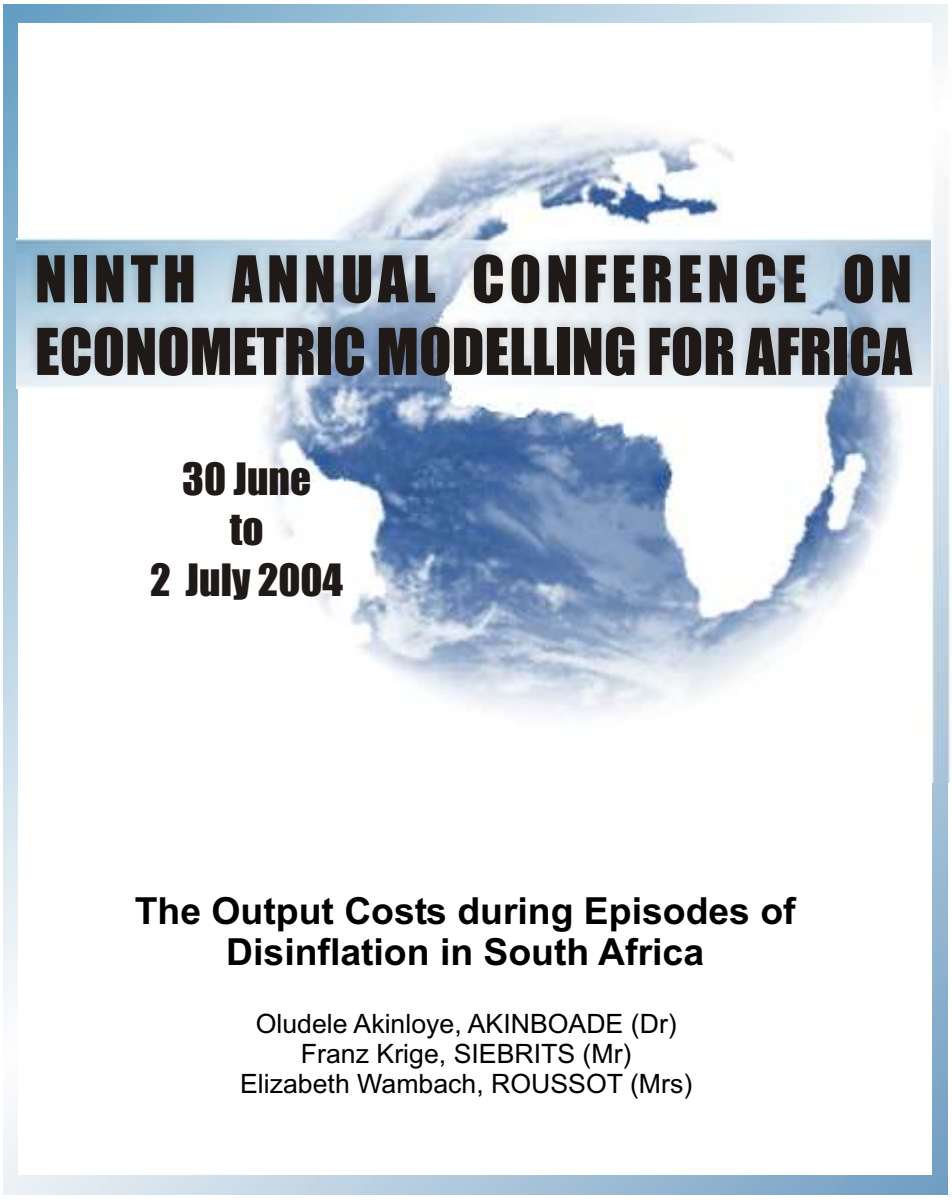

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## The Output Costs during Episodes of Disinflation in South Africa

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**ABSTRACT**

The tempo of price increases in South Africa has decreased significantly in recent times, though the rate of inflation remains above the inflation rates of the country's main trading partners. The South African Reserve Bank is committed to a policy of inflation targeting in order to ensure that the rate of inflation falls within the 4-6 percentage range. This study develops a model to estimate the output costs associated with four disinflationary episodes in South Africa, using three different methods for estimating potential output and the output gap. Whereas, results from using the linear deterministic time trend suggest positive sacrifice ratios, irrespective of the dis-inflation period, the other two methods suggest negative sacrifice ratios during the last two episodes of disinflation.

## 1.0 Introduction

Although the tempo of price increases in South Africa has decreased significantly in recent times, the rate of inflation remains above the inflation rates of the country's main trading partners.[1] The South African Reserve Bank (SARB) remains committed to reducing the rate of inflation to the levels prevailing in these countries – an objective which implies that the continued inflation differential between South Africa and her trading partners imposes an unacceptable cost on the South African economy that exceeds the cost of achieving inflation parity.

In a study, Akinboade, Siebrits & Niedermeier (2001), of the determinants of inflation in South Africa, we found that the South African Reserve Bank (SARB) has limited leverage over most of the key determinants of inflation in South Africa, and concluded that it may be difficult and potentially costly, in terms of output and employment losses, to achieve the inflation parity objective. The purpose of the present study is to provide empirical perspective on this conclusion. More specifically, we develop a model to estimate the output costs of disinflation in South Africa and use it to forecast the likely costs of further reducing inflation to the trading-partner parity level. We believe that this study and that its findings represent an important contribution to the ongoing debate about appropriate objectives for monetary policy in South Africa, especially with regard to the following questions:

[1]Consumer price inflation in South Africa dropped to 5.2 per cent in 1999 – the lowest annual rate of increase since 1970 – before increasing to 5.4 per cent in 2000, 5.7 per cent in 2001 and 10.1 per cent in 2002. The relatively rapid increase in 2002 followed upon the sharp depreciation of the Rand in the closing months of 2001. In 2001, the inflation rates in countries which are South Africa's major trading partners were as follows: Germany 2.5 per cent, Japan -0.7 per cent, the United Kingdom 1.8 per cent and the United States 2.8 per cent (World Bank 2003).

I. Should monetary policy be geared towards attaining an even lower inflation level?
II. What are the output costs of the disinflation policy of the South African Reserve Bank?
III. Is lower inflation necessary to achieve real output growth in South Africa?

The remainder of this paper comprises six sections. Section 2 contains background information on inflation, growth, and monetary policy in South Africa. The theoretical and empirical literature are reviewed in section 3. Section 4 sets out the sources and time-series properties of the data used in the study, the estimation of output gap and explains the method used in estimating trend inflation and the sacrifice ratio. Section 5 presents the results of our study.

### 2.1 Inflation and monetary policy in South Africa

Inflation in South Africa increased significantly (albeit unevenly) during the 1970s and the first half of the 1980s, rising from 3.8 per cent in the first quarter of 1970 to 19.7 per cent in the third quarter of 1986. It then dropped sharply from 1986 to 1988 and again from 1992 onwards. The tempo of price increase fell to as low as 1.9 per cent in the third quarter of 1999 and ended 1999 at 2.2 per cent. It subsequently picked up to reach 4.6 per cent at the end of 2001 before accelerating to 17.1 per cent in the fourth quarter of 2001 decreasing slightly to 14.4 per cent in the fourth quarter of 2002. The acceleration in the tempo of price increases followed the sharp depreciation in the value of the Rand in the fourth quarter of 2001, when the nominal and real effective exchange rates measured against the weighted average of the basket of trading partner currencies fell by 17.2 per cent and 15.8 per cent on a quarter-on-quarter basis.

The rise in inflation during the 1970s took place during an era characterised by the extensive use of direct monetary policy instruments such as credit ceilings. Interest rates were not intensively used as an instrument of monetary control; in fact, they were relatively stable and in real terms negative throughout the decade (Whittaker 1992: 60-63). The 1980s saw the replacement of the system of direct controls by a cash reserve system in which the SARB 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). Nominal and real interest rates fluctuated during the

1980s, with negative real rates remaining common. Several commentators (e.g. Hodge 2001; Mohr 2001) have ascribed the erratic application of monetary policy during this period to general economic instability and the political pressure exercised on Gerhard de Kock, Governor of the SARB from January 1981 until August 1989. For the period during which Chris Stals was Governor of the SARB (August 1989 to September 1999) there was consistent application of tight monetary policies in the form of increases and the subsequent rise in real interest rates from 1993 onwards (Hodge 2001: 56-66; Mohr 2001: 124-127).

### 2.2 Economic growth in South Africa

The real growth performance of the South African economy reflects a pattern of secular deterioration that has been occurring since the end of the sixties. The rate of growth in South Africa's real GDP slowed and became more variable between 1970 and 2001. Real average annual GDP growth slowed from 5.8 per cent in the 1960s to 3 per cent in the 1970s, 1.8 per cent in the 1980s and 1.4 per cent in the 1990s. From the mid-1970s onwards, population growth often exceeded real output growth. GDP per capita at constant 1995 prices accordingly decreased from a peak of R16,347 in 1981 to R14,554 in 2002. The relatively poor growth performance of the South African economy reflects various factors, including the slowdown in world growth since the 1960s, structural weaknesses in the economy (exacerbated by the effects of an inappropriate import-substitution strategy, factor-price distortions and poor utilisation of production factors) and a series of political and economic shocks. In a recent study, Aron and Muellbauer (2002) found that high real interest rates (the result of tight anti-inflationary monetary policy) also significantly constrained economic growth in South Africa during the 1990s.

### 3.1 The costs of disinflation: a review of literature

One of the most often cited arguments against reducing inflation is the cost of lost output or employment associated with doing so. As indicated by the traditional Phillips curve analysis, reducing inflation could lead to lower output and employment if expectations, price or output decisions are sticky. If disinflation persists, macroeconomic theory suggests that the economy in question should eventually adjust

to the new monetary policy as output and employment recover. The natural rate hypothesis of Friedman (1968) and Phelps (1967) suggests that such losses would be transitory and that output and employment would be restored to their previous natural levels. However, the more recent hysteresis argument postulates that the natural levels of employment and output depend on their past history (Blanchard & Summers 1986). As unemployment rises, workers lose their skills through lack of use, among others. In the process, the natural rate of unemployment itself rises. Though unemployment finally returns to its natural state, the natural state has increased in the meantime. This implies that disinflation leads to temporary losses of output and employment due to these variables being below their natural levels, as well as permanent losses from the shifts in the natural levels themselves.

Empirical estimates of the cost of disinflation are strongly influenced by the choice of models and assumptions. Classical models indicate that the costs of disinflation are low, whereas Keynesian models show much higher costs. When a central bank tries to reduce inflation by tightening monetary policy, the resulting reduction in aggregate demand causes unemployment to rise. The classical model suggests that the economy returns to full employment fairly quickly. The Keynesian model, on the other hand, suggests that the adjustment of wages and prices will cause a long period of higher unemployment. For example, Meyer and Rasche (1980) ran simulations on four models to determine the cost of reducing the US inflation rate from 10 per cent to 2.5 per cent. They found that the costs of disinflation in a Keynesian model are six times as high as those in a classical model. Gordon and King (1982) found that reducing the US inflation rate by 5 percentage points would cost 29% of a year's GNP. However, Hakkio and Higgins (1985) and Dowd (1994) argued that the long run benefits of reducing inflation greatly exceeded the short run costs.

The credibility of the central bank's commitment to reducing inflation appears to be an important determinant of the duration of an economy's adjustment to disinflationary policies. Boschen and Weise (2001) developed a model to study the impact of the extent of policy credibility at the start of a disinflation programme on the output losses during the programme. In the model, the central bank has to choose between an inflationary and a dis-inflationary policy during each period of rising inflation. In taking a

decision as to which direction to follow, the central bank weighs the cost of disinflation against the cost of continuing the inflationary policy. The authors use the probability of successful disinflation as a measure of policy credibility and link their estimation of ex ante credibility to observed economic and political factors that could influence perceptions about the strength of the commitment to disinflation. They found that more credible disinflation periods are associated with smaller losses in aggregate output. Hutchison and Walsh's (1998) analysis of the disinflationary experience of New Zealand from 1986 to 1992 arrives at the same conclusion. They found that the initial drop in inflation was accompanied by a drop in the GDP, an increase in unemployment (from 7 per cent in early 1990 to a peak of 11 per cent in 1991) and a sharp fall in capacity utilization (from 87.2 per cent in 1990 to 83.7 per cent in the third quarter of 1991). However, once the independent central bank and the inflation-targeting regime had established credibility, capacity utilization increased from 84 per cent in 1992 to 91 per cent in 1994 without a surge in inflation.

### 3.2 Empirical Findings on Phillip's Curve Studies on South Africa

The structuralists' view of inflation is that up until a certain critical inflation rate, there is a positive relation between inflation and growth (Johnson, 1984). Because of factor immobility and downward rigidity of factor prices, structural imbalances that arise from expanding and declining sectors of the economy are inflationary. Upward movements in wages and prices are, however, necessary to reallocate scarce resources in the most efficient way. The inevitable trade-off between growth and inflation suggests that higher growth and lower unemployment can only be achieved at the cost of some inflation. Paul et al. (1997), suggest that the structuralists' description of the relationship between inflation and growth is bi-directional.

Empirical studies during the 1950s and 1960s suggest that mild inflation either exerted a positive impact on growth (Dorrance, 1963), or that there was no discernible relationship. However, in the 1970s and 1980s, there generally seemed to be a negative relation between growth and inflation (Bruno and Easterly, 1996). Sarel's (1996) empirical results show that there is a non-linear relation between growth and inflation and that the structural break occurs when inflation is about 8 percent. Above 8 percent,

inflation exerts a powerful negative impact on growth, but below 8 percent, the impact of inflation tends to be slightly positive. The panel study by Ghosh and Phillips (1998) also finds a structural break, but the positive impact of inflation on growth only occurs at inflation rates between 2 and 3 percent, otherwise inflation and growth are negatively related. Barro (1995) concludes from his panel study that although there is a small, but negative relation between inflation and growth, the effect largely occurs in high inflation countries. Bruno and Easterly (1996) show that the negative impact of inflation on growth is only relevant above a threshold of 40 percent.

Several researchers have investigated the issue of the existence or otherwise of a Phillips curve trade-off between inflation and growth/unemployment in South Africa (Krogh 1967; Gallaway et al 1970; Hume 1971; Truu 1975; Levin & Horn 1987; Hodge 2002). Hodge (2002: 428) summarises the findings of the earlier studies as follows:

The general conclusion of these studies is that a stable wage and price inflation Phillips curve existed in South Africa for most of the post-war period until the late 1960s. Thereafter, in common with similar studies of other countries, the relationship is far less stable with extended periods of stagflation evident during the 1970s and the 1980s. To the extent that a trade-off still occurred, it was at much higher levels of wage and price inflation.

Nell (2000) studies the costs and benefits of inflation for South Africa. The country's inflationary experience.is divided into four inflationary episodes. The empirical results suggest that inflation within the single-digit zone may be beneficial to growth, while inflation in the double-digit zone appears to impose costs in terms of slower growth. However, further results indicate that even during periods when deflationary policy yielded growth benefits as a result of a more stable economic environment, the costs of deflation outweighed the benefits.

Hodge's (2002) study indicated that short-run changes in inflation, unemployment and employment in South Africa were essentially independent from 1970 to 2000. However, he uncovered evidence of a significant positive short-run relationship between inflation and economic growth using unit-root adjusted OLS regressions. These findings indicate

that expansionary fiscal and monetary policies may raise aggregate demand in the short run, but are unlikely to create jobs – a situation related to the structural change in the labour-absorbing capacity of economic growth in South Africa.

### 4.1 Data sources

Quarterly secondary data on nominal gross domestic product (GDP) and real gross domestic product in 1995 prices (Y), employment (L), the consumer price index, CPI (P), the index of import prices (Pm), unit labour costs (Wc) and the nominal effective exchange rate (E) for the period 1970:01 to 2002:04 are drawn from the electronic database of the South African Reserve Bank (SARB 2003). Quarterly data for the capital stock series are available only from 1975 from the South African Reserve Bank.

The underlying consumer price index (CPI), which excludes highly volatile food prices and housing costs, will be 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, this index is defined as the headline consumer price index excluding food and non-alcoholic beverages, home owner=s costs and value-added tax. The construction of the nominal effective exchange rate and the index of foreign prices (Pm) to be used in the study will follow the approach developed in Akinboade, Siebrits and Niedermeier (2001). All the variables are integrated of the first order or I(1). This implies that all the series are non-stationary in levels but are stationary in first differences.

### 4.2 Measuring potential output and the output gap

The most delicate issue in calculation of sacrifice ratios is the measurement of the potential output. The reason being that small differences in the fitted trends can effect large differences in sacrifice ratios. The importance of potential output stems from the fact that the output gap is a key variable for forecasting inflation and for studying the transmission mechanism of monetary policy. Potential output forecasts are simple and intuitive in spite of the high uncertainty associated with their determination. We used the split time trend (with structural breaks), the Cobb-Douglas production function

approach and the Hodrick-Prescott filter (HP) method to estimate potential output used in the calculation of output gap.

The output gap is defined as the gap between actual and potential output, where potential output is the level of output that is consistent with a stable rate of inflation, given the productive stock of capital. Due to their simplicity, deterministic trends remain appealing. Some authors use deterministic trend methods, particularly when simplicity is greatly valued as in some applications regarding monetary policy evaluation. This method builds on the basis assumption that GDP can be decomposed into a deterministic trend component and a cyclical component. In this equation, potential output is given by the trend component (constant + t). However, the linear time trend method of estimating potential output is generally flawed for not relying on economic theory. The growth of potential output is linked to the growth of factor productivity and factor inputs. The simple time trend used to estimate the growth rate of potential output implies that the level of potential output growth is constant, and all movements in output around the time trend are interpreted as demand shocks (Claus, Conway & Scott 2000). There is no a priori reason to assume that these are constant over time, especially in a country like South Africa that has undergone structural transformation. The residuals ($u_t$) from the regression equation provide a measure of the output gap. Output gap estimates obtained from a linear time trend are sensitive to the sample period chosen. Therefore other more flexible approaches should also be considered for estimating potential output and the output gap for South Africa.

The Cobb-Douglas production function method is quite flexible, because it can deal with different technologies and with some advances of the new growth theory, such as changes in the quality of inputs (e.g. human capital). Moreover, it makes it possible to take into account and determine the effects of economic policy changes on potential output. The path of labour inputs is strongly correlated with population growth, which is a relatively easy variable to forecast. The production-function method allows enough flexibility for the policymakers to exercise their judgment about how the key variables will evolve and affect growth. On the contrary, capital stock estimates carry considerable uncertainty. The production function approach has been employed by the SARB (cf. De Jager & Smal 1984; De Jager 1986). The estimation of the potential output involves two

stages. In the first, total factor productivity (TFP) is obtained using the growth accounting technique. Just like potential output, TFP is an unobserved variable. In order to obtain accurate TFP estimations, it is extremely important to measure the flow of services of capital and labour accurately. Once TFP figures have been obtained, the potential or "full employment" level of labour input is determined. Potential output is then determined by means of the Cobb-Douglas production function, using these input levels and the TFP trend. The estimates suggests that labour share in the production process is 0.51 which is quite close to the estimates used in South Africa's national accounts (0.55). It however differs from the findings of Smit and Burrows (2002) who report a labour share for South Africa of 0.68.

The Hodrick-Prescott filter is a simple smoothing procedure that has been popularized on account of its flexibility in tracking the characteristics of fluctuations in trend output. When the H-P filter is used, trend output is obtained by minimising a combination of the gap between actual output (Y) and trend output (Y*) and the rate of change in trend output for the whole sample of observations (T). The advantage of the HP filter is that it enables estimation of potential output with predetermined degrees of smoothness, depending on data frequency. A major drawback of this measure is the need to determine an appropriate detrending parameter. It also suffers from high end-of-sample biases. Harvey and Jaeger (1993) and Cogley and Nason (1995) found that the HP filter with (nearly) integrated data can induce spurious cyclicality.

The time trend approach predicts a 3.12 percent estimate of the growth rate of potential output, whereas the Cobb-Douglas production function and the HP filter predict an average potential growth rate of 2.1 percent and 2.27 percent respectively. Other disinflation period-specific estimates are reported in table 2.

**Figure 1: Output gap in South Africa 1970:1 – 2002:4**

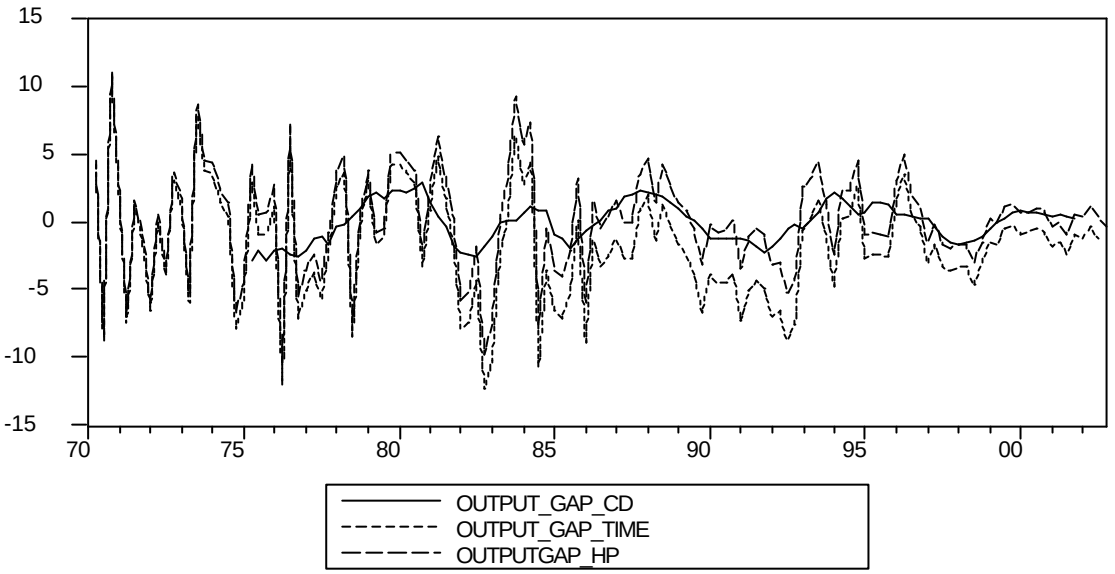



Figure 1 depicts estimates of the output gap in South Africa based on the three measures of potential output discussed above. The output gaps resulting from estimating potential output with the production-function approach and the HP filter approach are very similar in magnitude, but the use of the simple time-trend method to estimate potential output yields a much higher estimated output gap. Our results are very similar to those recently generated by Smit and Burrows (2002).

### 4.3 Estimating Trend Inflation for South Africa

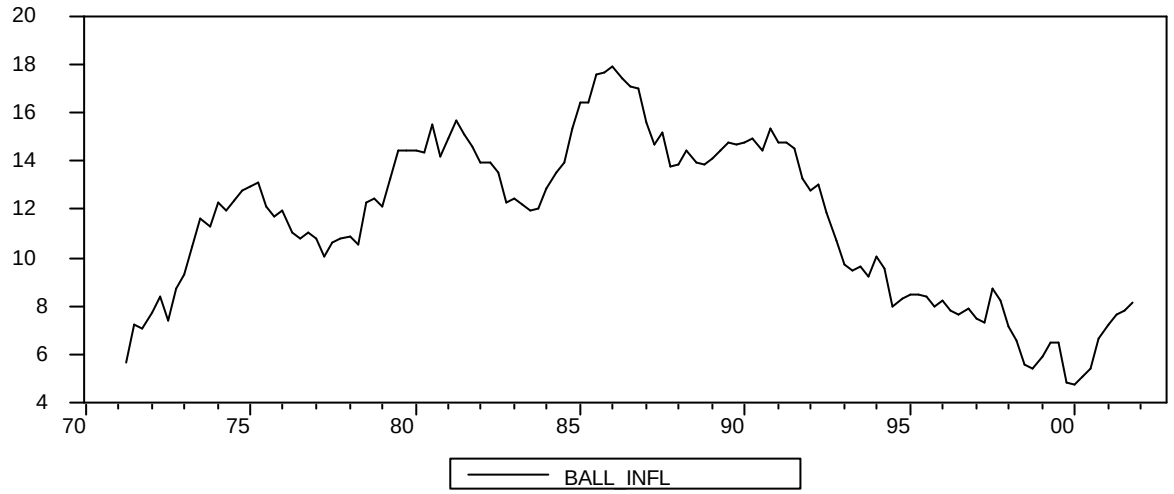
Actual quarterly inflation rates fluctuate substantially over short periods of time making it difficult to identify clearly the periods of disinflation in South Africa. One technique is to identify inflation peaks and troughs. Following Anderson and Wascher (1999), we defined inflation peaks (troughs) as quarters in which the inflation rate was higher (lower) than in both the preceding and the following quarter. This exercise yielded 27 disinflation episodes in South Africa from 1970 to 2001. Unfortunately, none of these

lasted longer than five quarters. Alternative specifications of inflation peaks and troughs did not yield econometrically meaningful disinflation periods either. In view of this, we have estimated trend inflation over the study period to enable us get a proper picture of the periods of deliberate disinflationary policy implementation in the country. Ball (1994) smoothes the inflation series with a nine-quarter moving average to extract longer run movements. In this study, the trend inflation is first measured as a centred five period moving average of the year on year increase of the actual Consumer Price Index. However, when the nine period centred moving average of actual inflation was used as the trend inflation, four clearer disinflation episodes are found as is the case when a centred five period moving average is used. As such, we have simply maintained the definition introduced by Ball (1994). When we shortened the range of the moving average procedure, we have found a less smoothened inflation trend in which disinflations is seen less clearly. We then defined the inflation peak/trough as a point in time where the trend inflation was higher/lower than in the previous and the next eight quarters. Then an inflation episode is the period, which starts with an inflation peak and ends with an inflation trough. Using this approach we can find four clear disinflation episodes for South Africa over the sample period.

To fully capture the costs of disinflation, South Africa's disinflationary experience over a long and extended period is divided into four disinflationary episodes. The figure below presents the four disinflationary episodes. These episodes together with the corresponding mean and median real gross domestic product (GDP) growth rates over the sample period are presented in table 1. These disinflationary episodes correspond to significant structural, political and regime changes in the South African economy. The period 1975-1978 presents a breakpoint, following the abandonment of the Bretton Woods system in 1971 and the oil price shock in 1973. In contrast to the low and stable inflation rates experienced during the 1960s, exchange rate devaluations during the early 1970s and the oil price shock in 1973 led to accelerating inflation. After the gradual implementation of more market-oriented monetary policy measures since 1980, the periods 1981-1983, 1986-1988 signify another breakpoint when the SARB attempted to reverse the accelerating inflationary trend experienced since the early 1970s. It also coincides with the implementation of labour market reform in 1984 that saw the unbanning of the black labour unions. The period since 1991-2000 represents the final

breakpoint following South Africa's political liberalization leading to the first democratic election and the return to single-digit inflation rates. Also, the South African Reserve Bank adopted a tight monetary policy stance during this period which it also terminated before the adoption of an inflation targeting framework in 2000.

**Figure 2: Episodes of disinflation in South Africa 1970-2002**




The distinguishing feature characterising the four dis-inflationary episodes is that they represent the periods of stabilisation (the deflationary period), where inflation decelerated before (1975-78 and 1981-83) and after (1986-88 and 1991-2000) the historically high level of 18 percent in 1986. Easterly (1996) has shown that periods of stabilisation are generally characterised by an expansion in short-run output.

It is important to investigate this evidence further to analyse the growth costs of lower inflation. It would also be useful to examine the growth costs in the period before 1986 when the underlying factors were pushing inflation higher and in the subsequent period when the fundamentals were pushing inflation lower.

**Figure 3: Episodes of disinflation and Growth in South Africa 1970-2002**

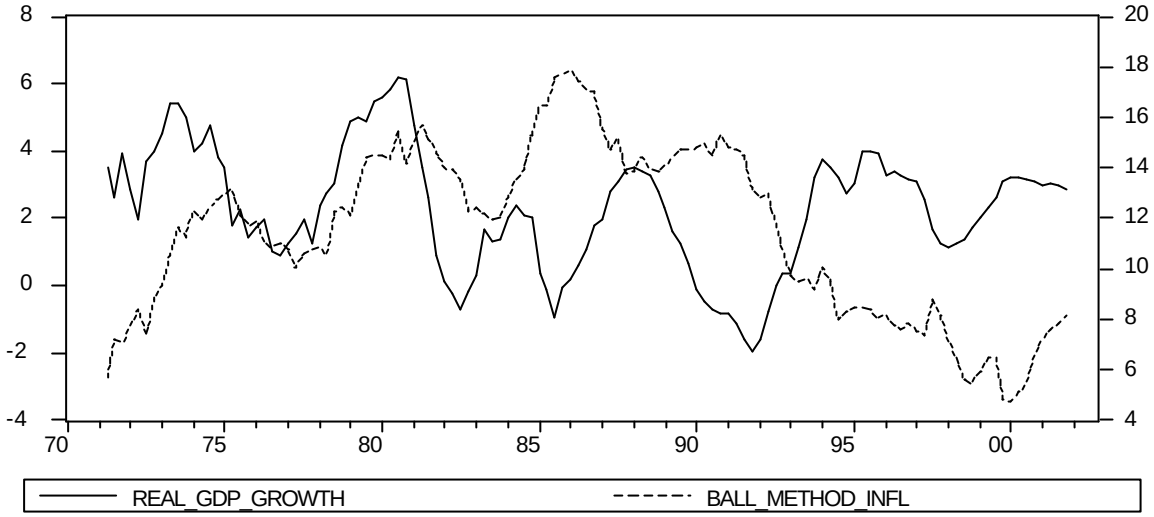



Table 1 shows how the different dis-inflationary episodes evolved over time in South Africa. The general conclusion that can be inferred from the above table and figure is mixed. Whereas a high and rising average growth rate was associated with high inflation up to the first period of disinflation, during the very short second period, high inflation was associated with very low growth. However there were severe balance of payments difficulties in the 1980s, which could have also affected real GDP growth. The dis-inflationary experience of the third period, during which the economy was recovering from the highest inflation peak of about 18 percent, resulted in high average economic growth.

**Table 1: Dis-inflation and Real GDP Growth Statistics in South Africa:1970:1-2002:4**

| | Whole Sample | First Episode | Second Episode | Third Episode | Fourth Episode |
|---|---|---|---|---|---|
| Inflation | 1970:1-2002:4 | 1975:2-1978:2 | 1981:2-1983:3 | 1986:2–1988:4 | 1990:4-2000:1 |
| Mean | 11.43 | 11.18 | 13.57 | 15.18 | 9.06 |
| Median | 11.97 | 10.87 | 13.72 | 14.72 | 8.33 |
| Std Deviation | 3.38 | 0.83 | 1.32 | 1.42 | 2.88 |
| Real GDP Growth | | | | | |
| Mean | 2.37 | 2.54 | 0.26 | 3.14 | 1.75 |
| Median | 2.61 | 3.24 | 0.78 | 2.87 | 1.66 |
| Std. Deviation | 4.07 | 4.99 | 5.53 | 1.77 | 2.89 |

Finally, dis-inflation during the 1990s was accompanied by a low average growth of 1.8 percent. The early part of the 1990s witnessed the implementation of a programme of political reform with the unbanning of the African National Congress, the release of political prisoners and the commencement of political negotiations, all of which could have impacted on growth. Overall, there appears to be some co-movement between inflation and growth until around the mid-1980s after which the two variables appear to be generally moving in opposite directions.

### 4.4 Estimating sacrifice ratios during episodes of disinflation for South Africa

This study calculates sacrifice ratios directly from episodes of disinflation. The endpoints of each episode are determined through inspection of changes in inflation rates. Sacrifice ratios are then calculated over each pre-defined episode. Ball (1994) proposes a simple method to calculate the sacrifice ratio based on observation of actual disinflation episodes. This involves first identifying the beginning of a disinflation period as a year in which the change in the CPI was less than the change in the previous year. The end of the disinflation period is identified in a similar manner. The sacrifice ratio is then calculated as the cumulative change in the output gap over the period (calculated using an HP filter), divided by the change in inflation. A slight variation on his method is suggested by Andersen and Wascher (1999) who date inflation peaks (troughs) as years in which the rate of inflation was higher (lower) than in both the preceding and the following year, with the cumulative disinflation measured as the change in the rate of inflation between peaks and troughs. Output losses during the periods of disinflation are calculated as the cumulative rise in the output gap.

We measure the cost of disinflation in South Africa by estimating the quantity of output lost for each percentage point reduction in the rate of inflation. The sacrifice ratio is the cumulative loss of output during a disinflation episode as a percentage of initial output divided by the cumulative reduction in the rate of inflation. During the period of

disinflation, the denominator of the sacrifice ratio is the distance from the trend inflation at the peak to the trend inflation at the trough.

Ball's method defines potential output for a disinflation episode based on the following assumptions:
(1) Output is at its natural level at the start of a disinflation episode or the inflation peak; (2) Output returns to its potential level four quarters after the end of an episode i.e four quarters after an inflation trough; (3) Potential output grows log-linearly between the two points when actual and potential outputs are equal. Ball hence calculates the sacrifice ratio (SR) for a disinflation episode, which starts at period S and ends at period E, as the ratio of output loss to the change in trend inflation as follows:

$$SR = \left[ \sum_{t=s}^{E+4} \left( y_t - y^*_t \right) \right] / \left( \Pi_t - \Pi_{t-1} \right) \qquad (1)$$

Apart from using Ball's method, we have also used the output gap suggested by the estimation of the Cobb-Douglas production and the HP Filter methods to calculate the sacrifice ratios during each of the periods of disinflation. The reason for using alternative methods is that there is no unanimous agreement among economists regarding the assumptions made by Ball. The assumption that output is at its potential in an inflation peak is widely accepted but the other assumption that output returns to its potential level four quarters after a dis-inflation episode is not widely accepted. Zhang (2001) followed Ball's first assumption regarding the estimation of potential output at the start of a disinflation episode but made no assumption about the degree of persistence. Output could return to its potential at any time after the trough.

Hence, we also adopt Zhang's (2001) method in the application of HP filter for estimating potential output and output gap for South Africa as follows. We assume that output is at its potential at the beginning of the of the disinflation episode. We use HP filter to predict potential output for South Africa by first calculating the HP filter of the log of real GDP and then finding the growth rates of HP filter. Potential output is then

assumed to grow at the rate estimated by the HP filter at the beginning of the disinflation episode.

### 5.1 Results of our study

The results are presented below. Table 2 shows that trend inflation declined by more than 2 points in each of the dis-inflation episodes. This is in conformity with one of the assumptions made by Ball (1994). In a low inflation country like South Africa, these individual declines were likely to have been clearly noticed. It is also interesting that the inflation differentials increased per episode. The largest differential in trend inflation is observed in the fourth dis-inflationary episode in the 1990s.

**Table 2: Estimates of the sacrifice ratio for South Africa during episodes of disinflation**

| | First Episode Peak Through | Second Episode Peak Through | Third Episode Peak Through | Fourth Episode Peak Through |
|---|---|---|---|---|
| Duration | 1975:2-1978:2 | 1981:2 -1983:3 | 1986:1– 1988:4 | 1990:4- 2000:1 |
| Fall in Inflation | 13.15 10.58 | 15.71 11.97 | 17.90 13.84 | 15.32 4.73 |
| HP Method Potential Output growth (average) | 2.92% | 1.92% | 1.38% | 1.88% |
| Actual Output Growth (average) | 2.54% | 0.26% | 3.14% | 1.75% |
| Cummulative Output Gap Ball's Method | -7.41 | -18.67 | 12.78 | 63.35 |
| Inflation Differential | -2.57 | -3.74 | -4.06 | -10.59 |
| Sacrifice Ratio | 2.88 | 4.99 | -3.15 | -5.98 |
| Cummulative Output Gap Zhang's Method | -4.98 | -26.60 | 15.39 | 51.97 |
| Sacrifice Ratio | 1.937 | 7.11 | -3.79 | - 4.91 |
| Cobb Douglas Potential Output growth (Average) | 3.51% | 2.14% | 1.12% | 1.91% |

| | | | | |
|---|---|---|---|---|
| Actual Output growth (Average) | 2.54% | 0.26% | 3.14% | 1.75% |
| Cobb-Douglas Cumm. Output Gap Method | **na** | -24.52 | 14.27 | 45.91 |
| Sacrifice Ratio | **na** | 6.56 | -3.51 | -4.34 |
| Linear Time Trend Potential Output | 3.12% | 3.12% | 3.12% | 3.12% |
| Actual Output Growth (Average) | 2.54% | 0.26% | 3.14% | 1.75% |
| Linear Time trend | -7.53 | -28.59 | -7.54 | -56.73 |
| Cumm.Output Gap | 2.93 | 7.64 | 1.86 | 5.36 |
| Sacrifice | | | | |

Despite the high degree of similarity in approaches, the different methods typically give rise to a wide range of different estimates of the output gap. The difference between the highest and lowest estimate is sometimes close to two percent of output. The linear deterministic time trend approach is also unique in suggesting estimates of positive sacrifice ratio, irrespective of the dis-inflation period. This is partly due to the constancy of real output growth of 3.12 percent suggested by this method. Evaluated against this estimate, actual growth rates have fallen behind in most cases, resulting in cumulative output losses.

With the exception of the linear time trend estimate, other estimates suggest negative sacrifice ratios for the third and fourth periods of disinflation. This therefore implies no output loss during these dis-inflationary episodes. These are also the periods during which potential output growth was far below the actual growth in real GDP. Output gains represent between 3.5 percent and six percent depending on the method used. More output gains occurred during the fourth and most recent dis-inflationary episode. The fact that there are such levels of output growth during the third and the fourth dis-inflationary episodes is traceable in large part to the level of potential output predicted at the start of each dis-inflationary episode. The HP filter approach predicts potential

output growths of 1.18 percent and 0.38 percent at the start of the third and fourth dis-inflationary episodes. Similarly, the Cobb-Douglas method predicts 1.14 percent and 0.55 percent for the respective periods. In line with previous studies, it was assumed that the rate of growth of potential output from the beginning to the end of the dis-inflation episode was constant and equal to the rate predicted at the beginning of the episode (Cetinkaya and Yavuz, 2002, Zhang, 2001, Ball 1994). These rates are so much lower than the average potential output growth predicted for each episode as well as the actual output growth realized. Hence, it has been possible to achieve negative sacrifice ratios during the two episodes.

During the first two dis-inflationary episodes, real output growth was lower than the potential resulting in output losses and estimated sacrifice ratios ranging between 2 and 7.6 percent of GDP. In the second episode, the HP filter predicts potential output growth rate of 2.92 percent at the start of the episode, which is quite close to the 3.37 percent predicted by the Cobb-Douglas method. It was against these constant growth rate estimates that cumulative output gap has been calculated in reference to actual output growth. Estimates of the sacrifice ratio were also close for the all the methods used in estimating potential output, ranging between 5 and 7 percent of real GDP. This will imply that the individual cost of disinflation during the first two periods was between small to medium. In most cases a one-percentage decline in trend inflation was associated with between 2 and 7.6 percentage drop in real GDP.

## 6.0 Concluding Remarks

In this paper, we have estimated the output costs of disinflation for South Africa. We have estimated sacrifice ratios during episodes of disinflation in the country. The methodology makes the sacrifice ratio reflect the cost of deliberate disinflation policy. Using three methods for estimating potential output and the output gap, our results suggests sacrifice ratios of between 2 and 7 percent during the first two episodes of disinflation and negative sacrifice ratios during the latter two episodes. As the experience from the most recent episodes indicate a favourable short-run inflation-output trade-off, i.e., negative sacrifice ratios, the results suggest that the monetary

authorities of South Africa were right in pursuing disinflationary policies during those times.

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