INFLATION TARGETING AND INFLATION PERFORMANCE IN SOUTH AFRICA

P. Burger and M. Marinkov[1]

Abstract: Since 1980 there have been three distinct monetary policy regimes in South Africa. During the first period, from 1980 to 1989, monetary policy was not successful in containing inflation. The second period, 1990 to 2000, saw a significant improvement in the pursuit of a lower inflation rate. The third period, 2000 till present, also sees the SARB in pursuit of low inflation, but this period differs from the second in that the SARB pursues an official and explicitly stated inflation target. Although this paper suggests that compared to the 1990s, the explicit inflation targeting regime might have been marginally more successful in keeping inflation at lower levels, the inflation targeting system still displays limited success in keeping inflation within the official target range. Against this background the paper considers whether or not the official inflation targeting regime in South Africa improves inflation performance compared to the unofficial (implicit) inflation target regime South Africa of the period 1990-2000. In addition, the paper argues that improved inflation performance is not only measured in terms of a lower inflation rate. It should also be reflected in a better anchoring of inflation expectation, lower inflation inertia, a weaker relationship between inflation and cost-push factors such as oil price changes, a changed Phillips curve relationship, and lower inflation forecast errors. To seek answers the paper uses state-space modelling as well as recursive and moving-window VAR modelling.

JEL codes: E31, E52

1. Introduction

Since 1980 there have been three distinct monetary policy regimes in South Africa. During the first period, from 1980 to 1989, monetary policy was not successful in containing inflation. The second period, 1990 to 2000, saw a significant improvement in the performance of the South African Reserve Bank (SARB) in pursuit of a lower inflation rate. Given that the SARB did

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not pursue an explicit inflation target, this period can be characterised as a period of implicit inflation targeting. The third period, 2000 till present, also sees the SARB in pursuit of low inflation, but this period differs from the second in that the SARB pursues an official and explicitly stated inflation target. Although this paper suggests that compared to the 1990s, the explicit inflation targeting regime might have been marginally more successful in keeping inflation at lower levels, the inflation targeting system still displays limited success in keeping inflation within the official target range. This is apparent when considering that since the implementation of inflation targeting the CPIX exceeded its 6% upper bound in 29 of the 72 months between January 2002 (the first month of the first year that inflation had to be within its target range given a 24 month policy lag) and December 2007.

Against this background the paper considers whether or not the official inflation targeting regime in South Africa improves inflation performance compared to the unofficial (implicit) inflation target regime South Africa of the period 1990-2000. Following Ball and Sheridan (2003), Corbo, Landerretche and Schmidt-Hebbel (2002) as well as Jeménez (2004), the paper argues that improved inflation performance is not only measured in terms of a lower inflation rate. It should also be reflected in:

- a better anchoring of inflation expectation,
- lower inflation inertia,
- a weaker relationship between inflation and cost-push factors such as oil price changes,
- a changed Phillips curve relationship, and
- lower inflation forecast errors.

To assess whether or not the inflation performance of South Africa improved, this paper considers all these aspects of inflation performance. The methods

used in the analysis include state-space modelling as well as recursive and moving-window VAR modelling.

2. Inflation Performance Since the 1980s: Some Historical Background

Monetary policy in South Africa went through several regime and other changes in the past quarter century (approximately since 1980). As the discussion below indicates, these changes did impact on the performance of monetary policy, more specifically on the impact of policy on inflation. Some of the highlights in the history of monetary policy in South Africa for the period 1980 till present are:

(i) The period since 1980 has been marked by the tenure of three SARB governors, Gerhard de Kock during the 1980s, Chris Stals during the 1990s and Tito Mboweni since 2000 (cf. Aron and Muellbauer, 2006).
(ii) Financial markets liberalised during the 1980s and deepened since the mid 1990s.
(iii) A system of money supply (M3) targets/guidelines was in place between 1986 and 2000. The M3 targets/guidelines (usually stated as a margin such as 6%-10%) acted as intermediate targets, with price stability being the ultimate objective.
(iv) A system of official inflation targets are in place since February 2000. Because of the 18-24 month policy lag, government set the first target for 2002.

In terms of effective policy, the period 1980-2007 can be divided into three sub-periods: the period 1980Q1-1989Q3, 1989Q4-2000Q1 and 2000Q2-2007Q4. Following the international inflationary problems of the 1970s, the SARB, unlike the central banks in countries such as the US and UK, did not

adopt an effective anti-inflationary stance. Thus, the period 1980Q1-1989Q3 was a period of weak monetary policy with relative high double-digit inflation. In addition, real interest rates were negative for a very large part of the decade. Note that this weak monetary policy existed notwithstanding the implementation of the M3 targets in 1986 and the stated objective of the SARB being the protection of the internal and external value of the Rand.

The inflationary stance of the SARB changed significantly when Stals took over as governor of the SARB. The objective of the SARB remained the protection of the internal and external value of the Rand, but with the change at the helm this objective was actively pursued. Inflation dropped to single-digit numbers by the early to mid 1990s and with the exception of a brief inflationary spell following the Asian crisis, remained there for the remainder of the decade. A notable characteristic of this period was that the SARB succeeded in reducing the inflation rate (its ultimate policy objective) notwithstanding the fact that it did not succeed in containing M3 growth (its intermediate target) within the target range set by the bank. Towards the late-1990s the SARB also recognised the problems with using money supply targets/guidelines, particularly given the rapid growth in M3 resulting from the deepening and opening of the South African financial system in the 1990s. The opening of the South African financial system was further assisted by the relaxation of capital and exchange controls since the mid-1990s (including the abolition of the Financial Rand in 1995).

Given that the SARB actively pursued the lowering of the inflation rate, but did so without an official inflation target, the 1990s can be characterised as a period of implicit inflation targeting (so as to distinguish it from the regime of explicit inflation targeting implemented later).

As noted, the mission of the SARB in the 1990s was the protection of both the internal and external value of the Rand. Thus, the SARB aimed at reaching and maintaining a low and stable inflation rate and stable exchange rate. Though it succeeded in reaching the objective regarding inflation, it was less successful in reaching the objective regarding the stable exchange rate. The 1990s was also marked by two periods of currency crises: 1996 an 1998. Particularly the second crisis had a deep impact on the economy. The SARB attempted to counter the depreciating forces by increasing the repo rate substantially and by intervening in the forex market. The result was a significant negative impact on domestic borrowing, investment and growth in the immediate aftermath of the currency crisis, as well as a substantial deterioration of the net open forward position (NOFP) of the SARB (cf. Aron and Muellbauer 2006).

The third sub-period commences with the implementation of an official inflation targeting regime by the SARB in February 2000. As such, it can be denoted as a period of explicit inflation targeting. Whereas previously the mission of the SARB had been the protection of both the internal and external value of the Rand, the SARB now only protects the internal value of the Rand (in the belief, of course, that low and stable inflation will, without the need for policy intervention, translate into a stable exchange rate). This change in policy focus can also be seen in the subdued reaction (subdued relative to the 1998 crisis) of the SARB to the 2001 currency crisis.

When considering the success of the explicit inflation targeting regime, it is apparent that since the implementation of inflation targeting the CPIX exceeded its 6% upper bound in 29 of the 72 months between January 2002 (the first month of the first year that inflation had to be within its target range given a 24 month policy lag) and December 2007. This raises the

question whether or not explicit inflation targeting is more successful than implicit inflation targeting.

Figure 1. Inflation and policy regimes

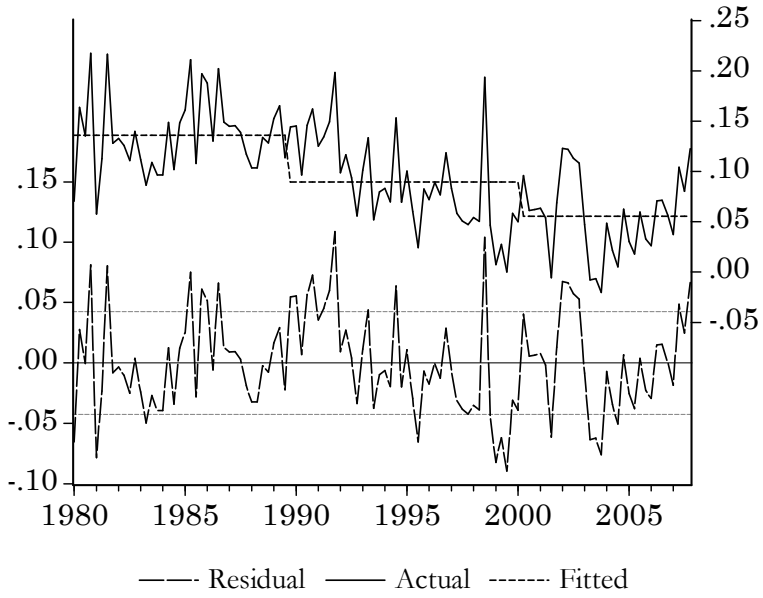


Table 1. Inflation and policy regimes

	Constant	**Dummy (1989Q1-2000Q1)**	**Dummy (2000Q2-2007Q4)**
Estimate	0.136	-0.047	-0.080
p-value	0.000	0.000	0.000
Adjusted R^2	0.356		

Figure 1 and Table 1 show the results of a simple OLS regression that regresses the inflation rate on two dummies, one for the period 1989Q4-2000Q1 (i.e. the period of implicit inflation targeting) and one for the period 2000Q2-2007Q4 (i.e. the period of explicit inflation targeting). Compared to the 1980s, Figure 1 and Table 1 show that inflation on average was lower during the 1990s, the period of implicit inflation targeting. Figure 1 and

Table 1 also show that during the third sub-period, i.e. the period of explicit inflation targeting, inflation on average was lower than in the second sub-period. It is also notable that the average for inflation in the third sub-period is approximately 6%, which is the upper bound of the inflation target. This is an indication of a hardening upper bound resulting from the SARB not pursuing a mid-point inflation target (i.e. monetary policy relaxes as soon as it reached the upper bound of its target range). The hardening of the upper bound also explains why the SARB missed its target roughly 40% of the time.

3. What is Meant by Inflation Performance? A Brief Overview of the Literature

As mentioned in the introduction this paper follows Corbo *et al.* (2002), Ball and Sheridan (2003), as well as Jeménez (2004), to argue that improved inflation performance is not only measured in terms of a lower inflation rate. It should also be reflected in:

- a better anchoring of inflation expectation,
- lower inflation inertia,
- a weaker relationship between inflation and cost-push factors such as oil price changes,
- a changed Phillips curve relationship, and
- lower inflation forecast errors.

Ball and Sheridan (2003) compare a sample of inflation targeting countries to a sample of countries that do not officially target inflation. Comparing different sample periods in their bivariate (OLS) analysis (where the sample periods are defined as periods without inflation targets, periods with constant inflation targets and periods with changing inflation targets) Ball and Sheridan (2003:23-8) investigate three relationships.

The first relationship is a simple accelerationist/augmented Phillips curve relationship that relates the change in the inflation rate to the output gap as estimated with a Hodrick-Prescott filter. Ball and Sheridan (2003:23) argue that the Phillips curve relationship can either strengthen or weaken with inflation targeting. It may strengthen because inflation targeting reduces the costs of disinflation, or it may weaken because inflation becomes more anchored. The second relationship relates the change in inflation to a commodity price index, while the third relates expected inflation (measured as the OECD inflation forecast) to the lagged inflation rate. With inflation targeting both the second and third relationship is expected to weaken as inflation targeting is supposed to anchor inflation and inflationary expectations. Ball and Sheridan (2003:23) also mention that the first and second relationship can be estimated as one relationship.

To explore whether or not official inflation targeting improves macroeconomic performance, Ball and Sheridan (2003:23-8) compare the size of coefficients in the three relationships for the period without inflation targets to the period with inflation targets. They conclude that official inflation targeting did not improve macroeconomic performance (i.e. performance in terms of inflation, output and interest rates) in the countries that they explored (Ball and Sheridan 2003:29).

Jeménez (2004:27-9) follows Ball and Sheridan (2003) to explore a Phillips curve relationship between inflation, the output gap (as estimated by a Hodrick-Prescott filter) and commodity prices. Unlike Ball and Sheridan (2003) who use OLS applied to different sample periods, Jeménez (2004:28) uses state-space modelling to estimate changing parameters over the complete sample period that he considers. Jeménez (2004:29) finds that the impact of the implementation of inflation targeting on inflation performance is mostly positive.

Using a five-variable unrestricted VAR containing inflation, production, money, the interest rate and the nominal exchange rate, Corbo *et al.* (2002:232-3) compares the inflation performance of explicit inflation targeting countries with non-targeting countries. Using VARs Corbo *et al.* (2002:232-3) generate one-period-ahead forecasts of inflation, that they use in turn to generate the squares of the one-period-ahead forecast errors. To generate one-period-ahead forecasts of inflation Corbo *et al.* (2002:232-3) use a seven-period moving window for their VARs, as well as a recursive estimation based on additional sample information. To render all their variables except the interest rate stationary Corbo *et al.* (2002:232) use the Hodrick-Prescott filter. Corbo *et al.* (2002:236-7) find that inflation targeting contributes to the accuracy of inflation forecasts by reducing the squared forecast errors.

4. Method and Empirical Results

Does explicit inflation targeting contribute to a better anchoring of inflation expectation, lower inflation inertia, a weaker relationship between inflation and cost-push factors such as oil price changes, a changed Phillips curve relationship and lower inflation forecast errors? To investigate the aspects contained in the first four questions, the paper uses state-space modelling, while to investigate the aspect contained in the fifth question the paper uses recursive and moving-window VAR modelling.

To answer the first four questions the section draws partially on the Ball and Sheridan (2003:23) and Jeménez (2004). The section first follows Ball and Sheridan (2003:23) and considers the relationship between the change in inflation, the output gap, commodity prices and expected inflation. Ball and Sheridan (2003:23) compare changes in coefficients for sample periods with no inflation targeting with the coefficients for sample periods where inflation

was officially targeted. However, this paper cannot replicate the OLS procedure of Ball and Sheridan (2003:23) because the time-series for expected inflation (obtained from the Bureau of Economic Research) only starts in the third quarter of 2000. Instead, this paper focuses on the period of official inflation targeting in South Africa since 2000 to investigate whether or not inflation performance improved as the period that official inflation targeting has been in place lengthened. Using recursive estimates of coefficients estimated within a state-state framework, the analysis therefore seeks to establish whether or not the coefficients behaved as expected on *a priori* grounds as the period that official inflation targeting has been in place lengthened. Thus, the following regressions are estimated (for the period 2000Q3 – 2008Q1) in the state-space form (Ball and Sheridan, 2003; Jeménez, 2004; Levin *et al.*, 2004):

$$\Delta\pi_t = a(y_t - y_t^*) + b(\Delta p_t^{oil} - \pi_t^{US}) + \xi_t \qquad [1]$$

$$\pi_t^e = K_1 + c\pi_{t-1} + \psi_t \qquad [2]$$

where π_t denotes the South African inflation rate (calculated as the log first difference of the South African CPI series), $(y_t - y_t^*)$ denotes the output gap (calculated as the log difference of South African GDP series and the long run level GDP estimated using the Hodrick-Prescott filter), Δp_t^{oil} denotes the oil price inflation (log difference of the oil price), π_t^{US} denotes the US inflation rate and π_t^e denotes the inflation expectations for South Africa (please note that a more detailed description of the data is contained in Appendix I). The error terms ξ_t and ψ_t are assumed to be IID and mutually uncorrelated with constant variances. Inflation targeting should affect the a, b and c coefficients in equations [1] and [2] so these coefficients are estimated recursively in the state-space form. The a coefficient in equation [1]

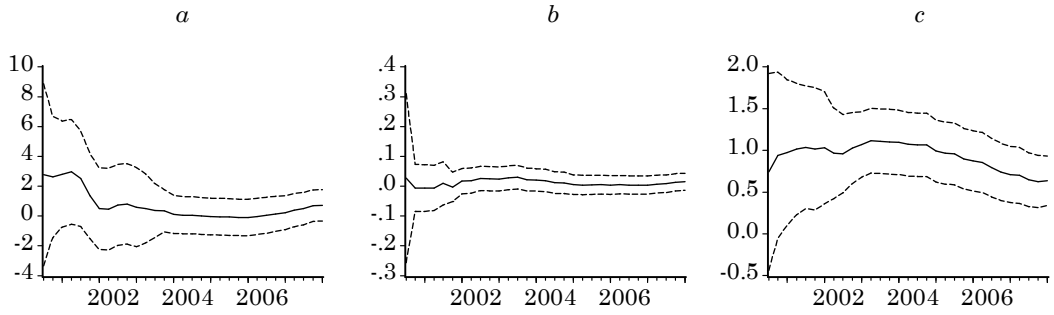
measures the output gap effect on South African inflation and can either be rising (suggesting that inflation targeting reduces the costs of disinflation) or falling (suggesting that inflation becomes more anchored). The *b* coefficient in equation [1] measures the inflationary effect of changes in the relative price of oil (i.e. a supply shock) and should be falling with successful inflation targeting. Lastly, the *c* coefficient in equation [2] measures how inflation expectations respond to movements in past inflation and should be falling if inflation expectations are "anchored" (Levin *et al.*, 2004). Table 2 reports the estimation results for equations [1] and [2] and it shows that the only significant change is the response of expectations to inflation movements (i.e. the coefficients of equation [2] are the only statistically significant results). Figure 2 presents how *a*, *b* and *c* coefficients evolve over the sample period. Coefficients *a* and *b* verify the statistically insignificant results of the estimation in Table 2, while greater anchoring of inflation is suggested by the third panel (i.e. coefficient *c*, which shows a steady decrease from about 2005).

Table 2. Estimation results for equations [1] – [2]

Coefficient	***a***	***b***	K_1	***c***
Estimate	0.014	-0.001	0.056*	0.635*
Z-statistic	0.047	-0.038	13.658	4.293

Note: 1. Significance at the 1% level is denoted by *.
2. Final states are reported for the *a*, *b* and *c* coefficients.

Figure 2. Recursive estimates of the a, b and c coefficients from equations [1]-[2][2]



However, a limitation of the above model is its limited sample period (which is limited because of the limited time-series available for expected inflation). One implication of the limited sample period is that the output gap contained in the estimation does not cover a full business cycle. The question exists as to whether the short sample period contributed to the statistically insignificant role of the output gap. To address this problem the section again considers the relationship between inflation, output and commodity prices (thus excluding expected inflation). However, this time it follows Jeménez (2004) in using state-space modelling to estimate a Phillips curve for the period 1980Q1 to 2008Q1. The following equations are specified in state-space form (cf. Jeménez, 2004; IMF, 2005):

$$\pi_t = \alpha\pi_{t-1} + \beta(y_t - y_t^*) + \delta(\Delta p_t^{oil}) + \zeta_t \qquad [3]$$

$$\alpha = \alpha_{t-1} + \mu_t \qquad [4]$$

$$\beta = \beta_{t-1} + \eta_t \qquad [5]$$

$$\delta = \delta_{t-1} + \upsilon_t \qquad [6]$$

Equation [3] is the Phillips curve where the parameters are state variables that follow a random walk process. In addition, the α, β and δ parameters

[2] Dashed lines represent the 2RMSE confidence bands.

capture the inertia, output gap and supply shock effects, respectively. The variables μ_t, η_t and v_t are random, identically and independently distributed variables with constant variances.

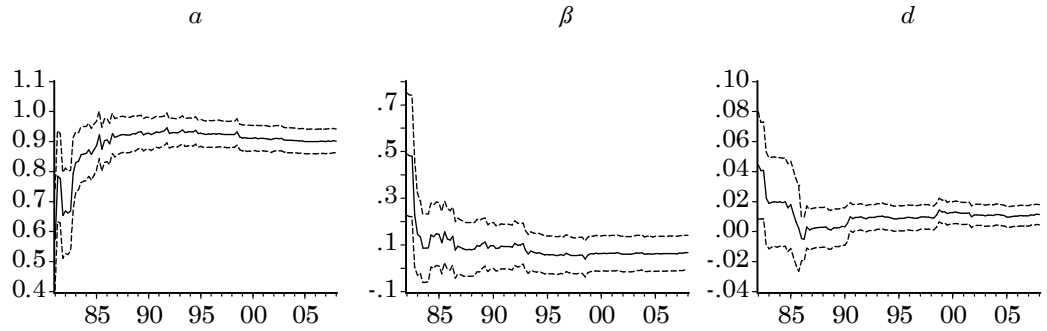
Table 3. Estimation results for equation [3]

Coefficient	α	β	δ
Estimate	0.901*	0.067	0.011
Z-statistic	22.470	0.906	1.675

Note: 1. Significance at the 1% level is denoted by *.
2. Final states are reported for the α, β and δ coefficients.

Table 3 reports the estimation results of equation [3] for the period 1980Q1 to 2008Q1. The parameter of the lagged inflation variable is the only parameter that is significant at the 1% level. There are no output gap effects while there does seem to be some, though limited, commodity price influence on South African inflation (the δ coefficient is significant at the 10% significance level and compares in value to that of Jeménez (2004)). Figure 3 presents the plots of the recursive coefficients for equation [3]. It shows that the relationship between inflation on the on hand and its own lag, the GDP gap and commodity prices on the other hand, did not change with the implementation of inflation targeting. In fact, the relationships remained remarkably stable over the entire sample period. Thus, based on these results inflation targeting did not contribute to lower inflation inertia, while the output gap was statistically insignificant even before the implementation of official inflation targeting. (The latter concurs with the fixed-parameter estimates of the Phillips curve by Burger and Marinkov (2006)).

Figure 3. Recursive estimates of the α, β and δ coefficients from equation [3][3]



To return to the questions posed above, namely does explicit inflation targeting contribute to a better anchoring of inflation expectation, lower inflation inertia, a weaker relationship between inflation and cost-push factors such as oil price changes, and a changed Phillips curve relationship, the answer seems to be in the negative for all except the first question. Thus, the above seems to suggest that inflation targeting does contribute to a better anchoring of inflation, but inflation inertia, and the relationship between inflation and the oil price (though weak) and between inflation and the output gap (which remains absent) remain unchanged. This leaves one question still to answer: did the implementation of an official inflation targeting regime lower inflation forecast errors? This question also relates to the anchoring of inflation and inflation expectations.

To answer this question the section follows Corbo *et al.* (2002). As such, the section estimates recursive and rolling-window VARs for the South African economy using quarterly data for the period 1980Q1 to 2008Q1 (i.e. 113 observations) to investigate how the one-period-ahead inflation forecast errors have evolved over time. If the implementation of official inflation

[3] Dashed lines represent the 2RMSE confidence bands.

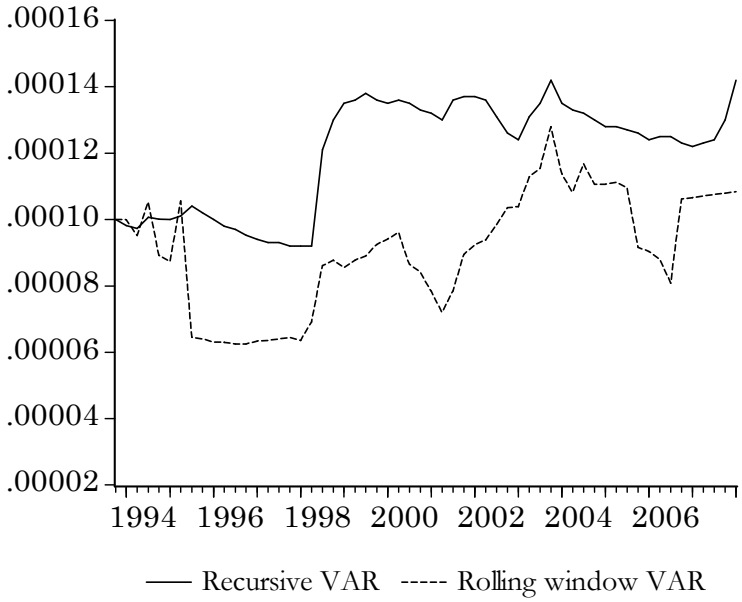
targeting improved inflation forecasts, then the one-period-ahead inflation forecasts should become smaller.

The endogenous variables included in the VAR are Gross Domestic Product (GDP), the Consumer Price Index (CPI), the Treasury Bill rate, the R/$ exchange rate and tax revenue. Two exogenous variables are also included in the estimation and these are the US interest rate as well as the oil price. All variables, with the exception of the two interest rates, are expressed as log deviations from the long run trend as specified by the Hodrick-Prescott filter (again, more detail on the data used in estimation is provided in Appendix I.) The assumption is that the structure of South African economy can be captured by a non-structural vector autoregressive simultaneous equation system.

Each VAR is estimated using additional sample information after which the inflation equation of each VAR is then used to generate a one-period ahead forecast of inflation.[4] This forecast of inflation is then used as a proxy for inflationary expectations. To assess the role of inflation targeting regime in South Africa on the formation of inflationary expectations, the square of the forecast errors are generated from each VAR and then averaged. Two types of VARs are used for the purpose of robustness – namely, the recursive VAR and the rolling window VAR. The results are presented in Figure 4.

[4] For the overall period, the Akaike and Hannan-Quinn information criteria indicated that two lags need to be included in estimation, while the Schwartz criterion indicated the use of one lag. In order to conserve degrees of freedom, one lag was included in the estimation of each VAR. The first VAR was estimated for the period 1980Q1-1993Q4, giving 56 observations which were sufficient to avoid degrees of freedom issues. The recursive VARs were estimated by adding a quarter at a time to the sample, while for the moving window VARs, a 56 quarter window is used.

Figure 4. Average quadratic errors of inflation deviation forecasts obtained from recursive and moving window VARs



The results for both the recursive VARs and the rolling window VARs first indicate an increase in the quadratic forecast errors in the third quarter of 1998, which coincides with Asian crisis. In South Africa the crisis is associated with a peak in inflation and interest rates and a depreciation of the Rand. The forecast error of inflation has not substantially decreased since 1998. However, since the implementation of inflation targeting (in 2000 to be reached in 2002) and once the effect of the temporary depreciation of the Rand in 2001 wore off, a very modest decrease in the quadratic forecast error is detectable between 2003 and 2006, which is also the period during which inflation moved within the target range of 3%-6%. Nevertheless, since 2007 the quadratic forecast error increased; an increase that coincides with the substantial increase in the oil price and inflation during the same period.

As shown above as well as in Marinkov and Burger (2007), there is a positive link between the oil price and inflation in South Africa. What the results in

this section suggest is that not only does an increase in the oil price contribute to a higher inflation rate (with the effect not diminishing after the implementation of an official inflation targeting regime), but possibly also to an increase in the quadratic forecast error of inflation. Reading this against the background of the very modest fall in the quadratic forecast error of inflation between 2003 and 2006, indicates that an official inflation targeting regime might improve inflation forecasts (though the evidence is slim), but external shocks such as exchange rate and oil price changes may undermine inflation forecasts, even with an official inflation targeting regime in place.

5. Conclusion

This paper shows that compared to the periods without inflation targeting (1980-89) and implicit inflation targeting (1990-2000), inflation, on average, is lower during the period of explicit inflation targeting (the period since 2000). However, this does not mean that inflation performance was uniformly better since the implementation of explicit inflation targets. Indeed, the CPIX exceeded its 6% upper bound in 29 of the 72 months between January 2002 (the first month of the first year that inflation had to be within its target range given a 24 month policy lag) and December 2007. This uneven inflation record raises further question regarding inflation performance. Following Ball and Sheridan (2003), Corbo, Landerretche and Schmidt-Hebbel (2002) as well as Jeménez (2004), the paper argues that inflation performance encompasses more than just the level of inflation. It also encompasses a better anchoring of inflation expectation, lower inflation inertia, a weaker relationship between inflation and cost-push factors such as oil price changes, a changed Phillips curve relationship, and lower inflation forecast errors. The paper finds that inflation targeting seems to contribute to a better anchoring of inflation expectations and in the absence of external shocks it may also contribute to lower quadratic forecast errors for inflation, which

also points to a better anchoring. However, official inflation targeting seems to leave inflation inertia unchanged. It also seems to leave the relationship between inflation and the oil price (though weak) and between inflation and the output gap (which remains absent) unchanged.

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Appendix I – Data Description

Variable	Description	Units	Source
CPI	South African Consumer Price Index (CPI); total consumer prices of goods (metropolitan areas), seasonally adjusted	2000 = 100	STATSSA
GDP	South African Gross Domestic Product, real, seasonally adjusted	R millions	SARB
Oil price	Crude oil (petroleum); simple average of three spot prices – Dated Brent, West Texas Intermediate and the Dubai Fateh	USA dollar per barrel	IMF
US inflation rate	CPI inflation rate for the United States	Percentage	IMF
Inflationary expectations	CPIX inflation expectations	Percentage	SARB
Interest rate	South African Treasury Bill rate	Percentage	IMF
Exchange rate	South African foreign exchange rate	Rand per USA dollar	IMF
Tax revenue	Taxes on production and imports plus current taxes on income and wealth (deflated using the CPI series)	R millions	SARB, authors calculations
US interest rate	US rate on three month trade financing	Percentage	SARB