Interest Rate Channel and Monetary Transmission in Zambia

Mbewe Kalikeka,
Department of Economics,
University of Namibia,
Windhoek, Namibia.

Johannes Peyavali Sheefeni Sheefeni,
Department of Economics,
University of Namibia,
Windhoek, Namibia.
E-mail: peyavali@gmail.com

Abstract

This paper analyses the monetary policy transmission in Zambia, with a particular focus on the interest rate channel. The study uses a VAR approach to estimate annual data from the year 1980 to 2011. The paper also employed time series techniques namely, unit root tests, cointegration, Granger causality test, impulse response and forecast error variance decomposition. The cointegration test showed that cointegration exists. Granger causality test showed a bi-directional causality between inflation and interest rate. There is a unidirectional causality running from gross domestic product to interest rate. The impulse response function indicated that output responded negatively to monetary policy, and the rate of inflation had an inverse relationship on the rate of interest. The forecast error variance decomposition showed that CPI was attributed to itself, while GDP was largely attributed to itself with a significant contribution to CPI and no contribution from the rate of interest. On the other hand, in forecasting the rate of interest, it was found that the rate of interest was largely attributed to itself, with a successive increase in CPI. The results provide evidence of the functional interest rate channel existence in the Zambian economy.

Keywords: Vector autoregressive, Monetary policy, Monetary transmission, Interest rate, Consumer price index, GDP, Zambia.

JEL Classification: E43
1. Introduction

As a phenomenon monetary policy seeks to control aggregate demand by directly controlling the money supply or by altering the rate of interest and then backing this up by any necessary changes in money supply (Sloman and Wride, 2009). Broadly speaking, monetary policy refers to any deliberate action by the monetary authority which is designed to change the availability or cost of money (Stanlake, 1974). It can referred to as either being expansionary; increases the money supply and lowers the rate of interest, or contractionary; expands the money supply more slowly than usual and increases the rate of interest. Schematically defined by the traditional Keynesian view, monetary transmission can be illustrated as a monetary expansion using the following (Mishkin, 2004).

\[ \text{M} \uparrow \rightarrow \text{i}_r \downarrow \rightarrow \text{I} \uparrow \rightarrow \text{Y} \uparrow \]

Attention has been devoted by macroeconomists over the recent years, trying to understand the monetary policy transmission mechanism. A new structuralist critique that has stirred controversy is the interest rate powered by the monetary policy transmission mechanism. McKinnon (1973) and Shaw (1973) have been the most prominent advocates of interest rates in developing countries – a policy that has been characterized as an essential element of “Orthodox” macroeconomic thinking (Agenor and Montiel, 1996).

Essentially the path of the interest rate has very sensitive effects in the economy, in the sense that a change in the interest rate will lead to a change in investment costs and subsequently to a change in consumption. Taylor (1995) acknowledges that the most effective channel of monetary policy transmission is through the interest rate channel. If an effect from the short term interest rate to the long term interest rate is captured then the interest rate channel of monetary policy is termed to be effective (Bonga-Bonga, 2010). However, Taylor (1995) states that, between short term interest rates and long term interest rates, there stands a minimal distinction on which of the two has a greater effect of economic activity.

Following the liberalization in Zambia, monetary policy was aimed at economic growth, and interest rates were controlled by the Central Bank of Zambia. These policies by the central bank led to serious problems on the country’s balance of payment (as discussed by Simatete, 2004). Restructuring of the monetary policy transmission mechanism in Zambia came about when the IMF issued a conditional loan to Zambia in 1983, and in response institutionally set interest rates increased. Following this regime the central bank has targeted to maintain the level of reserve money in line with the programmed money supply growth, interest rate and inflation rate (Bank of Zambia, 2005).
Monetary policy transmission and the rate of the interest are key aspects in a nation’s formulation of policies, and it is always imperative to strike a balance on how monetary policy affects the rate of interest. Proven by economic theory, it is known that there exists a relationship between monetary policy and the rate of interest, and this paper ought to find out how the various explanatory variables that involve monetary policy affect the rate of interest, prices and GDP. Zambia has recorded very high interest rates between 2008 and 2011, with the highest in 2009 recorded at 22.1% and the lowest recorded in 2011 at 18.8% (World Bank, 2013). Given the high episodes of interest rates between 2008 and 2011, this study will investigate how interest rate affects prices and output in Zambia. The article is organized as follows: the next section presents a literature review. Section 3 discusses the methodology. The empirical analysis and results are presented in section 4. Section 5 concludes the study.

2. Literature Review

The Keynesian framework of the AD-AS provides a framework of the monetary policy transmission. It builds a structural model and describes how the economy operates using a collection of equations of firms and consumers in many sectors of the economy. Mishkin (2004), outlines that a change in money supply, affects the interest rate, which in turn affects the level of investment spending. With this change in the level of investment spending, this will lead to a change in aggregate output and aggregate spending. The Keynesians examine the relationship between money supply and output with the link being interest rates and the level of investment.

In literature, Keynes (1936) in his book “General Theory of Employment, Interest and Money”, highlighted that, a policy induced increase in the short term nominal interest rate leads first to an increase in longer term – nominal interest rates, as investors act to arbitrage differences in risk adjusted expected returns on debt instruments of various maturities as described by the expectations hypothesis of the structure.

Economic theory of investment developed by James Tobin in 1969, which is the ratio between the market value and replacement value of the same physical asset. The theory stated ‘q’ as the ratio of the market value of a firms existing shares (share capital) to the replacement cost of the firms physical assets. The ideal state is where q is approximately equal to one denoting that the firm is in equilibrium. Supposing that q is greater than one, the profits generated would exceed the cost of firm’s assets and additional investment would be required. In the case where q is less than one the firm would be better off selling its assets (Business Dictionary, 2013).

To sum up the theory, this can be presented as follows in figure 1. This figure represents an expansionary monetary policy.
In terms of empirical literature, there are a number of studies that assessed the impact of the interest rate channel. In Thailand, Disyatat and Vongsinsirikul (2003) applied the Vector Autoregressive Model (VAR) to assess the pass through from money market rates to retail rates. Using quarterly data from the periods 1993Q1 to 2003Q4, analysis of the results pointed out a transmission mechanism in which investment is particularly sensitive to monetary shocks and banks act as an important conduit for monetary policy to real activity.

Norris and Floerkemier (2006) examined monetary policy transmission in Armenia. Covering monthly data from 2000:5 to 2005:12, VAR analysis was used to obtain the results and the results showed that the interest rate channel remained weak, although there was some evidence of transmission to prices of changes in the repo rate, the central bank’s new operating target for inflation. They found that the capability of monetary policy to influence economic activity and inflation is still limited, and the exchange rate had a strong impact on the inflation rate.

Mutoti (2006) conducted a cointegrated SVAR examination on monetary policy transmission in Zambia covering the monthly data from the periods 1993 to 2003. Having applied SVAR to the Zambian economy, it showed that the impact of money supply shocks on Zambia’s output is little and temporary. It was also discovered that money supply shocks also hardly explain Zambia’s CPI inflation, and the role of money – demand shocks is only pronounced in the short run. Support was then shifted to an exchange rate channel of transmission.

Bonga – Bonga (2010) examined the monetary policy and the long – term interest rates in South Africa. The author examined how short term and long term interest rates react to supply, demand and monetary policy shocks. Using quarterly time series data from the first quarter of 1986 to the fourth quarter of 2007, the SVAR was used for the analysis. The author chose to account for two broad monetary regimes which was, the period of aggregate monetary targets from 1986 and the period of explicit inflation targeting from 2000 onwards. Results showed a positive correlation between the two interest rates after a monetary and demand shock and a negative correlation after a supply shock, and the operation of the monetary transmission was effective.

A study was conducted in Mauritius using the Vector Autoregressive (VAR) techniques, and variables were expressed in logarithms and seasonally adjusted, expect the REPO rate.
Tsangarides (2010) examined the transmission of monetary policy on output and prices. Using monthly data from 1990Q1 – 2009Q3, the results showed that (i) the increase in the Bank of Mauritius policy, lead to a decline in prices and output, but the effect on output was weaker, (ii) a decrease in prices will be caused by an unexpected increase in the nominal effective exchange rate, or an unexpected decrease in money supply, and (iii) fluctuations in output and prices were accounted for by small percentages in variations of policy variables.

Empirical studies have critically assessed the interest rate channel of monetary policy transmission. Sheefeni and Ocran (2012) conducted an empirical study of Namibia’s monetary policy transmission on interest rates, and how output, prices and long term interest rates respond to monetary shocks. Covering the quarterly periods from 1993Q1 – 2009Q4 it was empirically tested using impulse response functions and variance decompositions obtained from a Structural Vector Autoregressive Model (SVAR). The authors conclusion found out that both long run and short run interest rates have a significant effect on prices and output.

In the case of Russia the interest channel of monetary policy transmission channel was examined by Balkovskaya and Pilneva (2012). They investigated it using two stages of interest channel of monetary policy transmission. Assessing the ability of the central bank to influence systematically its operational interest rate as the first stage, and then examining the effect of the operational rate on real variables, in specific terms the output and inflation. Data from 2003:Q1 to 2011:Q4 was used in the study and the empirical study found out that the operational rate increases have a negative impact on output growth rate with the lag of three quarters, and no significant effect of the operational rate on inflation. The results provided evidence of the functional interest rate channel in the Russian economy.

A study was conducted to examine the monetary policy transmission in Saudi Arabia. Ziaei and Bahru (2012) applied the Structural Vector Autoregressive Model (SVAR) to evaluate different channels of monetary policy over the last 15 years. The authors used quarterly data from the periods of 1992:Q4 to 2007:Q4 and specifically examined three channels: the interest rate channel; the exchange rate channel: and the credit channel. The authors conclusion from the empirical results showed that: firstly monetary policy tightening which leads to a fall in domestic demand, so there is an active interest rate channel; the exchange rate channel plays a very limited role in transmitting monetary policy shocks to the economy; and the effect of the credit channel is more pronounced in comparison to the exchange rate channel.

From the empirical studies, the results obtained have shown that in most cases the interest rates have a significant impact on output and prices. In a few economies the interest rate
channel remained weak and other channels of monetary policy had a more significant impact. A lesson can also be learnt from the empirical findings, which is that the VAR has been the most used econometric model in assessing the transmission mechanism. This study intends to cover the gap in literature, as the recent study in Zambia was done by Mutoti in 2006. Following the recent developments in policy formulation in economies, this study will also look at the dynamic changes that the interest has had on key macroeconomic variables.

3. Methodology

3.1 Econometric Framework and Model Specification

Empirical studies that have covered monetary policy transmission have usually used the Vector Autoregressive Model (VAR). This study adopts a VAR model that was used by Balkovskaya and Pilneva (2012), when the authors examined the interest rate channel of monetary policy transmission in the case of Russia. VAR is a model with multiple dependent variables that depend on its own lags of other variables (Suslov, Ibragimov, Talisheva, and Ciplakov, 2005). Consider a k – dimensional time series:

\[ \alpha_{0}Y_t = \alpha_{1}Y_{t-1} + \ldots + \alpha_{k}Y_{t-k} + \varepsilon_t \]  

Where: \( Y_t \) denotes k x 1 vector of endogenous variables. \( \varepsilon_t \) is a vector of exogenous variables. \( \alpha_{0}, \alpha_{1}, \ldots, \alpha_{k} \) represent k x k matrices of the structural VAR form. The model can be written more compactly with the lag operator L:

\[ \alpha(L)Y_t = \varepsilon_t \]  

Where: \( \alpha(L) \) is the autoregressive lag or polynomial. The variance-covariance matrix of the structural error term \( \varepsilon_t \) is normalized:

\[ E(\varepsilon_t, \varepsilon_{t'}) \equiv \Sigma_{\varepsilon} \equiv I_k \]  

First of all, it means that the model includes as many structural shocks as variables. Secondly the structural shocks are by definition not correlated with each other, which implies that \( \Sigma_{\varepsilon} \) is a diagonal matrix. Thirdly, the variances of the structural shocks are normalized to 1. In order to estimate the structural model it is necessary to derive its reduced-form representation by expressing \( Y_t \) as a function of its own lags only. With that purpose we multiply both sides of the original equation by \( \alpha_{0}^{-1} \):

\[ \alpha_{0}^{-1}\alpha_{0}Y_t = \alpha_{0}^{-1}\alpha_{1}Y_{t-1} + \ldots + \alpha_{0}^{-1}a_pY_{t-p} + \alpha_{0}^{-1}\varepsilon_t \]  

Thus we obtain the reduced form of the VAR:

\[ Y_t = \varphi_1Y_{t-1} + \ldots + \varphi_kY_{t-k} + \eta_t \]
Where: \( \varphi_t = \alpha_0^{-1} \alpha_t, t = 1, 2, ..., k; e_t = \alpha_0^{-1} \epsilon_t \) Equivalently the model can be written more compactly as:
\[
\varphi(L) Y_t = e_t \quad \ldots 6
\]

Where \( \varphi(L) = \varphi_0 + \varphi_1 L - \varphi_2 L^2 - \cdots - \varphi_k L^k \) is the autoregressive lag or polynomial. The ultimate goal is to derive the impulse response functions (IRF) for each of the structural shocks \( \epsilon_t \). Standard evaluations methods allow obtaining estimates of the reduced-form parameters: \( A_t, t = 1, 2, ..., k \), errors \( e_t \) and the covariance matrix. However, \( e_t \) represent linear combination of structural shocks \( \epsilon_t \) and there is no economic content behind them. In order to move on to the structural form parameters we need to know \( \alpha_t, t = 1, 2, ..., k \).

Equation 6 is a common VAR specification because many macroeconomic time series appear to have a unit root. Because of the low power of tests for unit roots, their existence is controversial. VARs can accommodate either side of the debate however. Each variable is a function of lagged values of variables, which makes the VAR a general dynamic specification. This generality, however, comes at a cost. Because each equation has many lags of each variable, the set of variables must not be too large. Otherwise, the model would exhaust the available data. If all shocks have unit roots, equation 6 is estimated.

Under the assumption the process that \( Y_t \) is stationary the reduced form model polynomial can be inverted (Suslov, Ibragimov, Talisheva, & Ciplakov, 2005):
\[
Y_t = \varphi(L)^{-1} e_t \quad \ldots 7
\]

thus we get the infinite-order moving average representation for vector autoregression:
\[
\sum_{i=0}^{\infty} \tau_t \epsilon_{t-i} \quad \ldots 8
\]

Matrices \( \tau_t \) represent the impulse response functions and can be written as:
\[
\tau_t = \frac{\partial Y_t}{\partial \epsilon_{t-1}} \quad \ldots 9
\]

Identification of structural shocks is based on the introduction of restrictions on the parameters of the matrix \( \alpha_0 \). That is, we accept that the diagonal elements of the matrix \( \alpha_0 \) in the equation \( e_t = \alpha_0^{-1} \epsilon_t \) equal unity. In this case, \( \alpha_0 \) is a lower triangular matrix, and hence \( \alpha_0^{-1} \) is a lower triangular matrix as well.

The focus of this study is to measure the relative importance of the interest rate channel of monetary policy transmission. In order to assess the monetary transmission process, the empirical model for interest rate channel is constructed as presented below. The vector of endogenous variables for the interest rate channel model includes:
\[
Y_t = (\Delta GDP_t \ \Delta CP_t \ IR) \quad \ldots 10
\]

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With $\Delta GDP_t$ denoting output growth, $\Delta CP_t$ is the rate of inflation; $IR$ is the short-term interest rate, represented by the lending rate.

In conducting the VAR analysis, several steps have to be followed:

1. Testing for unit root and determine the order of integration for two variables by employing tests devised by Augmented Dickey - Fuller (ADF), Philips and Peron (PP) and Kwiatkowski-Phillips-Schmidt-Shin (KPSS).

2. Testing for cointegration and if there is cointegration relationship among the variables can be re-parameterised as an Error-Correction Model (ECM) which will contain both short and long-run effects. The Johansen cointegration can be applied in this respect.

3. Granger-causality. That is if there is cointegration there should be Granger-causality in at least one direction.

4. Impulse response and variance decomposition

### 3.2 Data and Data Source

Annual time series data which will cover the period 1980 to 2011. Data will be collected from various sources some of which are: Bank of Zambia bulletins; National Accounts; World Bank Statistics; and the Zambia Central Statistic Office. The macroeconomic data to be obtained will be namely, output (GDP), inflation, and real short-term interest rates.

### 4. Empirical Analysis And Results

#### 4.1 Zambia Trends

In this section, different maturities of interest rates are presented, which are better known as the yield curve. Bonga-Bonga (2010), describes the yield curve as the plot of the interest rates on bonds with different terms to maturity but the same risks, liquidity and tax considerations.

Figure 2: Deposit Rate and Lending Rate

Figure 3: Inflation and Deposit Rate
Figure 2 shows the relationship between the deposit rate and the lending rate. In the figure, the two short term interest rates tend to move in the same direction. However, in the early 90s, there was a sharp increase in the lending rate, while the deposit rate increased moderately. This increase was not long lasting as it decreased, and the two rates began to fluctuate around the same trends.

Figure 3 gives the relationship between the rate of inflation and the deposit rate. Inflation is moderately high in the beginning, while the deposit rate remains moderately low compared to inflation. The figure shows that the deposit rate and inflation rate generally move in the same direction and fluctuate around the same trends. Figure 4, gives the relationship between the rate of inflation and the lending rate, and it basically has the same trend as figure 3.

In figure 4, GDP growth is presented from the period 1986 to 2010. It is observed that GDP was fluctuating between the years of about 1988 to 1998. However, after this GDP has increased implying positive economic growth.

4.2 Unit Root Test

Being non-stationary implies that the mean, variance and covariance is not constant over time. When data contains unit root it means any result accrue to such data will be spurious or nonsensical. Testing for Stationarity or non-Stationarity of the variables and determine their order of integration, this study employs the Augmented Dickey Fuller (ADF) statistic, and the Phillips-Perron (PP) tests for unit root. The results of the unit root test in level form, first difference and second difference are presented in table 1 below. The table show that the series were found to be non-stationary in level form. After differencing them, the test statistic shows that the Interest Rate (IR) and Consumer Price Index (CPI) became stationary. However, the study proceeds to the second difference for Gross Domestic Product (GDP) to become stationary.
Table 1: Unit root tests: ADF and PP in levels, first difference and second difference

<table>
<thead>
<tr>
<th>Variables</th>
<th>Model Specification</th>
<th>ADF</th>
<th>PP</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>lnCPI</td>
<td>Intercept and trend</td>
<td>-2.33</td>
<td>-6.31**</td>
</tr>
<tr>
<td></td>
<td>Intercept</td>
<td>-1.11</td>
<td>-5.45**</td>
</tr>
<tr>
<td>lnGDP</td>
<td>Intercept and trend</td>
<td>0.15</td>
<td>-2.33</td>
</tr>
<tr>
<td></td>
<td>Trend</td>
<td>2.63</td>
<td>-1.09</td>
</tr>
<tr>
<td>lnIR</td>
<td>Intercept and trend</td>
<td>-1.36</td>
<td>-5.18**</td>
</tr>
<tr>
<td></td>
<td>Trend</td>
<td>-1.9</td>
<td>-4.73**</td>
</tr>
</tbody>
</table>

Source: Author compilation from Eviews
Notes: (a) ** means the rejection of the null hypothesis at 5%

Based on the information criteria, a reduced form VAR is estimated after establishing the statistical properties. To determine at which level VAR will be estimated, there is need to check the stability condition. To estimate VAR in level form, it has to be stable, which means that all the roots lie within the unit circle. However, if it is not stable, VAR is estimated in first difference. Therefore, the convergence lag length was found to be two. The results for the lag length structure and roots of characteristics polynomial are shown in tables 2 and 3 respectively.

Table 2: Lag length Criteria for the Interest Rate Channel

<table>
<thead>
<tr>
<th>Lag</th>
<th>LagL</th>
<th>LR</th>
<th>FPE</th>
<th>AIC</th>
<th>SC</th>
<th>HQ</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>28.59155</td>
<td>NA</td>
<td>3.23e-05</td>
<td>-1.827968</td>
<td>-1.685232</td>
<td>-1.784332</td>
</tr>
<tr>
<td>1</td>
<td>45.97554</td>
<td>29.80113</td>
<td>1.78e-05</td>
<td>-2.426824</td>
<td>-1.855879</td>
<td>-2.252281</td>
</tr>
<tr>
<td>2</td>
<td>63.72002</td>
<td>26.61673*</td>
<td>9.81e-06*</td>
<td>-3.051430*</td>
<td>-2.055227*</td>
<td>-2.745979*</td>
</tr>
</tbody>
</table>

Source: Author’s compilation using Eviews

Table 3: Roots of Characteristic Polynomial for the Interest Rate Channel

<table>
<thead>
<tr>
<th>Root</th>
<th>Modulus</th>
</tr>
</thead>
<tbody>
<tr>
<td>-0.1418359 - 0.726265i</td>
<td>0.838144</td>
</tr>
<tr>
<td>-0.418359 + 0.726265i</td>
<td>0.838144</td>
</tr>
<tr>
<td>-0.447186</td>
<td>0.447186</td>
</tr>
<tr>
<td>0.263555 - 0.334213i</td>
<td>0.425628</td>
</tr>
<tr>
<td>0.263555 + 0.334213i</td>
<td>0.425628</td>
</tr>
<tr>
<td>0.097830</td>
<td>0.097830</td>
</tr>
</tbody>
</table>

Source: Author’s compilation using Eviews
Notes: No roots lie outside the unit circle. VAR satisfies the stability condition
4.3 Testing for Cointegration

Table 4: Johansen Cointegration Test Based on Trace and Maximum Eigen Values of the Stochastic Matrix

<table>
<thead>
<tr>
<th>Maximum Eigen Value</th>
<th>Trace Test</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ho: Rank R = r</td>
<td>Ha: Rank R = r</td>
</tr>
<tr>
<td>r=0</td>
<td>r=1</td>
</tr>
<tr>
<td>18.17</td>
<td>21.13</td>
</tr>
<tr>
<td>r&lt;=1</td>
<td>r=2</td>
</tr>
<tr>
<td>13.43</td>
<td>14.26</td>
</tr>
<tr>
<td>r&lt;=2</td>
<td>r=3</td>
</tr>
<tr>
<td>6.64</td>
<td>3.84</td>
</tr>
</tbody>
</table>

Source: Author’s Compilation using Eviews

Note: Trace tests indicate 3 cointegrating equations at the 0.05 level, while the Maximum eigenvalue indicates one cointegrating equation. Sample period 1980 to 2011.

Cointegration is generally defined as a concept which mimics the existence of the long run equilibrium relationship among variables. The results for the Johansen cointegration test based on trace and maximum eigen values test statics are presented in table 4. The results for the maximum eigen values test statistic show at least one test statistic which is greater than the 95% critical value therefore, rejecting the null hypothesis of no cointegrating variables. On the other hand, the trace test statistic reviewed that there are three cointegrating equations. This follows rejecting the null hypothesis of no cointegration of variables at 5%. The trace test statistic is preferred to the maximum eigen value test, because it is termed to be more specific and not general. After determining that cointegration was present, the study proceeds by estimating the data with the Vector Error Correction Model (VECM) and not the general VAR. The reason for the divergence from the VAR to the VECM is that, the VECM is preferred for long run dynamics.

4.4 Granger Causality Test

Table 5: Granger Causality Test for the Interest Rate Channel

<table>
<thead>
<tr>
<th>Regressor</th>
<th>Dependent Variable in Regression</th>
</tr>
</thead>
<tbody>
<tr>
<td>CPI</td>
<td>CPI, GDP, IR</td>
</tr>
<tr>
<td>GDP</td>
<td>0.02</td>
</tr>
<tr>
<td>IR</td>
<td>0.004**</td>
</tr>
</tbody>
</table>

Source: Author’s compilation using Eviews

Notes: ** mean the rejection of the null hypothesis at 5%

Granger causality test is considered a useful technique for determining whether one time series is good for forecasting the other. The Granger Causality results for the three variable VAR are shown in table 5. In the above table, the results show that, interest rate helps to predict CPI, and CPI also helps to predict the interest rate, and this suggests a bi-directional causal relationship. GDP on the other hand, is not predicted by the interest rate; however the
interest rate can be predicted by GDP. This suggests a uni-directional causal relationship between the interest rate and GDP.

4.5 Impulse Response Function

The response of GDP and CPI, to innovations in the short term interest rate is presented in figure 6. GDP responds negatively to monetary policy shocks for a few years. The effects of the shocks are transitory on GDP and die out in the short run. Thereafter, there is convergence toward the steady state although slightly below the baseline. These effects remain to be constant in the long run. The IRF showed that CPI decreased as the interest rate increased, which is line with theory. The short term effects die out sooner compared to permanent price effects which remain relentless in the long run. In this case, the interest rate channel of monetary policy is proving to be effective, since the interest rate is able to transmit effects to output and prices.

Figure 6: Impulse responses of output and consumer prices: The interest rate channel

4.6 Forecast Error Variance Decomposition

Table 6 below shows the results of the forecast error variance decomposition which are presented over a 10 year forecast horizon. The relative importance of each random innovation in affecting the variables in the VAR, are provided by the variance decomposition. The results show that fluctuations in forecasting CPI in the first period are mostly attributed to itself. This
trend is persistent even after 10 years with an insignificant contribution by the other two variables.

The error in the forecast of GDP in the first period is greatly dominated by itself but with a significant contribution attributed to CPI of 19.8% but no contribution from IR. Over the following period fluctuations in forecasting GDP dwindled accounting for only 47.8% with substantially contribution from CPI and IR in year 10 respectively. Fluctuations in forecasting IR were greatly attributed to itself in the first period but with a successive increase in the contribution of CPI by the 10 year and a trivial contribution by IR.

Table 6: Variance decomposition for the interest rate channel

<table>
<thead>
<tr>
<th>Year</th>
<th>CPI</th>
<th>GDP</th>
<th>IR</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>100</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>4</td>
<td>92.037</td>
<td>5.84</td>
<td>2.12</td>
</tr>
<tr>
<td>6</td>
<td>91.56</td>
<td>6.14</td>
<td>2.31</td>
</tr>
<tr>
<td>10</td>
<td>90.17</td>
<td>6.83</td>
<td>3.01</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Year</th>
<th>CPI</th>
<th>GDP</th>
<th>IR</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>19.83</td>
<td>80.17</td>
<td>0.00</td>
</tr>
<tr>
<td>4</td>
<td>28.52</td>
<td>55.16</td>
<td>16.31</td>
</tr>
<tr>
<td>6</td>
<td>35.31</td>
<td>49.24</td>
<td>15.45</td>
</tr>
<tr>
<td>10</td>
<td>35.98</td>
<td>47.80</td>
<td>16.22</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Year</th>
<th>CPI</th>
<th>GDP</th>
<th>IR</th>
</tr>
</thead>
<tbody>
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<td>10</td>
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Source: Author’s compilation using Eviews

5. Conclusion

The objective of this paper was to determine if the interest rate channel was effective in transmitting shocks to prices and output. The variables, GDP, CPI, and the interest rate were used. The study employed the VECM, because cointegration was found to be present among the variables, which consisted of data from the periods 1980 to 2011. Following this, the study also employed the Granger causality test, which reviewed that the lending rate and CPI are able to predict each other. However, GDP is able to predict the interest rate and not the interest rate predicting GDP. Looking at the impulse response functions, output growth responded negatively to monetary policy shocks, and the effects are not permanent, and GDP converges to the steady state in the long run. On the other hand the impulse response functions show that consumer prices had a negative relationship with the interest rate. The forecast error variance decomposition show that in forecasting CPI, all the fluctuations were
attributed to CPI itself, with an insignificant contribution from the other two variables in the long run. Forecasting GDP, showed that, in the beginning GDP fluctuations were greatly dominated to itself, however in the long run there was a significant contribution from CPI and IR. In forecasting IR, fluctuations were greatly attributed to itself with an increase in the contribution of CPI and GDP. In general, the results review that the channel of monetary policy through the interest rate channel is effective in Zambia. Based on the empirical finding, this paper recommends the following: Bank of Zambia (BOZ) should still continue to use interest rates as a monetary policy tool, since interest rates are able to transmit an effect to the general price level. Therefore, BOZ can still control prices in an event of an economic shock. In the case of GDP, interest rates are not able to transmit shocks to output. Therefore, BOZ should consider an additional or complementary policy tool, in order to affect output.

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