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IS LOW INFLATION A PRECONDITION FOR FASTER GROWTH?

THE CASE OF SOUTH AFRICA

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Abstract

In a recent article, Weeks (1999) identifies excessively high real interest rates as one of the reasons why the South African government's GEAR (Growth, Employment and Redistribution) programme has thus far been unsuccessful. This paper examines a related issue, namely whether inflation, at any given level, is always harmful to growth. The methodology employed presents a departure from standard time series case studies. In an attempt to study the costs and benefits of inflation, South Africa's inflationary experience over the last four decades is divided into four inflationary episodes. The empirical results suggest that inflation within the single-digit zone may 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.

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1. Introduction

One of the main features of the South African government's GEAR (Growth, Employment, and Redistribution programme) policy document is an orthodox macroeconomic programme of tight monetary and fiscal policy[1]. In a recent article, Weeks (1999) presents a critical analysis of the GEAR policy document. According to Weeks, since its implementation in 1996, growth has remained far below the 4.2 percent target stipulated in the GEAR programme, despite relatively low inflation rates. He identifies fiscal contraction and excessively high real interest rates as the underlying reasons why the GEAR programme has thus far been unsuccessful.

The analysis by Weeks (1999) presents one of the most pervasive questions in macroeconomics, i.e. whether inflation, at any given level, is always harmful to growth. There seems to be widespread consensus amongst Central Banks that very low inflation is an important precondition for high and sustainable growth[2]. In an article published by the South African Reserve Bank (SARB), Smal (1998) provides theoretical and descriptive evidence that only emphasises the costs of inflation in South Africa. Despite this widely held belief, Levine and Zervos (1993) conclude that:

> "Given the uncharacteristically unified view among economists and policy analysts that countries with high inflation rates should adopt policies that lower inflation in order to promote economic prosperity, the inability to find simple cross-country regressions supporting this contention is both surprising and troubling" (p. 429).

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[1] Michie and Padayachee (1998) present a detailed exposition of the main features of the GEAR programme.

[2] Despite this widely held belief, Stanners (1993) finds no empirical evidence to support the notion that very low inflation leads to improved growth rates.

Although stringent deflationary policies may be the appropriate response when inflation is well into the double-digit zone, it becomes more difficult to justify restrictive policies when inflation is brought back to single-digit rates. More importantly, there are various theoretical reasons (Thirlwall, 1974) supported by recent empirical evidence (Sarel, 1996) to believe that mild inflation can actually be beneficial to growth.

Like many other countries, South Africa experienced high and accelerating inflation during the 1970s and 1980s. With inflation reaching a historically high level of 18 percent in 1986, the SARB implemented a strict deflationary policy to bring inflation down to lower levels. Single-digit rates were again reached after 1993 and, during the period 1994-1999, overall consumer price inflation averaged around 7.8 percent. Inflation rates of 6.8 percent and 5 percent in 1998 and 1999, respectively, were the lowest levels in thirty years. During the 1990s, the SARB's unofficial target ranged between 1-5 percent, which was roughly in line with the average of South Africa's major trading partners (Casteleijn, 1999). On 23 February 2000 the government announced an official inflation target for overall consumer price inflation (excluding interest rates on mortgage bonds) of 3-6 percent for the year 2002 (Mboweni, 2000). Based on these targets, it would appear as if the SARB's conservative stance towards inflation has not changed, despite the return to single-digit inflation rates since the mid-1990s.

Against the background of an official unemployment rate which has reached an unprecedented high level of 40 percent during the 1990s, the question is whether monetary policy should be geared towards attaining even lower inflation, or whether inflation should be allowed to vary within the single-digit zone given the potential benefits of mild inflation.

The main purpose of this paper is to examine whether very low, or close to zero, inflation, is a necessary condition for faster real economic growth in South Africa. The second part of the paper investigates the cost of disinflationary policy. For policy purposes, it is not

only relevant to establish whether a more stable economic environment is conducive to faster growth rates, but also to determine whether this potential benefit outweighs the cost of disinflation policy.

Section 2 presents a theoretical discussion and an overview of empirical studies that have analysed the costs and benefits of inflation. Section 3 describes the methodology to be employed in the empirical section together with descriptive evidence on the growth-inflation relationship in South Africa. Section 4 presents the empirical results. The focus in section 5 is on the short-run costs of disinflation policy. Section 6 provides conclusions and policy implications.

2. The Costs and Benefits of Inflation: Theory and Empirical Evidence

The most damaging costs of inflation are arguably those associated with unanticipated inflation (Briault, 1995; Moosa, 1997). Unanticipated inflation may cause confusion between relative and aggregate price changes, which leads to the misallocation of scarce resources and slower growth. Moreover, uncertainty about future price levels could force investors to delay investment decisions, since investment is a sunk cost and largely irreversible (Pindyck, 1991). Lastly, high and variable prices imply uncertainty about the real interest rate. If savers and investors form different expectations about the real interest rate, funds will be allocated inefficiently. Empirical studies that have found the distortionary effect of inflation to impact negatively on economic growth include those conducted by De Gregorio (1992, 1993); Fischer (1993); Grimes (1991); Kormendi and Meguire (1985); and Smyth (1992).

To avoid a one-sided view that only emphasises the cost effects of inflation, it is important to highlight some of the potential benefits of mild inflation[3]. The main essence of

[3] For a comprehensive theoretical discussion of the potential benefits of mild inflation, see Thirlwall (1974).

the Keynesian view is that inflationary finance can mobilise resources for capital accumulation. The redistribution of wealth from money into physical assets may proceed through two main channels, one of which originates from the Keynesian approach and the other from the Quantity Theory approach. If money wages are slow to adjust to inflation, the Keynesian view asserts that inflation will redistribute income from workers with low saving propensities to entrepreneurs with higher saving propensities. According to the Quantity Theory approach, inflation acts as a tax on real money holdings, which redistributes wealth from the holders of money balances to the government who invests the proceeds on behalf of society. The Keynesian view also stresses other important means through which inflationary finance could stimulate saving and investment, such as lower real interest rates and a rise in the nominal rate of return on investment.

According to a structuralist view of inflation, the argument is held that up until a certain critical inflation rate, there is a positive relation between inflation and growth (Johnson, 1984). Due to factor immobility and downward rigidity of factor prices, structural imbalances that arise from expanding and declining sectors are inflationary. However, upward movements in wages and prices are 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. As noted by Paul *et al*. (1997), the relationship between inflation and growth described by structuralists is bi-directional, a departure from most empirical studies that investigate uni-directional causality from inflation to growth.

In one of the few papers that has attempted to test empirically the costs and benefits of inflation, Sarel (1996) conducted a panel study for 87 countries during the period 1970-1990. Sarel's main point of departure is a distinction between empirical studies conducted during the 1950s and 1960s when inflation was relatively low, and studies during the 1970s and

1980s when many countries experienced high and accelerating inflation. Empirical studies during the 1950s and 1960s found that mild inflation either exerted a positive impact on growth (Dorrance, 1963; Thirlwall and Barton, 1971), or that there was no discernible relationship. By contrast, studies during the 1970s and 1980s found 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 2-3 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 comes from 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.

3. Data, Methodology and Descriptive Evidence

The empirical methodology in this paper departs from standard time series case studies in one important aspect[4]. To capture the costs and benefits of inflation, South Africa's inflationary experience over a long and extended period is divided into four inflationary episodes. The overview in the previous section suggests that growth-inflation studies may not generate unbiased results without explicitly taking into account that the inflation-growth relation may be non-linear. Table 1 presents the four inflationary episodes together with the

[4] For a comprehensive overview of time series case studies, see Temple (2000).

corresponding mean and median real gross domestic product (GDP) growth rates over the period 1960q2-1999q2.

[Table 1]

The four inflationary episodes correspond to significant structural, political and regime changes in the South African economy. The early 1970s present 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 period 1986-1993 signifies another breakpoint when the SARB attempted to reverse the accelerating inflationary trend experienced since the early 1970s. The period since 1994 represents the final breakpoint following South Africa's first democratic election and the return to single-digit inflation rates.

The underlying reason for sub-dividing South Africa's inflationary experience into four episodes is based on two main considerations. First, an analysis of the inflation-growth relationships in the zero and single-digit periods may capture the benefits of mild inflation. Second, the accelerating and deflationary episodes may represent periods that are particularly useful to study the costs of inflation. The distinguishing feature between the four inflationary episodes is not only based on periods of high and low inflation, but also includes a period of stabilisation (the deflationary period), where inflation decelerated from an 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, which makes such an analysis particularly useful to study the growth benefits of lower inflation.

Figure 1 plots the growth and inflation data over the period 1960q2-1999q2, and shows how the different inflationary episodes have evolved over time, especially the accelerating

and deflationary episodes which cannot be distinguished by the mean and median inflation rates in Table 1. Although there are some outliers in the different inflationary episodes, most notably 1998q3, overall, the different episodes relate to the mean inflation rates given in Table 1.

[Figure 1]

The general picture presented by Table 1 and Figure 1 is that high average growth rates coincide with low average inflation rates. Conclusions drawn from simple contemporaneous correlations between growth and inflation, however, say little, if anything, about the direction of causality, or whether the inflation-growth correlations truly represent the costs and benefits outlined in the previous section. In an extensive survey of inflation-growth studies, Temple (2000) identifies the absence of good cyclical adjustments as one of the major flaws of time series case studies. Inflation and growth may both be endogenous to restrictive or expansionary government policy, or be the joint outcome of shocks such as those experienced to oil and commodity prices in the 1970s. Studies conducted by Freeman and Yerger (1997); Karras (1993); Rudebusch and Wilcox (1994); and Sbordone and Kuttner (1994), have all shown the importance of good cyclical adjustments. These studies show that the relation between inflation and growth without cyclical adjustments is usually strong and negative, but when adjustments are made for cyclical factors the relationship is much weaker or disappears[5].

A casual overview of South Africa's growth and inflation experience over the period 1960q2-1999q2, suggests that commodity and oil price shocks in the 1970s, severe balance of payments difficulties in the 1980s and early 1990s following the immediate repayment of

[5] Freeman and Yerger (1997) and Karras (1993) have shown that the strong negative impact of inflation on growth shown by Smyth (1995) and Grimes (1991), respectively, is much weaker once cyclical factors are taken into account.

foreign debt and political shocks, and restrictive monetary policy measures to maintain price stability since 1986, are all factors which may lead to a spurious relationship between inflation and growth.

To capture the impact of cyclical and other factors in the relation between inflation and growth, consider the following Vector Auto Regressive (VAR) representation:

$$\dot{y}_t = \beta_0 + \sum_{i=1}^{m} \beta_{\dot{g}i} \dot{y}_{t-i} + \sum_{i=1}^{m} \beta_{t\dot{o}ti} t\dot{o}t_{t-i} + \sum_{i=1}^{m} \beta_{\dot{p}i} \dot{p}_{t-i} + \sum_{i=1}^{m} \beta_{\dot{m}3i} \dot{m}3_{t-i} + \sum_{i=1}^{m} \beta_{\dot{r}i} \dot{r}_{t-i} + \xi_t, \qquad (1)$$

where $\dot{y}$ is the real GDP growth rate; β_0 is an intercept term; $t\dot{o}t$ is the rate of change of the terms of trade (including the price of gold) that reflects supply shocks; $\dot{p}$ is overall consumer price inflation; and $\dot{m}3$ and $\dot{r}$ are the rates of change of the M3 money stock and nominal lending rate respectively, to capture the impact of cyclical factors such as government policy and other demand factors. All the variables are measured quarterly and are seasonally adjusted[6]. The null hypothesis that inflation does not cause growth can be represented by $H_0 : \beta_{\dot{p}i} = 0 \ \forall \ i$, based on a standard F-test. Reverse causality, with inflation as the left-hand side variable, can be tested along similar lines.

Unit root tests based on Dickey-Fuller, the Augmented Dickey-Fuller test, and Perron (1989, 1990) tests that allow for structural breaks in the time series, showed that all the rate of change variables are stationary at the 5% significance level over the period 1960q2-1999q2. The empirical tests will be based on a short to medium-run analysis that allows for supply shocks and other cyclical factors.

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[6] All the data in this paper are obtained from the SARB's historical data set published on the internet (http://www.resbank.co.za/Economics/econ.html). The exception is the nominal lending rate, which is taken from International Financial Statistics (various issues).

4. Empirical Results

Table 2 reports the Granger causality results based on equation (1) for the different inflationary episodes identified in Table 1.

[Table 2]

4.1 Zero Inflation (1960q2-1970q4)[7]

Table 2 shows that although the null hypothesis of no causal relation from inflation to growth in the growth equation cannot be rejected, the most noteworthy feature is that the sum of the inflation coefficients is positive. Causality from growth to inflation and the negative sum of the growth coefficients may reflect the impact of supply shocks such as droughts, which are not adequately captured by the other insignificant variables.

4.2 Accelerating Inflation (1971q1-1985q4)

Only the M3 money supply is significant in the accelerating period, with uni-directional causality from the M3 money supply to growth and a positive sum of coefficients in the growth equation. The results presented thus far support Paul *et al*.'s (1997) empirical study during the period 1960-1985, which found no causal relation in a bivariate inflation-growth model for South Africa.

4.3 Deflationary Period (1986q1-1993q4)

In the deflationary period, restrictive monetary policy was primarily based on the cost of borrowing from the discount window. The impact of restrictive monetary policy measures can

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[7] Due to data unavailability in the zero inflation period, the money supply and interest rate are represented by the M1 money supply and the nominal discount rate respectively, and taken from International Financial Statistics (various issues). For all the other inflationary episodes the variables are defined as before.

be captured by the nominal lending rate, assuming that banks base their lending rate as some mark-up over the cost of borrowing from the discount window. The nominal lending rate represents the actions of government policy and can be used to assess whether inflation exerts an independent influence on growth, or whether the inflation-growth relation is mainly the outcome of government policy. Consider the following two hypotheses to test the robustness of the inflation-growth relation. If inflation is significant when the lending rate is excluded from the regression, but turns insignificant when the lending rate is included, then the result shows that the inflation growth-relation is dictated by monetary policy. On the other hand, if inflation and the lending rate are both significant in the growth equation, then the result indicates that inflation and the lending rate may both exert an independent effect on growth.

From the results for the deflationary period in Table 2, it can be seen that inflation is insignificant in the growth equation that excludes the lending rate. However, the growth equation that includes the lending rate shows that inflation, the M3 money supply and the lending rate are all highly significant and negative. The inflation-growth relation is therefore robust and indicates that inflation and the lending rate both exert an independent negative impact on growth. The results are consistent with Easterly's (1996) contention that periods of stabilisation are particularly useful to study the cost-effects of inflation outlined in section 2.

4.4 Single-Digit Inflation (1994q1-1999q2)

The results for the single-digit inflation period in Table 2 again show that causality from inflation to growth is insignificant when the lending rate is excluded, but turns highly significant when the lending rate is included. Although the lending rate is marginally insignificant with a value that falls just below the 10% significance level, the result confirms the independent impact of inflation on growth. The most striking result is the positive sum of

the inflation coefficients in the growth equation, emphasising the growth benefits of mild inflation.

The empirical results have shown that the costs and benefits of inflation are both relevant in South Africa. Because the number of observations in the different inflationary episodes is relatively small, Figure 2 supplements the causality tests by investigating the growth-inflation relation in a bivariate context. Figure 2 divides the inflation rate into different sub-samples together with the corresponding average real GDP growth rates.

[Figure 2]

By using a 1-5 percent inflation range as a benchmark, Figure 2 shows that there is hardly any difference between the average growth rate of 4.64 percent in the inflation range of 0-5 percent, compared to the average growth rate of 4.48 percent in the inflation range of 5-10 percent, thus making a good case for the growth benefits of mild inflation. By contrast, the low average growth rates of 1.37 and 0.87 percent in the 10-15 percent and 15-24 percent range respectively, support the contention that double-digit inflation should be avoided. The picture presented by Figure 2 strongly supports the empirical results presented in Table 2.

The empirical results in Table 2 and Figure 2 provide a useful starting point to determine an optimum inflation rate. Based on the empirical results in Table 2, inflation exerts a positive, but insignificant impact on growth in the zero inflation period (1960q2-1970q4). During the single-digit inflation period (1994q1-1999q2) the impact of inflation is significant and positive. The corresponding mean inflation rates over the zero and single-digit periods in Table 1, suggests that policy makers should allow inflation to vary between 3-8 percent, given the benefits of mild inflation. Inflation above a threshold of about 8 percent should be avoided, given the negative impact of double-digit inflation during the deflationary period (1986q1-1993q4). Although Table 2 and Figure 2 suggest a threshold inflation of as

high as 10 percent, a threshold inflation of 8 percent is probably a more sensible approach. Inflation above 8 percent is likely to fuel expectations and a resulting inflationary process which, for some time, may be beyond the direct control of the monetary authorities.

5. The Short-Run Costs of Disinflationary Policy

5.1 Theoretical Issues

The results in the previous section have shown that there are growth benefits to be gained from bringing double-digit inflation down to single-digit rates. For policy makers this is not the only relevant issue. Deflationary policy is not a costless procedure and can involve huge output losses, which may swamp the benefits gained from lower inflation. Following Clark *et al*. (1996); Filardo (1998); and Laxton *et al*. (1995), the short-run output cost of disinflation policy is studied in a Phillips curve model, which relates inflation to an output gap:

$$\dot{p}_t = \alpha + \sum_{i=1}^{k} \delta_i \dot{p}_{t-i} + \sum_{i=1}^{m} \beta_i (\dot{y} - \bar{\dot{y}})_{t-i} + \varepsilon_t \; ; \;\; \sum_{i=1}^{k} \delta_i > 0 \, , \; \sum_{i=1}^{m} \beta_i > 0 \, , \tag{2}$$

where α is an intercept term; $\dot{p}^e$ is inflation expectations and proxied by the sum of the lagged values of $\dot{p}$; and the output gap is defined as the actual real output growth rate ($\dot{y}$) minus the potential real output growth rate ($\bar{\dot{y}}$). The rate of change of potential output is measured as a centred-moving average filter:

$$\bar{\dot{y}} = \frac{1}{2k+1} \left(\dot{y}_t + \sum_{i=1}^{k} (\dot{y}_{t+i} + \dot{y}_{t-i}) \right), \tag{3}$$

where $k = 8$[8]. Because equation (3) is measured as an eight-sided centred-moving average filter and data are available from 1960q2 to 1999q2, the estimation sample period effectively runs from 1962q2 to 1997q2. Equation (2) represents a simple model of inflation, rather than a 'complete' model. The choice of this simple specification is based on the contention that the output gap may display a high degree of intercorrelation with other 'causes' of inflation. A simple specification may avoid problems of multicollinearity[9].

Figure 3 plots a linear Phillips curve to visualise the output costs implied by a linear relation. For simplicity, note that the linear curve is drawn to run through the origin, which according to the long-run analysis of Friedman (1968), implies that $\dot{p} = \dot{p}^e$, i.e. inflation is non-accelerating in the long-run.

[Figure 3]

Based on the linear curve, the output cost of reducing inflation by one percentage point $(1/\sum_{i=1}^{m}\beta_i)$ is the same irrespective of whether we are in the overheated (inflation zone) or weak (disinflation zone) economy stage. Monetary authorities need not take drastic steps during any stage of the business cycle, because inflation is easily wrung out of the system during recessionary conditions.

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[8] The value of k was determined by experimenting with different values, and then choosing the value which was most consistent with a Phillips curve relation. At one extreme, a value of $k = 0$ implies that potential and actual output are the same, so that a Phillips curve relation disappears. At the other extreme, a very high value for k suggests that most of the movements in the business cycle are associated with actual output and not potential output (Clark *et al*., 1996).

[9] The specification of equation (2) performs reasonably well in the empirical section, despite criticisms by Debelle and Laxton (1997) that such a specification excludes forward looking wage setters, and Harvey and Jaeger's (1993) assertion that output gaps constructed from simple filters may induce spurious regressions. These issues form important areas for future research.

In addition to a linear Phillips curve, Figure 3 plots a convex curve. According to Filardo (1998), a convex curve is consistent with an economy subject to capacity constraints and downward rigidities in prices and wages. The convex curve predicts that inflation will become increasingly sensitive to output changes as the economy moves from the weak stage to the overheated stage. For stabilisation policy a distinction between the two curves becomes important to assess the cost of disinflation policy. The convex Phillips curve implies that it is easier and more effective to implement deflationary policy during an upswing in the business cycle. In contrast to the linear curve, which shows that the output cost is the same irrespective of the business cycle, the convex curve predicts that the output cost will be lower compared to the weak economy. The convex curve implies that restrictive monetary policy should specifically focus on the overheated stage, because inflation is not equally offset during the weak economy stage.

To capture non-linearities in a Phillips curve relation, equation (2) can be represented as a piecewise linear regression:

$$\dot{p}_t = \alpha + \sum_{i=1}^{k} \delta_i \dot{p}_{t-i} + \sum_{i=1}^{j} \beta_{1i} (\dot{y} - \bar{\dot{y}})_{t-i}^{overh} + \sum_{i=1}^{z} \beta_{2i} (\dot{y} - \bar{\dot{y}})_{t-i}^{weak} + \xi_t ;$$

$$\sum_{i=1}^{j} \beta_{1i} > 0, \quad \sum_{i=1}^{z} \beta_{2i} > 0, \tag{4}$$

where the output gap variable in the inflationary zone, or overheated stage, $(\dot{y} - \bar{\dot{y}})^{overh}$, takes the value of zero when the output gap is negative and its positive value otherwise, and the output gap variable in the disinflation zone, or weak economy stage, $(\dot{y} - \bar{\dot{y}})^{weak}$, takes the value of zero when the gap is positive and its negative value otherwise. Inferences on the shape of the Phillips curve can be drawn by inspecting the magnitude of the slope coefficients.

Although our main interest is to determine whether there were any net benefits from the SARB's deflationary policy over the deflationary period (1986q1-1993q4), for illustrative

purposes it is useful to analyse Phillips curve relations over the different inflationary episodes identified in Table 1. Valid policy inferences can only be drawn once it has been established that a Phillips curve relation is stable. Following Alogoskoufis and Smith (1991), equation (2) was estimated recursively as an unrestricted model of order three over the period 1962q2-1997q2 (not reported here). An inspection of the recursively estimated coefficients revealed that inflation expectations and the output gap coefficients may have shifted during the early 1970s and mid-1980s. The results suggest that Phillips curve relations should be investigated over the different inflationary episodes in Table 1, and not over the whole sample period. Preliminary Ordinary Least Square (OLS) regression results over the zero inflation period (1962q2-1970q4) yielded insignificant results, which indicate that a Phillips curve relation based on equation (2) and (4) may not have been relevant over this period[10]. Figure 4 plots the output gap over the period 1971q1-1997q2, and shows how the output gap has evolved over the accelerating (1971q1-1985q4) and deflationary periods (1986q1-1993q4).

[Figure 4]

The output gap displays cyclical fluctuations until the mid-1980s, but thereafter seems to fade away considerably following adverse economic and political conditions, which resulted in a stringent deflationary policy to protect the country's balance of payments.

[10] Two reasons may be advanced to explain the insignificance of a Phillips curve relation over the zero inflation period. First, the specifications of equation (2) and (4) assume that pressure in the product market is a good proxy for pressure in the labour market. This assumption may not be true over the zero inflation period. Second, a Phillips curve relation remained insignificant over the zero inflation period when we experimented with higher and lower values for *k* in equation (3). Since inflation was very low over the zero inflation period, the value of *k* in equation (2) may be equal to zero, i.e. potential and actual output are the same.

5.2 Empirical Results

Table 3 reports the results for the linear and non-linear Phillips curve relations over the accelerating (1971q1-1985q4) and deflationary (1986q1-1993q4) periods. Despite the low coefficients of determination in all the models, the diagnostic tests are all passed at the 5% significance level and the F-tests show that most of the models are overall significant.

[Table 3]

Table 3 shows that the output gap is highly significant in the linear model over the accelerating period (1971q1-1985q4). The results for the non-linear model indicate that the output gap in the overheated economy stage is significant, but insignificant in the weak economy stage. The zero coefficient of the output gap in the weak economy stage suggests that a Phillips curve relation over the period 1971q1-1985q4 is only relevant in the overheated economy stage.

The output gap in the linear model over the deflationary period (1986q1-1993q4) is insignificantly different from zero. The non-linear model shows signs of multicollinearity, with a high degree of collinearity between inflation expectations and the output gap in the overheated stage - the output gap has the incorrect theoretical sign and the inflation expectations coefficient is insignificantly different from zero. The negative correlation may reflect the negative growth-inflation correlation identified in the previous section.

A common technique for dealing with multicollinearity is to try to extend the sample size, which is possible in this case up until 1997q2. The results in the final column in Table 3 for the extended model (1986q1-1997q2) shows that the output gap in the overheated economy stage is insignificant, while the inflation expectations coefficient is highly significant. The output gap coefficients in the weak economy stage not only maintain their significance at the 5% level over the periods 1986q1-1993q4 and 1986q1-1997q2, but the coefficients display parameter constancy. To supplement the results, the Chow test for a

structural break in 1994 indicates that the null hypothesis of structural stability cannot be rejected. The results strongly suggest that the South African economy has been in the weak economy stage from 1986q1 until 1997q2.

Based on the non-linear models, Figure 5 traces the Phillips curve relations over the accelerating (1971q1-1985q4) and deflationary (1986q1-1997q2) periods together with the associated costs of disinflation policy.

[Figure 5]

During the accelerating period (1971q1-1985q4) a Phillips curve relation is only relevant in the overheated economy stage (inflation zone). A one percentage point reduction in inflation translates into a 2 percent fall in the actual real GDP growth rate. By contrast, over the deflationary period (1986q1-1997q2) a Phillips curve is only relevant in the weak economy stage (disinflation zone). A one percentage point reduction in inflation results in an output cost of 1 percent of actual real GDP growth.

Based on the results in Figure 5, we can assess whether there were any net gains from the SARB's deflationary policy since 1986. Returning to Table 2, it can be seen that the short-run growth benefits gained from a one percentage point reduction in inflation over the deflationary period (1986q1-1993q4) amount to 0.70 percent of actual real GDP growth. The corresponding cost of disinflation policy is 1 percent of actual real GDP growth, which shows that there have been no net gains from the SARB's deflationary since 1986, but instead net losses in terms of output foregone to reduce inflation.

6. Conclusions

The paper has examined whether very low, or close to zero, inflation, is a necessary condition for faster real economic growth rates in South Africa. In an attempt to study the

costs and benefits of inflation, South Africa's inflationary experience was divided into four inflationary episodes. Although this study does not claim to have identified a precise optimum inflation rate, the results suggest that inflation which is allowed to vary 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. This hypothesis is consistent with Sarel's (1996) empirical study.

Against the background of low, and sometimes negative, real economic growth rates since the mid-1980s, the study suggests that the SARB's approach towards inflation may be too conservative. South Africa has been in a deflationary period since 1986, despite the return to single-digit inflation since 1994. If mild inflation exerts a positive impact on growth there are obviously no net gains from implementing deflationary policy measures when inflation is already at low levels. Instead, the results have shown that deflationary policy is not a costless procedure. Even during periods when restrictive monetary policy yielded growth benefits as a result of a more stable economic environment, the costs of deflation outweighed the benefits. The analysis seems to be consistent with the main findings of Weeks (1999). Excessively high real interest rates may provide one of the underlying reasons why the GEAR policy programme has thus far been unsuccessful.

The paper ends on a cautionary note. It is difficult to determine to what extent the slowdown in the output gap since 1986 can directly be attributed to restrictive monetary policy, as opposed to the recessionary conditions that prevailed until 1993. What does transpire from the analysis is that South Africa has been in the weak economy stage (disinflation zone) since 1986, despite more favourable external conditions following the democratic election in 1994.

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Table 1

Inflation and Real GDP Growth Statistics in South Africa: 1960q2-1999q2

	Whole period	Zero inflation	Accelerating inflation	Deflationary period	Single-digit
Inflation	**1960q2-1999q2**	**60q2-70q4**	**71q1-85q4**	**86q1-93q4**	**94q1-99q2**
Mean	9.41	3.02	12.20	13.83	7.87
Median	9.51	0	12.45	14.36	7.77
Standard dev	6.22	4.21	4.77	4.37	4.68
GDP Growth	**1960q2-1999q2**	**60q2-70q4**	**71q1-85q4**	**86q1-93q4**	**94q1-99q2**
Mean	3.18	6.02	2.67	0.96	2.26
Median	2.94	5.94	3.51	1.16	1.66
Standard dev	5.42	7.25	4.95	3.01	2.40

Table 2

Granger Causality Tests in a Five Variable VAR Model

Equation	*m*	R^2	LM-test	Right-hand side variables				
1960q2-1970q4 (zero inflation period)								
$\dot{y}$	2	0.39	(0.47)	$t\dot{o}t$	$\dot{y}$	$\dot{p}$	$\dot{m}3$	$\dot{r}$
F-test:				0.62		1.79	0.43	0.21
Sum of coefficients:				-0.09		0.83	0.07	0.003
Causality results:								
$\dot{p}$	2	0.38	(0.08)	$t\dot{o}t$	$\dot{y}$	$\dot{p}$	$\dot{m}3$	$\dot{r}$
F-test:				0.24	2.82*		1.99	1.01
Sum of coefficients:				0.01	-0.34		-0.009	0.01
Causality results:					$\dot{g} \Rightarrow \dot{p}$			
1971q1-1985q4 (accelerating inflation)								
$\dot{y}$	1	0.09	(0.36)	$t\dot{o}t$	$\dot{y}$	$\dot{p}$	$\dot{m}3$	$\dot{r}$
F-test:				0.09		0.02	2.82*	0.23
Sum of coefficients:				-0.002		-0.02	0.14	0.008
Causality results:							$\dot{m}3 \Rightarrow \dot{g}$	
$\dot{p}$	1	0.07	(0.01)	$t\dot{o}t$	$\dot{y}$	$\dot{p}$	$\dot{m}3$	$\dot{r}$
F-test:				0.04	0.46		0.89	0.91
Sum of coefficients:				-0.005	0.08		0.07	0.01
Causality results:								
1986q1-1993q4 (deflationary period)								
$\dot{y}$ (excluding $\dot{r}$)	3	0.65	(0.96)	$t\dot{o}t$	$\dot{y}$	$\dot{p}$	$\dot{m}3$	$\dot{r}$
F-test:				0.45		0.92	3.50**	
Sum of coefficients:				-0.02		-0.30	-0.20	
Causality results:							$\dot{m}3 \Rightarrow \dot{g}$	
$\dot{y}$ (including $\dot{r}$)	3	0.79	(0.17)	$t\dot{o}t$	$\dot{y}$	$\dot{p}$	$\dot{m}3$	$\dot{r}$
F-test:				1.78		3.71**	5.18**	3.73**
Sum of coefficients:				0.02		-0.70	-0.06	-0.08
Causality results:						$\dot{p} \Rightarrow \dot{g}$	$\dot{m}3 \Rightarrow \dot{g}$	$\dot{r} \Rightarrow \dot{g}$
$\dot{p}$	3	0.71	(0.10)	$t\dot{o}t$	$\dot{y}$	$\dot{p}$	$\dot{m}3$	$\dot{r}$
F-test:				2.23	1.08		2.53	1.51
Sum of coefficients:				-0.14	0.32		-0.09	0.01
Causality results:								

Table 2 continued

Equation	*m*	R^2	LM-test	Right-hand side variables				
1994q1-1999q2 (single-digit inflation period)								
$\dot{y}$ (excluding $\dot{r}$)	1	0.37	(0.51)	$t\dot{o}t$	$\dot{y}$	$\dot{p}$	$\dot{m}3$	$\dot{r}$
F-test:				0.91		2.52	0.90	
Sum of coefficients:				0.08		0.17	-0.05	
Causality results:								
$\dot{y}$ (including $\dot{r}$)	1	0.45	(0.33)	$t\dot{o}t$	$\dot{y}$	$\dot{p}$	$\dot{m}3$	$\dot{r}$
F-test:				0.58		5.25**	0.54	2.85
Sum of coefficients:				0.05		0.35	-0.04	-0.03
Causality results:						$\dot{p} \Rightarrow \dot{g}$		
$\dot{p}$	1	0.09	(0.37)	$t\dot{o}t$	$\dot{y}$	$\dot{p}$	$\dot{m}3$	$\dot{r}$
F-test:				0.11	1.15		0.02	0.008
Sum of coefficients:				-0.06	0.53		-0.02	0.004
Causality results:								

Notes:

1. *** denotes significance at the 1% level, ** at the 5% level and * at the 10% level.
2. *m* denotes the order of the VAR models.
3. The Akaike Information and Schwartz Bayesian selection criteria were used to determine the order of the VAR models. In cases were the two selection criteria contradicted each other, a likelihood ratio test was performed to eliminate lags from a general to a more specific model.
4. The VAR models, with one notable exception, pass diagnostic tests such as the Lagrange Multiplier (LM) test for serial correlation, heteroscedasticity, normality and functional form specification at the 5% significance level.
5. The figures in parentheses ( ) are probability values. Values which fall below 0.05 indicate that the probability of no serial correlation is less than 5%.

Table 3

Linear and Non-Linear Phillips Curves

	Accelerating inflation		**Deflationary period**		
Period	**71q1-85q4**		**86q1-93q4**		**86q1-97q2**
Variables	Linear (2-3;1-2)	Non-linear (2-3;2;2)	Linear (1-3;1)	Non-linear (1-3;1;1)	Non-linear (1-3;1;1)
intercept	4.10** [2.28]	3.21 [1.56]	4.19 [0.97]	9.54** [2.15]	5.03** [2.09]
$\dot{p}^e$	0.69*** [4.72]	0.69*** [4.68]	0.68*** [2.46]	0.44 [1.59]	0.68*** [4.27]
$(\dot{y}-\bar{\dot{y}})$	0.40*** [2.83]		0.17 [0.57]		
$(\dot{y}-\bar{\dot{y}})^{overh}$		0.50** [2.23]		-1.04* [-1.83]	-0.46 [-0.99]
$(\dot{y}-\bar{\dot{y}})^{weak}$		0.06 [0.29]		1.12** [2.43]	1.01** [2.27]
Diagnostic tests					
R^2	0.33	0.33	0.22	0.40	0.43
F	(5,54): 6.74	(5,54): 6.54	(4,26): 1.84	(5,26): 3.45	(5,40): 5.91
LM: $\chi^2(4)$	5.86	4.42	1.57	4.08	5.66
Ff: $\chi^2(1)$	2.49	2.75	0.95	0.40	0.39
N: $\chi^2(2)$	1.49	2.75	0.71	1.16	1.45
H: $\chi^2(1)$	0.36	0.03	0.06	0.07	0.07
Chow test					(6,35): 1.69

Notes:

1. *** denotes significance at the 1% level, ** at the 5% level, and * at the 10% level.
2. The figures in brackets [ ] are t-statistics.
3. The figures in parentheses ( ) are the lag lengths and determined by the Akaike and Schwartz Bayesian Criteria.
4. R^2 is the coefficient of determination; F is an F-test for the overall significance of the regressions; LM is the Lagrange multiplier test for up to fourth order serial correlation; Ff is Ramsey's reset test for functional form misspecification; N is a test for normality; H is a heteroscedasticity test statistic; and the Chow test is a test for the structural stability of the model.

Figure 1

Inflation and Growth in the Four Inflationary Episodes, 1960q2-1999q2

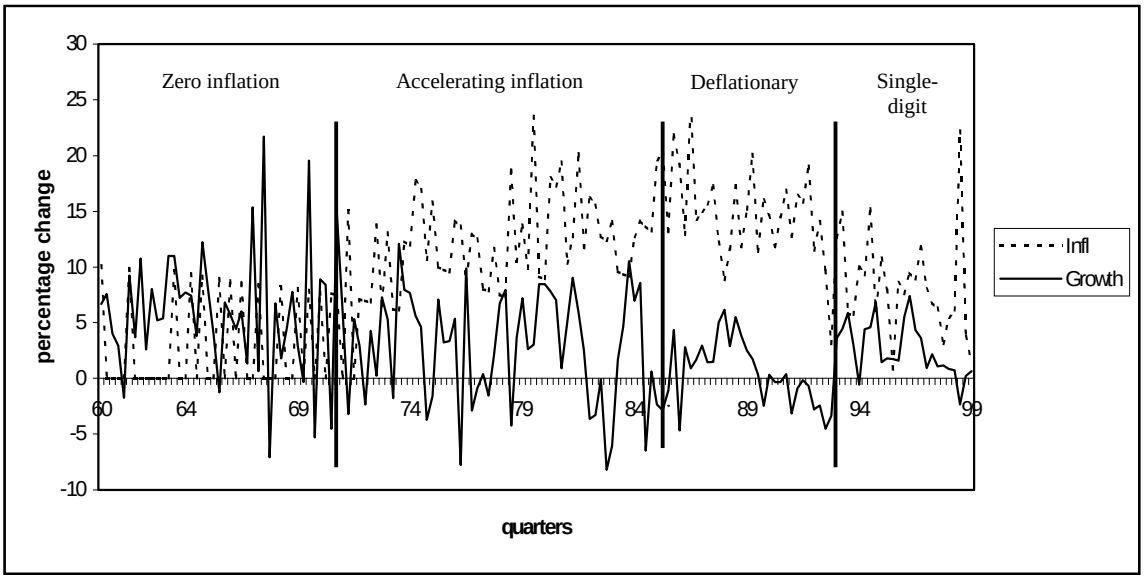

Figure 2

Growth and Inflation Correlations in Different Sub-samples

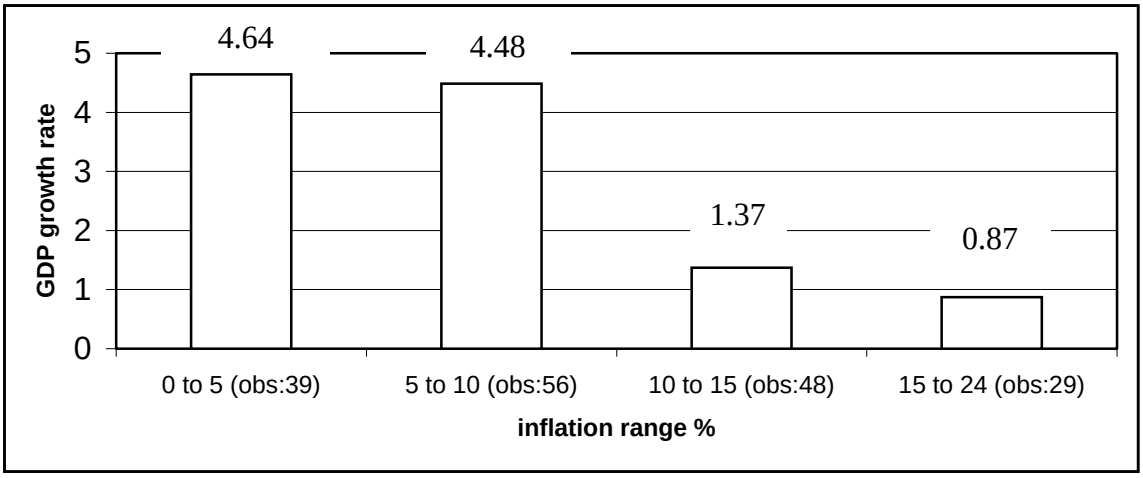

Figure 3

Different Shapes of Phillips Curve Relations

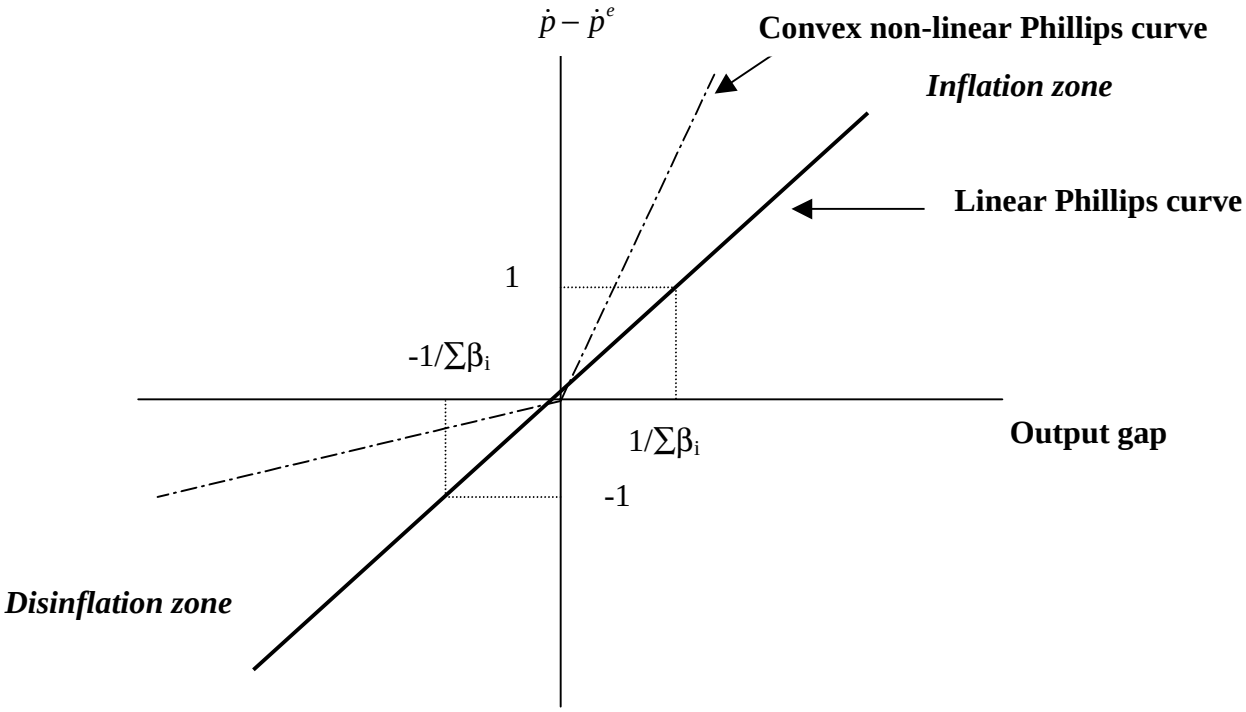

Figure 4

The Output Gap, 1971q1-1997q2

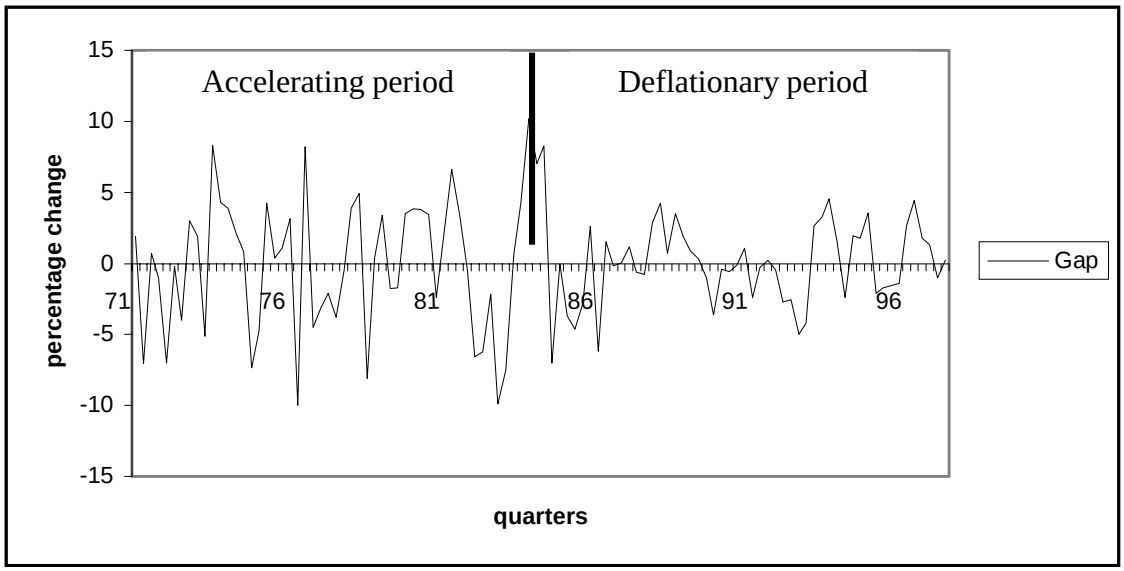

Figure 5

Phillips Curves, 1971q1-1985q4 and 1986q1-1997q2