An Analysis of the Effectiveness of Inflation Targeting Monetary Policy Framework in South Africa

ABSTRACT
The aim of this study was to investigate the effectiveness of inflation targeting in South Africa using the Vector Autoregressive method (VAR). The VAR methodology was used to investigate the response of inflation to monetary policy shocks under the inflation targeting framework. The findings from the study revealed that the response of inflation is not consistent with the Taylor rule hence increases in the repo rate meant to reduce inflation actually increase the inflationary pressures in the economy. This is due to the composition of the Consumer Price Index. Housing constitutes the largest weight on the CPI hence this has an impact on how the Repo rate affects inflation. The autoregression model of inflation showed that the sum of the coefficients is less than one (0.965) showing that inflation targeting has effectively reduced the persistence of inflation in South Africa.

Keywords: Inflation targeting, monetary aggregate and nominal exchange rate.

INTRODUCTION

The ultimate objective of monetary policy in South Africa is to institute a stable financial environment that supports sustainable real economic growth over the medium and long term [7]. This is achieved through maintaining a low inflation rate that has no material effects on the macroeconomic decisions of economic agents. According to [4] financial stability is achieved when people are not concerned about the rate of inflation or any systemic risks in the financial sector when important economic decisions are made

The implementation of inflation targeting is based on the theory of rational expectations. This theory assumes that economic agents set wages and prices based on expectations of future prices [8]. Furthermore, [8} adds that the assumption of forward looking monetary policy has also been widely criticized by various scholars who argued that economic agents are not forward looking when making economic decisions. However, critics argue that monetary policy instruments under an inflation targeting regime would be ineffective when the necessary preconditions do not prevail [4].

Literature review

Inflation targeting is premised on the rational expectations assumption that economic agents are forward looking in setting their economic decisions. [10] identified adaptive learning by economic agents as a crucial source of persistence. Adaptive learning could render inflation targeting ineffective in controlling inflation persistence or containing inflation within the targets set by monetary authorities

[9] highlighted that the fact that inflation targeting regime is based on the assumption of rational expectations complicates inflation forecasting because rationality is an overwhelming assumption of the economics literature. W+ revealed that policies designed to be efficient under rational expectations can perform very poorly when knowledge is imperfect and

expectations deviate from the rationality assumption. This presents further evidence that the use of inflation targeting in South Africa may lead to the impotence of monetary policy given the survey outcomes. In addition, [7] revealed that irrational economic expectations increase the potential for instability in the economy; therefore it is important to ensure that monetary policy is effective in anchoring inflation expectations.

Numerous scholars have empirical examined the effectiveness of monetary policy and inflation targeting using various econometric techniques. [13] conducted a Vector Auto Regression (VAR) analysis on South Africa, New Zealand and Canada to investigate the appropriateness of the inflation targeting framework. The study concluded that South Africa is not a good candidate for an inflation target relative to the other two countries because of the relative importance of foreign shocks and of the weak linkage between monetary policy and inflation.

[13] investigated the evolution of monetary policy in South Africa since the 1980s, through analyzing the various channels of the transmission mechanism. A VAR model was developed to illustrate the various channels of the transmission mechanism and demonstrate the time lags of monetary policy instruments. The results of the model indicated that there is a fairly long time lag of approximately one year before a monetary policy shock affects the level of real economic activity, and another year before it has an effect on the domestic price level.

[1] evaluated the performance of inflation targeting using European Union data. Their focus was on the effects of forward looking monetary policy frameworks on real output. Using ARMA modelling the study investigated the effectiveness of inflation targeting in terms of output losses. The results showed that forward-looking rules encompassed in the inflation targeting framework contribute to macroeconomic stability and monetary policy credibility, and that a positive inflation target, as opposed to zero inflation, leads to higher and less volatile output.

[12] investigated the effectiveness of inflation targeting in Brazil. They used the Taylor rule to model the relationship between monetary policy instruments and inflation. In addition to the Taylor based regression model, the study employed the VAR methodology using quarterly data on M1, CPI, Deposit Rate, Real GDP and the nominal exchange rate. The results revealed that inflation targeting was effective in controlling inflation. This was because there was a strong linkage between M1 and CPI revealed from the variance decomposition.

[6] investigated the relationship between inflation and monetary policy instruments in Nigeria and Ghana using the vector autoregression model. The VAR model included money supply, prices, exchange rate and interest rate. The study revealed that prices in the short run are significantly explained by their own shocks rather than monetary policy shocks. This study concluded that monetary policy linkage between inflation and monetary policy instruments is weak hence inflation targeting would perform dismally.

A study by [2] in BRICS nations proved that a higher inflation target undermines expectations, as feared by Bernanke [3].This study used quarterly data on inflation, nominal interest rate and real GDP from 1990 to 2005. [2] used a model based on the Taylor rule and their results were that a higher inflation rate decreases the speed of convergence of expectations. In addition, their study revealed that he higher the inflation target, the more the policy should respond to inflation and less to output which may also trigger political interference hence the importance of being transparent diminishes with the level of the inflation target.

[13] examined the performance of inflation targeting in Malaysia. This study examined the relationship between CPI, money supply (M1), money market rate, and exchange rate of the Malaysian economy using monthly data for the period 1976 to 2007. The Johansen- Juselius (JJ) multivariate cointegration procedure and Vector Error Correction Modelling (VECM) are applied to investigate both short and long run relationships between the variables. The study showed that interest rate changes had significant impacts on the exchange rate but not on money supply. This showed that money aggregates do not significantly explain the changes to the inflation rate.

[8] evaluated the effectiveness inflation targeting using ten countries using autoregression (AR) modelling. The countries under study were New Zealand, United Kingdom, Australia, Czech Republic, Korea, Canada, Israel, Chile, Poland and Sweden. The results showed that inflation targeting was not effective in controlling inflation persistence in six of ten countries. [10] adds that inflation targeting yielded less results in emerging-market economies compared to developed economies due to the fact that achieving inflation targeting is more challenging in emerging markets rather than to a lack of commitment to the targets.

3. Materials and Methods

3.1 Data and Analytical Procedures

The sample considered for this study consisted of monthly data on Consumer Price Index, Repo Rate, Monetary Aggregate M1 and Nominal Exchange Rate data collected from the year 2000 to 2013 by the South African Reserve Bank. The researcher considered monthly data on CPI, M1, Repo Rates and the Nominal Exchange Rate for VAR analysis. The Repo rate served as a policy instrument in the model, M1 and CPI served as target variables. The nominal exchange rate was included to account for the South Africa's trade openness.

3.2 Model

The VAR methodology was used to analyse the effectiveness of inflation targeting as a monetary policy framework in South Africa. The VAR model is very effective in describing the dynamic behavior of economic time series and for forecasting. The VAR model was adopted for analytical purposes because it often provides superior forecasts to those from univariate time series [12]. According to [3], VAR models eliminate the need for structural modelling by modelling every endogenous variable in the system as a function of the lagged values of all of the endogenous variables in the system.

The mathematical form of a VAR is shown below:

$$y_t = \beta_{10} + \beta_{11} y_{t-1} + \cdots + \beta_{1k} y_{t-k} + \varepsilon_{1t}$$

Where ϵ_{it} is a white noise disturbance with $E(\varepsilon_{it}) = 0, (i = 1,2)$, $E(\varepsilon_{1t}, \varepsilon_{2t}) = 0$ and

y_t is a vector of endogenous variables containing M1, Repo Rate, Nominal Exchange Rate and the Consumer Price Index.

4. RESULTS AND DISCUSSION

4.1 Unit Root Tests

Formal tests for stationarity were carried out using the Augmented Dickey Fuller (ADF) test and the Philip Perron (PP) test. The results from the unit root test are presented in table 4.1 below:

Table 4.1 Unit Root tests at level

Variable	Test		t-test	t-critical	Probability	Conclusion
DCPI	ADF	Intercept	-0.857	-2.886	0.785	Non-stationary
		Trend and Intercept	-0.895	-3.449	0.985	
	PP	Intercept	-0.764	-2.884	0.864	
		Trend and Intercept	-0.848	-3.445	0.985	
DNER	ADF	Intercept	-0.655	-2.884	0.753	Non-stationary
		Trend and Intercept	-0.564	-3.446	0.673	
	PP	Intercept	-0.568	-2.884	0.993	
		Trend and Intercept	-0.569	-3.445	0.899	
DRR	ADF	Intercept	-0.896	-2.884	0.789	Non-stationary
		Trend and Intercept	-0.756	-3.446	0.846	
	PP	Intercept	-0.577	-2.884	0.635	
		Trend and Intercept	-0.756	-3.445	0.864	
DM1	ADF	Intercept	-0.466	-2.884	0.994	Non-stationary
		Trend and Intercept	-0.564	-3.446	0.973	
	PP	Intercept	-0.759	-2.884	0.944	
		Trend and Intercept	-0.576	-3.446	0.845	
		Trend and Intercept	-0.466	-3.445	0.234	

Source: Authors' Compilation

The Philip Perron test and the Augmented Dickey Fuller test were conducted on the series above. The two tests use a null hypothesis that the data is stationary. The results above show that CPI, NER, RR and M1 were non stationary at levels since t-test values were greater than t-critical values on all cases. The corresponding probabilities were greater than the value of 0.05 in all the series. The null hypothesis for the data is the series above contain a unit root, meaning they are non-stationary, given the results above; the null hypothesis could not be rejected. The conclusion is that all the series are non-stationary at levels. The differencing method was used to achieve stationarity in the data series.

Table 4.2 Root tests at first difference

Variable	Test	Exogenous	t-test	t-critical	Probability	Conclusion
DCPI	ADF	Intercept	-7.020	-2.886	0.000	Stationary
		Trend and Intercept	-7.106	-3.449	0.000	
	PP	Intercept	-7.854	-2.884	0.000	
		Trend and Intercept	-7.993	-3.445	0.000	
DNER	ADF	Intercept	-9.159	-2.884	0.000	Stationary
		Trend and Intercept	-9.237	-3.446	0.000	
	PP	Intercept	-9.166	-2.884	0.000	
		Trend and Intercept	-9.199	-3.445	0.000	
DRR	ADF	Intercept	-3.266	-2.884	0.019	Stationary
		Trend and Intercept	-3.319	-3.446	0.048	
	PP	Intercept	-10.593	-2.884	0.000	
		Trend and Intercept	-10.644	-3.445	0.000	
DM1	ADF	Intercept	-13.667	-2.884	0.000	Stationary
		Trend and Intercept	-13.682	-3.446	0.000	
	PP	Intercept	-14.368	-2.884	0.000	
		Trend and Intercept	-14.581	-3.446	0.000	
		Trend and Intercept	-9.164	-3.445	0.000	

Source: Authors' Compilation

The Philip Perron test and the Augmented Dickey Fuller test were conducted on the data in first difference. The two tests use a null hypothesis that the data is stationary. The results above show that CPI, NER, RR and M1 were stationary in first difference since t-test values were less than t-critical values on all cases. The corresponding probabilities were lower than the value of 0.05 in all the series. The null hypothesis for the data is the series above contain a unit root, meaning they are non-stationary, given the results above, the null hypothesis is rejected. The conclusion is that all the series are stationary at first difference.

4.2. Appropriate Lag Length Selection

Table 4.3 Lag Length selection

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-2703.316	NA	5.41e+13	42.973	43.063	43.010
1	-1802.585	1729.977	43080153	28.930	29.380	29.113
2	-1757.505	83.72015	27174575	28.468	29.279*	28.798
3	**-1728.017**	**52.89087***	**21980640***	**28.254***	**29.425**	**28.730***
4	-1715.702	21.30576	23390710	28.313	29.843	28.935

* indicates lag order selected by the criterion

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

FPE: Final prediction error

AIC: Akaike information criterion

SC: Schwarz information criterion

HQ: Hannan-Quinn information criterion

Source: Authors' Compilation

Prior to conducting cointegration tests and VAR analysis, the information criterion methods were used to determine the appropriate lag order for both the cointegration tests and VAR analysis. The table above shows the appropriate lag order for the system of equations selected by each information criteria. Given the results from the information criterion, the researcher selected a lag order of 3 which is the optimum lag length for the Akaike Information Criterion, Final Prediction Error; Sequential modified LR statistic and Hanna-Quinn information criterion. A lag length of 3 will therefore be applied in the Johansen cointegration test and the VAR analysis

4.3 Cointegration Test

Table 4.4: Johansen Cointegration Test

Number of cointegrating equations	Trace Test			Maximum Eigenvalue Test		
	Trace Statistic	Critical Value (0.05)	Probability	Maximum Eigenvalue Statistic	Critical Value (0.05)	Probability
None	23.320	27.584	0.075	23.320	27.584	0.160
At most 1	22.622	29.797	0.265	10.947	21.132	0.653
At most 2	11.676	15.495	0.173	9.593	14.265	0.240
At most 3	2.083	3.841	0.149	2.083	3.842	0.149

Source: Authors' Compilation

Cointegration is conducted to test the existence of a long run relationship between two or more time series. The Johansen test was used to test for cointegration among the CPI, M1, RR and NER series. The t test is less than t critical values in both the maximum Eigen value test and the trace statistic. The conclusion is that there is no evidence of cointegration at 5% level. Given this result, it follows that the VAR model is adopted for analytical purposes.

4.4 Response of CPI to Structural Shocks in the VAR model

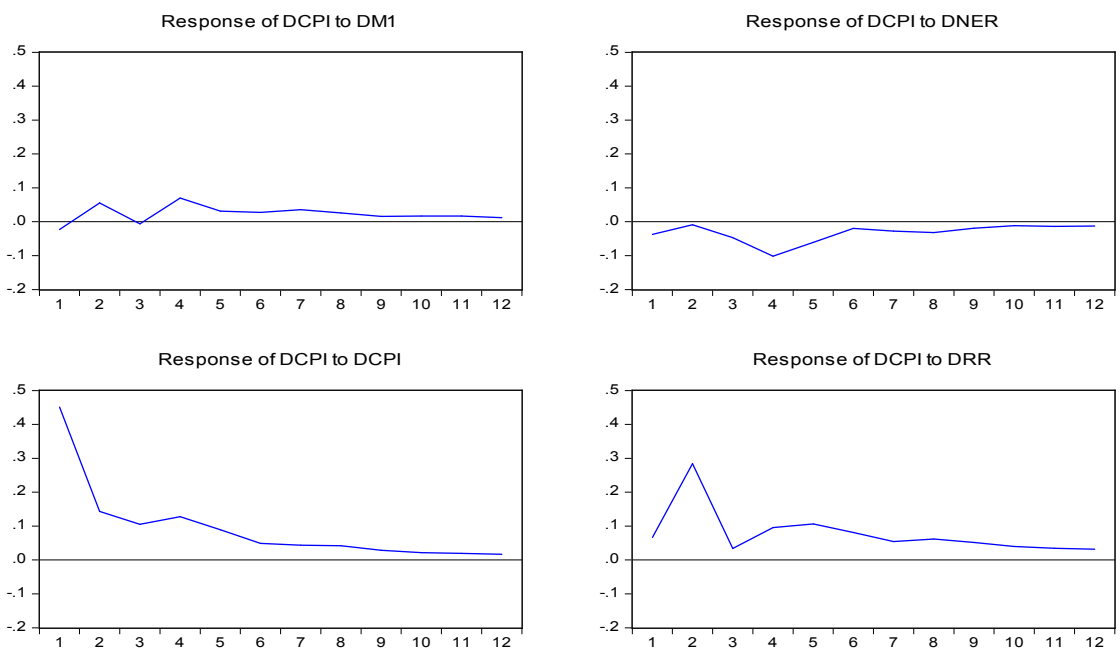

Figure 4.1: Impulse Response Output

The results in Figure 4.1 above shows generalized impulse response function results of DCPI to DM1, DNER, DRR and DCPI. The effect of a monetary policy shock is transitory because the economy approaches steady state after ten months. This is consistent with the theory of long run money neutrality which states that monetary policy cannot be used to peg the price level in the long run [4]. A one standard deviation shock on M1 causes an increase in CPI inflation in the second period. The full impact of a monetary policy shock in form of a monetary expansion is realised after four months. This is due to the transmission lag of monetary policy which is the period taken by variables to respond to policy actions. The results are consistent with theory because an increase in money supply is expected to increase the aggregate demand in an economy thus exerting inflationary pressures in the economy.

The response of DCPI to DNER shows the effect of the nominal exchange rate on inflation. The figure shows that a one positive standard deviation on the nominal exchange rate (depreciation) will result in lower levels of inflation from the second month to the ninth month. The effect of DNER on DCPI steadily increases from the second month and reaches its peak after four months. After four months, the exchange rate effect on inflation steadily decreases and they approach steady state after ten months. [10] highlighted that the effect of exchange rate depreciation on inflation is complicated. The exchange rate affects the inflation rate through the effect of depreciation on the price of imported goods. This is termed as import inflation. Depreciation makes imported goods more expensive on the local market hence depreciation is expected to result in higher inflation which is in contrast to the result above. [11] pointed out that the effect of depreciation depends on the price elasticity of exports and imports. A depreciation results in a greater demand for South African commodities by trading partners since they find them cheaper. South Africa is a predominantly exporting country hence a demand for its exports induced by a depreciation of the rand will likely result in an increase in the price of commodities [13]. The effect of depreciation on inflation is only temporary because the response of DCPI to a one standard deviation shock in the wears of in the 10th month.

The response of DCPI to DCPI above shows the effect of a one standard deviation shock to DCPI over a year. This impulse response function shows how long inflationary shocks persist in the South African economy. The figure above shows that inflationary shocks have the biggest effect on actual inflation in the first period. Some researchers argue that if inflationary shocks have a great impact on inflation, inflationary pressures in emerging marketing economies can render inflation targeting ineffective [3]. However, figure two shows that the impacts of inflationary shocks are only transitory because the DCPI approaches steady 12 months after the shock to inflation. This suggests that inflation targeting framework is effective in reducing the degree of inflation persistence. Additional autoregressive modelling will be conducted to examine inflation persistence.

The response of DCPI to DRR shows the link between inflation rate and the main monetary policy instrument in South Africa. The figure shows that a one standard deviation to the repo rate will lead to a steady increase in CPI inflation from the first month and reaching in the second month. This increase falls sharply from the second to the third month as the inflation rate approaches steady state. After the twelfth month, the monetary policy action will have negligible effect on the inflation rate showing that the effects of DRR on DCPI are only transitory. This in contrast to the Taylor rule which postulates that inflation should decrease whenever the repo rate is increased. Scholars have however indicated that the composition of CPI has strong bearing on the response of inflation to monetary policy instruments. Increases

in interest rates are expected to lead to lower aggregate demand thus lower levels of inflation. According to SARB [13], housing constitutes the largest proportion of CPI (22.8%). This implies that increases in interest rates tend to discourage prospective home owners from purchasing houses when the cost of credit is high. These individuals may rent houses while waiting for interest rates to fall down so that they could get mortgage loans on at cheaper cost. This increase in demand for rentals will push rental prices up hence the inflation level tends to increase as the repo rate is increased. Previous studies have pointed out that the repo rate is an ineffective policy instrument in taming inflation [5]. The findings from this study show that the repo rate is moving the inflation in an undesired direction thus it is an ineffective monetary policy instrument.

4.5 AR Estimation of Inflation Persistence

Table 4.5: Inflation persistence results

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	3.540	1.430	2.475	0.0145
AR(1)	1.402	0.079	17.730	0.000
AR(2)	-0.437	0.077	-5.644	0.000

Source: Authors' Compilation

In Table 4.5, the sum of the coefficients of the AR (2) model of CPI inflation is 0.965. [8] stated that if the sum of the coefficients of inflation is less than one, it is an indication that inflation is not persistent. Given the results above, the findings are that inflation targeting framework is effective in controlling inflation persistence.

5. CONCLUSIONS

The study revealed that there is a weak link between the intermediate target of monetary policy (M1) and inflation. The effect of monetary expansion was found to be consistent with the theory of long run neutrality of money because the response of CPI to shocks in M1 was temporal.

The findings from the study showed that there is a relatively strong link between the main monetary policy instrument and the inflation rate. The Repo Rate contributes 24% of forecast errors in CPI after a period of 3 months. The contribution of monetary policy shocks increases to about 26% of forecast errors in the CPI in the twelfth month. However, this link between the monetary policy instrument and inflation is not in the desired direction and is inconsistent with the Taylor rule. Increases in the repo rate are expected to reduce aggregate demand hence ultimately reduce inflationary pressures in the economy. However, due to the large contribution of housing in the Consumer Price Index, increase in interest rates increase demand for rentals since mortgages become expensive thus prospective home owners resort to renting. The increased demand for housing thus increases price of rentals and this increases the overall inflation rate.

The autoregression estimates showed that the sum of coefficients of the AR (2) model of inflation is 0.965. This entails that the inflation targeting framework has been effective in reducing inflation persistence. This is consistent with the results from the impulse response

functions which provided that a one standard deviation shock to CPI persists for a period of about 10 months in the economy. It is clear that exogenous shock on inflation caused by other factors outside the model only impact on the economy for 10 months.

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