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HOW HAS INFLATION TARGETING AFFECTED MONETARY POLICY IN SOUTH AFRICA?

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OVER THE LAST SEVERAL YEARS, there has been increasing support for conducting monetary policy with the aid of specified inflation targets. This growing enthusiasm now extends to open and developing economies (see for example, "Floating with An Anchor", *The Economist* (29/1/2000)). The advocates of inflation targeting (IT) emphasise the importance of fixing a nominal quantity to "anchor" long-run inflation and inflationary expectations. And, relative to the alternatives of controlling the money supply or the exchange rate, inflation targets have important advantages. Foremost among these is that an inflation target preserves the central bank's discretion to react to information about the current state of the economy in a flexible manner. In addition, particularly relative to an exchange rate anchor, an inflation target allows for some flexibility in the exchange rate to stabilise foreign sector shocks. As a result of these advantages, many endorse the use of an inflation target by the South African Reserve Bank (Casteleijn, [1999], Jonsson [1999], Mboweni [2002]).

But even the advocates of IT recognise that the flexibility of the exchange rate is a double-edged sword. Flexibility of the exchange rate with an inflation target, also means that foreign

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sector shocks can cause a depreciation of the currency, which at least in the short run will increase inflation. Consequently, these foreign shocks may require, particularly in countries targeting measures of consumer prices, a contractionary monetary policy when the real economy is already weak. This potential problem causes some (see Ball [2000] and Woglom [2000]) to argue that in open economies with inflation targets, it is particularly important to target long-run inflation and not to react to transitory changes in the exchange rate.

While the disadvantages and advantages of IT are well known, the international consensus around the desirability of IT appears to be growing. As noted by Neumann and von Hagen (2002), this growing consensus has developed in spite of the absence of definitive evidence on IT:

"The debate over IT exposes a couple of odd characteristics. One is that despite a lot of effort, empirical studies on IT have consistently failed to show convincingly that IT has been an important factor in speeding up disinflation, or raising the credibility of the central bank's commitment to low inflation. An important challenge for IT supporters comes from the observation that the environment of the 1990s, when IT was first undertaken, was generally benign, implying the particular strategy of IT may have done little to improve monetary policy outcomes over what any reasonable strategy could have achieved." (p. 127).

Unfortunately, for South Africa the period after the adoption of the inflation target was far from "benign." Instead, the Reserve Bank's inflation target was almost immediately challenged by the problem of an exogenous fall in the exchange rate.

South Africa's recent experience, however, makes it an interesting case study in the IT debate, and this paper aims at gathering empirical evidence on two questions:

(i) Has IT affected the conduct of monetary policy;

(ii) Has IT made monetary policy more predictable or "transparent?"

Because IT is less than 3 years old in South Africa it is difficult to draw definitive conclusions, but my evidence suggests that:

(i) With the exception of the monetary policy response to the Asian crisis (in the second half of 1998), the changes in the conduct of monetary policy have been modest, but consistent with the adoption of an IT regime.

(ii) Most notably, the role of exchange rate movements in the formulation of monetary policy appears to have changed since the adoption of inflation targets.

(iii) In addition, the adoption of an inflation target appears to have made monetary policy actions more transparent.

(iv) Some evidence, however, suggests that financial markets remain uncertain about the Reserve Bank's response to exchange rate shocks. In my view, the Reserve Bank reacted correctly in not trying to offset completely the real depreciations of 2000 and 2001. This policy response, however, appears to have been a surprise and also probably means that the inflation targets will not be met during 2003. This experience raises an unresolved policy issue: Can the Reserve Bank maintain its flexible response to exchange rate shocks while preserving its credibility and the transparency provided by an inflation target?

The paper is organised as follows. In the next section, I review the recent macroeconomic data for South Africa. Even this simple data review reveals the sharp contrast between the Reserve Bank's reaction to the 1998 exchange rate shock and the more recent shocks. In Section 2, I review the theory of so-called Taylor rules for characterizing monetary policy regimes and present estimates of Taylor rules for South Africa to provide evidence on whether the conduct of monetary policy has changed with IT. In Section 3, I use the forecasting power of the yield curve for changes in short-term interest rates to provide evidence on the transparency and consistency of monetary policy in the pre-IT and IT periods. The final section presents my conclusions and some thoughts on the unresolved policy issue.

1. MACROECONOMIC PERFORMANCE: PRE-IT AND IT PERIODS

Fig. 1-4 display the basic, quarterly macroeconomic data for South Africa used in this paper, beginning in 1990. The details about the data sources and methods of measurement are relegated to the Appendix, but of some importance is that the data are measured as quarterly averages of annual rates, with the exception of the 3 month Treasury bill rate, which is the weekly average rate during the first week of the quarter. While the quarterly averages are volatile, a few trends are worth noting.

First, Fig. 1 shows the decline in inflation that followed the spike at the end of 1998 and the most recent increase in inflation. But as Fig. 2 indicates the reduction in inflation coincided with a slow down in the real economy. Figs 3 and 4 make clear that both of these developments were related to the Asian crises that caused a substantial real devaluation of the rand and the Reserve Bank's sharp response.

This monetary policy reaction is in sharp contrast to the more recent bouts of depreciation. For example, as shown in Fig. 3, during 2000 there was a moderate depreciation with stable short-run interest rates shown in Fig. 4. The sharp depreciation in 2001 was initially accompanied by a fall in interest rates and then followed by an increase in interest rates, but the magnitude of the increase was small relative to the 1998 reaction. The greater stability of short-run interest rates is also reflected in a somewhat more stable real economy. But by the end of the period the real depreciation was apparently causing an upward trend in the inflation rate. Thus the simple data suggest that monetary policy during 1998 was apparently different than it has been during IT.

Table 1 summarises these data in terms of averages and standard deviations during the pre-IT and IT periods. Again, it is interesting to note that the volatility in the short-run interest rate has decreased during the IT period, while there is a smaller decrease in the volatility of the real economy. This evidence is only suggestive, however, because of the short duration of the IT period. In the next section I use econometric techniques to get a better understanding of how, if at all, the conduct of monetary policy has changed in South Africa.

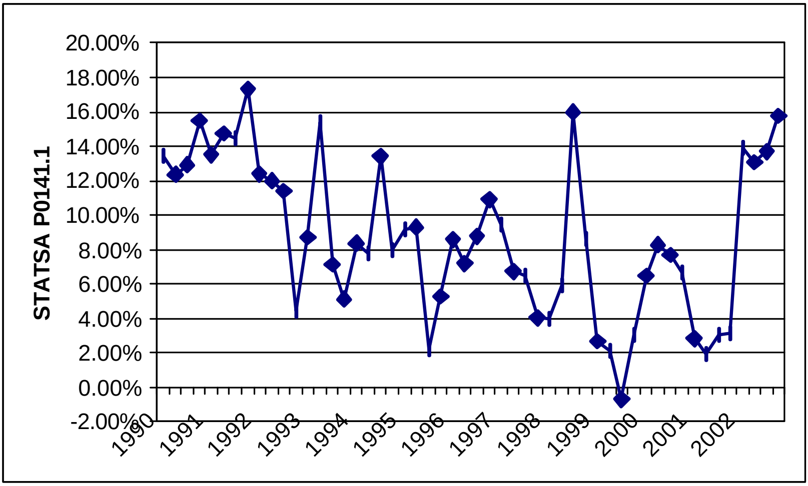

Figure 1. Quarterly Average Inflation

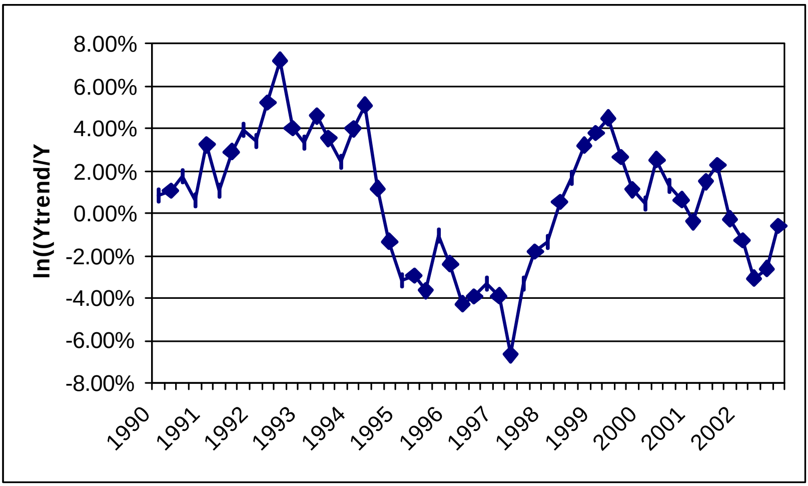

Figure 2. Quarterly Average Output Gap Output is the volume pf Production (SARB 7075N)

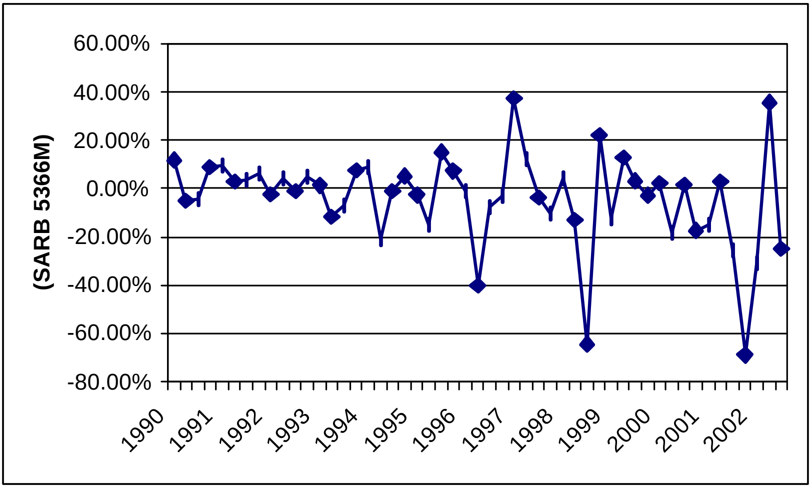

Figure 3. Quarterly Average Real Appreciation

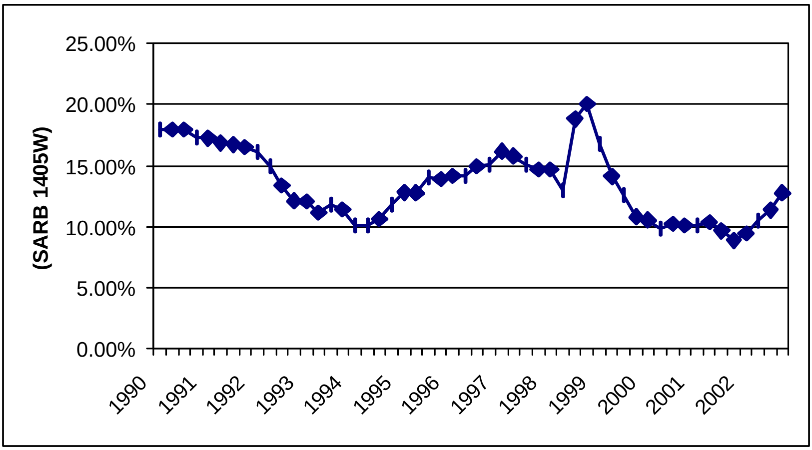

Figure 4. 3 Month Tbill Rates (First week of the Quarter)

Table 1. Volatility: Pre and Post IT

	1990:Q1-1999:Q4		2000:Q1-2002:Q4	
	Average	Std. Deviation	Average	Std. Deviation
	(1)	(2)	(3)	(4)
I	14.5%	2.6%	10.0%	0.7%
π	9.0%	4.5%	7.3%	4.5%
Gap	0.9%	3.3%	1.2%	1.9%
App	-1.0%	16.2%	-14.4%	26.1%

i the average Treasury Bill rate (Tbill) during the first week of a quarter.

π is the quarterly inflation rate expressed as an annual rate.
Gap is a measure of the output gap.
App is the real appreciation of the currency over the quarter expressed as an annual rate. (last observation is 2002:3)

2. TAYLOR RULES FOR SOUTH AFRICA

In discussing monetary policy rules it is important to distinguish between various types of policy rules: rules for policy targets and rules for policy instruments. A rule for a policy instrument specifies how the central bank will determine the value of its policy instrument, in most cases a short-run interest rate. A rule for the policy target specifies the objectives of monetary policy. For example, during the Greenspan era, the US Federal Reserve (Fed) has had neither a rule for policy objectives nor for its policy instrument, the federal funds interest rate. Instead, it uses discretion in setting the value of its policy instrument to achieve numerically unspecified objectives for real output and inflation. In contrast, during the 1970s the Fed followed self-imposed, numerical targets for the growth in the money supply[1], while it had no formal rule for setting its policy instrument. Other combinations of policy rules and discretion are also possible. For example, a fixed nominal exchange rate regime in a small open economy with perfect capital mobility is the case of a simultaneous rule for the policy instrument and the policy target.

1 Technically, the targets for money growth were described as intermediate policy targets, where the final policy objectives were price stability and full employment.

The policy objective of fixing the nominal exchange rate can only be achieved when changes in the policy instrument are solely determined by the continuous need to meet the policy target. An inflation target is a rule for the policy target. Inflation targets can be implemented with policy rules for the instrument or with discretion, as is the case in South Africa.

John Taylor (see his 1999 piece for a summary of this work), however, argued that, at least for the United States, the distinctions between a rule for the policy instrument and discretion might not be as great as people thought, and that this was a good thing. He showed that despite the Fed's complicated official pronouncements, with its unclear inflation and output objectives, variations in the Fed's policy instrument could be tracked by a simple 3 variable regression of the form[2]:

$$i_t = \alpha + \beta_1 i_{t-1} + \beta_2 \pi_{t-1} + \beta_3 Gap_{t-1} + e_t \qquad (1)$$

where i is a short-run nominal interest rate, the federal funds rate in the case of the US Fed, π is a measure of inflation, and Gap is a measure of the output gap. Given the Fed's legislated goals of price stability and full employment, one would expect that $\beta_2 > 0$, and $\beta_3 < 0$. The lagged interest rate appears in (1) because of the (somewhat controversial) tendency of central banks to try to "smooth" fluctuations in interest rates, their policy instrument. Note that, given the presence of the lagged interest rate, the long-run effect of an increase in inflation on the policy instrument is $\beta_2/(1-\beta_1)$. In order for monetary policy to stabilise the long-run inflation rate, one would expect that the long-run response of the nominal interest rate to inflation would be greater than one.

Thus while the Fed did not have a formal, explicit rule for the policy instrument, Taylor's findings suggested that they exercised their discretion over the policy instrument in a way that mimicked

2 The original Taylor rule for the Fed does not include a lagged interest rate, but for most central banks the presence of the lagged interest rate reflects preferences for interest rate smoothing.

a simple rule. Since Taylor's first demonstration, implicit Taylor rules have been estimated for many countries (see Neumann and von Hagen [2002]), and the theory of when an explicit Taylor rule would be an "optimal" way of conducting monetary policy has also evolved (see Clarida, Gali, and Gertler [1999]). This theory also includes how a central bank with an inflation target can usefully employ either an explicit or implicit Taylor rule. While clearly lagged inflation should affect the Taylor rule for an IT central bank, the output gap can also matter because of Phillips curve effects. Thus the general form of a Taylor rule could describe a variety of types of monetary policy regimes with different policy objectives, where the differences would show up in the size of the coefficients.

Laurence Ball [2000], however, has argued that for open economies the Taylor rule must be adjusted to take account of the real exchange rate. Ball proposes that for open economies the Taylor rule should be written as:

$$i_t = \alpha + \beta_1 i_{t-1} + \beta_2 \pi_{t-1} + \beta_3 Gap_{t-1} + \beta_4 App_{t-1} + e_t \qquad (2)$$

where App is the real appreciation of the currency. Theory suggests that β_4 should be negative for two reasons. Firstly as already noted, real depreciations (App <0) will feed through to inflation and therefore will require a contractionary monetary policy response. Secondly, in open economies a major way that monetary policy is transmitted to the real economy is through changes in the exchange rate. Thus, with everything else equal (an important qualifier), a real depreciation is associated with expansionary monetary policy. In fact, Ball argues that a monetary conditions index operating procedure can be implemented with the use of an "open economy" Taylor rule, such as (2).[3] In this case, β_4 will be larger (in absolute value) the more changes in the real exchange rate affect the "long-run rate of inflation - a

[3] See de Wet [2002] for a discussion of the monetary conditions index for the South African economy.

measure that filters out the transitory effects of exchange rate fluctuation." (Ball [2000], p.3).

Estimating a Taylor rule for South Africa during the pre-IT and IT periods should shed some light on the first question: Has IT affected the conduct of monetary policy? If IT "matters," one would expect the determinants of the policy instrument, as reflected in the implicit Taylor rule, would change. Exactly how the Taylor rule would change is less clear, but one can draw the following inferences. IT is supposed to make the conduct of monetary policy more consistent, which would suggest the explanatory power of the Taylor rule should increase with IT. To the extent that one views South African inflation as having significant cost push elements, one might also expect that the short and long-run responses to inflation should be larger with IT.

Table 2 Monthly Taylor Rules: Pre and Post IT

	Simple		**Open Economy**	
	(1)	(2)	(3)	(4)
	1990:1-1999:12	2000:1-2002:12	1990:1-1999:12	2000:1-2002:10
i_{-1}	0.94	0.78	0.94	0.91
	(33.6)	(13.4)	(33.6)	(7.3)
π_{-1}	0.025	0.039	0.023	0.041
	(2.0)	(2.5)	(1.7)	(2.2)
Gap_{-1}	-0.060	-0.118	-0.072	-0.099
	(2.1)	(2.5)	(2.7)	(1.7)
App_{-1}			-0.012	-0.002
			(2.5)	(0.6)
LR Response to Inflation	0.41	0.18	0.36	0.44
	(2.1)	(3.1)	(1.6)	(0.8)
Adj. R^2	0.93	0.89	0.93	0.87
Durbin's h	2.78**	0.37	1.49	0.62
Std Error of Reg	0.0069	0.0031	0.0066	0.0030
F test: econ. var	F(2,116)=2.44	F(2,32)=6.60	F(3,115)=5.97	F(3,29)=4.68
Chow Test	F(4,148) = 0.57		F(5,144) = 1.63	
Breakpoint 1998:10	F(4,148) = 6.55**		F(5,144) = 7.85**	

Dependent variable is the average 3 month Treasury Bill rate during the first week of the month. All the independent variables are lagged 1 month and the regressions contain a constant. Standard errors are calculated using Newey West procedures to account for the autocorrelation of the residuals; absolute "t" ratios are in parentheses

Table 2 presents estimates of simple and open economy Taylor rules for the pre-IT and IT periods using monthly observations on the basic data depicted in Figs 1-4. Note that all of the estimated coefficients have the expected *a priori* signs. The long-run responses to inflation are all below 1, but Mishkin (2002) has argued that this could be due to the measurement error of using past inflation instead of inflationary expectations which is what in fact the central bank is responding to.[4]

Thus, as with the US, the data suggest that the conduct of monetary policy in South Africa can usefully be characterised by an implicit Taylor rule. In addition, there are some interesting differences to note since the implementation of IT:

(i) The degree of interest rate smoothing appears to have decreased, (*i.e*., β_1 has fallen);

(ii) The short-run response to inflation appears to have increased (β_2 has increased);

(iii) The short-run response to real depreciations appears to have decreased and is not significantly different from zero in the IT period. The "F" tests for the economic variables (*i.e.*, p_{-1}, Gap_{-1}) and App_{-1}) tell a conflicting story, with the explanatory power of these variables increasing substantially in the IT period for the simple rule, but decreasing for the open economy rule. The first set of Chow tests suggests that monetary policy has been stable over these periods.

There are, however, a couple of problems with these estimates: Firstly, they assume the conduct of monetary policy changed once upon the announcement of the formal adoption of IT. Since the Reserve Bank had been contemplating such a change for over a year, it seems likely that any change in the conduct of monetary policy occurred prior to the formal adoption of IT. Secondly, it assumes that the conduct of monetary policy was constant *after* the adoption of the inflation target, whereas the conduct of monetary policy may have evolved with the experience of operating under an inflation target. Consequently, it seems

[4] All the estimated coefficients are within the range of coefficients for monthly Taylor rules reported by Neumann and von Hagen (2002). Their estimates are for 7 countries, 4 with inflation targets over two time periods.

important to let the data indicate when, if at all, the most recent change in the conduct of monetary policy occurred. Identifying unknown structural breaks in a regression can be accomplished by the so-called CUSUM tests developed by Brown, Durbin and Evans (1975). The CUSUM tests are based on the out-of-sample forecasting power of the regression as it is estimated over more and more of the sample period. Under the null hypothesis of structural stability, the size of these cumulated recursive residuals and their squared values should lie within a confidence interval calculated by Brown *et al.*.

In the current situation, one is interested in whether and when monetary policy changed to the *current* regime, where it is not clear when the previous regime or regimes started. Given this interest in the most recent shift in regimes, the CUSUM tests were run "backwards," where the model was first estimated with the most recent data and then earlier and earlier observations were added. The results of this test procedure for the simple Taylor rule are illustrated in Figs 5 and 6 (the results for the open economy Taylor rule are very similar). Both the CUSUM and CUMSUMSQ statistics are well below the upper confidence intervals for all of the most recent data until late 1998. In fact, there is a discrete jump in the CUSUM statistic in September of 1998 and the CUSUM statistic continues to rise until the June 1998 observation is added at which point the CUSUM statistic is fairly flat, and the CUSUMSQ graph displays a similar story. These results are not terribly surprising in light of Figs 3 and 4. The conduct of monetary policy was different after 1998 in that sharp real depreciations did not lead to sharp increases in interest rates. The second set of Chow tests in Table 2 confirms the fact that if the breakpoint for the two samples is chosen around the time of the Asian crisis there is a statistically significant break in the conduct of monetary policy as characterised by the Taylor rule, whether it is the simple Taylor rule or the open economy Taylor rule.[5]

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5 One must be careful in interpreting the Chow tests since the breakpoint

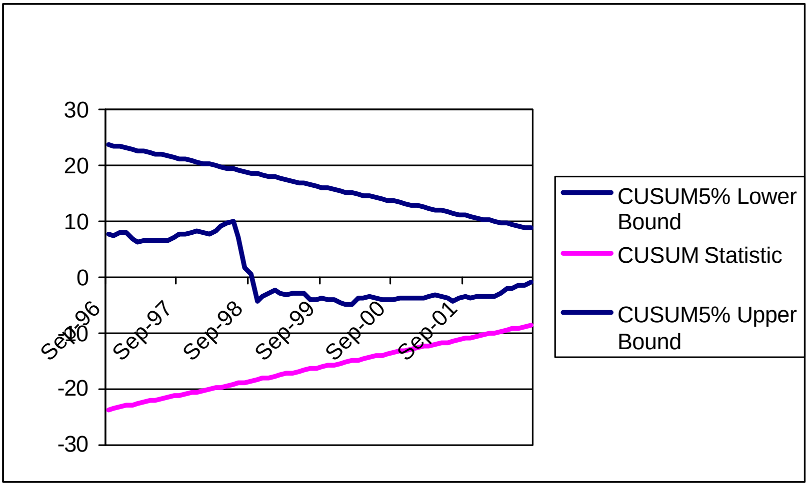

Figure 5. Cusum test

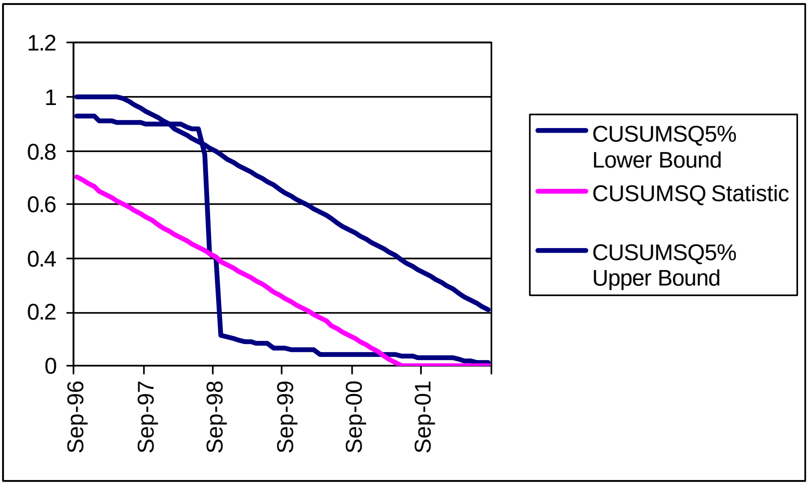

Figure 6. CusumsQ Test

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was selected on the basis of the CUSUM results. Notice, however, that the CUSUMSQ statistic crosses the upper 95 per cent confidence interval. In this sense the Chow tests are confirming the CUSUMSQ test.

The CUSUM tests are interesting, not only because they indicate the sharp break in policy in late 1998, but also because the test statistics are so stable *both* before and after the 1998 episode. This suggests that perhaps the monetary policy reaction to the Asian crisis was a one-off event in the midst of a more stable conduct of monetary policy. To test for this possibility the Taylor rules were reestimated for the pre and post Asian crisis periods, where the 6 months of the crisis period were excluded. The results of these estimates are displayed in Table 3.

Table 3. The Stability of the Policy Rule

	Simple Taylor Rules		**Open Econ Taylor Rules**	
	(1)	(2)	(3)	(4)
	1990:1-1998:6	1999:1-2002:12	1990:1-1998:6	1999:1-2002:10
i_{-1}	0.96 (54.0)	0.91 (39.9)	0.96 (52.5)	0.93 (27.7)
π_{-1}	0.015 (1.2)	0.023 (2.1)	0.016 (1.3)	0.035 (2.5)
Gap_{-1}	-0.030 (1.1)	-0.079 (2.1)	-0.036 (1.4)	-0.081 (1.6)
App_{-1}			-0.006 (1.0)	-0.001 (0.5)
LR Response to Inflation	0.34 (1.4)	0.26 (2.1)	0.42 (1.6)	0.52 (1.9)
Adj. R^2	0.97	0.97	0.97	0.97
Durbin's h	0.80	-0.12	0.33	-0.21
Std Error of Reg	0.0044	0.0033	0.0043	0.0033
F test: econ. var	F(2,98)=0.90	F(2,44)=7.68	F(3,97)=2.03	F(3,41)=7.05
Chow Test	F(4,142) = 1.75		F(5,138) = 1.59	

The first thing to note in this Table is that one still cannot reject the null hypothesis that the implicit Taylor policy rules guiding monetary policy were the same in the two periods. However, there are some interesting changes in the estimated coefficients.

The short-run response to inflation is bigger and significant in the more recent period, but because of less interest rate smoothing, the long-run response is smaller for the simple rule. For both rules, the output gap appears to be more important. In addition, it is interesting to note that for the open economy rule the estimated coefficient on the exchange rate is very small and insignificant in the IT period. Thus, the real exchange rate appears to have no effect on the conduct of monetary policy in the more recent period, independently of its effect on inflation.

Finally, it is important to note that the "F" test for the explanatory power of the economic variables in the Taylor rule increases substantially for both rules during the IT period. Thus in terms of the anticipated changes in the coefficients with the adoption of the IT framework the verdict is mixed from the results in Table 3:

(i) the short-run response to inflation is bigger, but the long-run response in one case is smaller;

(ii) the output gap appears to play a larger role during IT;

(iii) the real exchange rate appears to play a smaller or no role in monetary policy during IT;

(iv) the Treasury bill rate is more systematically related to the underlying economic variables.

Thus while the verdict is mixed, the results are generally supportive of the notion that IT has made the conduct of monetary policy more consistent.

Table 4 provides estimates of the simple Taylor rule using the measure of the CPI that the Reserve Bank actually targets (*i.e.*, CPIX), which is only available for the more recent period. The result that the real exchange rate does not have much impact on monetary policy is robust to the measure of inflation used (regressions not shown). The output gap is statistically significant and the size of the coefficient is larger than the comparable estimate in column (4) of Table 3.

Finally, it is interesting to note that the short and long-run responses to CPIX inflation are greater in Table 4 than the comparable estimates in Tables 2 and 3. This result is consistent with Mishkin's conjecture that the policy response to inflation will be larger the closer one gets to the actual measure of inflation or inflationary expectations that the policy maker is using in formulating policy.

Table 4. Estimated Taylor Rules with the CPIX Measure of Inflation

	Simple Taylor Rules	
	(1)	(2)
	1999:1-2002:12	2000:1-2002:12
i_{-1}	0.91	0.81
	(39.1)	(13.1)
π_{-1}	0.031	0.045
	(1.8)	(2.4)
Gap_{-1}	-0.100	-0.134
	(3.2)	(2.9)
LR Response to Inflation	0.35	0.23
	(1.9)	(2.8)
Adj. R^2	0.97	0.89
Durbin's h	0.10	1.75
Std Error of Reg	0.0034	0.0032
F test: econ. var	F(2,44)=7.25	F(2,32)=5.32

The monthly estimates are attractive because they provide more apparent degrees of freedom for the short IT period. The apparent number of degrees of freedom, however, may overstate the reality given the overlapping nature of the independent variables. While the standard errors have been adjusted to account for this, the Newey West procedures only provide consistent estimates of these standard errors and the sample sizes are not large. Consequently, it is important to check these results with comparable quarterly estimates, the results of which are provided in Tables 5 and 6.[6]

With one exception, the general conclusions from the quarterly estimates are similar to the monthly estimates:

(i) If the Asian crisis period is excluded, one cannot reject the null hypothesis of rule stability;

(ii) the exchange rate appears to be less important in the more recent period;

(iii) the coefficient on the output gap is significant and very slightly larger during the IT period;

6 To avoid the period of interest rate turbulence the first quarter of 1999 must also be excluded from the later period. The lagged dependent variable for the first quarter of 1999 is the Treasury bill rate on the first week of October 1998.

(iv) the coefficient on inflation is higher when CPIX is used in the place of CPI. The one result from the quarterly estimates that differs from the monthly estimates is the change in the coefficient on inflation. The short-run and long-run responses to inflation appear to be smaller in the IT period. In spite of this, however, the explanatory power of the economic variables as measured by the "F" statistic is higher during the IT period.

Table 5. Quarterly Policy Rule

	Simple		**Open Economy**	
	(1)	(2)	(3)	(4)
	1990:Q1-1998:Q2	1999:Q2-2002:Q4	1990:Q1-1998:Q2	1999:Q2-2002:Q4
i_{-1}	0.78	0.75	0.80	0.77
	(14.9)	(12.3)	(15.3)	12.2)
π_{-1}	0.134	0.091	0.130	0.095
	(4.0)	(2.8)	(4.0)	(2.9)
Gap_{-1}	-0.161	-0.162	-0.160	-0.164
	(5.0)	(2.0)	(5.1)	(2.1)
App_{-1}			-0.014	-0.005
			(1.8)	(1.2)
LR Response to Inflation	0.60	0.37	0.66	0.42
	(4.9)	(3.1)	(4.6)	(3.0)
Adj. R^2	0.94	0.92	0.95	0.93
Durbin's h	-0.61	-2.89**	-0.08	-2.65**
Std Error of Reg	0.0056	0.0038	0.0055	0.0039
F test: econ. var	F(2,30)=13.74	F(2,11)=19.16	F(3,29)=10.88	F(3,10)=13.70
Chow Test	F(4,44) = 1.13		F(5,39) = 0.91	

Dependent variable is the average 3 month Treasury Bill rate during the first week of the month.

Table 6. Quarterly Taylor Rules with the CPIX Measure of Inflation

	Simple	
	(1)	(2)
	1999:2-2002:4	2000:1-2002:4
i_{-1}	0.72	0.81
	(12.1)	(5.2)
π_{-1}	0.177	0.176
	(3.2)	(3.5)
Gap_{-1}	-0.170	-0.162
	(2.4)	(2.2)
LR Response to Inflation	0.63	0.92
	(3.9)	(2.1)
Adj. R^2	0.93	0.86
Durbin's h	-1.34	-1.34*
Std Error of Reg	0.0037	0.0032
F test: econ. var	F(2,11)=22.38	F(2,8)=23.10

Thus the answer to the first question is a cautious yes; IT has apparently changed the conduct of monetary policy. While the changes are not statistically significant, the combination of lagged inflation and the lagged output gap appear to have a stronger, more consistent effect on the short-term interest rate. In addition, the real exchange rate appears to play a much smaller (if any) role in the formulation of monetary policy. These apparent changes are consistent with the predictions of the proponents of the benefits of IT for monetary policy. In the next section, I use the term structure of interest rates to see whether financial market participants have perceived these changes in monetary policy, and thus to answer the second question: Has IT made monetary policy more transparent?

3. THE TRANSPARENCY OF MONETARY POLICY AS REFLECTED IN THE TERM STRUCTURE

In the Appendix, I show how the expectations hypothesis of the term structure of interest rates can be interpreted to imply that the current spread between yields on short and longer-term securities should help forecast future changes in short-term yields. The most basic of these equations, derived in the Appendix (A.3), is:

$$ss63_t = -\theta + s63_t + v_{t+1} + v_{t+2} + v_{t+3} + [\theta - \theta_t] \qquad (3)$$

where ss63 is one half of the subsequent change in the 3 month yield, three months in the future (sometimes called the perfect foresight spread) and s63 is the yield spread between 6 and 3 month negotiable certificates of deposits (CDs). θ is the average term premium on 6 month CDs relative to 3 month CDs, and the error term is the sum of the time variation in the term premium and forecast errors, the v's. These forecast errors are the sum of two kinds of shocks that occur after time *t*: unforeseen exogenous shocks to the economy and surprise changes in monetary policy. As a consequence, one would expect that the correlation between the yield spread and future changes in the interest rate would be higher the more consistent and the more transparent is the conduct of monetary policy for two reasons:

(i) Future changes in interest rates should be more predictable with a more transparent monetary policy; and

(ii) Monetary policy surprises should be less frequent with a more consistent monetary policy.

These predictions, however, may be hard to discern if there are changes in the variability of exogenous shocks hitting the economy or unrelated increases in the time variability of the term premium.[7]

Given the interest rate turbulence of the second half of 1998, the sample period for the term structure estimates was split into two periods, 1990:1-1998:3 and 1999:1-2002:11. The earlier period had to be shortened because ss63 includes the change in the interest rate 3 months into the future. A sample period after 1998:3 would have included changes in the 3 month rate during the period of extreme volatility.

The results of these estimates are given in Table 7, and these results are surprising. At least for the United States (see Campbell, Lo and McKinley [1997]), the forecasting power of the short end of the term structure is relatively modest and the estimated slope coefficients are very small. Coefficients close to or above one raise suspicion. One should note, however, that the correlation between the CD rates and Treasury bill rates is above 90 per cent during this period and that the results are not due to the overlapping nature of the error terms. If one uses non-overlapping observations measured at quarterly intervals, the results are very similar, including an estimated coefficient substantially above 1 that is statistically significantly different from zero in the most recent period, in spite of only 15 observations. In addition, note that simple Chow tests for the regressions in columns *(i)* and *(ii)* reject stable coefficients. The results of these regressions therefore must be viewed with some caution.

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[7] The idea to use the term structure to gauge the transparency of monetary policy is not new. See for example, Campbell, Lo and McKinley (1997)

Table 7. Simple Term Structure

	1990:1-1998:3	**1999:1-2002:11**
	(1)	(2)
s63	0.606	1.605
	(5.8)	(5.8)
Adj. R^2	0.18	0.43
Std Dev	0.37	0.49
Dependent Variable is ss63 = (y3(+3)-y3)/2		

Taken at face value the regressions are consistent with the view that changes in short-term interest rates have become more predictable in the more recent period. While these results are supportive of greater transparency in monetary policy, they are somewhat indirect because they do not relate the greater correlation to the more consistent policy. Transparency means that future changes in short-term interest rates should be more predictable on the basis of the incoming data upon which policy is based.

I try to test that hypothesis more directly by looking at what kind of information is contained in the yield spread, and the results are presented in Table 8. These regressions compare the explanatory power of the incoming economic data to the yield spread in predicting the change of the 3 month CD rate, 3 months in the future. Columns (1) and (3) indicate that the incoming economic data (including the current yield) do have statistically significant explanatory power for the change in the 3 month CD rate. In addition, the signs of the coefficients on the economic variables are identical to the expected coefficients in the Taylor rule equations.[8] Finally, note that the incoming economic data have little explanatory power in the earlier period, but much more in the recent period, another result that is consistent with greater

8 Note that ss63 = (y3(+3)-y3)/2, and that y3 is also an independent variable. Therefore, this regression is identical to the regression of y3(+3) on y3 and the other independent variables, which is more similar to the Taylor rule regressions. The coefficients on the latter regression are twice the value of the regressions in Tables 8, with the exception of the coefficient on y3 which is one plus twice the coefficient of the regressions in Table 8.

monetary policy transparency.

Table 8. The Predictability of Future Interest Rates

	1990:1-1998:3		**1999:1-2002:11**	
			CPIX	
	(1)	(2)	(3)	(4)
s63		0.545		0.111
		(4.9)		(0.5)
y3	-0.061	-0.030	-0.172	-0.165
	(2.5)	(1.5)	(7.9)	(7.7)
π_{-1}	0.011	0.004	0.098	0.092
	(0.9)	(0.3)	(5.2)	(4.3)
Gap_{-1}	-0.033	0.008	-0.067	-0.067
	(1.5)	(0.4)	(2.2)	(2.2)
App_{-1}	-0.001	0.000	-0.004	-0.004
	(0.5)	(0.1)	(3.2)	(3.1)
Adj. R^2	0.08	0.18	0.81	0.75
Std Dev	0.37	0.37	0.49	0.49
F test : econ. var		F(4,93)=0.92		F(4,41)=23.41**
Dependent Variable is ss63 = (y3(+3)-y3)/2				

There is, however, one major difference between the open economy Taylor rule regressions in columns 3 and 4 of Tables 3 and 5 and the regressions in columns (1) and (3) of Table 8. In the Taylor rule specifications, the coefficient on real appreciations and its associated "t" statistic are lower (in absolute value) in the earlier period than they are in the later period. In Table 8, the reverse is true.[9] Thus, the earlier conclusion that the exchange rate appears to be playing little or no role in recent monetary policy is not robust. More likely, the timing of the response to exchange rate movements has changed, and this change in timing cannot be picked up in the simple lag structure of either Tables 3, 5 or 8.

The results in columns (2) and (4) are also dramatic. In the earlier period, one cannot reject the hypothesis that all of the explanatory power of the incoming economic data is contained in the yield spread. Thus in the earlier period, one cannot reject the efficient markets hypothesis: the current yield spread incorporates all the information for future changes in yields that is in the current yield, *i.e.* lagged inflation, the lagged output gap and lagged

[9] This result is still true if one uses Tbill rates instead of CD rates in the regressions

real appreciations. In the latter period, however, this is not the case. In spite of the apparently more consistent monetary policy, the yield spread does not reflect all of the information in incoming economic data (F statistic over 20). Thus the answer to the second question is more complex: Future changes in interest rates appear to have become more predictable, but it is not clear that financial markets are exploiting fully the information that monetary policy makers are in fact using to set interest rates.

The fact that monetary policy has not been completely transparent in the most recent period is undoubtedly due in part to the turbulent movement in the exchange rate. Recall that the real exchange rate started to fall in May of 2001 and reached its low point in December of that year. During this same time period, however, the Treasury Bill rate fell by over 1 percentage point. Given the contrast of this policy response with the monetary policy response of 1998, it is not surprising that financial market participants were confused. Even the regressions of Tables 3 and 5 in contrast to Table 8 imply a confusing role for the exchange rate.

The Monetary Policy Committee of the Reserve Bank tried to clarify the conduct of Monetary Policy in its March 2003 statement (Mboweni [2003]). They argued that there were 4 reasons for the acceleration of inflation during 2002:

(i) The depreciation of the rand;
(ii) food price increases;
(iii) increases in oil prices; and
(iv) increases in administered prices.

They then concluded that:

"This brief exposition of the major reasons why the inflation target was not met during 2002 indicate that it was largely due to extraordinary events that could not be foreseen and which were beyond the control or influence of monetary policy."

I believe that this diagnosis is accurate, but its publication was not timely and led to unnecessary confusion:

"At the beginning of 2002, when it had already become apparent that the inflation target would not be met, the Reserve Bank considered whether to make use of the escape clause, which recognises circumstances which could temporarily lead to deviations from the target. In the end the Bank decided that *it would be unwise to make use of this clause*. Continued monetary discipline was regarded as essential for price stability and high economic growth. (Mboweni [2003], emphasis added)"

This statement begs the questions of what constitutes an "escape clause," and under what circumstances would it ever be invoked? Three of the four reasons the Reserve Bank cite for the acceleration of inflation are classic reasons for temporarily abandoning an inflation target. If these conditions were not sufficient to invoke the escape clause, what conditions would be? More importantly, however, the Reserve Bank's insistence that it did not invoke the escape clause is a semantic argument. The Monetary Policy Committee Statement makes it clear that during 2002, the policy instrument was not being set with any hope of achieving the inflation target. There may not have been an explicit public invocation of the escape clause, but monetary policy was not following an inflation target during 2002.

In addition, the Reserve Bank seems to be equating invoking the escape clause with the abandonment of monetary discipline, which is an unfortunate polarization of two regimes. Clearly, it is possible to invoke the escape clause while maintaining a disciplined monetary policy, and this fact can be communicated. In order to accomplish this, however, one would need to announce how monetary policy would be conducted during the interim period when the inflation target would be breached. More specifically, policymakers would need to specify the indicators they would monitor during the interim period to keep the unusual, unforeseen factors of 2002 from feeding into inflationary expectations in 2003. Possible candidates for temporary indicators include the price of domestic goods, unit labour costs, and various sub categories within the CPIX index.

4. CONCLUSIONS

As opposed to the other countries that have adopted an inflation target, South Africa has not enjoyed the luxury of relatively calm macroeconomic conditions during the targeting period. Instead, the inflation target has been challenged by a number of external shocks that have led to real depreciations largely outside the control of monetary policy. In my view the Reserve Bank has acted flexibly and wisely in responding to these shocks. They have taken seriously the qualifier in their Constitutional mandate "to protect the value of the currency of the Republic *in the interest of balanced and sustainable economic growth*." And up to the present, this flexibility has led to only a small price in terms of the transparency and credibility of monetary policy, in spite of the fact that the targets for inflation have not been met.

As this paper has documented, inflation targeting has led to modest changes in the conduct of monetary policy, and policy appears to have been conducted more systematically on the basis of information from past inflation and the output gap. The role of the exchange rate in current monetary policy making, however, is less clear and the source of some apparent confusion. In addition, because of the Bank's flexible approach toward real depreciations the credibility of the inflation target has also probably fallen. (Unit labour costs accelerated from the 5.5 per cent range in the first half of 2002 to over 11 per cent in the third quarter.)

Inflation targeting is intended to provide benefits in terms of a credible commitment to controlling inflation along with a more consistent and predictable conduct of monetary policy. In order to preserve these benefits, some changes in the targeting procedure seem called for. In particular, it would be desirable to make the Reserve Bank's flexible response to exchange rate movements more transparent. This could be accomplished if the Reserve Bank would be more willing to invoke explicitly (as opposed to implicitly and in private) the escape clause and to communicate how policy will be guided in the interim.

Appendix: Data and Methods

All data except for the CPI were taken from the Reserve Bank of South Africa's Web site. For the Taylor rule the basic data were: the 3 month Treasury bill rate (SARB Series # 1405W) for the short-term interest rate; the real effective exchange rate (5366M) for the real exchange rate, ε, and the volume of manufacturing production (7075N) for the measure of output, Y. For the term structure equations, the annual interest rates on 3 month and 6 month negotiable certificates of deposits (1411W and 1412W) were the basic data for measuring yields, y. CPI data were taken from the Statistics South Africa Web site. CPI is the consumer price index for all items in metropolitan areas and CPIX is the same index excluding mortgage interest rates.

The output gap is the natural log of the ratio of trend output, Y^T, to real output, Y. Trend real output was estimated using a Hodrick-Prescott filter on the monthly output data using the recommended value of 14,400 for the smoothing parameter λ. Fig. 7 shows the trend output and actual output that results from this procedure. The quarterly average of the output gap was used in the estimates of the Taylor rule.

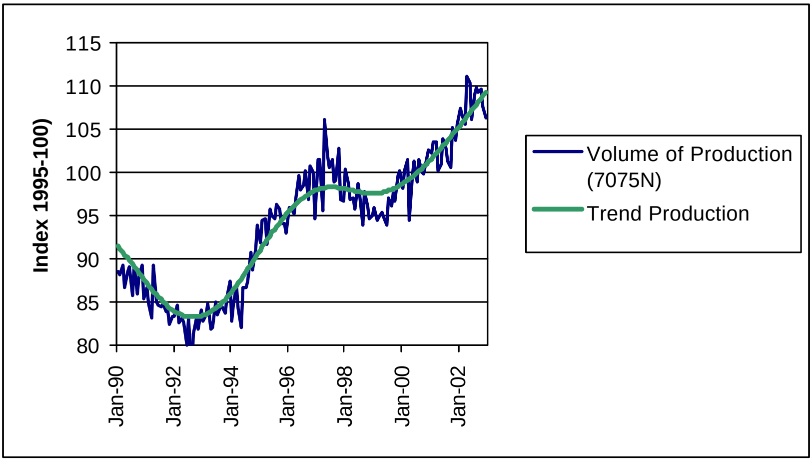

Figure 7. Hodrick-Prescott Filter (λ= 14,400) and the Real Output Gap .

Inflation rates were measured as continuously compounded annual rates. So for example, an annual inflation rate for January of 2000 equals $\ln(CPI_{1/2000}) - \ln(CPI_{1/1999})$. The quarterly inflation rate for January 2000 is $4[\ln(CPI_{1/2000}) - \ln(CPI_{10/1999})]$. Quarterly real appreciation rates were calculated in a similar way, with the real effective exchange rate taking the place of the CPI.

The policy instrument was taken to be the first week of the month's value for the 3 month Treasury bill rate. Therefore, the Taylor rule equation for the January 2000 observation can be written as:

(A.1)

$$Tbill_{1/1/2000} = \alpha + \beta_1 Tbill_{1/12/1999} + \beta_2 4[\ln(CPI_{12/1999}) - \ln(CPI_{9/1999})]$$
$$+ \beta_3[\ln(Y^T/Y)_{12/1999} + \ln(Y^T/Y)_{11/1999} + \ln(Y^T/Y)_{10/1999}]/3$$
$$+ \beta_4 4[[\ln(\varepsilon_{12/1999}) - \ln(\varepsilon_{9/1999})] + e_{1/2000}$$

The quarterly data for estimating Taylor rules were derived by transforming all of the basic data into quarterly averages with the exception of the bill rate. The quarterly averages were then transformed into continuously compounded annual rates for inflation and the real appreciation. Trend output was estimated from applying a Hodrick-Prescott filter with λ equal to 1,600 to the quarterly average of the output measure. The bill rate was taken as the bill rate on the first week of the quarter. The equations were also estimated with real GDP as the measure of output, but this measure of the output gap consistently was less significant.

The choice of using CD rates to measure the term structure was based on data availability, but the 3 month CD rate is highly correlated with the 3 month Tbill rate. The correlation coefficient between the first differences of the bill rate and CD rate is over 0.9 during the sample period.

Notice, also that measuring interest rates in terms of continuously compounded rates (i.e. $y = \ln(1+i)$, where i is the annual interest rate) avoids the non-linearities due to compounding. For example, the expectations hypothesis of the yield curve can be expressed as:

(A.2) $$y6_t = [y3_t + E(y3_{t+3})]/2 + \theta_t,$$

where time is measured in months, θ_t is the term premium on 6 month CDs relative to 3 month CDs, and the expectation is measured at time t. The assumption of rational expectations implies $E(y3_{t+3}) = y3_{t+3} - 2[v_{t+1} + v_{t+2} + v_{t+3}]$, where v_{t+i} reflects new information, or "shocks" that are uncorrelated with any information at time t. Note that these shocks can come both from exogenous factors and from monetary policy surprises. Using the rational expectations hypothesis allows one to write (A.2) as:

(A.3)

$$y6_t = [y3_t + y3_{t+3}]/2 - v_{t+1} - v_{t+2} - v_{t+3} + \theta_t \text{ , or}$$
$$(y3_{t+3} - y3_t)/2 = (y6-y3)_t + v_{t+1} + v_{t+2} + v_{t+3} - \theta_t$$
$$\Delta y3_{t+3}/2 = -\theta + (y6-y3)_t + v_{t+1} + v_{t+2} + v_{t+3} + [\theta - \theta_t]\text{, or}$$
$$ss63_t = -\theta + s63_t + v_{t+1} + v_{t+2} + v_{t+3} + [\theta - \theta_t]$$

where $s63_t$ is the current yield spread, $(y6\text{-}y3)_t$, and ss63 is the subsequent change in the 3 month rate, $\Delta y3_{t+3}/2$ (sometimes called the perfect foresight spread), and θ is the average term premium. The last line above expresses the expectations hypothesis in terms of an important implication: the slope of the term structure is a forecast of future changes in short-term interest rates. Using (A.3) as the basis of a regression highlights the fact that with overlapping monthly data on 3 month yields, the error term has a 3 period moving average component by construction. At a minimum this requires adjusting the standard errors to take account of the autocorrelation of the error terms. This can be done using the Newey-West procedure, but it is important to note that the resulting standard errors are only consistent, and the small sample properties of these estimates may be very different (See, for example, Campbell *et al* [1997])

REFERENCES

BALL, L (2000): "Policy Rules and External Shocks," *NBER Working Paper* 7910

CASTELEIJN, AJH (1999): "The Viability of Implementing an Inflation Targeting Monetary Policy Framework in South Africa," *South African Reserve Bank Quarterly Economic Review*, June.

CAMPBELL, J, A. LO AND A MCKINLEY(1997), *The Econometrics of Financial Markets*:: Princeton: Princeton University Press

DE WET, W (2002): "Coping with Inflation and Exchange Rate Shocks in the South African Economy," *South African Journal of Economics*, v70(1): p. 78-94.

JONSSON, G (1999): "The Relative Merits and Implications of Inflation Targeting for South Africa," *IMF Working Paper*.

MBOWENI, T. (2002): "Governor's Address at the Bureau of Economic Research," South African Reserve Bank, 11 November.

______ (2003): "Statement of the Monetary Policy Committee," South African Reserve Bank 20 March.

NEUMANN, J, AND J. VON Hagen, (2002) "Does Inflation Targeting Matter? " Federal Reserve Bank of Saint Louis, *Review*, (July-August 2002), 127-48.

MISHKIN, F, (2002) "Commentary " Federal Reserve Bank of Saint Louis, *Review*, (July-August 2002), 127-48.

WOGLOM, G (2000): Inflation Targeting in South Africa: a VAR Approach, " *Journal for Studies in Economics and Econometrics* v24, n2 (August 2000): 1-18.