

SOUTH AFRICA'S INFLATION DYNAMICS: IMPLICATIONS FOR POLICY¹

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At this juncture monetary policy in South Africa is aimed at reducing inflation and improving international competitiveness. A framework of inflation targeting is used. The rate of inflation in South Africa remains above the rates of the country's main trading partners, namely Germany, Japan, the UK and the USA. There is therefore a need to determine the extent to which the South African Reserve Bank (SARB) can combat inflation with the traditional instruments of monetary policy such as the money supply and interest rates.

A study of the determinants of inflation in South Africa is a good starting-point for investigating ways in which inflation can be combated. An understanding of the forces driving and perpetuating inflation in South Africa should shed light on the SARB's control over the inflation process and the relative efficacy of alternative monetary policy frameworks and instruments.

The following monetary and structural determinants of inflation in South Africa are investigated in this study:

- The extent and significance of the pass-through of changes in foreign prices and the exchange rate to domestic prices in South Africa. This is to shed light on the desirability, or otherwise, of the policy of achieving inflation parity with the country's main trading partners.
- The link between the growth of the money supply and price formation in South Africa. This issue is closely related to the extent of demand-pull inflation in the economy.
- The extent of the wage-push inflation in South Africa. This is an important issue in the South African context, where the labour market is characterised by a powerful and highly centralised union movement, highly unequal distributions of income and wealth, and widespread poverty even among full-time workers in a number of sectors.

The remainder of the paper comprises five sections. Section 1 provides background information on trends in inflation and monetary policies in South Africa from 1960 to 1999. The theoretical and empirical literature on the determinants of inflation is reviewed in Section 2. Section 3 sets out the data sources and the salient features of the model adopted. The results are presented in Section 4. The final section discusses policy implications.

1. TRENDS IN INFLATION AND MONETARY POLICY, 1960-1999

(a) Trends in Inflation

Figure 1 shows trends in inflation, expressed as the annual percentage change in the consumer price index (CPI). Inflation was relatively low until the early 1970s, averaging 2.5% during the 1960s. It subsequently accelerated and entered the double-digit range in 1973. During the 1970s, the average inflation rate was 10.3%. After a period of relative stability around a level of 11% in the late 1970s, inflation rose again in the early 1980s. The 1980s were characterised by high, but

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relatively stable rates of inflation ranging from 11.5 to 18.6%. The average inflation rate for the decade was 14.7%. Inflation subsided significantly in the early part of the 1990s. After peaking in 1986, the rate of inflation began decreasing and in 1993 it dropped to beneath 10%. It subsequently decreased further to 5.2% in 1999. On average, consumer prices rose by 9.3% during the 1990s.

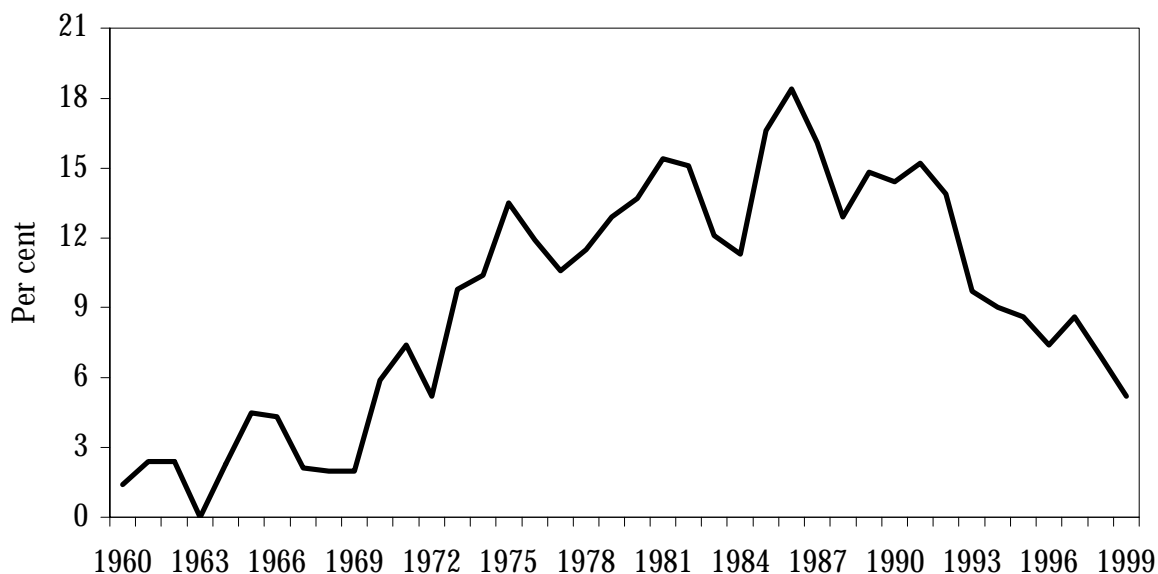


Figure 1: Consumer price inflation in South Africa, 1960-1999

The SARB (1996) has attributed the slow-down in inflation during the first half of the 1990s to the consistent application of conservative monetary policy since the late 1980s and the impact of the drawn out recession of 1989-1993 on inflation expectations and wage settlements. These factors were supported by the relative price stability in South Africa's main trading partner countries and a somewhat more stable exchange rate of the Rand.

During the past four decades inflation in South Africa seldom entered the moderate range, defined by Dornbusch and Fischer (1993: 11) as persistent annual rates of price increases ranging between 15 and 30%. Table 1 provides a comparison of inflation rates in South Africa and its main trading partners. The table shows that the inflation rate in South Africa remains considerably higher than the inflation rates of the country's main trading partners.

Table 1: Inflation rates for South Africa and major trading partners, 1980-1999

Country	Average annual rate (%)		1999
	1980-1990	1990-1998	
South Africa	14.8	9.1	5.2
<i>Trading partners:</i>			
Germany	-	2.4	0.6
Japan	1.7	0.9	-0.3
United Kingdom	5.8	2.9	1.6
United States of America	4.2	2.7	2.2

Source: World Bank (2001a; 2000b).

(b) The evolution of monetary policy

In South Africa, the main instruments of monetary policy are the money supply and interest rates. Figure 2 shows the annual rates of growth in the broad money supply or M3. For the period from 1986 onwards, the figure also shows the SARB's guideline ranges for M3 growth.

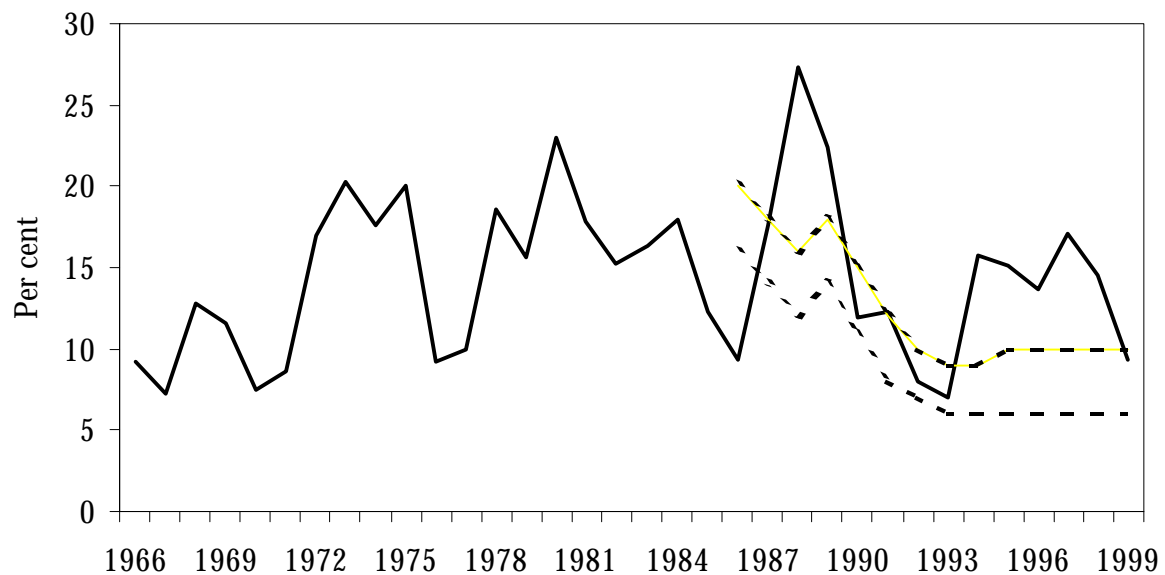


Figure 2: Growth in broad money supply (M3) in South Africa, 1966-1999

Interest rates were relatively stable and, in real terms, negative for most of the 1970s (cf. Whittaker, 1992: 60-63), and were therefore not intensively used as instruments of monetary control. Instead, various forms of credit ceilings were used to bolster the authorities' control over the monetary aggregates. The direct controls were ineffective instruments for curbing money supply growth and for preventing the rise in inflation. Moreover, the controls had a distorting impact on measured money supply growth as disintermediation became pervasive.

It was in the milieu of rising inflation and growing dissatisfaction with the prevalent system of monetary control that the De Kock Commission was appointed in August 1977. The recommendations of the De Kock Commission led to a series of monetary policy reforms from 1979 onwards. The most important reform was the replacement of the system of direct controls by a cash reserve system based on the central bank's powers to strongly influence market interest rates. Under this system, the central bank determined the price at which it provided cash reserves to banks and money market institutions by means of its accommodation procedures at the discount window (Meijer, 1988: 12). In so doing, it attempted to influence private sector behaviour by means of price or interest rate incentives.

The recommendations of the De Kock Commission also led to the introduction of monetary targeting in 1986. From the start, the targets were applied in a flexible manner, and in 1991 they were officially renamed "guidelines" to avoid the impression that they represented forecasts of or binding commitments to rates of monetary expansion.

The second half of the 1990s saw a comprehensive overhaul of the monetary policy framework. The accommodation system, which had been adapted several times (notably in 1993), was

replaced by the so-called repo system in March 1998. Under the new system, Bank rate was replaced by repo rates, which are the outcome of a process whereby banks enter into repurchase agreements in respect of various securities sold by tender to the Reserve Bank on a daily or intra-day basis for the purpose of acquiring liquidity. In principle, the main advantage of the repo system is its greater flexibility, which enables market conditions to exert a stronger influence on interest rates than under the previous system³. However, the Reserve Bank can still control interest rates by providing insufficient liquidity.

As was the case in many other countries, South Africa experienced serious problems with monetary targeting, including difficulty in controlling the money supply. Figure 2 shows that the targets were seldom met, and the discrepancies between guidelines and actual money supply growth increased sharply in the 1990s as South Africa's reintegration into the international financial system accelerated. Furthermore, the relationships between money supply growth and ultimate policy objectives (e.g. reducing inflation) proved to be highly unstable. In a recent empirical study, Moll (1999: 59) concluded that no "close and reliable relationship between broad money and real and nominal variables can be uncovered." The decision to adopt formal inflation targeting was taken in 1999, and the new monetary policy framework was introduced in February 2000. The target was specified as the achievement of an average rate of increase in the overall consumer price index, excluding mortgage interest cost, of between 3 and 6% for the year 2002.

2. REVIEW OF RELEVANT LITERATURE

The determinants and economic impact of inflation are discussed widely in the literature. Some of the most often cited factors influencing inflation are connected with the exchange rate regime, or are monetary in nature and highlight the importance of the money supply and of policies aimed at controlling money supply growth. Other models emphasise structural factors, such as market imperfections and cost pressures (including those of import prices), whereas yet other models emphasise demand pressures (these include the cost of government services and expenditures, the amount of revenue collected, debt and debt servicing, *et cetera*). Greene (1989) provides a review of empirical models used to explain inflation in African countries.

(a) The purchasing power parity approach

The simplest approach to price determination in an open economy is that of purchasing power parity (PPP). The evidence on the validity of the PPP theory for less developed countries (LDCs) is mixed (Boyd and Smith, 1999). The PPP theory tends to perform better for countries that are geographically close to each other and where trade links are strong. It also appears to work well for high inflation countries such as many in Latin America that have witnessed rapid exchange rate depreciations (Mahdavi and Zou, 1994; McNown and Wallace, 1989). Holmes's (2000) study covering 27 African LDCs, over the 1974-1997 period, confirms the PPP theory with additional evidence to support its prevalence in the case of high inflation LDCs.

Agenor and Montiel (1996: 305) point out that the exchange rate may have a short-term impact on inflation in small, open developing countries. Exchange rate depreciation directly affects the prices (in domestic currency units) of tradable goods, but may also indirectly affect the general price level if pricing decisions are affected by the cost of imported inputs. Moreover, if nominal wages are explicitly or implicitly indexed, exchange rate depreciation may lead to higher nominal wages.

³ In practice, the repo system has been characterised by certain weaknesses. The recently announced proposals to improve the functioning of the system (cf. South African Reserve Bank, 2001b) will not change its basic features.

(b) The monetarist approach to the determinants of inflation

According to the monetarists, inflation is a domestic monetary phenomenon which comes about when the central bank increases the money supply in excess of the demand for money. Such increases in money supply can be caused by the monetary financing of fiscal deficits or by extending too much credit to the private sector. Monetarists see the short term solution to inflation as the implementation of a contractionary or restrictive monetary policy. The modern literature on inflationary financing of budget deficits builds on the work of Cagan (1956) and Bailey (1956). Recent contributions include the model by Dornbusch and Reynoso (1993) and a review of the literature by Dornbusch and Fischer (1993).

In practice, inflationary financing of budget deficits and exchange rate depreciation may interact to produce a devaluation-inflation spiral. Following Rodriguez (1978), Agenor and Montiel (1996: 305) show how efforts by the central bank to finance fiscal deficits by means of money creation may raise prices and erode foreign reserves. This may lead to devaluation if the central bank has limited access to borrowing in the international capital markets.

(c) Structuralist models of the determinants of inflation

Structuralist economists distinguish between basic (or structural) inflationary pressures and mechanisms that transmit or propagate such pressures (see Kirkpatrick and Nixon, 1987: 176-177). Key structural bottlenecks identified include distorting government policies, the conflicts between capitalists and workers over the distribution of income between profits and real wages (Agenor and Montiel, 1996: 298-299), the inelastic supply of foodstuffs, the foreign exchange constraint and the government budget constraint. The mechanism that propagates inflation is therefore the efforts by social classes and/or sectors to maintain their relative positions in the face of price increases (Kirkpatrick and Nixon, 1987: 177). One of the best-known structuralist models of inflation was developed by Cardoso (1981).

(d) Structuralist-monetarist models of the determinants of inflation

In recent years, several authors have developed models with both monetarist and structuralist features by directly augmenting the monetarist approach with cost-push factors. One approach has been to model the fiscal deficit as the original force and the propagating mechanism in the inflationary process (e.g. Aghevli and Khan, 1978). Others introduce inherently structuralist features into monetarist models (e.g. Corbo, 1985; Chhibber, 1992; Sowa and Kwaye, 1993; Jha, 1994: 224-227; Adam, 1995; Ross, 1998; Durevall and Ndung'u, 1999; Ndung'u and Ngugi, 1999). Others account for money supply dynamics in structuralist models (e.g. Agenor and Montiel, 1996: 311-314).

(d) Earlier research on the determinants of inflation in South Africa

The determinants of inflation in South Africa have been studied before, but advances in econometric techniques and the availability of a longer data series make this an opportune time to revisit the issue. Truu (1975) emphasised the structural nature of inflation in the country and the causal role of imbalances between claims and resources. By contrast, Strydom (1976) and Strydom and Steenkamp (1976) concluded that the 1960s were characterised by demand-pull inflation accompanied by monetary expansion, whereas the acceleration of inflation during the early 1970s mainly reflected cost-push factors related to successive devaluations of the Rand. In their view, the experience of South Africa during the early 1970s was an example of the familiar vicious circle resulting from inflationary devaluation of the currency. Strydom (1976) argued that

other institutional factors such as wage pressures, non-competitive market structures and increases in indirect taxes were related to the inflationary process during this period, but were not the main causal factors behind the acceleration of inflation in the early 1970s.

Dollery (1984) and Fourie (1984) investigated the applicability of the administered price hypothesis in the South African context and found that prices in concentrated sectors of the economy respond at a slower or the same tempo to demand increases as in less-concentrated sectors. Both authors pointed out that the relatively concentrated nature of economic activity in South Africa and the consequent moderate responsiveness of prices to demand conditions may hamper the effectiveness of anti-inflationary demand policies. Fourie (1991) confirmed this finding in a later study using better data.

The final report of the De Kock Commission (1985) emphasised the monetary causes of inflation in South Africa. Alternative causes such as salary and wage increases in excess of productivity growth, inadequate competition, tax increases and imported inflation were found to have had a much smaller effect on inflation. The Commission's analysis was criticised by, *inter alia*, Mohr (1986) on methodological and analytical grounds. He argued that the Commission's strong bias for monetarist views precluded an objective analysis of the determinants of inflation in South Africa, and that the Commission's method of analysing the impact of each potential cause in isolation is weak. In his view, a process approach which takes cognisance of the linkages between factors would have yielded more sensible results. Similarly, Moore and Smit (1986) provided econometric evidence to show that wage increases have had a powerful impact on inflation in South Africa.

De Wet and associates (1987) also found that wage increases contributed to the structural acceleration and cyclical upward movements of the inflation rate. They also emphasised the inflationary impact of rising import prices, intersectoral productivity differences not reflected in relative levels of remuneration and market distortions such as administered prices, markets characterised by low levels of competition, and increases in indirect taxes. Their study indicated that fiscal and monetary factors had contributed to cyclical movements in inflation, but had not been major determinants of its secular upward trend.

Recently, Pretorius and Smal (1994) confirmed that changes in labour costs, largely driven by inflation expectations, are crucial elements influencing prices in South Africa. The cost of imported goods was identified as another important variable, although its importance decreased after 1989 when exchange rate movements became less volatile.

Fedderke and Schaling (2000) employed an expectations-augmented Phillips curve framework to investigate the link between inflation, unit labour cost, the output gap, the real exchange rate and inflation expectations. They found robust evidence for mark-up behaviour of output prices over unit labour costs. They estimated the mark-up to be about 30%, three times as high as was found for the United States by other authors.

The public finances are a considerably less important cause of inflation in South Africa than in many other developing countries. On the whole, the Government's financing practices have been prudent. Until 1989, insurance companies and pension funds were compelled to invest heavily in government paper by a system of prescribed asset requirements. This created a captive market for such paper which significantly reduced the Government's dependence on inflationary financing options. Studies by Abedian and Abrahams (1996a; 1996b) confirm the limited impact on inflation of fiscal policy in South Africa.

3. THE MODEL DEVELOPED IN THE STUDY

(a) Data Sources

Quarterly secondary data series, covering the period 1970:01 to 2000:02, on nominal as well as real gross domestic product in 1995 prices (Y), the broad definition of money stock, M3 (M), the nominal interest rate, i (commercial banks' lending rate), the consumer price index, CPI (P), unit labour costs (Wc), and the nominal effective exchange rate (E) were sourced from the electronic database of the SARB (SARB 2001c).

The underlying consumer price index (CPI), which excludes highly volatile food prices and housing costs, is used in the study as opposed to the headline consumer price index. For the period 1970:01-1974:04, the series was defined as the headline consumer price index net of housing costs. From 1975:01 onwards, we defined the index as the headline consumer price index excluding food and non-alcoholic beverages, home owner's costs and value-added tax. Akinboade, Siebrits and Niedermeier (2001) discuss the construction of the nominal effective exchange rate and the index of foreign prices (P^f) used here.

(b) The Model

The overall inflation model estimated in this study is as follows (logarithms are represented as lower-case letters):

$$p = f_1(p^f + e) + f_2 wc + f_3(m/p_{-1}) + f_4 i + f_5 p^e + f_6 y + Di \quad (1)$$

Three dummy variables (Dppp, Dmd and Dwc) were introduced to capture the structural breaks associated with the effects of the 1985 debt standstill, the 1987 global stock market crash and the 1998 Asian crisis. These are determined by the respective shocks highlighted by the residuals of the variables following a Recursive Least Squares estimation. These shocks could have affected the real exchange rate, the nominal interest rate and the domestic price level. The dummy variables (Di) take the value of 1 for each quarter during the periods 1985 (for the PPP relationship), 1987 and 1998 onwards (for the money demand relationship), or zero otherwise. In the labour market relationship the dummy variable takes the value of 1 for the period 1983-84, when a series of politically inspired strikes took place, and from 1998 onwards, when the rate of change in nominal unit labour costs slowed sharply as employers reacted to intensified international competition by controlling labour costs, or zero otherwise.

The model enables us to identify the basic sources of inflation in South Africa. It is expected that the partial derivatives of price with respect to M, W and P^f will be positive. Increases in the supply of money, foreign prices and the non-agricultural wage rate as well as decreases in the exchange rate and the interest rate are expected to generate inflationary pressures. However, since increases in real output ease demand pressure, inflation is anticipated to be a decreasing function of Y. It is also expected that a high inflation rate for a previous year may be built into wage negotiations, thus resulting in an inflationary spiral.

4. PRESENTATION AND ANALYSIS OF RESULTS

(a) Time-series Properties of Data used

Comparing the unit root test statistics with their corresponding critical values suggests that all the variables are I(1). All the series are non-stationary in levels but stationary in first differences. We employed the use of a structural vector autoregression (VAR) model and cointegration tests to

examine the existence of possible long-run relationships among the variables included in our model.

(b) Testing for Cointegration

The results of the cointegration tests are presented in Table 2. They suggest the presence of three cointegrating relations in our model. Economic theory leads us to believe that long-run relationships could be found between domestic prices, foreign prices and the nominal effective exchange rate in order for the purchasing power parity (PPP) assumption to hold; between domestic prices, money, real income and the interest rate, in support of the money demand relationship (MD); and between unit labour costs, domestic prices and real income, to support a possible labour market (LM) relationship. As such, three long-run relationships could be found among the variables included in the model.

We therefore impose restrictions on the structural VAR to split the model into three as suggested by economic theory. All the variables included in the model are treated as endogenous except for the dummy variables, which are modelled as exogenous. The choice of the optimal lag lengths of the variables was determined by the multivariate forms of the Akaike Information Criterion (AIC) and the Schwartz Criterion (SC). In minimising the AIC and the SC, we minimise the natural logarithm of the residual sum of squares (adjusted for sample size) and the number of parameters included in the model.

We develop three error correction terms to take account of the short-run adjustments in the three markets as well as the long-run relationships. They are specified as follows:

$$ECMPPP = er - 4.78 + 1.04cpi - 0.99p^f + 0.21Dppp \quad (2)$$

$$ECMMD = md + 4.7 - 0.003cpi - 1.06y - 0.01r + 0.06Dmd \quad (3)$$

$$ECMWc = wc + 5.4 - 0.9cpi - 0.5y - 0.003Dwc \quad (4)$$

Table 2: Johansen Cointegration test results

Unrestricted structural VAR model: 1970:1 - 2000:2									
Sample size: 120									
Test assumption: Linear deterministic trend in data									
Series: cpi, y, p ^f , e, i, wc, m3									
Eigenvalue	Likelihood ratio	Critical value		Hypothesised number of cointegrating relationships					
		5%	1%						
0.420	205.79	156.00	168.36	None**					
0.296	140.96	124.24	133.57	At most 1**					
0.259	99.14	94.15	103.18	At most 2*					
0.184	63.39	68.52	76.07	At most 3					
0.101	39.24	47.21	54.46	At most 4					
0.048	20.35	29.68	35.65	At most 5					
0.014	7.64	15.41	20.04	At most 6					
0.102	1.74	3.76	6.65	At most 7					
Likelihood ratio test indicates 3 cointegrating equations at the 5% significance level.									
Restricted structural VAR models: 1970:1 - 2000:2									
Sample size: 120									
Test assumption: Linear deterministic trend in data									
Series: cpi, y, p ^f , e, i, wc, m3									
Lags		Coin-tegra-ting vectors	cpi	e	p ^f	y	M3	wc	i
2	PPP	2	1.0	1.0	-1.38	0	0	0	0
	PPP	2	1.0	1.0	-1.38	0	0	0	0
	MD	3	1.0	0	0	2.03	-1.19	0	0.02
	MD	2	-0.84	0	0	-1.70	1.0	0	-0.02
	LM	1	1.0	0	0	-0.27	0	-0.93	0
	LM	1	-0.93	0	0	-0.81	0	1.0	0
3	PPP	3	1	0.97	-1.28	0	0	0	0
	PPP	3	1.03	1.0	-1.32	0	0	0	0
	MD	3	1.0	0	0	2.03	-1.19	0	0.02
	MD	2	-0.92	0	0	-0.74	1.0	0	-0.04
	LM	2	1.0	0	0	-1.29	0	-0.76	0
	LM	2	-0.87	0	0	-1.26	0	1.0	0
4	PPP	3	1.0	0.91	-0.98	0	0	0	0
	PPP	3	1.1	1.0	-1.07	0	0	0	0
	MD	1	1.0	0	0	1.17	-1.13	0	0.03
	MD	1	-0.89	0	0	-1.04	1.0	0	-0.03
	LM	0	1.0	0	0	-0.42	0	-0.92	0
	LM	0	-0.85	0	0	-1.25	0	1.0	0

(c) Short-Run dynamics

The short-run dynamics of the determinants of inflation are presented in Table 3. Inflation expectations (proxied by lagged cpi) are positively correlated with current inflation. There is a positive correlation between labour costs and domestic inflation in South Africa. Labour costs lagged by one quarter appear to be more significant than when they are lagged by two quarters.

An appreciation of the rand or an increase in the nominal effective exchange rate will lower domestic inflation. This result is significant only when the nominal effective exchange rate is lagged twice. In the PPP relationship our time dummy variable is also significant at the 1% level. The error correction terms pick up the magnitude of the quarterly adjustments of domestic inflation to any deviation in the long run relationships. The estimated coefficient of the error correction term for the PPP relationship is small, negative and significant at the 5% level.

Disequilibria in the money market and the labour market do not trigger an inflation adjustment in the short run.

Table 3: OLS method of modelling inflation in South Africa, short-run dynamics

Variable	Coefficient	Standard error	t Statistic	Probability
C	0.009816	0.003421	2.869105	0.0049
cpi ₋₂	0.241293	0.082390	2.928676	0.0041
m3 ₋₃	0.099762	0.059643	1.672665	0.0972
wc ₋₁	0.165702	0.051276	3.231595	0.0016
wc ₋₂	0.102631	0.054378	1.887361	0.0617
e ₋₂	-0.034571	0.019722	-1.752899	0.0824
Dppp	0.020142	0.006092	3.306401	0.0013
Ecmppp ₋₁	-0.025360	0.010762	-2.356576	0.0202
ecmmd ₋₁	0.016779	0.035693	0.470076	0.6395
ecmwc ₋₁	0.052145	0.041608	1.253256	0.2136
R ²			0.402651	
Adj R ²			0.364638	
D-W			1.963148	
Standard Error			0.011470	
RSS			0.014220	
Schwarz Criterion			5.678242	
F			10.592241	0.0000
B-G LM Test			0.157405	0.8545
ARCH Test			0.112101	0.7384
Ramsey Reset Test (2)			0.733721	0.3936

Note: The system includes four lags of each variable. The optimal lag length was selected on the basis of the minimum AIC criterion.

Uncontrolled money supply increases will trigger inflation. The result is significant at the 10% level. The coefficients of foreign prices and real output were insignificant in the short run.

(d) Long-Run Dynamics

We performed a number of restricted cointegrating tests based on the presence of three cointegrating vectors in our model. The parameters in the restricted model were constrained to test whether the three stationary vectors could be represented by the three long-run relationships suggested by economic theory.

When the PPP relationship is normalised by the coefficient of domestic prices, the coefficients of the nominal exchange rate and the index of foreign prices are quite close to unity, and have the expected signs. This suggests that the purchasing power parity hypothesis holds in the case of South Africa. The joint movements of the nominal effective exchange rate and foreign prices are almost fully reflected in domestic prices in the long run. This is evident in the sense that the estimated parameters of the two variables are quite close to two. The unconstrained coefficients of the nominal effective exchange rate and the index of foreign prices are 0.86 and -1.13 respectively.

In order to estimate how the nominal effective exchange rate relates to inflation differentials between South Africa and its major trading partners in the long run, we constrained the coefficient of the index of foreign prices to be equal to unity. This yielded an estimated coefficient on nominal effective exchange rate of 0.98, which is not significantly different from unity.

The estimated coefficients of the money demand relationship have the expected signs. The coefficients of real income range between -1.04 and -1.70 and those of the short-term interest rate from -0.2 to -0.4. Constraining the coefficient of the money supply to -1 results in an estimated income elasticity of 1.02, which is not significantly different from unity.

When normalized by the coefficient of domestic prices, the coefficient of aggregate demand ranges between 1.17 and 2.03, suggesting that a shock to real output could contribute significantly towards increasing domestic prices in the long run.

In the labour market equation the coefficient of unit labour costs ranges from -0.76 to -0.93 when normalised with the coefficient of domestic prices. This suggests that domestic price setters are strongly influenced by wage changes, adjusting domestic prices by a little less than unit labour cost changes. When normalised by the coefficient of unit labour costs, the estimated coefficient of domestic prices is also quite close to -0.90. This suggests that about 90% of the changes in unit labour costs translate to domestic price increases. Under this scenario, the coefficient of real income ranges between -0.81 and -1.26.

(e) Variance Decomposition

We decomposed the forecast error variance in the model, using Sim's Recursive Choleski method, in order to identify the most effective instrument to use in targeting each variable of interest. We used the VAR model with four lags to decompose the innovations of the endogenous variables into portions that can be attributed to their own innovations and to innovations from the other variables. Only the impacts on domestic prices of innovations in other variables are reported here; for a more detailed discussion see Akinboade, Siebrits and Niedermeier (2001).

The predominant source of variation in domestic inflation's forecast errors is own shocks, which account for between 14 and 92% of the forecast errors in domestic inflation over a eight-year horizon. In the short term, own shocks account for 75 to 92% of the forecast error variance. Innovations from labour costs and nominal effective exchange rates are also important sources of the forecast error variance in domestic inflation. The least significant source of forecast-error variance in domestic inflation is the rate of interest, closely followed by real GDP. From a purely technical point of view, the most effective mechanisms to achieve inflation targets are control over the rate of wage increases, and appreciation of the Rand. In the medium term, control over excessive money supply increases will also be useful.

(f) Impulse response functions

The effects of unanticipated shocks on the stability of domestic prices, real output, money, the nominal interest rate, labour costs and deviations from the long-run equilibrium values of the nominal effective exchange rate can be ascertained from the impulse response functions of a reduced form VAR model. The impulse response functions give an indication of the lag structure in the economy. We implemented impulse response functions with an eight-year horizon (or 32 quarters) after shocking the CPI, nominal effective exchange rate, real output, money supply and interest rate equations. Each innovation was obtained by using the traditional Choleski decomposition method.

A negative shock to the nominal effective exchange rate, say a depreciation, immediately results in higher inflation. On the other hand, a positive shock to the nominal effective exchange rate (an appreciation of the Rand) immediately results in a lowering of inflation. This decrease continues

till the second quarter before bottoming out. Following this initial positive shock to the nominal exchange rate, domestic prices continue their downward trend until about the twentieth quarter before establishing a new equilibrium level. A positive shock to foreign prices causes a response in domestic prices in the same direction.

A positive shock to broad money stock begins to exert inflationary pressure from the sixth quarter. The upward trend in inflation continues thereafter until a new equilibrium level is attained beyond the thirty-second quarter. A positive shock to the nominal interest rate does not impact immediately on domestic prices. Prices only begin to fall after about nine quarters and continue to fall thereafter. A positive shock to real GDP results in domestic price increases only after about five quarters. The impact on prices is marginal until after the eighth quarter by which time domestic prices rise more steeply, peaking at around the twentieth quarter.

A positive shock to the money stock results in the adoption of a contractionary monetary policy stance reflected in a sharp increase in the nominal interest rate which peaks in the fourth quarter before beginning a downward trend. This sharp upward trend in the nominal interest rate is associated with an equally sharp decline in domestic prices until about the fifth quarter, after which domestic prices return to their equilibrium path from the fifteenth quarter. A positive shock to unit labour costs causes inflationary pressure from the first quarter. This trend then continues for at least 32 quarters.

5. POLICY IMPLICATIONS

This paper has shown that inflation in South Africa is largely structural in nature and that the monetary authorities have limited control over the main determinants thereof. This suggests that it will be difficult to achieve the objective of reducing inflation to the levels prevailing in the country's main trading partners. Inflation reduction is likely to be particularly slow and costly in terms of output and employment if pursued exclusively by interest rate manipulation and continuously counteracted by depreciation of the exchange rate and wage increases in excess of productivity growth.

Possible alternatives to the current monetary policy framework in South Africa of inflation targeting include targeting of a monetary aggregate or the nominal exchange rate. Our results indicate that the variables targeted by both these frameworks are important determinants of inflation in South Africa, albeit less so than growth in nominal unit labour costs.⁴ However, Jonsson (1999a: 17) has recently argued that neither of these frameworks is appropriate in the present South African context. Monetary targeting is unlikely to have the desired effect on inflation because of the monetary authorities' limited ability to control the monetary aggregates; moreover, such a framework will lack credibility in view of its earlier failure in South Africa. Nominal exchange rate targeting is likely to result in wide swings in interest rates, inefficient output stabilisation and regular speculative attacks on the Rand. In many respects, inflation targeting is also a limited framework for monetary policy in South Africa. In common with the other two frameworks, it relies strongly on the interest rate as an instrument to fight inflation, and has no direct influence on the crucial labour costs variable in the inflation equation. However, its greater transparency and more explicit focus on the reduction of inflation may eventually exert stronger downward effects on inflation expectations than those of alternative frameworks.

⁴ South Africa's reintegration into a world economy characterised by the globalisation of economic activity has subjected South African firms to fierce international competition. This has stimulated the adoption of cost-containing practices and new technologies which have contributed to a sharp reduction in the growth in nominal unit labour costs. The rate of growth in nominal unit labour costs slowed from 10.8% in 1994 to 2.8% in 1998 and 2.3% in 2000. See SARB (2001c).

The interest rate remains the principal instrument of monetary policy in South Africa despite being subject to long outside lags (our results indicate that interest rate adjustments only affect the inflation rate after nine quarters). At present, the monetary authorities' leverage over the level of the nominal exchange rate is severely circumscribed by factors such as the modest value of South Africa's gross gold and foreign-exchange reserves and the extent of the SARB's net oversold position in foreign currency. Progress has been made towards removing these impediments to a more stable currency, but the present Governor of the SARB has stated that currency instability is a fact of life of globalised financial markets about which central bankers in individual countries can do little (cf Mboweni, 2001).⁵ All in all, this paper shows that the monetary authorities' leverage over most of the key determinants of inflation in South Africa is decidedly limited.

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⁵ South Africa's gross gold and other foreign reserves increased from US\$4,105 million at the end of 1994 to US\$11,230 million at the end of 2000. During the same period, the net open position of the SARB decreased from US\$25,202 million to US\$9,051 million. See SARB (2001c).

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