Is There a Bank Lending Channel in Southern African Banking Systems?

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Abstract: Macroeconomic models currently used by policymakers generally assume that the functioning of financial markets can be fully summarized by financial prices, because the Modigliani and Miller (1958) theorem holds. However, the assumption that this theorem holds is questionable. This paper argues that there are frictions in the market which traditional models based on the Modigliani and Miller theorem fail to take into account in explaining how monetary policy and other shocks are transmitted to the economy and points to new directions. A comprehensive macroeconomic model should incorporate financial market interactions to enhance the understanding of the transmission mechanisms of monetary policy and other shocks. If market dynamics are not taken into account, macroeconomic models used by policymakers may point to wrong policy choices. Motivated by the lack of assessment of the recently launched financial reforms, deregulation, consolidations, financial innovations and joint payment systems, the paper assesses the process of monetary transmission mechanism by investigating evidence of a bank lending channel in SADC during the period 1990–2006 using data from the banking sector. Data from a panel of banks is used to identify shifts in the loan supply curve in response to changes in monetary policy using a vector autoregression (VAR) model. Although the results are mixed the paper generally reports the existence of a bank-lending channel in all SADC countries in the sample. The take-off point for monetary policy effects differs from one country to another.

1. Introduction

Monetary policy has long been a subject of economic research as many economists have attempted to scrutinize its effects on the real economy. The popular and conventional wisdom asserts that although ineffective in

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the longer run, monetary policy is a powerful tool in influencing economic activity at shorter horizons. According to the stylized fact given by Christiano *et al.* (1996), for the US economy, monetary policy actions impact on the real sector with an average delay of 4 months and this can last up to 2 years. This finding is also borne out in Romer and Romer (1989). Another salient feature of monetary policy, put forth by Barth and Ramey (2000), is that small changes in short-term interest rates could result in large changes in output, commonly referred to as the amplification effect. These findings are, however, rather suggestive than conclusive as the lag of the pass-through to the real economy appears to change over time and across countries. Notably, there should be a difference in the way monetary policy affects the real economy between developed and developing countries. Nonetheless, Bernanke and Gertler (1995) deem the mechanism through which monetary policy actions are transmitted to the real economy as a black box. Interest in resolving this conundrum has given rise to a large body of theoretical literature and to a plethora of empirical papers that take pains in matching theory with real data. The most traditional explanation is the interest rate channel developed in textbook IS-LM models. However, the early observation that the interest rate channel cannot neatly explain output fluctuations entailed by monetary policy actions has given birth to the credit channel literature. Thirdly, asset prices are also believed to constitute a bridge between nominal and real variables. Finally, and importantly, monetary policy can also exert its effect through changes in exchange rates. Therefore, the monetary transmission mechanism remains as Bernanke and Gertler (1995) mentioned, a black box to be explored.

There are at least two good reasons for studying the monetary transmission mechanism in transition economies. First, a genuine and precise understanding of how fast and to what extent a change in the central bank's interest instrument modifies inflation lies at the heart of inflation targeting. And an increasing number of transition countries already make use of inflation targeting. Second, with countries participating in single markets — such as the European Union (EU), Southern African Development Community (SADC) and Common Market for Eastern and Southern Africa (COMESA) — many in academia and in policy circles are anxious to find out how monetary transmission mechanism operates in relatively heterogeneous trading blocs. To fully understand how the monetary transmission mechanism has evolved over nearly twenty years and how it works now, it is necessary to review the developments of monetary policy on which central banks in southern Africa have relied.

Generally, the profound economic transformation that occurred during the late 1980s and early 1990s involved, among others, a liberalization of prices and trade, which resulted in a surge of inflation and large external imbalances. This is why most central banks had at that time more than one main policy objective. According to Chirwa (1999) and Aron (2000), typically, central banks pursued price stability and external stability as their final objectives. Aron (2002), however, reports that over time, the relatively advanced countries of the region such as South Africa adopted a single price stability goal while others still today pursue dual objectives. Alternatively, some countries such as Malawi, Namibia, Botswana and Zambia adopted a double intermediary objective by complementing monetary aggregates with the nominal exchange rate (Aron and Muellbauer, 2000). With the move to inflation targeting by countries such as South Africa and Zambia in 1999, these intermediary objectives were replaced by inflation forecasts. The transformation of the monetary policy framework went hand-in-hand with changes in monetary policy instruments as well; Aron and Muellbauer (2000) argue that because of the absence of financial markets and of the long-prevailing soft budget constraints in the banking and non-financial corporate sector, this caused economic agents to be insensitive to changes in interest rates. Direct administrative measures such as credit ceilings, direct interest rate controls and reserve requirements were being used to control credit growth and banking sector liquidity. However, with the development of the inter-bank money market, indirect instruments assuming the proper functioning of markets were introduced. In particular, central banks started to influence very short-term interest rates by imposing interest corridors, which were typically maintained by means of open market operations (OMO) (Cross Border Initiative report, 1999).

1.1 Aims and Scope of the Study

The aim of this paper is to investigate the existence of the banking lending channel in SADC[1] banking systems. Since the early 1990s, African banking systems have experienced a trend towards consolidation. However, unlike the banking systems in developed countries, where consolidation was mainly a result of mergers and acquisitions motivated by potential efficiency gains from economies of scale and scope, consolidation in African banking systems was initially triggered by economic stabilization, liberalization of financial services and banking crises (Mehran, 1998; and Chirwa and Mlachira, 2000). All these factors contributed to reshape an industry that only some years before had been characterized by government control on credit allocation and interest rates and by poor regulation and supervision. Consequently, in this study, we try to answer three basic but relevant questions: How potent is monetary policy in the face of financial sector liberalization? How long does it take for monetary policy to take effect, and also how long does it take the bank to pass on the effect of monetary policy change to their customers? De Bondt (2000) argues that as major financial intermediary institutions in the economy, banks play a significant role in the determination of output by supplying funds for investment finance in the real economy. Bank loans constitute the major part of the sources of external finance for most firms. Therefore, economic activity appears to be sensitive to shocks on bank lending behaviour. Any monetary shock influencing bank reserves is expected to cause asset reallocation in bank balance sheets. In addition, as is argued by Dedola and Lippi (2000) and also by Gertler and Gilchrist (1993) if this allocation cannot be done in such a way that the effects of the shock are absorbed by some other assets than loans, the availability of bank loans to firms and, hence, the investment decisions of the bank-dependent firms, will be affected. Cecchetti (1995) reports that it has to be noted that this effect is a supply effect rather than a demand effect generated by changes in interest rates. The supply effect, which is transmitted by the credit channel, and the demand effect, which is transmitted by the interest rate channel, can be observed together. However, realizing the relative magnitudes of these effects may be important for the precision in policy-making. The factors that increase the relative potency of the transmission through the credit channel are credit market imperfections. The major imperfections that influence the lending behaviour of banks are their asymmetric cost structures in raising external finance and in evaluating and monitoring loan contracts. Golodniuk (2005) argues that the difference in the size of banks is one of the factors that can be considered as the cause of asymmetric cost structures. The asset size differences among banks and across countries may reflect the basis of the relative cost advantages in banks' raising external finance. This asymmetry leads to disproportionate lending responses of banks to monetary shocks unless banks buffer themselves against shocks through their liquid assets. Golodniuk (2005) further argues that the disproportionate lending responses of banks to monetary shocks are also transmitted to bank dependent firms in a disproportionate manner. Provided that the majority of the producer firms are dependent on bank loans as a source of external finance, there will be real output effects of monetary shocks in the aggregate economy because the supply of funds for financing investment projects and working capital needs are affected. Therefore, investigating the loan supply responses of banks is a crucial step in testing the credit view, particularly the bank lending channel.

1.2 Scope of the Study

In order to answer the above questions and provide a critical analysis of the banking systems in southern Africa, this paper is aimed at empirically investigating the presence of an active monetary transmission mechanism with particular emphasis on the bank lending channel in five SADC countries.[2] The empirical investigations are focused on the bank lending behaviour of deposit money banks over the period 1990–2006. To our knowledge, this is the first study in the literature analysing the bank lending channel of monetary transmission in the SADC economy. Moreover, the estimation methodology of the empirical analysis used in the study differs from that of similar studies in the literature, providing econometrically more efficient model estimates.

The study contributes to the literature and academic knowledge by exploring the dynamism within the monetary transmission framework and complexity of monetary policy. It also provides a contribution to the literature by outlining an assessment of the monetary transmission in African banking systems (on which there is limited literature at present). Most developing countries have time and again implemented policies that have proven workable in developed countries but not in their own systems. This study suggests that other factors such as macroeconomic environment and operating procedure of monetary policy need to be taken into account when implementing policy.

The rest of the paper is structured as follows; Section 2 presents a brief review on monetary transmission literature with a particular emphasis on the credit channel. Section 3 outlines the data and estimation methodology followed in this paper. Section 4 provides empirical findings of the research before drawing a conclusion in Section 5.

2. Monetary Transmission: A Brief Survey

In the recent literature, there are two main schools of thought on the channels of the monetary transmission mechanism. The first view (the traditional view) stresses the role of money and is referred to as 'the money view'. The second view stresses the role of credit and is referred to as 'the credit view/the bank lending view'. We briefly discuss below the money view before we delve in a lot more detail on the credit/bank lending channel as the main focus of our study.

2.1 The Money View

According to Bernanke and Blinder (1992), the money view is based on the notion that reductions in quantity of central bank money raise real rates of return which in turn leads to a reduction in investment because fewer profitable projects are available at higher required rates of return. This is a movement along a fixed marginal efficiency of investment schedule. The less substitutable the central bank funds are, the larger the interest changes. In the pure money version of the monetary transmission mechanism, there are effectively only two assets: money and bonds. Kashyap and Stein (2000) argue that in this world, the banking sector's only special role has to do with the liability side of its balance sheet built on the fact that it can create money by issuing demand deposits. An important implication of this traditional model of the transmission mechanism involves the incidence of the investment decline. Since there are no externalities or market imperfections, it is only the least socially productive projects that go unfunded. The traditional 'money view' of the monetary transmission mechanism is based on the so-called money or interest rate channel, featured by the standard Keynesian IS-LM framework. The basic assumptions that characterize the interest rate channel are: (1) sticky price adjustment to money supply shocks, (2) direct control of the monetary authority on nominal money supply by adjusting reserves, and (3) presence of two assets such as money and bonds where loans are perfect substitutes for bonds (Bernanke and Blinder, 1988).

However, the 'credit view' of the monetary transmission mechanism puts a special emphasis on the role of financial intermediaries or banks on the aggregate economic activity. The role of intermediation in the monetary economics literature has been ignored with the assumptions of perfect capital markets and homogenous financial structure, in the context of what is known as the Modigliani–Miller theorem. As such, finance is postulated to be a 'veil' which implies that intermediary institutions are redundant and the financial structure of firms is irrelevant to real output effects. However, Bernanke (1983) rejects this postulate and states the role of economic institutions in producing real effects arguing that increased credit intermediation costs, coupled with a credit squeeze during a financial crisis, propagate the real effects of turmoil. This indicates the significance of financial institutions in affecting transaction costs and thus real economic activity. According to Bernanke and Blinder (1988) and Bernanke and Gertler (1989), when loans are assumed imperfect substitutes, the monetary transmission mechanism operates not only through the interest rate channel, but through a credit channel as well. It is now assumed that firms can finance their investments by bank loans as well as bonds, and banks' asset portfolio now consist of loans beside reserves and bonds in simple terms. Within this three assets framework, banks play a significant role in the determination of output dynamics, which is not the case in the two assets framework of the money view. Market imperfection in the banking system is one of the crucial points that contribute to the presence of a credit channel. Bernanke and Gertler (1995) for example, point to capital market frictions originating from imperfect information aspects.

Informational asymmetry between the lender and borrower puts a wedge between the costs of internal and external funds, which is referred to as 'external finance premium' (Bernanke and Gertler, 1995). It is argued that the potency of monetary policy is reflected not only by interest rates, but by the external finance premium as well. Thus, Bernanke and Gertler (1995, p. 28) state that the credit channel is not a distinct, independent or a parallel channel, but rather 'a set of factors that amplify and propagate conventional interest rate effects'. The influence of monetary shocks on real economic activity has two dimensions in the credit view. First, a monetary shock can influence the financial position or the net worth of a borrower firm. A higher net worth of a firm's balance sheet makes external financing from the loan market possible and, hence, stimulates investment decisions. As the transmission of monetary shocks to the real economy occurs through the borrowers' balance sheets, this channel is called the balance sheet channel. Second, a monetary shock can influence the banks' loan supply to bank-dependent firms. This change in the availability of loans influences the investment decisions of the borrower firms by reducing an external source of finance. The transmission through such a channel is called the bank lending channel. The credit view is subdivided into two channels as discussed below.

2.2 The Lending View: Balance Sheet Effects

The second theory of monetary transmission mechanism within the credit view is the lending view which has two parts, one that does not require introduction of assets such as bank loans and one that does. This view is discussed in context by Gambacorta (2005). The first is sometimes referred to as the broad lending channel, or financial accelerator, and emphasizes the impact of policy changes on borrowers' balance sheets. It bears substantial similarity to the mechanism operating in the money view because it involves the impact of changes in the real interest rate on investment. According to this view, there are credit market imperfections that make the calculation of the marginal efficiency of investment schedule more complex. Hubbard (1995) reports that due to information asymmetries and moral hazard problems, as well as bankruptcy laws, the state of a firm's balance sheet has implications for its ability to obtain external finance. Policy-induced increases in interest rates (which are both real and nominal) can cause deterioration in the firm's net worth, by both reducing expected future sales and increasing the real value of nominally denominated debt. With lower net worth, the firm is less creditworthy because it has an increased incentive to misrepresent the riskiness of potential projects. As a result, potential lenders will increase the risk premiums they require when making a loan. The asymmetry of information makes internal finance of new investment projects cheaper than external finance (Gertler and Gilchrist, 1993).

The balance sheet effects imply that the shape of the marginal efficiency of the investment curve is itself a fraction of the debt-equity ratio in the economy and can be affected by monetary policy. Bernanke *et al.* (1994) refer to this as the financial accelerator since it causes small changes in interest rates to have potential large effects on investment and output. In terms of the simple textbook analysis, policy moves both the IS and LM curves. For a given change in the rate of return on outside money (which may be the riskless rate), a lender is less willing to finance a given investment the more debt a potential borrower has. This points to two distinctions between the money and lending views —the latter stresses both the distributional impact of monetary policy and explains how seemingly small changes in interest rates can have a large impact on investment (the financial accelerator).

Morsink and Bayoumi (1999) report that the balance sheet approach to the monetary transmission mechanism embodies the features that link a firm's investment decision with monetary shocks through changes in the firm's financial position. Interest rate effects of a monetary shock have two direct effects on the net worth of a borrower firm; first, by influencing interest payments on outstanding debt, and second by influencing the asset prices. The former influences the net cash flow and profits of the firm while the latter influences the value of collateral assets of the borrower firm. In agreement to such views, Bernanke *et al*. (2005) argue that, moreover, as an indirect effect, a monetary shock influences spending of the firm's customers thereby influencing the wedge between the revenues and fixed costs of the firm in the short run. Both of these direct and indirect effects determine the firm's net worth and credit-worthiness and hence the firm's borrowing capability from the loan market. As a result, the extent to which the real economy is affected depends on how the external finance premium and balance sheets of firms are affected by monetary shocks.

2.3 Lending View: Loans for Intermediaries

The second mechanism articulated by proponents of the lending channel can be described by dividing the 'other' assets in the investor's portfolio into at least three categories: outside money, loans and all the other assets. We are also assuming that there are firms for which loans are the only source of external funds, some firms cannot issue securities. Ramey (1998) reports that depending on the solution to a portfolio allocation problem, a policy action may directly change both the interest rate and the quantity of loans. There are two arguments to this, first, there are borrowers who cannot finance new projects except through loans, and secondly, policy changes have a direct effect on loan supply. Consequently, the most important impact of policy innovation is cross-sectional, as it affects the quantity of loans to loan dependent borrowers (Dale and Haldane, 1995).

The bank lending approach to the monetary transmission mechanism appears to be another important channel of the credit view as there are bank dependent borrowers who have few or no alternative sources of finance other than bank loans (Christiano *et al*., 2004). Any frictions in the asset-liability management of banks due to monetary shocks would be transmitted to real economic activity through the bank-dependent producers in the economy. A tight monetary policy draining reserves from the banking system would restrict the supply of loanable funds so that it increases the external finance premium of the bank-dependent borrower firms. The effect of a monetary shock on the external finance premium of small size firms is assumed to be higher than it is on large ones under the assumptions that large size firms have easier access to credit markets and have more alternative sources of finance. In this sense, output fluctuations due to monetary shocks can be explained not only by interest rate effects, but by external finance premium effects as well. Presence of an active bank lending channel may serve to explain the amplified and propagated conventional effects of policy shocks. It has to be noted that since the bank lending channel focuses only on the lending behaviour of banks affected by monetary policy shocks, this transmission channel view is assumed to be a narrow type of credit channel approach (Ehrmann, 2004).

3. Methodology

This paper uses vector autoregressions (VARs) to examine the monetary transmission mechanism in five southern African countries, namely Botswana, Malawi, Namibia, South Africa and Zambia. The choice of the VAR approach is inspired by the existence of a large empirical literature using VARs to examine the monetary transmission in the US, Japan and Europe focusing on reduced-form relationships between monetary policy and macroeconomic and financial variables (Christiano, Eichenbaum and Evans, 1996 offer a comprehensive survey). In particular, we follow an approach similar to Christiano *et al*. (2004) and Hulsewig, Mayer and Wollmershauser (2005) who investigate the loan response to a monetary policy shock in Germany.

The VAR approach treats every variable in the system as a function of the lagged values of all the endogenous variables. VAR is an econometric model used to capture the evolution and the interdependencies between multiple time series, generalizing the univariate autoregressive (AR) models. All the variables in a VAR are treated symmetrically by including for each variable an equation explaining its evolution based on its own lags and the lags of all the other variables in the model.

Based on this feature, Sims (1992) advocates the use of VAR models as a theory-free method to estimate economic relationships, thus being an alternative to the 'incredible identification restrictions' in structural models. A VAR model describes the evolution of a set of n variables (called endogenous variables) measured over the same sample period ($t = 1, \ldots, T$) as a linear function of only their past evolution. The variables are collected in a $n \times 1$ vector $\mathbf{y_t}$, which has as the ith element $y_{i,t}$ the time t observation of variable y_i. We briefly describe below how the VAR is estimated.

Following Sims (1992) and Christiano *et al.* (1996), the VAR recursive identification scheme is as follows: VARs focus on cross-correlations among a limited number of variables. The estimated (reduced form) VAR equation can be written as:

$$C(L)\mathbf{Y_t} = \upsilon_\mathbf{t} \ldots \tag{1}$$

where $C(L)$ is a matrix polynomial in the lag operator ($C_0 = I$), $\mathbf{y_t}$ is a ($n \times 1$) vector of endogenous variables and $\boldsymbol{\upsilon}_\mathbf{t}$ is the vector of reduced form errors with covariance matrix cov($\boldsymbol{\upsilon}_\mathbf{t}$) $= \sum$. Equation (1) above can be seen as the reduced form of the structural model

$$\mathbf{A_0 y_t} = \sum_{i=1}^{N} A_i \mathbf{y_t} - i + \varepsilon_t \tag{2}$$

where

$$\varepsilon_t \equiv A_o \upsilon_t \ldots \tag{3}$$

These three equations make it possible to derive the moving average representation:

$$\mathbf{y_t} = [\mathbf{A}_0 C(L)]^{-1} \varepsilon_t \tag{4}$$

from which the impulse response functions showing the dynamic response of each endogenous variable of the structural innovations (ϵ), are derived. To derive the impulse response functions, the $\mathbf{A_0}$ matrix must be identified, given the estimates of $C(L)$, $\boldsymbol{\upsilon}_\mathbf{t}$ and $\sum$. In order to achieve this identification, a set of restrictions must be imposed. One of the standard set of restrictions involves the assumption that the covariance matrix of the structural innovations is the identity matrix.

$$\sum(\varepsilon_\mathrm{t}\varepsilon_\mathrm{t}') = \mathbf{A}_0 \sum(\boldsymbol{\upsilon}_\mathrm{t}\boldsymbol{\upsilon}_\mathrm{t}')\mathrm{A}_0' = \mathrm{A}_0 \Sigma \mathrm{A}_0' = I \tag{5}$$

This amounts to assuming that the structural innovations of the endogenous variables are uncorrelated. Condition (5) imposes at most $n(n + 1)/2$ constraints on the n^2 unknown coefficients of $\mathbf{A_0}$. There are $n(n - 1)/2$ additional restrictions needed to identify all the elements of $\mathbf{A_0}$ (however, according to Christiano *et al.* (1996) this is a necessary but not sufficient condition). One particular way to achieve this is to assume that the $\mathbf{A_0}$ matrix is lower triangular (i.e. setting the $n(n - 1)/2$ off diagonal elements of $\mathbf{A_0}$ equal to zero) also known as the Choleski decomposition.

The identification of the policy effects based on recursive assumption relies on a partition of the endogenous variables (y_t) into three groups: the policy variables $y_{pt;}$ n_1 variables not responding contemporaneously to monetary policy but to which the policy variable responds contemporaneously (y_{1t}); n_2 variables responding contemporaneously to policy but to which the policy variable does not respond contemporaneously ($y_{2t;}$ with $n_1 + n_2 + 1 = n$). The $\mathbf{A_0}$ matrix may be written as:

$$y_i = \begin{bmatrix} y_i \\ (n_1 \times 1) \\ y_p \\ (1 \times 1) \\ Y_{21} \\ (n2 \times 1) \end{bmatrix} Ao = \begin{bmatrix} a_{11} & 0 & 0 \\ (n_1 \times n_1) & (n_1 \times 1) & (n1 \times n_2) \\ a_{21} & a_{22} & 0 \\ (1 \times n_1) & (1 \times 1) & (1 \times n_2) \\ a_{31} & a_{32} & a_{33} \\ (n_2 \times n_1) & (n_2 + 1) & (n_2 \times n_2) \end{bmatrix} \tag{6}$$

An important property of the recursiveness assumption shown by Christiano *et al.* (1998) is that the impulse response of all variables in y_t to a shock in the policy in the policy variable y_p is identified by the partition of $y_{t.}$ In synthesis, the recursiveness results show that if the variables in y can be partitioned in accordance with (6) then such a partition is sufficient to determine the effects of a shock to the policy variable y_p. Moreover, these effects do not depend on the ordering of the variables within y_{1t} and y_{2t} vectors. Hence, all that is required to identify the effects of a shock to y_p is the definition of the variables entering the policy reaction function simultaneously (y_{1t}). From a practical point of view, the recursive assumption justifies measuring the impulse responses to a policy shock by assuming a lower triangular $\mathbf{A_0}$ matrix (Choleski decomposition) which is consistent with the partition in (6).

Following the above analysis, our results are based on innovative analysis — impulse[3] response analysis and variance decompositions which are performed with an estimated VAR model transformed into its moving average representation. Innovations are identified by imposing a Wold causal chain (i.e. a model in which the policy variable is ordered first and the other variables follow). By ordering the short-term interest rate first, we capture the idea that it is the least endogenous variable which reflects both the fact that it is largely determined indirectly by outside forces and also the fact that in reality information on prices and real activity are available with lags. Barran *et al.* (1997) follow the same procedure for the nine European countries.

In Morsink and Bayoumi's (1999) words, VAR allows us to place minimal restrictions on how monetary shocks affect the economy, which given the lack of consensus about the workings of the monetary transmission mechanism is a distinct advantage. In addition, this approach recognizes explicitly the simultaneity between monetary policy and macroeconomic developments, i.e. the dependence of monetary policy on economic variables (the policy reaction function) as well as the dependence of economic variables on monetary policy. We examine the bank lending channel of the monetary transmission using cointegration within the context of the vectoautoregressive model following Christiano *et al.* (2004), Holtemaoller (2003) and Haulsewig *et al.* (2004), who investigate the response of aggregate bank lending in Germany in a similar framework using monthly and quarterly data. We estimate our model to evaluate the adjustment of bank loans to a monetary policy shock using a three-step procedure. We first estimate the general VAR model. Secondly, we generate impulse responses. Thirdly, we estimate variance decomposition estimates. We describe briefly below the three steps involved based on Christiano *et al.* (2004).

- **Step 1.** The general representation of the VAR model is as follows:

  $$\mathbf{Y}_{\mathrm{t}} = \mathrm{A}(L)\mathbf{Y}_{\mathrm{t}-1} + B(L)\mathbf{X}_{\mathbf{t}} + U_{t-1}. \quad (7)$$

  where $\mathbf{Y_t}$ is a vector of endogenous variables such as GDP, inflation (P_t), domestic nominal interest rate (r_t); $\mathbf{X_t}$ is a vector for exogenous variables; and $A(L)$ and $B(L)$ are polynomials of the lag operator while estimating model 7.
- **Step 2.** In the second step, we estimate a VAR model to derive empirical impulse responses. We generate impulse responses of the variables in $\mathbf{Y_t}$ (Equation 7 above) to a monetary policy shock, which is identified by imposing a triangular orthogonalization. In the second step, we estimate the real impact of each variable on other variables by generating variance decompositions. The impulse responses are obtained by inverting the estimated lag polynomials $B(L) = A^{-1}(L)$[4]
  Impulse response indicates how a shock to any one variable filters through the model to affect every other variable and feeds back to the original variable itself. It is used to uncover responses of the main macroeconomic variables to a monetary policy shock.
- **Step 3.** Lastly, in order to get an idea of the share of the fluctuations in a given variable that are caused by short-term interest rate innovation, we calculate variance decompositions for each variable at forecast horizon of one through to three years.

3.1 Data Sources and Description

The VAR is estimated with monthly data from 1990 to 2006 obtained from the International Financial Statistics (IFS) and various central banks' monthly and quarterly reports. Since we are particularly interested in examining the bank lending channel, the model takes into account the loan component of the banking sector based on Equation 8 below, which presents a general VAR model.

$$Y_t = A(L)\mathbf{Y}_{t-1}\mathbf{U}_t + \varepsilon_t \ \ldots \tag{8}$$

where $\mathbf{Y_t}$ is a vector of endogenous variables, $A(L)$ is a matrix of polynomials in the lag operator, $\mathbf{U_t}$ is a vector of constant terms and $\boldsymbol{\epsilon}_\mathbf{t}$ is a vector of error terms that are assumed to be white noise but potentially heteroskedastic.

The variable vector $\mathbf{Y_t}$ comprises eight variables as described below:

$$\mathbf{Y_t} = (GDP_t, M2_t MB_t, CPI_t, BR_t, BC_t, LR_t, DR_t) \tag{9}$$

where *GDP* stands for real output, *M*2 and *MB* are money supply measures, *CPI* for the price level, *BR* for the short-term rate often referred to as the bank rate controlled by the central bank, *BC* for aggregate bank loans, *LR* for the loan rate and *DR* is the deposit rate. Loan supply by the banks should depend on the credit margin, i.e. the spread between *LR* and *BR*, while loan demand should depend on real output and the loan rate. As such, we expect a decline in the level of output (*GDP*), bank loans (*BC*) and price level (*CPI*) following an increase in the bank rate (*BR*). On the other hand, we expect an increase in quantity of money (*M*2 and *MB*), lending rates (*LR*) and deposit rates (*DR*) following an increase in the bank rate (*BR*). The VAR model is estimated in levels to allow for implicit cointegration relationships between the variables.

In what follows we explain the choice of the variables we use in our estimation and also present a brief description of each variable and how we categorize our data.

Policy Variables

As a policy variable, the official rate (bank rate) is used as a measure of policy stance although some authors[5] have argued that this may be problematic if the historical interest rates have been relatively constant as they do not have much information about the monetary policy decisions. Nonetheless, we measure the stance of monetary policy in southern African countries using this variable. Although both the instruments and operating objectives of the central banks in these countries have evolved over time, mostly reflecting the development of financial markets, several authors such as Smal and Jager (2001), Chirwa and Mlachira (2000, 2001) and Alowole and Ikhide (1997) have noted that monetary policy has consistently placed a strong emphasis on short-term interest rates. Furthermore, this variable has previous been used as a measure of monetary policy in similar studies by Oliner and Rudebusch (1995), Kakes and Sturn (2002), Ehrmann (2004) and Bernanke *et al.* (2005) among others.

Macroeconomic Variables

The main macroeconomic variables that reflect the effects of monetary policy are real Gross Domestic Product (GDP) and price as measured by the Consumer price Index (CPI). In all countries in our sample actual GDP data is not available and instead we estimate the GDP using the Industrial Production Index (IPI). The choice to use GDP as one of our variables is based on Christiano *et al*. (2004) and Leeper *et al*. (1996) who argue that the final goal for monetary policy is to achieve optimum output and employment. At the same time, Freixas and Rochet (1997) in their derivation of the loan supply and demand function argue that demand for loan increases with an increase in output and falls with an increase in loan rate. We therefore include output levels in order to estimate the impact of monetary policy on output. The inclusion of the price level (CPI) is based on the fact that central banks aim at guaranteeing price stability by setting the short-term rate. Similar studies by Bernanke and Blinder (1992), Kakes (1994) and Barran *et al*. (1997) have included this variable in modelling the bank lending channel.

In order to capture changes in monetary policy when the official rate has been relatively constant, Sims, Leeper and Zha (1996) suggested that the quantity of money can be used as a measure of monetary policy. Indeed this variable has previously been used by Bayoumi *et al.* (2001) for a similar study on Japan. As such, in our model we also use the following variables to measure their response from a monetary policy shock, broad money ($M2$)[6] and monetary base (MB)[7] .

Kashyap and Stein (2000) argue that following a monetary policy shock, banks can react either by changing the loan supply or changing their loan and deposit rates. They suggest that a model of the bank lending channel should therefore include either a deposit or loan rate. This view is echoed in Cecchetti (1995, p. 92) who argues that it is not possible using reduced form estimates based on aggregate data alone, to identify whether bank balance sheet contractions are caused by shifts in loan supply or loan demand. As such, we include both the lending rate (LR) and deposit rate (DR) in our estimation.

Bank Balance Sheet Data

The aim of this study is to investigate the role of financial intermediation in the monetary transmission process by estimating the impact of monetary policy on bank assets such as bonds[8] and loans. We extend the basic VAR model by including the main component of private sector funding —specifically we add loans (BC) from banks. Similarly, Dale and Haldane (1995), Christiano *et al.* (2004) and Roternburg and Woodford (1998) include bank loans from banks' balance sheets to estimate shifts in loan supply as a result of a shift in monetary policy. Furthermore, as reported by Bernanke and Blinder (1988), the inclusion of bank loans incorporates the bank lending channel into the goods and money market equilibrium framework. The basic assumption is that bonds and loans are not perfect substitutes as they are in the IS-LM framework. An increase in interest rate of one asset leads to an increase in demand of the other asset. All variables are expressed in natural logarithms except for interest rates which are expressed in decimals. Having described our methodology and data, in the next section, we turn our focus to the empirical estimation.

4. Empirical Estimation Results

In Table 1 below, we report results of VAR estimations generated by estimating Equation (8) above. This table reports VAR coefficients for each variable due to a one percent change in monetary policy. Although we estimate individual VARs for each country, we summarize the results in a single table.

The coefficient for bank loans (*BC*) is positive but insignificant for South Africa (0.016), Botswana (0.0003), Zambia (0.005) and Malawi (0.002). The bank loan coefficient is, however, negative and significant for Namibia (–0.007) at the 5 percent significance level. It is worth noting that the coefficients for the policy rate (*BR*) are positive and significant for all countries. This implies that own shocks[9] are more important than shocks from other variables. However, according to our findings, a change in the policy rate also leads to significant positive changes in the monetary base in Botswana (0.018) and Zambia (0.006). In addition, a one percent change in the policy rate leads to positive and significant changes in loan and deposit rates in Namibia (0.30) and Malawi (0.23) while such a change leads to a significant and negative change in the loan rate in Botswana (–0.15). No significant changes in any variables are observed in South Africa following a monetary policy shock except that for the policy rate itself. Since we run VARs for a long period of time, theoretically monetary policy becomes ineffective in the long run. However, it is difficult to tell for how long using such an approach. In order to trace periodical effects of monetary policy shocks, we estimate impulse responses, the results or which are analysed below.

4.1 Impulse Responses

In order to trace the impact of monetary policy over time, we again estimate Equation (8) above to derive impulse responses. The results for the various

Table 1: VAR responses to monetary policy shock[a]

Country	*BR*	*BC*	*GDP*	*M2*	*MB*	*CPI*	*LR*	*DR*
South Africa	0.816***	0.016869	−0.000259	−0.004919	0.000217	−0.000329	0.050610	0.007642
	(0.0895)	(0.01941)	(0.00141)	(0.00389)	(0.00638)	(0.00697)	(0.05940)	(0.08236)
	[9.12685]	[0.86908]	[−0.18341]	[−1.26594]	[0.03396]	[−0.0479]	[0.85196]	[0.09278]
Namibia	1.055***	−0.007204**	−0.002165	−0.013071	−0.001968	0.002579	0.30021**	0.1515**
	(0.10589)	(0.00383)	(0.00222)	(0.01314)	(0.00674)	(0.00705)	(0.19459)	(0.06842)
	[9.96771]	[−1.88071]	[−0.97510]	[−0.99477]	[−0.29206]	[0.36584]	[1.54282]	[2.21452]
Botswana	0.511***	0.000314	−0.015148	0.001069	0.018126**	−0.004251	−0.1547**	−0.021388
	(0.10694)	(0.01233)	(0.01272)	(0.01962)	(0.01078)	(0.08130)	(0.09166)	(0.11380)
	[4.78520]	[0.02546]	[−1.19053]	[0.05447]	[1.68111]	[−0.0522]	[−1.68859]	[−0.18794]
Zambia	0.874***	0.000511	−0.000569	0.001389	0.006488**	0.001308	0.054126	0.034456
	(0.11144)	(0.00059)	(0.00058)	(0.00113)	(0.00411)	(0.00117)	(0.08991)	(0.08416)
	[7.84705]	[0.85897]	[−0.97583]	[1.23120]	[1.57975]	[1.11666]	[0.60198]	[0.40940]
Malawi	1.074***	0.002204	−0.003037	0.352595	0.011361	−0.000434	0.2343***	0.203***
	(0.08552)	(0.00639)	(0.00344)	(0.90731)	(0.01988)	(0.00369)	(0.08858)	(0.07304)
	[12.5645]	[0.34472]	[−0.88387]	[0.38862]	[0.57136]	[−0.1176]	[2.64547]	[2.79029]

Notes: *BR* = official bank rate, *BC* = bank loans, *GDP* = output, *M2* = broad money, *MB* = narrow money, *CPI* = consumer price index, *LR* = lending rate, *DR* = deposit rate.

Standard errors are in parentheses and *t*-statistics in square brackets.

***, ** and * indicates the result is significantly different from zero at 1%, 5% and 10% significance level.

[a] The estimated coefficients are similar to previous studies in terms of sign and magnitude. See for instance, Morsink and Bayoumi (1999), Alfaro *et al.* (2003) and Christiano *et al.* (2004).

SADC countries are reported in Tables 2–6 below. We report results for each individual country. The impulse response for each variable to a monetary policy shock for each country is reflected by a one standard deviation shock to the short-term rate (*BR*). The simulation horizon covers 12 quarters (36 months) reported as quarter 1 through to 12.

Table 2 shows that in South Africa, policy does not immediately affect the loan supply. The impact of a policy change is felt in quarter three where we observe a decline in loan supply. The decline continues until the end of the period. However, the change in loan supply due to a monetary policy shock is insignificant. By the end of the period, loan volume declines by a net value of 0.6 percent. Monetary policy has a significant effect on $M2$ (from second quarter to sixth quarter) and on loan rate (*LR*) and deposit rate (*DR*) (first quarter), after which the impact is insignificant. Own shocks of a policy rate are positive and significant up to the fourth quarter. The impact on output and prices is negative and insignificant throughout the sample period.

Table 3 illustrates that in Namibia monetary policy has a significant impact on loan supply immediately and continues to have a negative and significant impact up to the ninth quarter. Although the decline continues until the end of the period, the impact is insignificant from the ninth quarter. Monetary policy has a positive and statistically significant effect on the loan rate and the deposit rate immediately up to the fifth quarter. The impact on output, prices and money supply is insignificant throughout the sample period. The own shock coefficient[10] is significant up to the fourth quarter. At the end of the period, monetary policy affects loan supply by net 1.5 per cent.

Table 4 illustrates that in Botswana monetary policy does not affect the loan supply immediately as the relationship between policy rate and the loan supply is positive and significant for the first three quarters, after which the relationship is negative but statistically insignificant. The policy rate, however, affects the loan rate and the deposit rate positively and significantly from the first quarter through to the sixth quarter. The own shock coefficient is significant up to the sixth quarter. At the end of the period, the net change in loan supply is 0.08 per cent.

Table 5 shows that in Zambia loan supply is insensitive to policy rate changes throughout the sample period. The relationship between policy rate and loan supply is positive but insignificant. Monetary policy, however, has a positive and significant impact on loan rate and deposit rates immediately and up to four quarters, after which the impact becomes insignificant. Policy rate change does not significantly affect output, prices and money supply variables throughout the sample period.

Finally, Table 6 shows that in Malawi, the loan supply declines with an increase in policy rate up to the ninth quarter. However, the decline in loan supply is significant only in quarter two. Monetary policy has positive and

Table 2: Impulse response for South Africa[a]

Quarter	*BR*	*BC*	*GDP*	*M2*	*MB*	*CPI*	*LR*	*DR*
1	0.527***	0.003681	−0.000741	−0.007441	0.008779	−0.000202	0.33***	0.2538***
	(0.092)	(0.00952)	(0.00181)	(0.00409)	(0.00628)	(0.00448)	(0.0613)	(0.09008)
2	0.3397***	0.000125	−0.000795	−0.011***	0.006477	−0.003324	0.32***	0.185147
	(0.101)	(0.00566)	(0.00230)	(0.00496)	(0.00896)	(0.00522)	(0.1025)	(0.11886)
3	0.2730***	−0.001455	−0.001193	−0.011***	0.001848	−0.005025	0.247**	0.157818
	(0.11161)	(0.00556)	(0.00271)	(0.00564)	(0.01071)	(0.00499)	(0.1210)	(0.12818)
4	0.2246***	−0.002477	−0.001677	−0.011***	−0.001528	−0.005840	0.203**	0.137409
	(0.12876)	(0.00599)	(0.00312)	(0.00614)	(0.01256)	(0.00520)	(0.1334)	(0.13752)
5	0.189548	−0.003284	−0.002203	−0.011***	−0.004246	−0.006221	0.17194	0.120635
	(0.14314)	(0.00649)	(0.00350)	(0.00659)	(0.01436)	(0.00564)	(0.1445)	(0.14600)
6	0.161124	−0.003923	−0.002723	−0.010***	−0.006522	−0.006311	0.14632	0.105433
	(0.15644)	(0.00709)	(0.00389)	(0.00703)	(0.01616)	(0.00625)	(0.1547)	(0.15509)
7	0.13635	−0.004459	−0.003218	−0.009853	−0.008457	−0.006204	0.12395	0.090936
	(0.17007)	(0.00777)	(0.00428)	(0.00751)	(0.01797)	(0.00699)	(0.1652)	(0.16583)
8	0.113840	−0.004925	−0.003681	−0.009307	−0.010114	−0.005960	0.10350	0.076882
	(0.18537)	(0.00856)	(0.00471)	(0.00807)	(0.01983)	(0.00786)	(0.1775)	(0.17909)
9	0.092996	−0.005341	−0.004107	−0.008814	−0.011526	−0.005617	0.08443	0.063270
	(0.20371)	(0.00950)	(0.00516)	(0.00871)	(0.02176)	(0.00886)	(0.1926)	(0.19561)
10	0.073605	−0.005716	−0.004498	−0.008378	−0.012720	−0.005206	0.06657	0.050209
	(0.22618)	(0.01059)	(0.00565)	(0.00947)	(0.02377)	(0.01001)	(0.2117)	(0.21594)
11	0.055626	−0.006057	−0.004853	−0.007997	−0.013714	−0.004748	0.04991	0.037834
	(0.25345)	(0.01185)	(0.00618)	(0.01035)	(0.02587)	(0.01134)	(0.2354)	(0.24038)
12	0.039085	−0.006368	−0.005174	−0.007669	−0.014526	−0.004261	0.03450	0.026273
	(0.28576)	(0.01328)	(0.00675)	(0.01137)	(0.02805)	(0.01287)	(0.2641)	(0.26905)

Notes: See notes to Table 1.

[a] The findings in these estimations are similar in magnitude and sign to Morsink and Bayoumi (2001), Alfaro *et al.* (2003) and Worms *et al.* (2003).

Table 3: Impulse responses for Namibia[a]

Quarter	*BR*	*BC*	*GDP*	*M2*	*MB*	*CPI*	*LR*	*DR*
1	0.563***	−0.006***	−0.001056	−0.0154	−0.003802	−0.003404	0.319***	0.28634***
	(0.063)	(0.002)	(0.00132)	(0.0078)	(0.004)	(0.00596)	(0.07300)	(0.03674)
2	0.510***	−0.007***	−0.002482	−0.009191	−0.007715	−0.001936	0.415***	0.37747***
	(0.098)	(0.003)	(0.00161)	(0.0070)	(0.005)	(0.00676)	(0.07535)	(0.05884)
3	0.406***	−0.008***	−0.003162	−0.009005	−0.009751	0.001411	0.384***	0.37153***
	(0.125)	(0.004)	(0.00189)	(0.0091)	(0.006)	(0.00785)	(0.09068)	(0.08127)
4	0.295***	−0.010***	−0.003560	−0.009519	−0.010822	0.004117	0.317***	0.31490***
	(0.149)	(0.005)	(0.00225)	(0.0103)	(0.007)	(0.00872)	(0.10534)	(0.10308)
5	0.197	−0.011**	−0.003894	−0.009645	−0.011188	0.005694	0.242***	0.23864**
	(0.169)	(0.006)	(0.00271)	(0.011)	(0.0080)	(0.00940)	(0.11778)	(0.12340)
6	0.121	−0.0133**	−0.004283	−0.009300	−0.011195	0.006318	0.171891	0.16217
	(0.188)	(0.0071)	(0.00319)	(0.0114)	(0.009)	(0.00991)	(0.13049)	(0.14187)
7	0.065	−0.0144**	−0.004748	−0.008699	−0.011133	0.006286	0.111487	0.09618
	(0.208)	(0.008)	(0.00362)	(0.0115)	(0.0109)	(0.01025)	(0.14582)	(0.15898)
8	0.0298	0.015**	−0.005255	−0.008096	−0.011177	0.005846	0.064045	0.04508
	(0.227)	(0.009)	(0.00398)	(0.0116)	(0.0124)	(0.01036)	(0.16394)	(0.17521)
9	0.008	−0.0155**	−0.005750	−0.007671	−0.011395	0.005170	0.029567	0.00927
	(0.245)	(0.010)	(0.00431)	(0.0120)	(0.0130)	(0.01026)	(0.18314)	(0.19042)
10	−0.001	−0.0157	−0.006183	−0.007510	−0.011777	0.004373	0.006670	−0.01309
	(0.260)	(0.011)	(0.00463)	(0.0127)	(0.0140)	(0.01002)	(0.20119)	(0.20397)
11	−0.003622	−0.0156	−0.006519	−0.007615	−0.012271	0.003529	−0.006660	−0.02475
	(0.272)	(0.012)	(0.00499)	(0.0135)	(0.0150)	(0.00982)	(0.21637)	(0.21518)
12	−0.0011	−0.0153	−0.006744	−0.007938	−0.012813	0.002689	−0.012572	−0.02856
	(0.280)	(0.014)	(0.00541)	(0.0143)	(0.0160)	(0.00977)	(0.22776)	(0.22372)

Notes: See notes to Table 1.
[a] The findings in these estimations are similar in magnitude and sign to Morsink and Bayoumi (2001), Alfaro *et al*. (2003) and Worms *et al.* (2004).

Table 4: Impulse response to short term innovations for Botswana[a]

Quarter	*BR*	*BC*	*GDP*	*M2*	*MB*	*CPI*	*LR*	*DR*
1	0.3356***	0.015***	−0.003479	−0.001507	0.007011	0.012870	0.24087***	0.27445***
	(0.04348)	(0.0051)	(0.00483)	(0.00739)	(0.00451)	(0.01741)	(0.03293)	(0.04755)
2	0.2639***	0.013***	−0.005228	0.002525	0.008745	0.023117	0.25422***	0.25808***
	(0.05515)	(0.0066)	(0.00624)	(0.00999)	(0.00602)	(0.01472)	(0.04779)	(0.06164)
3	0.2127***	0.011***	−0.006103	0.006644	0.007106	0.027552	0.22765***	0.23136***
	(0.06215)	(0.0077)	(0.00720)	(0.01147)	(0.00673)	(0.01255)	(0.05634)	(0.06770)
4	0.1709***	0.008082	−0.006619	0.009111	0.004683	0.025561	0.19019***	0.19930***
	(0.06650)	(0.0087)	(0.00808)	(0.01273)	(0.00706)	(0.01225)	(0.06134)	(0.07214)
5	0.1355**	0.004990	−0.006848	0.009907	0.002376	0.021094	0.152848**	0.16515***
	(0.06929)	(0.0095)	(0.00901)	(0.01414)	(0.00734)	(0.01233)	(0.06453)	(0.07585)
6	0.1051	0.002050	−0.006854	0.009611	0.000497	0.016421	0.119643**	0.13228**
	(0.07091)	(0.0102)	(0.01001)	(0.01572)	(0.00770)	(0.01227)	(0.06649)	(0.07896)
7	0.07931	−0.000590	−0.006706	0.008779	−0.000902	0.012351	0.091592	0.102836
	(0.07176)	(0.0108)	(0.01106)	(0.01740)	(0.00817)	(0.01207)	(0.06746)	(0.08171)
8	0.05766	−0.002851	−0.006464	0.007765	−0.001873	0.009018	0.068443	0.077613
	(0.07220)	(0.0113)	(0.01214)	(0.01910)	(0.00874)	(0.01185)	(0.06760)	(0.08429)
9	0.039816	−0.004716	−0.006175	0.006750	−0.002495	0.006340	0.049543	0.056594
	(0.07254)	(0.0118)	(0.01324)	(0.02078)	(0.00940)	(0.01165)	(0.06719)	(0.08690)
10	0.025289	−0.006202	−0.005871	0.005807	−0.002845	0.004195	0.034210	0.039383
	(0.07308)	(0.0123)	(0.01433)	(0.02243)	(0.01011)	(0.01152)	(0.06659)	(0.08975)
11	0.013615	−0.007342	−0.005572	0.004949	−0.002991	0.002484	0.021848	0.025480
	(0.07403)	(0.0129)	(0.01542)	(0.02403)	(0.01084)	(0.01147)	(0.06616)	(0.09305)
12	0.004362	−0.008180	−0.005291	0.004169	−0.002987	0.001131	0.011963	0.014402
	(0.07552)	(0.0135)	(0.01651)	(0.02557)	(0.01158)	(0.01150)	(0.06615)	(0.09690)

Notes: *BR* = official bank rate, *BC* = bank loans, *GDP* = output, *M2* = broad money, *MB* = narrow money, *CPI* = consumer price index, *LR* = lending rate, *DR* = deposit rate.
Monetary policy impact after 3 months through to 3 years.
Standard errors in parentheses: Monte Carlo (100 repetitions).
***,** and * indicate statistical significance at 1%,5% and 10% significance level respectively.
[a] The results are close to previous findings. See, for example, Bernanke *et al.* (2005), Alfaro *et al.* (2003) and Kashyap and Stein (2000) in terms of sign and magnitude.

Table 5: Impulse responses to short term rate innovation for Zambia[a]

Quarter	*BR*	*BC*	*GDP*	*M2*	*MB*	*CPI*	*LR*	*DR*
1	5.02771***	0.005119	0.001081	0.012141	−0.014134	−0.001085	3.4341***	3.1060***
	(0.62324)	(0.00519)	(0.00388)	(0.01352)	(0.02373)	(0.00632)	(0.52211)	(0.49939)
2	3.00885***	0.007784	0.005953	0.020813	−0.037383	−0.004753	3.3189***	2.64068***
	(0.92125)	(0.00752)	(0.00577)	(0.01807)	(0.02918)	(0.00731)	(0.72007)	(0.69501)
3	1.391547**	0.008181	0.008549	0.018285	−0.042973	−0.006386	2.23723**	1.65450**
	(0.92416)	(0.00924)	(0.00757)	(0.02178)	(0.03247)	(0.00802)	(0.83408)	(0.76227)
4	0.497938	0.008289	0.009271	0.012165	−0.036824	−0.006654	1.26144**	0.850269
	(0.79594)	(0.00996)	(0.00920)	(0.02417)	(0.03442)	(0.00827)	(0.80828)	(0.70267)
5	0.133877	0.008551	0.008749	0.006380	−0.027133	−0.006419	0.645179	0.369874
	(0.68720)	(0.01016)	(0.01048)	(0.02571)	(0.03493)	(0.00820)	(0.73650)	(0.61452)
6	0.038615	0.008894	0.007646	0.002116	−0.017840	−0.005995	0.332653	0.142631
	(0.62722)	(0.01019)	(0.01139)	(0.02690)	(0.03440)	(0.00808)	(0.67982)	(0.55735)
7	0.032125	0.009146	0.006420	−0.000743	−0.010292	−0.005435	0.194427	0.056207
	(0.60205)	(0.01024)	(0.01202)	(0.02810)	(0.03333)	(0.00813)	(0.64652)	(0.53602)
8	0.028929	0.009185	0.005315	−0.002672	−0.004555	−0.004725	0.128519	0.027073
	(0.58885)	(0.01044)	(0.01250)	(0.02944)	(0.03206)	(0.00832)	(0.63159)	(0.53146)
9	0.005944	0.008971	0.004426	−0.004071	−0.000293	−0.003875	0.080871	0.011707
	(0.57665)	(0.01085)	(0.01292)	(0.03091)	(0.03082)	(0.00851)	(0.62405)	(0.53100)
10	−0.031488	0.008528	0.003770	−0.005161	0.002826	−0.002930	0.033229	−0.004935
	(0.57053)	(0.01144)	(0.01336)	(0.03238)	(0.02985)	(0.00856)	(0.62070)	(0.53716)
11	−0.071189	0.007910	0.003324	−0.006019	0.005020	−0.001960	−0.014467	−0.023713
	(0.57369)	(0.01214)	(0.01388)	(0.03376)	(0.02941)	(0.00842)	(0.62624)	(0.55350)
12	−0.103693	0.007182	0.003058	−0.006652	0.006421	−0.001037	−0.056704	−0.041105
	(0.58402)	(0.01290)	(0.01449)	(0.03498)	(0.02973)	(0.00808)	(0.64262)	(0.57748)

Notes: *BR* = official bank rate, *BC* = bank loans, *GDP* = output, *M2* = broad money, *MB* = narrow money, *CPI* = consumer price index, *LR* = lending rate, *DR* = deposit rate.
The period is reported in quarters and not months to measure monetary policy impact after 3 months through to 3 years.
Standard errors in parentheses: Monte Carlo (100 repetitions).
***,** and * indicates significance at 1%, 5% and 10% significance level.
[a] The results are consistent with previous studies. For example, Kishan and Opieal (2000), Alfaro *et al.* (2003) and Barran (1997).

Table 6: Impulse responses to short term innovations for Malawi[a]

Quarter	*BR*	*BC*	*GDP*	*CPI*	*M2*	*MB*	*LR*	*DR*
1	2.3857***	−0.013244	−0.010018**	3.933***	−0.072585	−0.01103	1.448***	1.492***
	(0.30203)	(0.02024)	(0.00644)	(2.7514)	(0.05533)	(0.0126)	(0.24177)	(0.18320)
2	2.120034***	−0.0465**	−0.012668**	1.975337	−0.042803	−0.01944	1.839***	1.9220***
	(0.42881)	(0.02444)	(0.00627)	(3.5248)	(0.07172)	(0.0163)	(0.34370)	(0.29608)
3	1.798234***	−0.041496	−0.006561	1.908287	−0.006602	−0.01583	1.825***	1.8209***
	(0.52566)	(0.02642)	(0.00698)	(4.0528)	(0.08892)	(0.0187)	(0.44576)	(0.39848)
4	1.510547***	−0.029085	−0.002871	2.150742	0.015250	−0.00938	1.615***	1.5705***
	(0.60852)	(0.02813)	(0.00716)	(4.5044)	(0.11301)	(0.0214)	(0.54640)	(0.49999)
5	1.272622***	−0.018818	−0.001570	2.257543	0.026858	−0.00372	1.3725**	1.32110**
	(0.68670)	(0.03065)	(0.00724)	(5.0195)	(0.13911)	(0.0248)	(0.62250)	(0.59068)
6	1.080361***	−0.011671	−0.001316	2.204501	0.033675	0.000463	1.159314	1.10947**
	(0.76262)	(0.03314)	(0.00734)	(5.5703)	(0.16369)	(0.0283)	(0.68680)	(0.67316)
7	0.923984	−0.006804	−0.001373	2.053077	0.038563	0.003441	0.985549	0.935688
	(0.83079)	(0.03525)	(0.00747)	(6.0940)	(0.18619)	(0.0316)	(0.74696)	(0.74700)
8	0.794597	−0.003383	−0.001474	1.856539	0.042661	0.005588	0.844677	0.792221
	(0.88690)	(0.03697)	(0.00763)	(6.5353)	(0.20698)	(0.0345)	(0.80106)	(0.80893)
9	0.685704	−0.000864	−0.001550	1.647050	0.046342	0.007186	0.728554	0.672107
	(0.93121)	(0.03847)	(0.00780)	(6.8632)	(0.22649)	(0.0372)	(0.84599)	(0.85816)
10	0.592846	0.001068	−0.001597	1.441368	0.049705	0.008411	0.630982	0.570235
	(0.96685)	(0.03996)	(0.00800)	(7.0776)	(0.24507)	(0.0398)	(0.88171)	(0.89726)
11	0.512931	0.002592	−0.001623	1.247397	0.052764	0.009372	0.547754	0.483001
	(0.99762)	(0.04154)	(0.00823)	(7.2086)	(0.26305)	(0.0424)	(0.91072)	(0.93053)
12	0.443728	0.003818	−0.001636	1.068424	0.055517	0.010136	0.476032	0.407800
	(1.02701)	(0.04323)	(0.00848)	(7.3119)	(0.28081)	(0.0449)	(0.93649)	(0.96242)

Notes: See notes to Table 5.
[a] The results are similar to previous studies such as Kashyap and Stein (1994, 2000) and Morsink and Bayoumi (1999).

significant effects on loan rate and deposit rates up to the sixth quarter. Own shocks are positive and statistically significant up to the sixth quarter. At the end of the period, bank loans decline by a net of 0.03 per cent.

In summary as shown in Tables 2–6, variables react differently in each country following an unexpected rise in short-term interest rate. Bank loans decline in South Africa, Namibia, Botswana and Malawi with an increase in the policy rate. These results corroborate the results of De Bondt (2000), Holtemöller (2003) and Haulsewig *et al.* (2004), who investigate the response of aggregate bank lending in Germany in a similar framework using monthly and quarterly data. The drop in bank loans continues for around several quarters until it breaks off. On the other hand, in all countries, the loan rate adjusts immediately following a monetary policy shock. The deposit rate reacts immediately too, though on a lower basis than the loan rate. As Bernanke and Gertler (1995) and Cecchetti (1995) point out, the decline in bank loans after a monetary tightening is consistent with the credit channel, but since the adjustment can be interpreted as being induced by loan supply and demand, clear predictions are difficult to establish.

Contrary to expectations, broad money ($M2$) decreases in Malawi, Botswana, South Africa, Namibia and Zambia although it increases thereafter. Output declines in all countries with an increase in short-term interest rate within the first quarter and continues to decline throughout.

Prices fall in South Africa, Botswana and Zambia but only as far as just over half a year after which any policy innovation seems to leads to an increase in prices. The price level responds positively to an interest rate innovation in Malawi and Namibia. A price increase after an increase in the policy rate apparently suggests that a monetary contraction produces inflation. This result is commonly found in the empirical literature on the monetary transmission mechanism in the United States and has been dubbed the 'price puzzle'. As noted by Sims (1992), the price puzzle could be a consequence of failing to include rich enough specification of the information available to policymakers. If policymakers can observe variables that contain useful information about future inflation, but those variables are not included in the model, there will be apparently unpredictable changes in interest rates that are actually symmetric responses to information implying that inflation is on the way.

All interest rates increase immediately with an increase in short-term rate in all countries although rates eventually fall. The response in terms of speed and magnitude is different from country to country. For instance, interest rates fall rather slowly in Namibia and Botswana at about 20 months after a monetary policy shock. Interest rates fall much quicker and sharper in Zambia than in other countries. It is notable, however, that in all countries, the response to a monetary policy shock is more pronounced in the short-term rate itself with lending and deposit rates following it rather sluggishly.

Table 7: Variance Decomposition owing to short term (BR) innovations[a]

Country	S.E	BC	M2	MB	GDP	CPI	BR	LR	DR	BLC
Quarter 1										
Botswana	0.07	8.54	0.15	0.11	4.62	0.04	71.01	0.46	15.03	W
Malawi	0.25	3.60	2.56	0.62	0.60	3.47	85.34	1.77	1.06	W
Namibia	0.03	2.38	3.49	1.74	0.66	1.51	89.18	0.786	0.83	W
S. Africa	1.18	1.98	0.40	1.87	2.07	0.05	91.84	1.17	0.57	W
Zambia	0.07	1.14	0.47	2.72	4.65	0.39	51.42	15.49	23.57	W
Quarter 4										
Botswana	0.14	12.13	1.45	0.90	4.23	0.68	64.82	0.58	15.18	M
Malawi	0.39	10.71	1.60	0.34	1.03	6.58	66.51	2.04	0.49	M
Namibia	0.06	0.98	2.82	17.69	2.94	8.23	54.58	9.07	3.65	W
S. Africa	2.05	6.91	6.50	13.89	2.00	0.65	46.89	6.11	17.00	W
Zambia	0.13	1.24	0.93	6.14	3.48	0.57	55.77	9.56	22.27	W
Quarter 8										
Botswana	0.18	13.87	4.65	3.21	3.56	0.91	57.62	2.32	13.83	M
Malawi	0.44	13.16	1.67	1.16	0.92	12.48	54.92	2.02	0.37	M
Namibia	0.09	0.83	1.30	27.16	6.66	11.36	33.33	14.87	4.08	W
S. Africa	2.79	5.76	7.83	31.45	3.00	0.53	27.08	5.01	19.31	W
Zambia	0.17	1.96	1.07	5.97	3.98	6.87	49.55	8.71	21.86	W
Quarter 12										
Botswana	0.21	13.36	6.74	5.96	3.28	0.96	52.30	4.41	12.94	M
Malawi	0.47	12.52	1.66	2.21	1.00	16.52	51.14	1.98	0.38	M
Namibia	0.13	1.41	1.68	29.19	8.29	10.62	29.43	15.47	3.89	W
S. Africa	3.20	4.47	6.73	44.04	4.24	0.41	20.64	3.89	15.54	W
Zambia	0.21	1.76	1.37	6.42	3.51	16.38	42.97	7.56	20.02	W

Notes: *BR* = official bank rate, *BC* = bank loans, *GDP* = output, *M2* = broad money, *MB* = narrow money, *CPI* = consumer price index, *LR* = lending rate, *DR* = deposit rate, S.E. = the forecast error, *BLC* = bank lending channel, *W* = weak bank lending channel, *M* = moderate bank lending channel.

[a] Overall, the findings are similar in sign and magnitude to previous studies that compute variance decompositions such as Alfaro *et al.* (2003), Kashyap and Stein (1994), Christiano *et al.* (2004).

Source: Author's calculations.

4.2 Variance Decomposition

In Table 7, we report results of variance decomposition as described in step 3 above of Section 3. These results are derived in order to get an idea of the share of the fluctuations in a given variable that are caused by short-term interest rate innovation. The variance decompositions for each variable are estimated at a forecast horizon of three months reported as quarter 1 in the table through to 36 months reported as quarter 12 in the table. The second column of Table 7 labelled (S.E) reports the forecast error of the variable for each forecast horizon.[11] The values across the column sum up to 100 per cent.

The results indicate that initially the loan volume is not immediately affected by changes in the short-term interest rate. Much of the changes in the initial stages is due to variables' own shocks. In Malawi, for instance, up to the fourth quarter a change in short-term rates only accounts for about 4 per cent change in loan volume while in South Africa it accounts for only 2 per cent; 13 per cent for Botswana; 1.2 per cent for Zambia and about 1 per cent change for Namibia in loan volume. The contribution of the short-term innovation improves with time but only as far as about the eighth quarter and eventually slows down again in all countries.

The results indicate that a change in short-term rates seems to have no major influence on monetary base in Malawi, Zambia and Botswana. However, innovations in short-term rates have a major influence in South Africa and Namibia over time. For instance, in South Africa after about three years short-term rates innovations contribute to about 44 per cent of the changes in the growth of monetary base, and 29 per cent in Namibia.

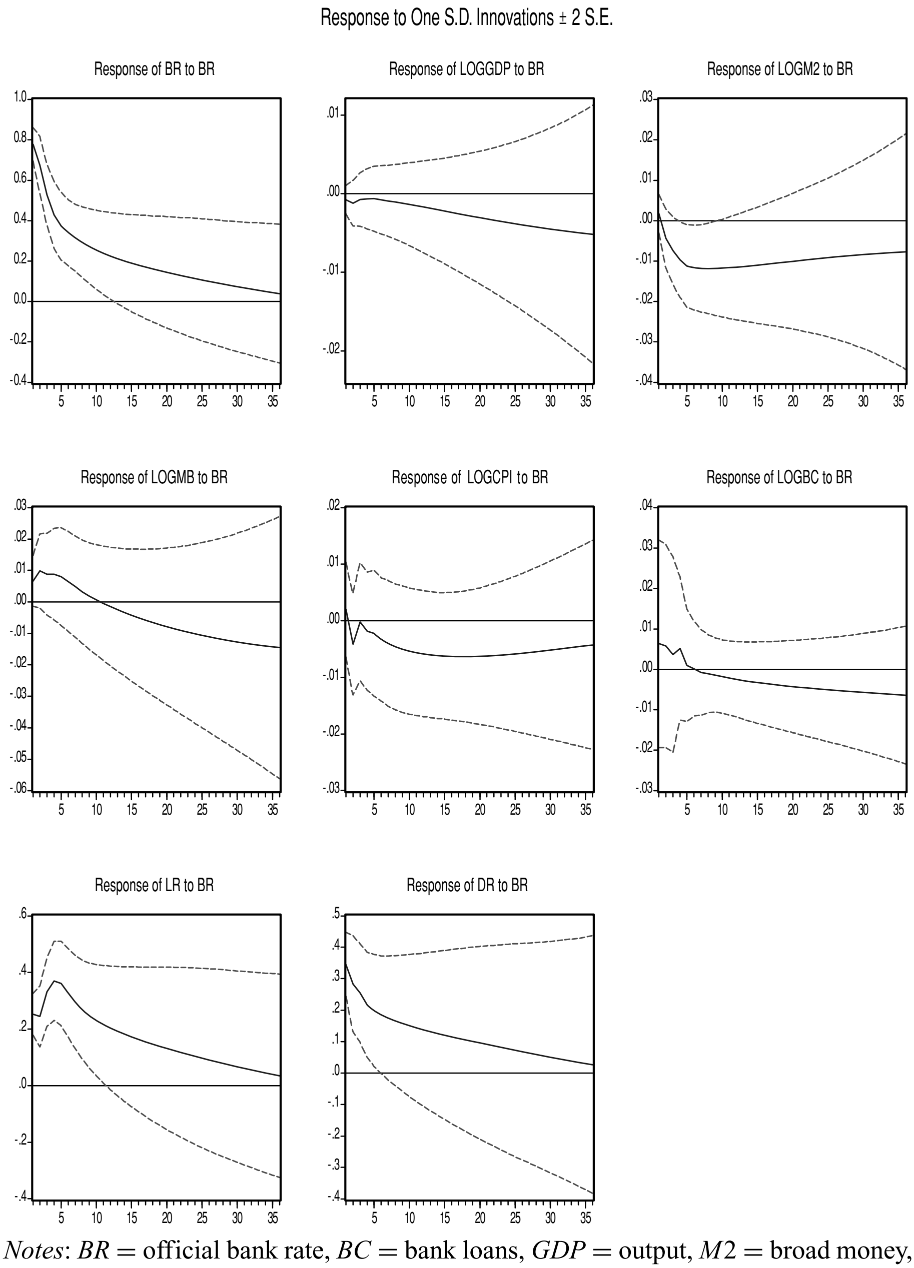
Changes in the official rate seem to have immediate influence in the deposit rate (15 per cent) in Botswana at about the third quarter and (12 per cent) after twelve quarters. In Zambia, changes in the official rate account for 23 per cent by the third quarter and 20 per cent by 12 quarters. We also observe that the official bank rate has a positive influence over time on GDP in Namibia accounting for about 8 per cent after about 12 quarters.

These results imply that the bank lending channel is mixed in southern African banking systems. On the supply side, these results imply that when monetary policy changes banks react by altering both their interest rates and loan portfolios although the change in loan portfolios seems to be weak. On the demand side, bank borrowers are interest rate insensitive. These results also imply that throughout the SADC region, non-policy variables such as the level of output, money supply and monetary base are equally important in explaining the extent of the bank lending channel as a monetary transmission mechanism.

Figures 1–5 graphically present the impulse response of the different variables following a monetary policy shock. The figures display an orthogonalized impulse response to a monetary policy shock. The solid lines display impulse responses of each variable measured on the vertical axis. The solid lines denote impulse responses. The dotted lines are approximate 90 per cent error bands that are derived from a bootstrap routine. In the case of bank credit, *GDP*, *CPI*, *M*2, and *MB*, a value of 0.001 corresponds to 0.1 per cent change of the baseline value, while in the case of interest rates a value of 0.1 corresponds to a change of 10 basis points. The dashed lines are 90 per cent error bands computed from bootstrap procedure with 100 repetitions. The horizontal axis is in quarters.

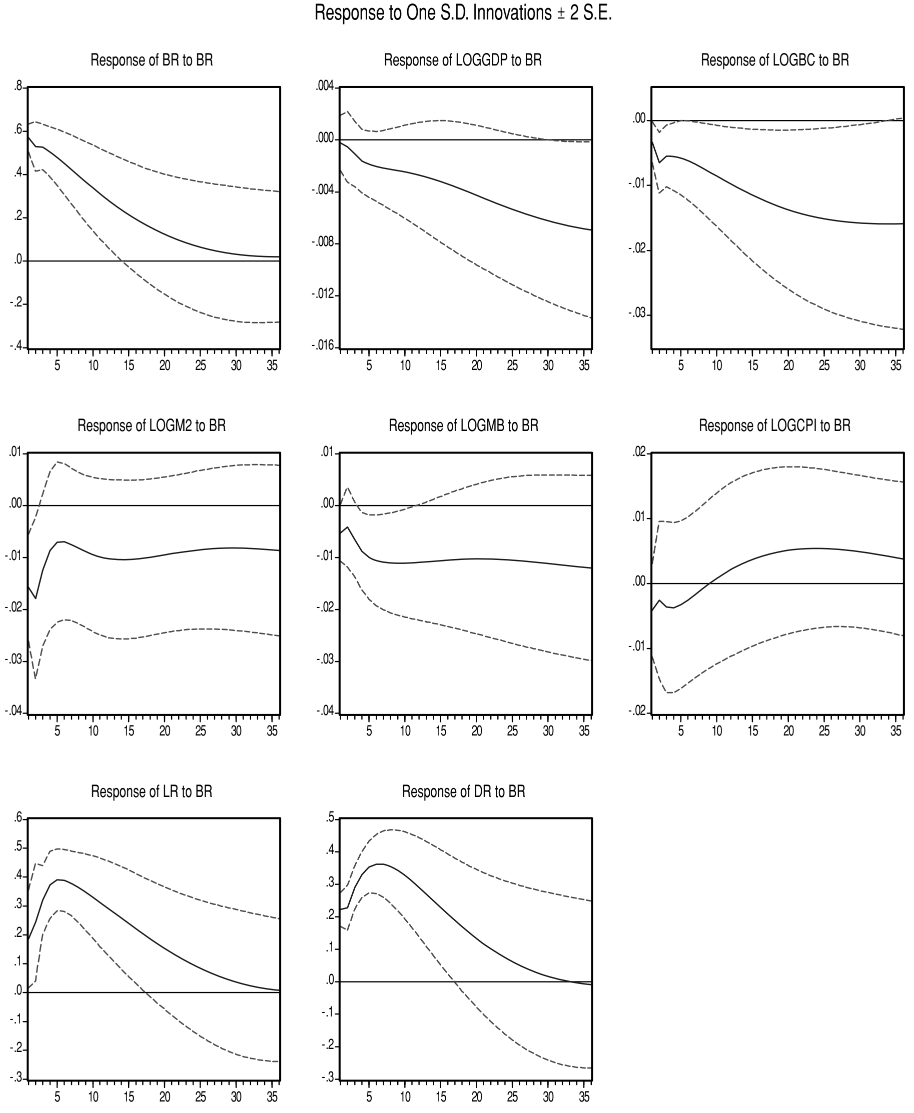
Since our focus is on the reaction of bank loans to a monetary policy shock, in Figures 1–5, we observe the following: The loan volume (*BC*) declines in South Africa, Malawi, Namibia and Botswana after a monetary policy shock. However, the magnitude and take off for the decline is different from

Figure 1: Impulse responses to a monetary shock for South Africa



Notes: *BR* = official bank rate, *BC* = bank loans, *GDP* = output, *M*2 = broad money, *MB* = narrow money, *CPI* = consumer price index, *LR* = lending rate, *DR* = deposit rate.

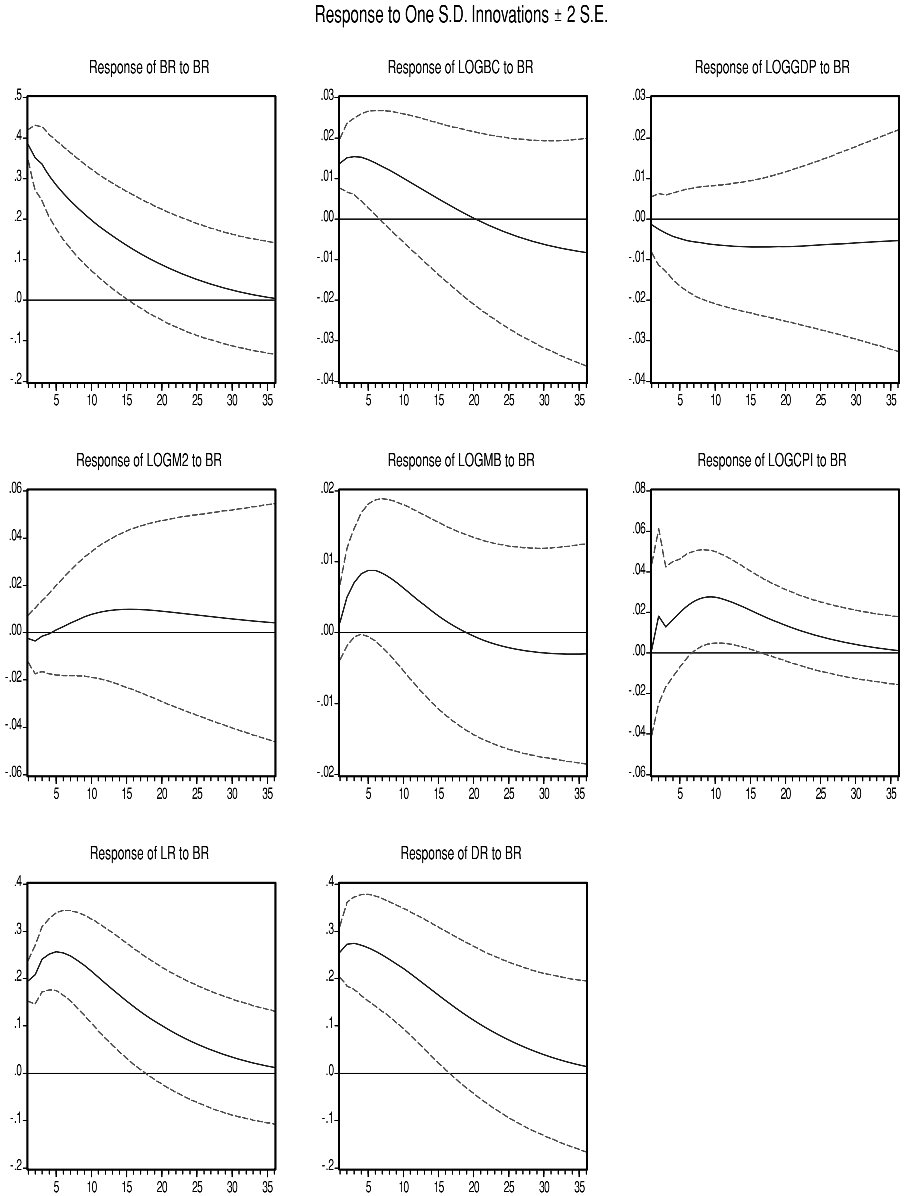
Figure 2: Impulse responses to a monetary shock for Namibia



Notes: See notes to Figure 1.

country to country.[12] For instance, In South Africa (Fig. 1), the take off for the loans decline is observed after six months while in Namibia and Malawi (Fig. 2 and Fig. 5) it is immediate. The decline is slower in Botswana as it is observed after 20 months, while in Zambia (Fig. 4) loan volume seems to be insensitive to a monetary policy shock. The other notable observation in these figures is that the reaction of the bank rate (*BR*) in all countries is more reactive to its own changes. The changes in this policy rate are observed

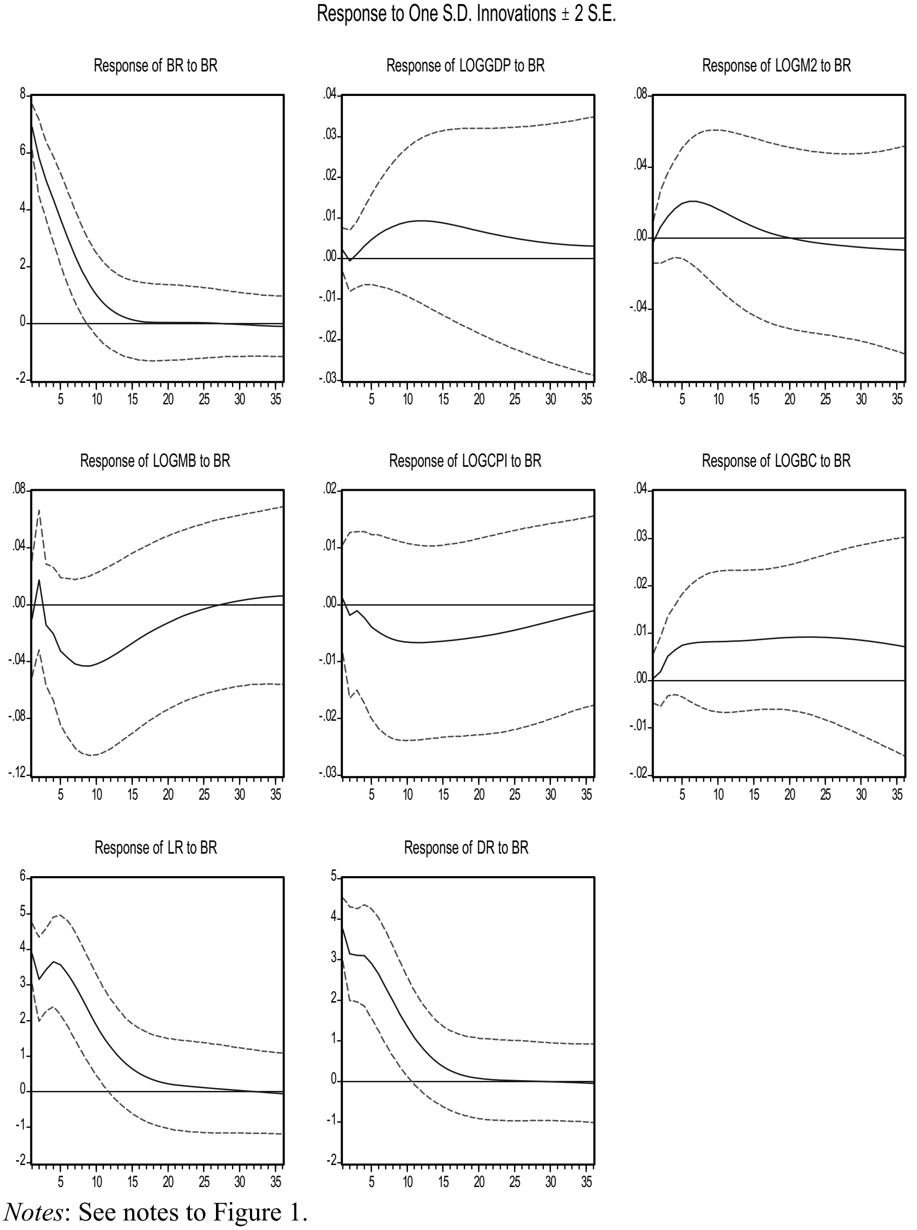
Figure 3: Impulse response to a monetary shock for Botswana



Notes: See notes to Figure 1.

immediately. Other variables react differently in the different countries. For instance, in Namibia (Fig. 2) as explained earlier, an increase in the policy rate leads to an increase in the price level (*CPI*). This is the case of the price puzzle explained earlier. GDP declines in all countries with a contractionary monetary policy. The decline is more pronounced in Namibia

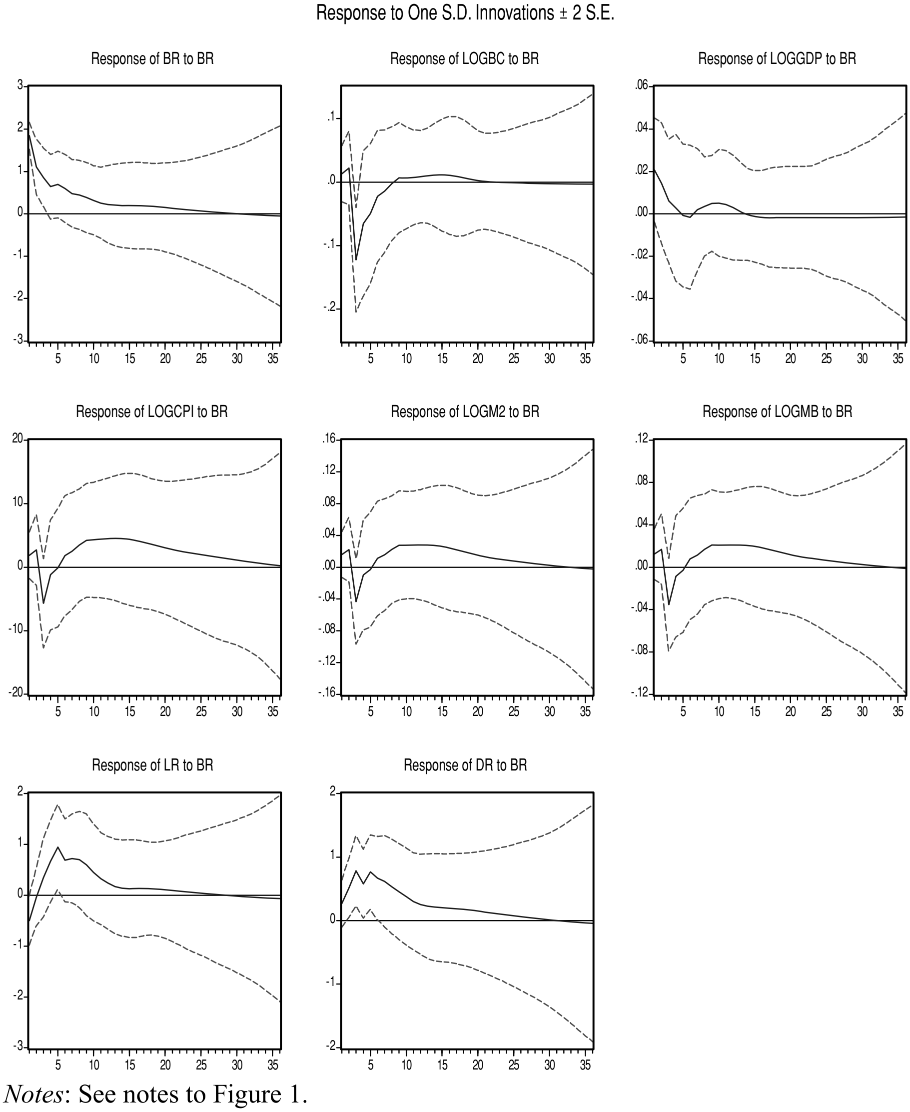
Figure 4: Impulse responses to a monetary shock for Zambia



Notes: See notes to Figure 1.

than in any other country and seems to be the least to react to changes in the policy rate in South Africa, Zambia and Malawi. In all countries, we observe that changes in the interest rates follow the movements in the policy rate.

Figure 5: Impulse responses to a monetary shock for Malawi



Notes: See notes to Figure 1.

5. Conclusion

This paper has investigated the bank lending channel in the SADC region by using a VAR approach on aggregate data from the banking sector. We have developed a stylized model of the banking firm in which banks decide on their loan supply in the light of expectations about the future course of monetary policy. Using our model as a guide, we evaluate the response of bank loans through impulse responses and variance decomposition to a monetary policy shock. Our findings suggest that the bank lending channel is working in SADC alongside other channels such as the interest rate channel, which is consistent with De Bondt (2000), Holtemaoller (2003), Haulsewig *et al.* (2004), and Worms (2003) for Germany and Kakes and Sturm (2002) and Kakes (2002) for the Netherlands, who draw similar conclusions. Since loans are theoretically driven by interest rates and loan demand by output, our results imply that loan supply by the banks declines with an expected fall in the credit margin after a monetary policy shock, while loan demand drops with a fall in the output level and an increase in the loan rate.

Our focus in this study has been on investigating the bank lending channel as a monetary transmission mechanism. The evidence gathered points towards a bank lending channel operating across the sample period abstracting from asymmetries related to time in and out of tight monetary policy and from the evolution of certain features in the economy that may affect the strength of the bank lending channel. For instance, information problems are likely to be less binding in periods of relatively loose monetary policy rendering the bank lending channel less relevant as a transmission mechanism in comparison with periods of tighter monetary stance.

On the policy front, we make the following observations and recommendations. In countries where policy targets both output and inflation, our results — which show that in some cases output declines with a tighter monetary policy and inflation increases with such a policy — imply that policymakers need to strike a balance between the levels of output the economy can attain without compromising much on the inflation levels at one time. In order to be able to make such an assessment, policymakers need to be aware of the speed, direction and, more importantly, the magnitude of the impact of monetary policy innovations on macroeconomic variables. Through variance decomposition, our results provide an insight to policymakers on how long and by what magnitude (forecasting horizon) monetary policy will take to affect each variable.

The role of banks in economic development cannot be over-emphasized. As such, monetary policy needs to bear in mind the reaction on banks and financial institutions to a policy shock and consequently the overall impact that such a policy will have on the economy. In economies where there are relatively under-developed capital and money markets this is where banks will be the most important source of external finance for business and investments. Such limited consumer choice may compel banks to be insensitive to monetary policy changes. It should be the role of monetary authorities to take this into account when formulating policy without necessarily allowing the banks to take advantage of bank dependent borrowers.

It is recommended that economic and financial solutions that have so far proved workable elsewhere be carefully assessed, taking into account the state of the economies in SADC and where necessary adjustment be made other than implanting such approaches on a wholesale basis. Above all, policymakers should bear in mind that policy formulation is not an end in itself — it calls for analysis, monitoring, evaluation and where necessary adjustment.

This study underscores one avenue for future research that may deepen our knowledge and understanding of the functioning of the credit channel in general and the bank lending channel in particular as a transmission mechanism for monetary policy in the SADC region. In order to investigate the importance of asymmetric information embedded in cost structures and asymmetry in reaction to monetary policy, future research should seek to categorize banks into different sizes using assets and balance sheet liquidity levels. These heterogeneous features of the banking system would assist us to examine the proportionate response different categories of banks have to a monetary policy shock. In the same way, a similar study may be appropriate to assess the bank-dependent nature of firms and their reaction to changes to monetary policy.

Notes

1. Including Angola, Botswana, Democratic Republic of Congo, Lesotho, Malawi, Mauritius Mozambique, Namibia, Seychelles, Swaziland, Tanzania, Zambia and South Africa.
2. Botswana, Malawi, South Africa, Namibia and Zambia.
3. The impulse response function has many applications in time series analysis because it shows how the entire time path of a variable is affected by a stochastic shock. The impulse response function traces the effects of a shock. In simple terms impulse responses are simply partial derivates with respect to the various past error terms. These partial derivates are nothing more than the coefficients of the error term sequence.
4. A simple way to calculate the vector moving average is to construct the companion form of the VAR as described in Sargent (1987, p. 309) and also discussed in Hamilton (1994).
5. See Mishkin (1995) and Gilchrist (1994).
6. Comprising currency in circulation, demand, saving and time deposits.
7. Comprising currency and commercial banks' reserves with the central bank.

8. Bonds are not well defined in most African countries and the data is mixed. Instead we only use bank loans.
9. Changes in a variable are more dependent on its lagged values than due to changes in other variables in the model.
10. Innovations due to a variable's lagged values other than those due to shocks from other variables.
11. The source of the forecast error is the variation in current and future values of the innovations to each variable in the VAR.
12. The magnitude is, however, consistent with previous studies. See Bernanke *et al.* (2005), Kishan and Opieal (2000) and Favero *et al.* (1999).-11

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