: Johansen Cointegration Test Results

Sample (adjusted) 2009M03 2012M12
 Included observations: 46 after adjustments
 Trend assumption: Linear deterministic trend
 Series: LZCPI LFOOD LMS LOIL LSCPI LSEXC

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE (s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None*	0.785179	183.4509	95.75366	0.0000
At most 1*	0.711248	112.7052	69.81889	0.0000
At most 2*	0.497110	55.56468	47.85613	0.0080
At most 3	0.219224	23.94500	29.79707	0.2028
At most 4	0.193587	12.56154	15.49471	0.1319
At most 5	0.056273	2.664245	3.841466	0.1026

Trace test indicates 3 cointegrating eqn (s) at the 0.05 level

*denotes rejection of the hypothesis at the 0.05 level

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE (s)	Eigenvalue	Max Eigen Statistic	0.05 Critical Value	Prob.**
None*	0.785179	70.74563	40.07757	0.0000
At most 1*	0.711248	57.14056	33.87687	0.0000
At most 2*	0.497110	31.61968	27.58434	0.0143
At most 3	0.219224	11.38346	21.13162	0.6091
At most 4	0.193587	9.897298	14.26460	0.2188
At most 5	0.056273	2.664245	3.841466	0.1026

Max-eigenvalue test indicates 3 cointegrating eqn (s) at the 0.05 level

*denotes rejection of the hypothesis at the 0.05 level

Table 3: Lag Length

Lag	Log L	LR	FPE	AIC	SC	HQ
0	-1124.753	NA	2.70e+14	50.25567	50.49656	50.34547
1	-869.5796	430.9588*	1.61e+10*	40.51465*	42.20087*	41.14325*
2	-845.5493	34.17651	2.99e+10	41.04663	44.17818	42.21404
3	-819.2548	30.38472	5.83e+10	41.47799	46.05487	43.18420

- indicates lag order selected by the criterion
 LR: Sequential modified LR test statistic (each at 5% level)
 FPR: Final prediction error
 AIC: Akaike information criterion
 SC: Schwarz information criterion
 HQ: Hannan-Quinn information criterion

Table 4: VEC Granger Causality Test Results

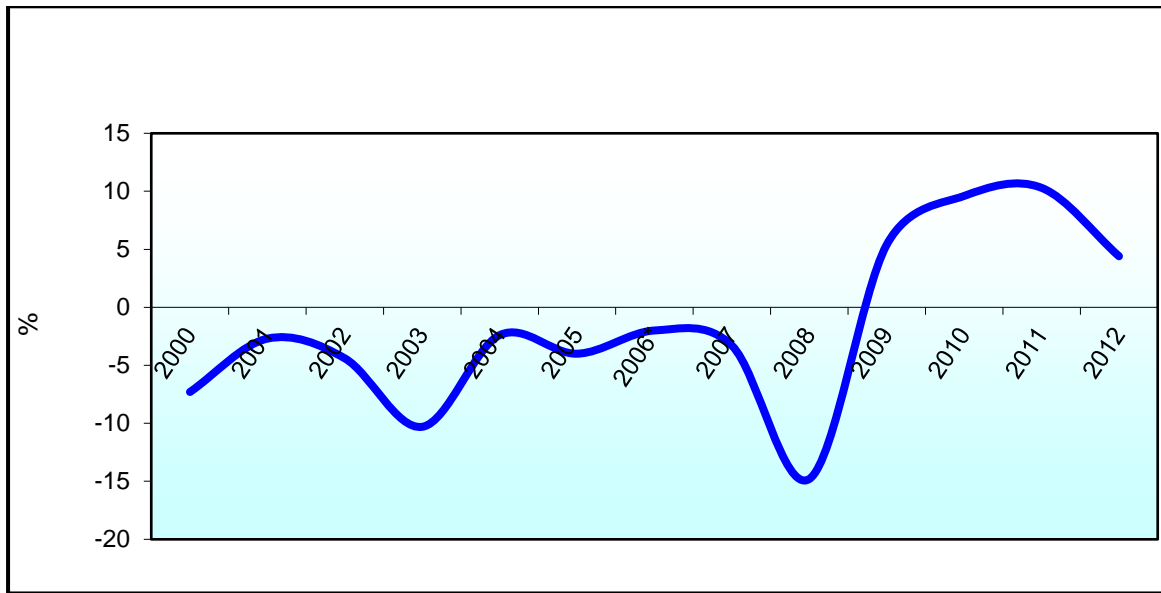
Regressor	Dependent Variable in Regression					
	LZCPI	LSEXC	LMS	LSCPI	LFOOD	LOIL
LZCPI	0.000	0.1584	0.0082	0.2398	0.7644	0.3976
LSEXC	0.0984	0.0000	0.0065	0.4180	0.6038	0.3371
LMS	0.0518	0.1330	0.0000	0.2240	0.6390	0.4067
LSCPI	0.0399	0.9563	0.0992	0.0000	0.7680	0.7186
LFOOD	0.0013	0.7511	0.3824	0.1279	0.0000	0.3933
LOIL	0.0015	0.2091	0.2294	0.2770	0.9395	0.0000

Note: Figures in brackets are *t* values

Table 5: Variance Decomposition of Inflation

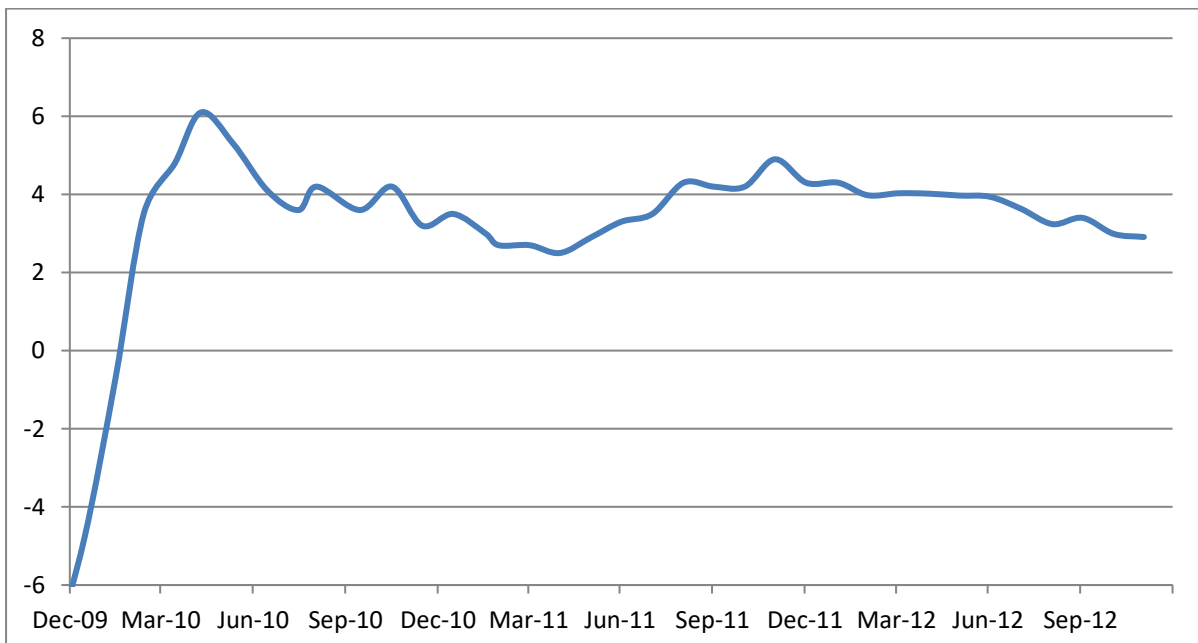
Period	S.E	LZCPI	LMS	LOIL	LFOOD	LSEXC	LSCPI
1	0.003057	100.0000	0.000000	0.000000	0.000000	0.000000	0.000000
2	0.004123	86.00599	0.546979	0.023115	4.117212	7.850738	1.455965
3	0.006409	62.25003	1.065027	4.703786	10.60968	19.07074	2.300741
4	0.008451	52.42239	1.140230	7.917731	11.96867	25.22149	1.329487
5	0.010203	46.64843	1.703750	10.98547	11.44496	28.28033	0.937061
6	0.011819	43.99835	1.580746	14.03508	9.685050	29.95294	0.747839
7	0.013119	42.69646	1.565083	15.80121	8.758141	30.55255	0.626557
8	0.014392	41.67638	1.493561	17.30234	7.874813	31.10781	0.545090
9	0.015545	41.21396	1.426184	18.15142	7.450282	31.27363	0.484525
10	0.016612	40.72404	1.391079	18.82910	7.138121	31.48363	0.434024
11	0.017635	40.42299	1.350836	19.29456	6.919815	31.61548	0.396309
12	0.018579	40.18081	1.321883	19.64071	6.771189	31.71983	0.365586
13	0.019485	39.38226	1.295783	19.93500	6.630096	31.81649	0.340372
14	0.020347	39.84267	1.270682	20.15962	6.523132	31.88391	0.319987
15	0.021172	39.71470	1.250858	20.35341	6.431386	31.94759	0.302053
16	0.021969	39.61316	1.231717	20.51602	6.352486	31.99960	0.287009
17	0.022736	39.52474	1.215669	20.65368	6.288366	32.04376	0.273781
18	0.023479	39.44582	1.201288	20.77615	6.229893	32.08462	0.262219
19	0.024200	39.37933	1.188211	20.88175	6.180011	32.11862	0.252087
20	0.024899	39.31856	1.176741	20.97655	6.135180	32.14995	0.243016
21	0.025580	39.26554	1.166163	21.06090	6.094958	32.17749	0.234950
22	0.026243	39.21785	1.156675	21.13645	6.059260	32.20210	0.227668
23	0.026890	39.17457	1.148031	21.20503	6.026665	32.22462	0.221078
24	0.027521	39.13572	1.140104	21.26697	5.997314	32.24480	0.215097

Figure 1: Real GDP Growth 2000-2012 (percent)



Source: ZIMSTAT

Figure 2: Annual Inflation (per cent)



Source: ZIMSTAT

Figure 3: Impulse Responses of ZCPI

Response to Cholesky One S.D. Innovations

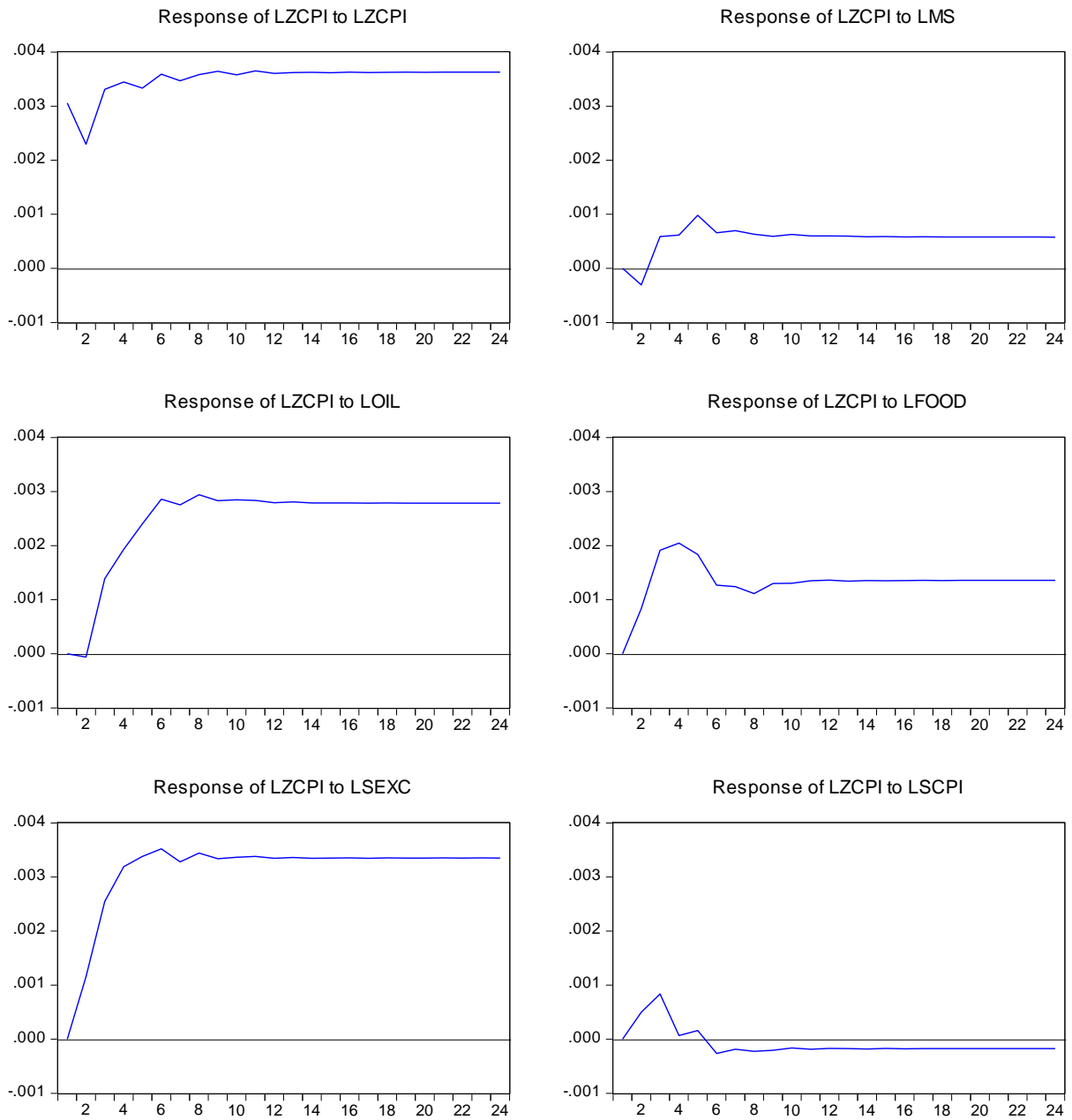


Figure 4

Inverse Roots of AR Characteristic Polynomial

