Monetary Policy Instrument and Inflation in South Africa: Structural Vector Error Correction Model Approach

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10 April 2015

MONETARY POLICY INSTRUMENT AND INFLATION IN SOUTH AFRICA: STRUCTURAL VECTOR ERROR CORRECTION MODEL APPROACH

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Abstract
Since the adoption of inflation rate targeting policy, there has been a great concern on the effectiveness of monetary policy to curb inflation in South Africa. The effectiveness of the repo rate as a policy instrument to control the level of inflation has been widely criticised not only in the South African context but also internationally. With the critics pointing out from a substantial lag for monetary policy changes to affect inflation to the inability of the policy instrument to effectively affect inflation level. In assessing the effectiveness of the monetary policy in South Africa, this paper makes use of the structural vector error correction model (SVECM) to characterise the dynamics of inflation to monetary policy shocks. The results of the impulse response function obtained from the SVECM found that while positive shocks to monetary policy decrease output but do not decrease credit demand and inflation in South Africa.
JEL classification: E52, C22.
Keywords: Inflation rate targeting, Policy instruments, Structural Vector Error Correction Model.

1. INTRODUCTION

The year 2000 has been marked by the adoption of an inflation targeting framework as the anchor of monetary policy of in South Africa. The initial target, decided by the Minister of Finance in collaboration with the South African Reserve Bank (SARB), was to achieve an average inflation rate of between six and three percent interval in 2002. The SARB has used the repo rate as the policy instrument to control the level of inflation and contain it within the chosen interval. The effectiveness of the repo rate as a policy instrument to control the level of inflation has been widely criticised not only in the South African context but also internationally. With the critics pointing out from a substantial lag for monetary policy changes to affect inflation to the inability of the policy instrument to effectively affect inflation level (see Bernanke and Woodford, 1997 and Mishkin, 2002). Since early 2007 the annual inflation rate in South Africa has evolved outside the interval of three to six percent. The continual increase in the repo rate in order to curtail the inflation rate has accelerated its trend rather than subduing it. The aim of this study is therefore to assess the extent to which the monetary policy tool, namely the repo rate, influences inflation rate in South Africa. This paper uses the structural vector error correction (SVEC) model to characterise the dynamics of inflation to monetary policy instrument shocks. Furthermore this study also assesses the responses of the credit extended to the private sector and the real domestic product (GDP) to monetary policy instrument shocks. The remaining of the paper is structured as follows: Section 2 the theories and literature review on inflation targeting policy. Section 3 discusses the trend of inflation and the monetary policy instrument in South Africa. Section 4 discusses the data and methodology of the SVEC model. Section 5 focuses on empirical results and discussion on the findings of the paper. Section 6 concludes the paper.

2. LITERATURE REVIEW

Inflation rate targeting (IT) was first adopted as monetary policy by the Reserve Bank of New Zealand in 1990, followed by the Bank of Canada in 1991, and the Bank of England in 1992. It has gained popularity in both industrial countries and emerging economies. To date the number of countries following this monetary policy is more than 20.

Svensson (2007) argues that a successful IT policy is characterized by, (1) an announcement of the numerical inflation target, (2) an implementation of monetary policy that gives a major role to an inflation forecast, (3) an adoption of short-term interest rates as the only monetary policy instrument, and (4) a high degree of transparency and accountability. Proponents of inflation targeting policy (Bernanke et al., 1999; Nadal De Simone, 2001; Corbo, Landerretche, and Schmidt-Hebbel, 2002; Neumann an von Hagen, 2002; Hyvonen, 2004; IMF, 2005; Vega and Winkerlied, 2005; Mishkin and Schmidt-Hebbel, 2007) demonstrate empirically that inflation targeting is associated with an improvement in overall economic performance. According to these authors the rational behind this success is that by targeting directly price, inflation target plays a role of explicit and a strong nominal anchor.

The application of the IT policy necessitates that the monetary authority announces the numerical target (point or interval). The central bank should also set out the period within which inflation will reach the target level. Whenever the inflation is outside the target, the central bank uses the short-term interest rates to bring it back within the target range. Such an explicit mandate requires independence of monetary authority, which in turn is accountable for missing the objective. The issue of accountability leads to improved communication or transparency with the public through the published inflation reports, minutes of monetary policy committee meetings and inflation forecasts of central bank econometric models. Without accountability and transparency it is difficult to establish credibility, and hence anchor inflation expectations.

The results of different studies suggest that inflation levels, persistence, and volatility are lower in inflation-targeting countries than in nontargeters. Furthermore, output volatility has improved during the post-targeting period. Finally, exchange rate pass-through effects have been reduced after the adoption of IT. Besides the improvement of economic performance, Johnson (2002, 2003) provides strong evidence an immediate fall in inflation expectations after the adoption of IT. Likewise, Gürkaynak, Levin, and Swanson (2007); Levin, Natalucci, and Piger (2004); Castelnuovo, Nicoletti-Altimari, and Palenzuela (2003) argue eloquently that inflation expectations are more anchored for targeters than nontargeters, particularly at longer horizons. Consequently, supporters of this view claim strongly that monetary policy has become more efficient under inflation-targeting.

On the other hand, Ball and Sheridan (2005), Roger and Stone (2005), Epstein and Yeldan (2007) state that the earlier victory proclaimed by the proponents of IT is still to be tested. Their analysis shows that industrialized nontargeters, like targeters, have experienced low inflation and high output growth during the same period. Similarly, for the same period their volatility of inflation and output growth declined. Hence, one cannot attribute a recent disinflation and increase in output growth solely to the success of the IT policy. As Ball and Sheridan (2005) clearly put it, the economic environment has been fairy tranquil during the inflation-targeting era, and central banks have not been tested severely. Likewise, Rogoff (2007) assigns these benefits to the forces of globalization. To support the effectiveness and success of IT, it should be tested during the hostile periods of high inflation, such as the current rise in global food and oil prices.

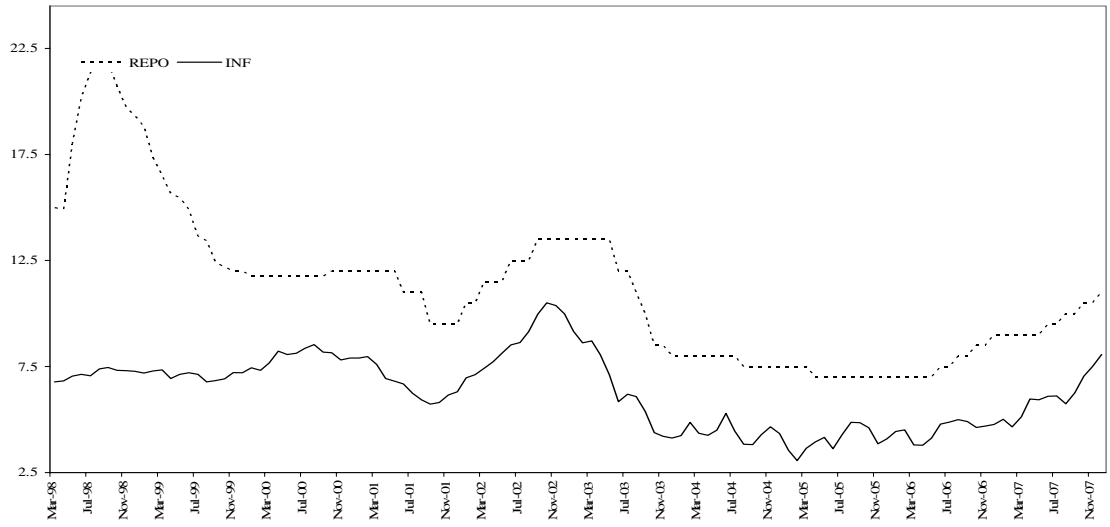
3. INFLATION TARGETING IN SOUTH AFRICA

Like many emerging market economies, in the aftermath of the Asian crisis, the South African Reserve Bank (SARB) adopted inflation rate targeting as its monetary policy in early 2000. Inflation becomes the primary and sole mandate of SARB, with a freely floating exchange rate. Similar to many targeters, the adherence to this new monetary policy framework reinforced the SARB independence. SARB ascribes to 3-6% target range to be achieved within the two years after its adoption. The subsequent characteristics of IT, as explained above, became reality in the South African context. To achieve its credibility the SARB has to bring inflation rate within the target range by increasing or decreasing its monetary instrument, the repo rate. The repo rate, which represents the cost of holding money, is the rate that the SARB charges commercial banks. By using the repo rates the SARB controls directly liquidity in the market. For example, if the central bank feels that there is excess liquidity in the market, it increases the repo rate to create shortage. The commercial banks will react to this contractionary monetary policy by increasing their lending rates. This will result in the decrease in the money demand and consequently the total demand. As the total demand decreases, the price level will tend to fall.

Figure 1 shows that inflation rate first reached the target band in August 2001. However, this success was short lived, in that the terrorist attack in the US on September 11, combined with massive depreciation of South African Rand put high pressure on inflation rate reaching a pick of 10.5% in October 2002. The SARB reacted by increasing the repo rate (see Figure 2) from December 2001 to September 2002 where the repo rate increased from 9.5% to 13.5%, respectively. The central bank action combined with the investigation committee, initiated by the government in order to investigate possibility of speculative attacks against the Rand, helped reduced inflation. Inflation was reduced gradually to below 6% in June 2003. The decline in inflation was followed by monetary easing up to 8% in December 2003. As depicted in Figure 1, inflation was back in up trend in March 2005 crossing the 6% limit in June 2007. From June 2006 onward the SARB has followed a contractionary policy increasing the repo rate from 7% to 11% in December 2007; that is, an increase of 4%. In the same time inflation has increased from 3.9 to 8.6% for the same period. Against this background, the question arises as to whether inflation rate targeting has been successful in decreasing inflation, following the recent price increase.

Source: Inet-Bridge, Authors estimation

Figure 1: Inflation (CPIX)



Source: Inet-Bridge

Figure 3: Inflation (CPIX) and Repo rate

4. METHODOLOGY OF THE SVEC MODEL

In assessing how monetary policy instrument affects inflation in South Africa this paper uses the SVEC model to characterise the dynamics of inflation rate to monetary policy instrument shocks. The modelling of dynamic behaviour of economic variables, through the impulse response function (IRF) analysis, is extensively used in a vector autoregressive (VAR) framework. Nonetheless the VAR model is "a-theoretic" and therefore there is little economic content in the results provided from the IRF analysis. Like structural vector autoregressive (SVAR) models, the SVEC models provide a framework where the results that are obtained from the IRF have an economic meaning. Contrary to SVAR models, SVEC models are suitable for identifying economic shocks when cointegration relationship exists between variables in the model. SVEC analysis starts from a reduced form standard VEC model

$$\Delta y_t = a\beta' y_{t-1} + \Gamma_1 \Delta y_{t-1} + \ldots + \Gamma_{p-1} \Delta y_{t-p+1} + \mu_t \qquad (1)$$

where y_t is a $K \times 1$ vector of time series, $\Gamma_1 \ldots \Gamma_{p-1}$ are $K \times K$ coefficient matrices. The reduced form disturbance μ_t is a $K \times 1$ unobservable zero mean white noise process with covariance matrix $\Sigma\mu$. From Johansen's (1995) version of the Granger's representation theorem it follows that the VEC model has the following moving average representation

$$y_t = \Xi \sum_{i=1}^{t} \mu_i + \Xi^*(L)\mu_t + y_0^* \qquad (2)$$

where $\Xi = \beta_{\perp}(a_{\perp}^{'}(IK - \sum_{i=1}^{p-1}\Gamma_i)\beta_{\perp})^{-1}a_{\perp}^{'}$ and represents the long-run effects of forecast error impulse response. $\Xi^{*}(L) = \sum_{j=0}^{\infty}\Xi_j^{*}L^{j}$ is an infinite-order polynomial in the lag operator with coefficient matrices Ξ_j^{*} that tend to zero as $j \to \infty$. It contains transitory effects. The term y_0^{*} contains all initial values of the vector time series. The forecast error impulse responses based on Ξ and the $\Xi(L)$ are without economic meaning as they are obtained from the reduced form disturbance (see Equation 2). Structural shocks need to be identified for a meaningful impulse response analysis. The relationship between the reduced-form disturbances and the underlying structural shocks is written as follows:

$$\mu_t = A\varepsilon_t \tag{3}$$

where $K \times 1$ vector ε_t contains the unobservable structural shocks and has a covariance of $\sum\varepsilon$. Substituting Equation (3) in Equation (2) yield a structural IRF given by ΞA . The long-run effects of ε_t shocks will therefore be given by ΞA . This matrix has a rank $K - r$, where r is the cointegrating rank of the system. In particular, if the system has r cointegrating relations, $k = (K - r)$ shocks have permanent effects, while at most r shocks have transitory effects. To exactly identify permanent shocks $k(k-1)/2$ additional restrictions (elements of the matrix ΞA set to zero) are needed. Similarly $r(r-1)/2$ additional contemporaneous restrictions are needed to identify the transitory shocks. Together, these are a total of $K(K-1)/2$ restrictions necessary to just identify matrix A.

5. DATA AND EMPIRICAL ANALYSIS

This study employs seasonally unadjusted monthly data for South Africa for the period from February 2000 to September 2007. February 2000 corresponds with the official starting of inflation targeting policy. In the benchmark specification the VEC model includes the following variables:

- The natural logarithm of credit extension (CREDIT)
- The natural logarithm of manufacturing production used as a proxy for real gross domestic product (MANU). Figure A1 shows that the two series present a common trend and may be used of a proxy of each other.
- the JIBAR rate as a proxy for repo rate (INTEREST). Figure shows that the trend of the JIBAR rate corresponds to the repo rate. We prefer to use the JIBAR rate as its time series is continuous compared to the repo rate that is close to a discrete series. Figure A1 shows that they have a common trend.
- the natural logarithm of consumer price index for metropolitan areas (PRICE).

The series are sourced from the South African Reserve Bank (SARB) database. Table A1 in the Appendix presents the unit root test of all the variables. All the variables are integrated of order one, I (1). This was tested with the Augmented Dickey Fuller (ADF) test whereby a trend was included in the test for the series CREDIT and MANU and only constant was included for INTEREST and PRICE.

As the SVEC analysis necessitates that variables be cointegrated and that the number of cointegrating relationship be known for the identification of shocks, Table A2 presents the trace test statistics. For the testing procedure the Johansen trace test was used. The number of autoregressive lags in the system chosen according to the Akaike Information Criteria is two. Table A2 indicates that there is existence of two cointegrating relationships in the system.

The vector of structural shocks in this study is given as $\varepsilon_t = \left(\varepsilon_t^{MANU}, \varepsilon_t^{PRICE}, \varepsilon_t^{CREDIT}, \varepsilon_t^{INTERST}\right)'$. As in section 4, for a 4-variable VEC we need $K(K-1)/2=6$ linearly independent restrictions to exactly identify the structural shocks. Since we have two cointegrating relations (r = 2), the number of shocks with permanent effects are $k=K-r=2$. A total of 2 shocks will have permanent effects, whereas $r=2$ shocks have transitory effects. In our 4-variable VEC model we assume that only shocks in CREDIT will not have permanent effects. To identify the three permanent shocks, $k(k-1)/2=1$ additional restriction is imposed in the long-run impact matrix ΞA. So we will assume in addition that productivity is only driven by technology shocks, ε^{MANU}.

The identification of the long run matrix ΞA in the 4-variable system is as follows:

$$\Xi A = \begin{pmatrix} * & 0 & 0 & 0 \\ * & 0 & * & 0 \\ * & 0 & * & 0 \\ * & 0 & * & 0 \end{pmatrix} \tag{4}$$

Unrestricted elements are indicated by asterisk. Referring to the vector of structural shock above, the interpretation of the above matrix is that shocks to PRICE have no long run effects on MANU, CREDIT or INTEREST. Also shocks to INTEREST have no long-run effects on MANU, CREDIT and PRICE. The rational behind the interpretations is that nominal variables such as price and interest should not influence economic activity in the long term. Another interpretation from this matrix, as discussed above, is that productivity is only driven by technology shocks, ε^{MANU}, and not any other shock.

As said earlier we need 6 linearly independent restrictions to exactly identify the structural shocks. But as it stands now the two zero columns represent $kr=4$ linearly independent restrictions and the zeros in (4) represent only five linearly independent restrictions. We then need in addition $r(r-1)/2=1$ contemporaneous restriction to unravel the effects of the two transitory shocks. The one additional restriction is therefore reported in the contemporaneous or short term matrix A. The choice made is that shocks to PRICE do not contemporaneously affect INTEREST. There should be a lag effect, especially in the case of South Africa. The short run matrix is therefore represented as

$$A = \begin{pmatrix} * & * & * & * \\ * & * & * & * \\ * & * & * & * \\ * & 0 & * & * \end{pmatrix}$$

6. INTERPRETATION OF THE RESULTS

Figure 3 provides the responses of MANU, PRICE, INTEREST and CREDIT to shocks from interest rate. Confidence intervals for the impulse responses are bootstrapped by procedure described in Breitung, Bruggeman, and Lutkepohl (2004). Bootstrap from percentile method proposed by Hall (1992) is used to construct the 95% confidence interval.

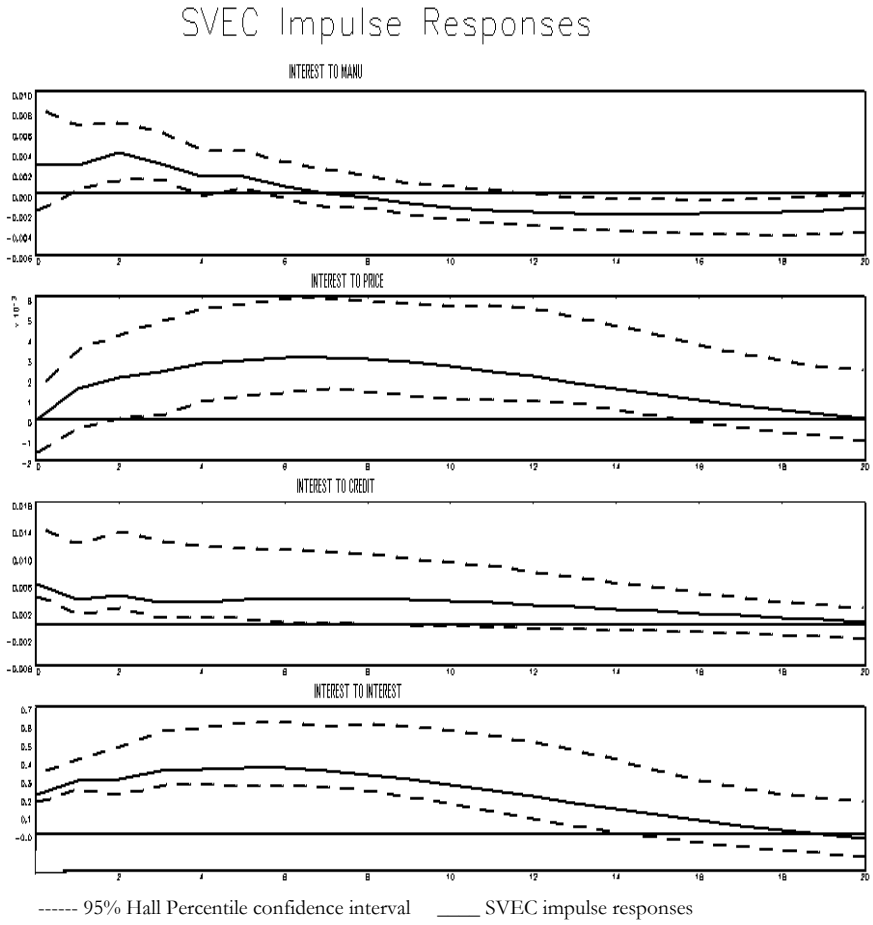


Figure 3: SVEC responses of MANU, PRICE, INTEREST and CREDIT to shocks from interest rate

The first row of Figure 3 shows the response of MANU to interest rate shocks. A positive shock to interest increases total production for the first 6 to 7 months. The negative response of total production to interest rate shocks occurs after 9 months. This expected effect actually occurs after a short term lag. This finding is in line with the outcome of a number of researches concerning the response of output to monetary policy shocks. In actual fact, recent research on monetary transmission confirms that monetary policy actions affect output in the short-run (Levin, Natalucci, and Piger , 2004). While output is quicker to respond to monetary policy, price displays inertial behaviour and remains largely unaffected for almost one year or even more. Movement in real output are not only substantial but also long-lived with the effect remaining up to 3 years (Friedman and Schwartz, 1963; Romer and Romer, 1989).

The second row shows the response of PRICE to interest rate shocks. A positive shock to interest rate increases PRICE for more than 18 months and for a period of at least 20 months there is no evidence that PRICE is likely to decrease after a positive monetary policy shock. These realities point to the possibility that either positive monetary shocks is unable to cause a decrease in inflation or that there is substantial lag in the effect of monetary policy on PRICE. Whichever the case may be, this points to the ineffectiveness of monetary policy instrument in affecting inflation in South Africa. This finding is supported by the recent work by Gupta and Komen (2008) using the Granger causality framework. The inability of the monetary policy shocks to influence the level of inflation raises a concern on the success of monetary policy stance. This apprehension is echoed by Jean-Claude Trichet, the president of the European Central Bank (ECB), remarking that central banks do their best work when their threats to raise interest rate deter inflation actions[1]. While a continuous increase in interest rate is not capable to reverse an increasing trend in inflation but succeed to depress economic growth, there is enough reason that the conduct of monetary policy be questioned in South Africa. A change of monetary policy stance from a simple inflation targeting to a dual target of inflation and employment (output growth), as applied in the USA, may be an option for bolstering monetary policy in South Africa. Why should the SARB continuously increase interest rate that has a neutral effect on inflation but compromises the growth path of the country? Even though many are of the opinion that the current increasing trend in inflation in South Africa is due to the increase in the petrol and food prices, without which inflation rate would be in the range of 5% (Mboweni, 2008), this should not be an excuse for the observed failure of the current monetary policy stance to steer back inflation within the target. Inflation targeting policy evokes an escape clause to justify a temporary inability of the monetary authority to contain inflation within the target. Nonetheless the escape clause is justified only if inflation is influenced by external shocks, such as petrol price. Altogether, it is warranted that the public question the effectiveness of inflation targeting policy in South Africa.

The third row shows the response of CREDIT from monetary policy shocks. There is slightly positive response of CREDIT to positive monetary policy shocks. This shows that an increase in interest rate is in general not effective enough to decrease the demand for credit in South Africa. Credit extension is at certain degree insensitive to high interest rate. It is evident that from Figure A1 that credit growth has been in an uptrend despite a continuous increase in interest rates. An increase in the repo rate of 1.5 percentage point, from June 2006 until March 2007, was matched by an increase in credit to private sector, for the same period, of 24.5 percentage point. This situation should also point out to the ineffectiveness of the repo rate as monetary policy instrument in South Africa. Actually, the very important channel through which repo rate should influence inflation is through credit demand which in turn affects total demand and then the price level. The institution of the new National Credit Act (NCA) as an additional measure to regulate the credit market in South Africa has proven to be effective as a complement to monetary policy. The NCA regulates the grating of consumer credit by all credit providers, including banks, microlenders, and retailers, to both enhance consumer protection and bolster banks' ability to manage their exposure to individual households risks (IMF, 2007).

The last row shows the response of INTEREST to its own shocks. The effect of interest rate to its own shocks has a tendency to be persistent. The effect dies out only in a period of 18 months. This provides evidence that initial increase in the repo rate has been followed by subsequent increases in the repo rate during the period of analysis. The results as provided in Figure 3 question the effectiveness of monetary policy in curbing inflation in South Africa. The positive effect of inflation to positive monetary policy shocks should be cause of concern for the monetary policy instrument used by the SARB. As from the observation in Figure 3 the persistence of the positive response of inflation to monetary policy shocks and the substantial lag before the effect dies out, all should be a cause of concern for the ability of the monetary policy instrument.

[1] From the article titled "ECB likely to hold rates steady and enjoy the gap" published in the Sunday time newspaper of 9 March 2008.

7 CONCLUSION

There is an increasing debate amongst academic, policymakers, and the general public as to whether inflation rate targeting is an effective monetary policy. In South Africa, the central bank has embarked in monetary tightening for more than a year, but it has been unable to bring inflation back to the target band. This study endeavoured to assess the effectiveness of monetary policy instrument, the repo rate, in influencing inflation rate in South Africa since the adoption of inflation rate targeting. The framework used is the structural vector error correction model that facilitates the analysis of the dynamics of inflation to monetary policy instrument shocks. This study found that positive monetary policy shocks are unable to negatively affect inflation after a period of more than 20 months. This pointed to the ineffectiveness monetary policy in affecting inflation in South Africa. Similarly, monetary policy in South Africa seems less potent in curbing demand for money, though this should be an important channel through which monetary policy should affect inflation. These facts prove that economic agents in South Africa are to a large extent insensitive to short-term interest rates. Credit demand by the private sector remains immune to central bank policy. However, this study shows that monetary policy does affect the real output in South Africa. A positive monetary policy shock decreases manufacturing production after six to seven months. The study concludes that inflation rate targeting as applied in South Africa does not help to curb inflation and credit demand by the private sector remains immune to central bank policy. The study then suggests that like in the USA, a dual inflation and employment (real output) target may be an option to consider for monetary policy in a developing country such as South Africa.

APPENDIX A

Table A1: Unit root test at the level

Series	**Adjusted t-statistics**
Price	-0.642
Credit	7.273
Interest	-2.059
Manu	-0.458

ADF is Augmented Dickey-Fuller test where the null hypothesis is of a unit root in the series. The estimated regressions include a constant and a trend.

Table A2: Johansen cointegration test

Null Hypothesis Number of CE	Eigenvalue	Trace Statistics	5% Critical Value	Probability
None*	0.310	79.692	63.876	0.001
At most 1*	0.288	46.721	42.915	0.020
At most 2	0.121	16.523	25.872	0.451
At most 3	0.055	5.045	12.518	0.590

Trace test indicates 2 cointegrating eqn(s) at the 5% level
* denotes rejection of the hypothesis at the 5% level
**MacKinnon-Haug-Michelis (1999) p-values

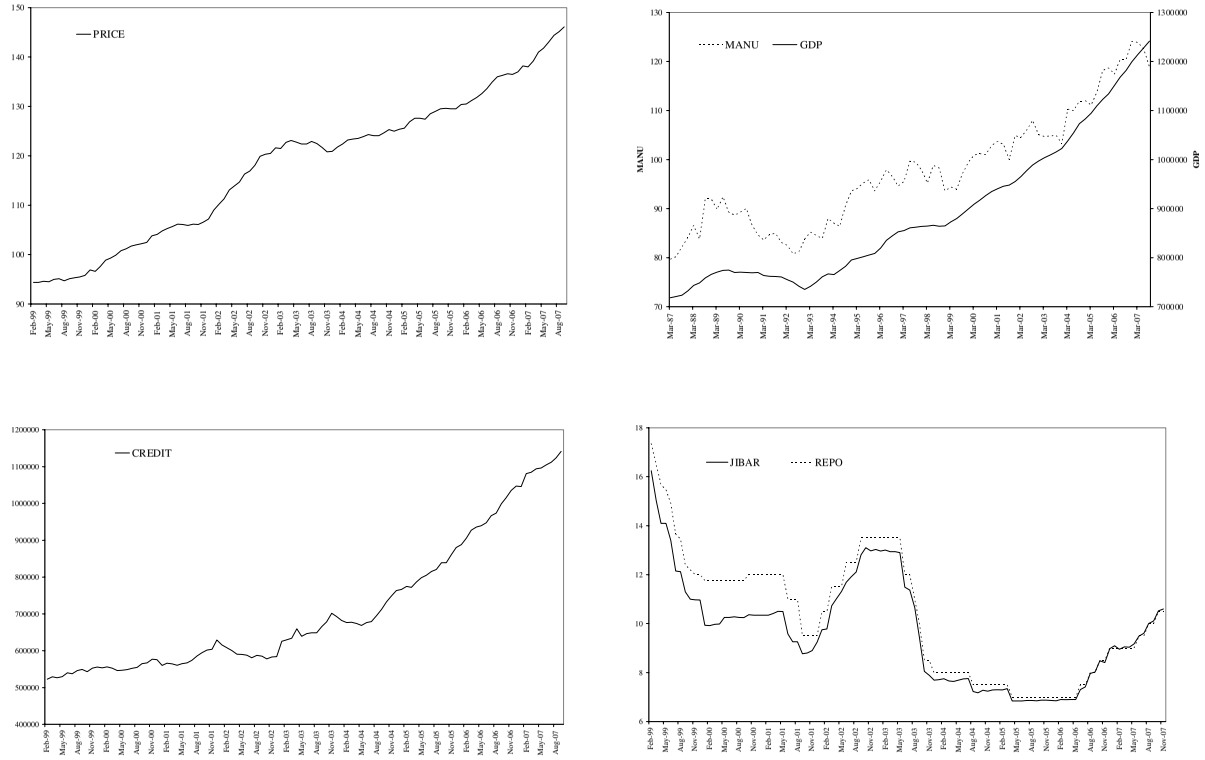


Figure A1: Variables

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