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Inflation and unemployment in South Africa: Is the Phillips curve still dead?

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ABSTRACT

It is regularly contended that the overly strict application of inflation targeting stifles employment growth in South Africa, with the contentious Phillips curve often used as seemingly authoritative reference. Proponents of this hypothesis argue that there is a trade-off between inflation and unemployment, which might be exploited to reduce the unemployment rate. Inflation-targeting central banks are consequently lambasted for their attempts to keep inflation low – attempts which could arguably contribute to higher unemployment. In response to conflicting results in the literature, a number of Phillips curve formulations are estimated to test this hypothesis in the modern South African economy. The article addresses a significant shortcoming in the existing South African literature by directly testing the relationship between inflation and the unemployment rate, instead of relying on traditional approximations of this relationship through variables such as the output gap or economic growth which might have contributed to the confusion in the first place. In the short run it finds no evidence of a trade-off between inflation and the unemployment rate, thus confirming the orthodox view, while there is conflicting evidence of a positive relationship between inflation and employment growth. The long-run estimation finds strong evidence of a negative relationship between inflation and employment, which leads to the conclusion that inflation harms employment creation.

Key words: employment creation, error correction, inflation, Phillips curve, unemployment rate

JEL: C25, E32, E37, E51

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Introduction

The relationship between monetary conditions such as the interest rate or money supply and real economic variables such as output and employment has long been a source of contention among academics and policymakers alike. Changes in monetary conditions are often believed to transmit to the real economy through the classical Phillips curve relationship as a trade-off between inflation and real output or employment. This idea of a trade-off was born out of findings by A.W. Phillips (1958), who detected a negative relationship between the rate of money wage changes and the unemployment rate in the British economy over the period 1861–1957. His graph of wage inflation plotted against the unemployment rate famously became known as the 'Phillips curve'. Academics and policymakers alike started to believe in a permanent and stable trade-off between inflation and unemployment, and that this relationship could perhaps be manipulated or exploited in favour of employment creation.

There is, however, still considerable debate as to the exact impact that monetary conditions could really have on real economic variables. While for many the Phillips curve represents a straightforward trade-off between inflation and unemployment, others caution against interpreting the relationship too literally or simplistically. Indeed, Burger and Du Plessis (2013: 31) warn that "a mistaken view of this relationship … has been responsible for much mischief in the design and implementation of monetary policy". The orthodox view is that, while there might exist a short-run trade-off between inflation and unemployment, there is generally no long-run trade-off. This view is, however, disputed, either explicitly or implicitly, by many critics of inflation targeting, who argue that an unreasonably strict focus on inflation directly harms employment creation. The debate is further obscured by conflicting findings being reported regarding the relationship between inflation and employment.

In the context of persistently high unemployment, the question is, however, especially pertinent. If the Phillips curve trade-off existed it could perhaps be a tool to realise lower unemployment (Cashell 2004; Epstein 2007). Unemployment in South Africa is widespread, with the official rate hovering around 20–25% for most of the past 25 years. Over the same time, annual inflation has fallen from a high of 15.3% in 1991 to consistent single-digit figures since 1993, with the exception of an 11.5% outlier in 2008 (Statistics South Africa [StatsSA] n.d). Price stability of this kind is believed to foster a stable macroeconomic environment, which would lead to improved productive investment opportunities, capital inflows, and stable and sustainable long-term economic growth. Relatively healthy (albeit unspectacular) economic growth over the same time has unfortunately done little to improve the bleak unemployment outlook. In fact, this period is characterised by two decades

of "low employment economic growth" (Mahadea & Simson 2010: 391). While the South African economy has grown at an annual average of roughly 2.5% per year since 1990, the unemployment rate has in fact significantly deteriorated. Over the same period, the actual number of people employed has grown by 1.6% per year, just over half the growth of real GDP. These numbers give the impression that low and stable inflation does play a part in helping the economy grow. At the same time, however, it does not appear that this economic growth is translated into sufficient employment growth, raising yet more questions regarding the complex relationships between inflation, output and employment.

This article investigates the notion that inflation targeting is a cause of South African unemployment. Combining newer data with a different econometric approach, this article aims to determine whether there is new evidence of a trade-off between inflation and the unemployment rate between 2000–2015. This specific period is primarily chosen due to data availability, but it conveniently also matches the adoption of inflation targeting in South Africa. For the first time, thanks to StatsSA's comprehensive Labour Force (LFS) and Quarterly Labour Force (QLS) surveys which have been published since 2000, the quality and span of South African unemployment data are sufficient to revisit the original Phillips curve hypothesis, and it is envisioned that this approach might shine a fresh light on the issue. This article further extends the analysis by investigating the long-term relationship between inflation and employment creation in South Africa since 1970. The article is organised as follows: the current debate around the appropriateness of inflation targeting is discussed in Section 2, while Section 3 provides a brief outline of the Phillips curve hypothesis and discusses some theoretical considerations behind these arguments. Section 4 presents an overview of the South African literature on comparable studies and investigates the data and some preliminary graphical evidence. Section 5 proposes a simple econometric approach based on Gordon's (1997) 'triangle' model. The short-run triangle model is subsequently extended to a long-run cointegration estimation. The results are presented and discussed. Section 6 concludes this article.

Inflation-targeting debate

Inflation-targeting central banks are often criticised that their efforts to keep inflation within the target range are detrimental to economic growth and – especially – employment creation. And, since many central banks around the world now (either explicitly or implicitly) follow some form of inflation targeting (Goodfriend 2007), the criticism is widespread. According to Taylor's (1998: 2) summary of the late-1990s 'new consensus' around the core of macroeconomics, "there is a short run

trade-off between inflation and unemployment". Nobel laureate Joseph Stiglitz (2008: 3) argues that inflation targeting brings a "weaker economy and higher unemployment". Rochon and Rossi (2006: 616) question "why inflation targeting [is] seen as a superior policy over a policy of, say, supporting employment or output growth". They argue that only "by collapsing aggregate demand and increasing unemployment, [inflation targeting] central banks may succeed in decreasing prices, but at a great cost to the whole economy" (2006: 626). Epstein (2003: 1) asserts that the focus on inflation targets "has led to slower economic growth and lower employment growth", while Rudebusch and Walsh (1998) acknowledge that inflation targeting can reduce the flexibility of monetary policy with respect to other policy goals. A related view is that a single-digit inflation target might be too low, especially in emerging economies where other macroeconomic goals should enjoy priority. Inflation targets could perhaps therefore be set somewhat higher in order to grant central banks more flexibility in pursuing these other goals. Epstein (2007: 9) argues that 'moderate' inflation has no "predictable negative consequences on the real economy". According to Pollin and Zhu (2006), higher inflation, up to a threshold of around 15–18%, can be associated with moderate gains in output which could extend to gains in employment.

The South African Reserve Bank (SARB) has not been spared criticism following its formal adoption of an inflation-targeting monetary policy framework in February 2000. Its government-mandated goal of keeping inflation within the 3–6% target band is often argued to constrain economic growth, consequently stifling employment creation and contributing to high levels of unemployment. According to Akinboade, Niedermeier and Siebrits (2002: 220), inflation reduction in South Africa following the adoption of the inflation-targeting regime "is likely to be slow and costly in terms of output and employment". Epstein (2008) calls for inflation targeting in South Africa to be replaced by "employment targeting", arguing that inflation targeting "was not successful ... in terms of key real sector goals such as lower unemployment and higher economic growth" (Comert & Epstein 2011: S95). Kumo (2015: 26) notes that the "cost of inflation targeting on output and employment … remains significant in South Africa". In the public debate the SARB has been accused of "applying the brake of inflation targeting" (*Financial Mail* 2011). A very vocal critic, trade union Cosatu (Congress of South African Trade Unions), calls the inflation-targeting policy "disastrous", and argues that it "has contributed directly to slowing down the rate of economic growth and thus of job creation and poverty alleviation" (Cosatu 2007). Cosatu (2016) has also condemned recent monetary tightening as "unwarranted and destructive" and argued that it will "stifle any chances of employment creation". In a recent public lecture, Stiglitz (2014) suggested that South African inflation targeting

is detrimental to growth as it "puts the risk of inflation ahead of job creation". It is therefore tempting to call for inflationary policies, tantamount to the significant relaxation – even abolition – of the inflation-targeting framework, in order to boost economic growth and employment. Indeed, as Burger and Du Plessis (2013: 37) argue, "the pressure on the SARB not to harm growth through an overly [vigilant] inflation policy is unrelenting", while Fedderke and Schaling (2005: 80) caution that "it may be attractive ... to put pressure on the central bank in order to generate a 'quick fix' of the economy through interest rate cuts".

On the other hand, there are those who believe that the current South African inflation-targeting monetary policy regime is appropriate. Inflation targeting has been shown to have important benefits for the countries that have adopted it (Bernanke, Laubach, Mishkin & Posen 1999; Goodfriend 2007). Inflation targeting serves to anchor inflation expectations (Mishkin 2007) and further to avoid the classical time inconsistency problem of monetary policy (Kydland & Prescott 1977). Goodfriend (2007: 61) argues that "inflation targeting yields the best cyclical behaviour of employment and output that monetary policy alone can deliver". Furthermore, the SARB itself officially pursues 'flexible' inflation targeting (SARB n.d.), by its own admission not focusing exclusively on inflation but also taking into account other macroeconomic variables such as economic growth and unemployment. The SARB asserts that "monetary policy cannot contribute directly to economic growth and employment creation in the long run", but that "by creating a stable financial environment, monetary policy fulfills an important precondition for the attainment of economic development" (SARB n.d.). There are also fears that overly expansionary monetary policy – even if it could boost economic growth and subsequently employment creation in the short run – would cause higher inflation which may have adverse effects in the long run, essentially destroying the progress made in the first place. It is a well-established fact, both globally and domestically, that high inflation has a negative effect on long-run economic growth (Sarel 1995; Horwitz 2003; Hodge 2006). Inflation also exacerbates inequalities within societies (Easterly & Fischer 2001), which is a critical consideration in the South African economy characterised by high levels of poverty and inequality.

More recently it has been argued that inflation targeting could be abandoned in favour of nominal income or GDP targeting (Romer 2011; Frankel 2012; Sumner 2012; Wren-Lewis 2013). One of the attractive features of this approach is the suggestion that a nominal income target would stabilise employment more effectively than an inflation target. Given the high negative correlation between nominal GDP and unemployment, employment would under nominal income targeting be less affected by adverse economic circumstances (Sumner 2012). Two recent papers argue

that inflation targeting is, however, still superior to nominal income targeting in the South African context. Du Plessis and Rietveld note that "the case for replacing inflation targeting as currently practiced with nominal income targeting based on the perceived inflexibility of the former framework fails on both theoretical and empirical grounds" (2014: 9). Hassan and Loewald (2013: 7) acknowledge management of capital flows, exchange rate volatility and inadequate response to asset price bubbles as possible limitations of inflation targeting, yet argue that "there are no evident reasons to expect nominal income targeting to resolve them". Addressing the employment issue, they argue that "[i]t is not however clear that abandoning a carefully managed flexible inflation targeting framework ... would necessarily permit a closer alignment of monetary policy with employment creation" (2013: 13).

Theoretical overview

Phillips' original hypothesis

In his seminal paper, Phillips (1958) detected a stable non-linear negative relationship between wage inflation and unemployment in the United Kingdom. He originally hypothesised that it is changes in the demand for labour which lead to changes in the money wage rate, stating that "[w]hen the demand for labour is high and there are very few unemployed we should expect employers to bid wage rates up quite rapidly, each firm and each industry being continually tempted to offer a little above the prevailing rates to attract the most suitable labour from other firms and industries" (1958: 283). He continues by arguing that "a second factor influencing the rate of change of money wage rates might be the rate of change of the demand for labour, and so of unemployment" (1958: 283). Phillips argues that a high demand for labour will lead firms to bid up wages in order to attract the desired labour. While it is certainly true that a higher wage rate could encourage more people to join the labour force, never does Phillips assert that a higher wage rate will reduce the unemployment rate. He clearly states that "[t]he purpose of the present study is to see whether statistical evidence supports the hypothesis that the rate of change of money wage rates ... can be explained by the level of unemployment and the rate of change of unemployment" (1958: 284), and not that unemployment is explained by wage inflation.

It could, however, conceivably be argued that more people would join the labour force if higher nominal wages were offered, which may explain how wage inflation might influence employment. This could have an impact on the unemployment rate and might be an unintentional by-product of Phillips' original hypothesis. A simple numerical example illustrates this possibility. The unemployment rate can be

calculated as (labour force – number of people employed) / (labour force). Assume an initial hypothetical labour force of 100 people, with 70 of them employed. The unemployment rate is therefore (100 – 70)/100 = 30%. If higher nominal wages encourage ten more people to join the labour force, and assuming optimistically that they are all immediately employed, the unemployment rate drops to (110 – 80)/110 = 27.3%. If, however, only six people or fewer are employed, the unemployment rate will actually increase. Of critical consideration is therefore how many of the new labour market entrants will be hired by existing employers. This simple example illustrates that the unemployment rate is therefore not only a function of the demand for labour (reflected by the wage rate), but also of the supply of labour. Even if higher nominal wages encourage new entrants into the labour market, how many of them will ultimately end up being employed by meeting the requirements of those very firms offering higher wages in the hope of attracting suitable workers? The higher wages on offer might encourage, hypothetically, five new entrants who will all be competing for only one or two positions. What about the three or four who fail to gain employment? They are now (at least for a while) part of the labour force and their unemployed status will skew the unemployment rate upwards.

While demand-side policies might reasonably be expected to succeed in increasing employment (i.e. creating jobs), the unemployment rate is a different and more complex metric altogether. Clearly, the quality of labour supplied is just as crucial in determining the unemployment rate. This is a very important question in the South African context of skills shortages in the labour market and will be briefly addressed below.

Causality

Phillips' (1958) study was repeated internationally, and a remarkably stable trade-off between inflation and unemployment was observed around the world throughout the 1960s. Given these results, it was asserted that "policymakers could 'buy' a lower rate of unemployment at the cost of a higher rate of inflation" (Cashell 2004: 2). Even though Phillips originally hypothesised that the unemployment rate explains the rate of money wage changes, it can be argued that causality might also run the other way, as mentioned earlier. By generalising the rate of money wage changes to the overall inflation rate, this trade-off can be interpreted as follows: Through expansionary monetary policy the central bank allows the economy to grow at a faster pace. Cheaper money, by virtue of lower interest rates, boosts consumption and investment spending, increasing aggregate demand and subsequently economic growth (Mishkin [2001] provides a detailed summary of the channels through which

changes in monetary policy transmit to the real economy). Higher growth leads to the expansion of output and productive capacity, increasing the demand for labour and thus increasing employment and lowering the unemployment rate. However, a by-product of a faster-growing economy is higher inflation. According to Sumner (2012: 17), "the inflation is essentially a side effect of the increased aggregate demand, the desired effect of which is greater employment and real growth." Because of the increased demand for labour, workers now have more bargaining power and nominal wage rates will increase at a faster pace. As a result, aggregate demand will increase further, exerting more upward pressure on prices. At the same time firms might increase the prices of their goods in order to protect their profit margins in the face of higher nominal wage demands, further contributing to a higher price level. The converse is also true. In order to realise lower levels of inflation, the central bank could employ contractionary monetary policy by way of higher interest rates. Through these same channels, aggregate demand should slow down to reduce inflationary pressures, but this could be to the detriment of economic growth and subsequently employment creation. In this framework, however, inflation does not drive changes in employment and it could therefore not strictly be described as a 'causal' relationship. It is merely a by-product of strong economic growth, where higher inflation could therefore perhaps be 'tolerated' in order to achieve higher employment targets.

Another possible theory explaining a more direct causal link between inflation and unemployment is derived from the Keynesian sticky-wage theory, which suggests that nominal wages are slow to adjust to changes in the price level. If the central bank were to pursue an expansionary monetary policy, prices would rise (inflation) and real wages would fall. Subsequently the demand for labour would increase, which could lead to a drop in the unemployment rate. When nominal wages eventually adjust to the higher prices, real wages would increase and demand for labour would fall. Inflation could therefore lead to an increase in employment, but this would only be a short-run increase. The symmetry of the theory predicts that employment should fall (return to equilibrium) as soon as nominal wages adjust to the higher price level. This theory has two shortcomings, however. First, "real wages do not exhibit the countercyclical behaviour that this theory predicts" (Mankiw 2001: C49). Second, even if the theory did hold, there is no guarantee that a higher demand for labour would translate into a drop in the unemployment rate, as was illustrated by the hypothetical examples above. It is therefore unlikely that changes in the inflation rate would directly cause changes in the unemployment rate – there is simply no reliable theoretical link.

The Phillips curve fails

Based on an appealing theory and data which supported it, the Phillips curve became an essential part of macroeconomic modelling and policy analysis of the 1960s. However, the Phillips curve broke down during the 1970s, when simultaneous high levels of inflation and unemployment were observed around the world, and the assumed relationship between inflation and unemployment was called into serious question. The direction of causality and deeper mechanical processes were obscured in opacity, and the Phillips curve was widely discredited. Furthermore, Lucas (1976), in his famous critique, argues that economic agents' optimal decision rules vary in response to changes in policy. In the Phillips curve context, it implied that the trade-off would cease to exist once monetary policymakers attempted to exploit it.

In response to this empirical breakdown of the relationship, newer forms of the Phillips curve were created. These include, among others, the natural rate hypothesis established by Friedman (1968) and Phelps (1967; 1970), and the expectations-augmented and New-Keynesian Phillips curves (see Mankiw [2001] and Zhu [2005] for an in-depth discussion of newer Phillips curve formulations), which have somewhat repaired the reputation of the Phillips curve. Blinder (1997: 241) claims that the reliability of the (new) Phillips curve was the "clean little secret" of modern macroeconomics. Subsequently, the idea of a trade-off between inflation and unemployment has also been revived. However, in spite of all the attention that the Phillips curve trade-off has enjoyed, "the economics profession has yet to produce a satisfactory theory to explain it" (Mankiw 2001). Contemporary analyses generally involve deriving structural equations based on microfoundations, which largely eliminates the Lucas critique. The Phillips curve is nowadays believed to be non-vertical in the short run (i.e. monetary conditions can impact real economic variables), whereas in the long run the impact of changes in the stance of monetary policy "falls mainly on the aggregate price level" (Burger & Du Plessis 2013: 30), with no effect on output or employment (i.e. a vertical long-run curve). Furthermore, modern studies generally use some formulation of the Phillips curve to express the price level (or inflation rate) in an economy as a function of certain other variables, often including some form of aggregate demand such as the output gap or an unemployment gap as an explanatory variable. The dependent variable in these modern formulations is the price level or inflation rate, not the unemployment rate. The contemporary approach confirms Phillips' original theory that the demand for labour determines the price level or (wage) inflation, not the other way around. While it could theoretically be possible for inflation to have a short-run stimulatory effect on employment growth,

this causal relationship can only be extended to the unemployment rate insofar as inflation, as a by-product of economic growth, affects the demand for labour.

Historical overview and South African evidence

Earlier research on inflation, growth and employment in South Africa

Numerous excellent studies have analysed the relationship between inflation, unemployment and economic growth in South Africa (see Hodge [2002] and Burger & Du Plessis [2013] for a thorough discussion of the literature). Due to South Africa's political history, however, there is hardly any official data available on black employment prior to the 1990s, while the data that are available are generally regarded as inaccurate. Hodge (2006: 175) finds South African unemployment data "patchy and unreliable", while "the lack of a reliable and sufficiently long unemployment time series" is lamented by Burger and Marinkov (2006: 1). It is therefore near impossible to model the traditional Phillips relationship between inflation and the unemployment rate over a sufficiently long period of time and spanning different South African monetary policy regimes.

Given the unavailability of reliable unemployment data, specifically during the period 1950–1985, previous work in the South African literature can be broadly classified into two categories: those studies testing the relationship between the unemployment rate and inflation, similar to Phillips (1958), and those substituting the unemployment rate for some other measure of aggregate demand. The former group includes most of the older papers, namely Gallaway, Koshal and Chapin (1970), Hume (1971), Truu (1975), Strebel (1976), Strydom (1976), Strydom and Steenkamp (1976) and Levin and Horn (1987). These early studies predominantly used the more reliable white unemployment data (Hodge 2002), and found a significant negative relationship between inflation and the unemployment rate up until the late 1960s, in line with the international experience at the time. However, the international inclination towards Friedman and Phelps' influential natural rate hypothesis, as well as "the increasing local unease with the accuracy of measured unemployment rates" (Burger & Du Plessis 2013: 35), encouraged researchers to move away from the unemployment rate to various measures of aggregate demand. The latter group therefore used economic growth (Krogh 1967) or the output gap (Strydom & Steenkamp 1976; Nell 2000, 2006; Hodge 2002, 2006; Fedderke & Schaling 2005; Burger & Marinkov 2006; Burger & Du Plessis 2013) as a proxy for unemployment to test the Phillips curve hypothesis in South Africa. Intuitively, a positive output

gap reflects an economy growing above its long-run trend, which should give rise to higher employment and therefore a lower unemployment rate.

The general conclusion from the South African literature is twofold. There is evidence of a trade-off between inflation and the unemployment rate from around the late-1940s to the mid-1960s, with the relationship deteriorating significantly during the 1970s and 1980s. On the other hand, inflation is found to have an inverse relationship with economic growth in the long run, in line with the international experience that it is "widely accepted that inflation has a negative effect on economic growth" (Sarel 1995: 199), and summarised by Hodge's (2006: 163) conclusion that "inflation drags down growth in South Africa over the longer term".

Preliminary data analysis

There are two shortcomings in the literature on the South African Phillips curve which this article directly addresses. First, the studies which estimated a direct relationship between inflation and the unemployment rate often did so with incomplete data. Given the data limitations at the time it was understandable; however, there might consequently be an inherent bias in their results. Second, the studies which attempted to circumvent these data constraints by replacing the unemployment rate with some form of aggregate demand or output gap term were essentially testing a different hypothesis: that of the relationship between inflation and growth, and not between inflation and unemployment. According to Hodge (2002), the trade-off between inflation and unemployment is reflected by a similar trade-off between inflation and the output gap, provided the aggregate production function remains unchanged, which offers the theoretical justification for the change in approach. However, this motivation is somewhat unsatisfactory. While theoretically there should be an inverse relationship between output and the unemployment rate (or at least a positive relationship between output and employment in line with the earlier discussion), making it intuitively appealing to estimate the much more readily observable relationship between inflation and some measure of output and extend the result to the unemployment rate, the South African data as discussed in the introduction show that an increase in output does not necessarily lead to a comparable increase in employment (not to mention a commensurate decrease in the unemployment rate). Furthermore, South African unemployment is often argued to be "structural" (Hodge 2002; Daniels 2007), and therefore less responsive to changes in aggregate demand. As such, economic growth is perhaps only a partial approximation of employment creation in this context. Given that the matter under consideration is whether policies boosting aggregate

demand can succeed in creating employment or lowering the unemployment rate, the latter warrants further investigation.

While South African employment and economic growth generally trend together over time (Figure 1), there is a quite inconsistent relationship between the growth rates of the two series (Figure 2). Figures 1 and 2 utilise data from the Standardised Employment Series, originally estimated by Roukens de Lange and Van Eeghen (1984, updated and revised in 1993), and extended by Hodge (2009) with data from various editions of the South African Labour Statistics (1990–1995), the October Household Survey (1995–1999) and the LFS (2000–2007). This series was further updated for the current article with employment data from the QLS up to 2014. Data are discussed in more detail in Appendix A1, with the full employment series reported in Table A1.

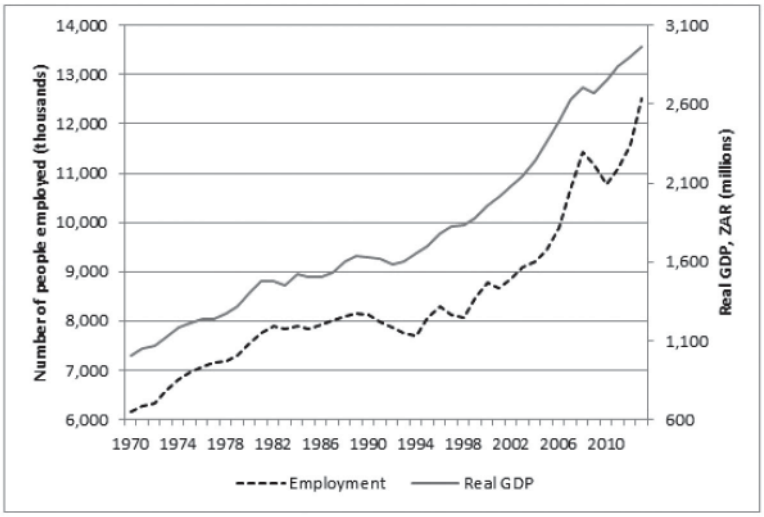

Figure 1: Employment and output, 1970–2014

Source: SARB, Hodge (2009), StatsSA

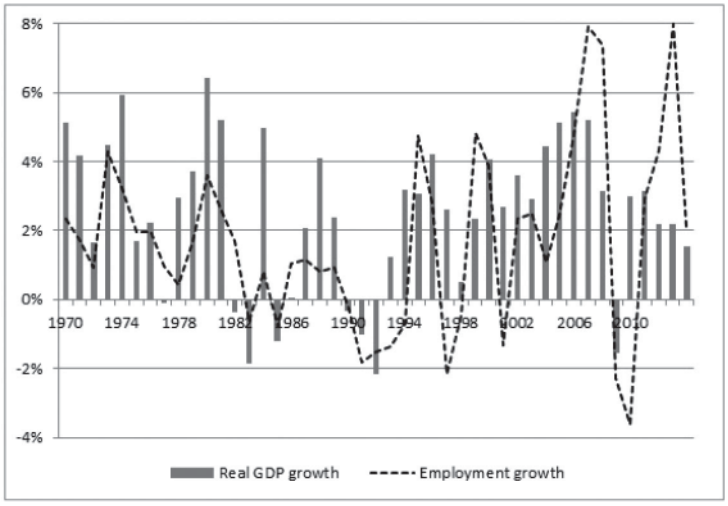

Figure 2: Real GDP growth vs. employment growth, 1970–2014

Source: SARB, Hodge (2009), StatsSA

In 1997, for example, the economy grew by 2.6% whereas employment contracted by 2.2%. In 1999 employment growth (4.8%) was double the economic growth (2.4%), while in 1973 and 2000 both the economy and employment grew by around 4.0%. This inconsistency is further substantiated by the contrasting rates of average annual economic growth (2.5%) and employment growth (1.6%) from 1990–2014, alluded to earlier. Hodge (2009) calculates an employment coefficient (the average rate of employment growth expressed as a fraction of the average rate of economic growth) of 0.5 for the period 1990–2007, which indicates that there is a substantially smaller than one-to-one relationship between employment creation and economic growth. This relatively low employment coefficient could also provide insight into a potential issue highlighted earlier: even though the demand for labour might increase due to economic expansion, and the supply of labour might also increase due to either higher profits enabling higher nominal wages or the prospect of employment in growing industries, this is no guarantee that new entrants into the labour market will be employed. The South African labour market is often said to be lacking proper skills (Daniels 2007), therefore the supply of labour might not meet the requirements of employers; subsequently many of these new entrants could be left structurally unemployed. An interesting paradox therefore emerges: in a labour market with a prevalent state of 'skills-shortage', an increase in either nominal wages or the demand for labour could be unlikely to lead to a

drop in the unemployment rate. Consider the example used earlier. If, out of the ten new entrants to the labour force only three possess the specific skills required by the employers in the industry which is currently growing, the unemployment rate will actually increase from 30% to (110 – 73)/110 = 33.6%. Immediately this appears to be a labour market failure of some kind, even though three people who previously had no (wage) income are now employed. This point is also made by Hodge (2009: 490), who argues that the unemployment rate "can rise if the labour force is growing faster than growth in employment". In his excellent survey of the South African unemployment landscape, Fourie (2011) argues that an over-supply of labour could explain high unemployment rates. Specifically, "labour markets are constrained because wage adjustments are inadequate in clearing the market" and "the consequence for the economy is a continued high unemployment rate" (2011: 56). The extent to which policies boosting aggregate demand would translate into employment creation, not to mention a reduction in the unemployment rate, would therefore appear to be quite limited.

A graphical analysis of the relationship between inflation and unemployment during the inflation-targeting period yields interesting results. A selective reading of the data, such as the period 2008–2014, might lead to the conclusion that the Phillips curve is indeed present (Figure 3).

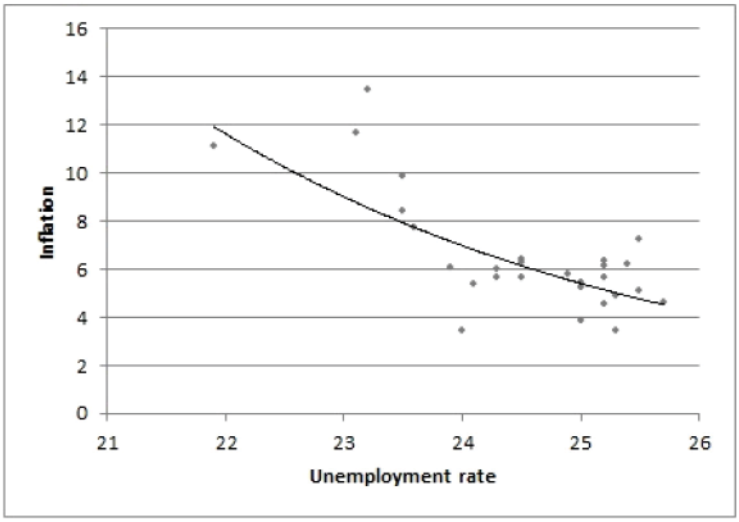

Figure 3: The South African Phillips curve, 2008–2014

Source: StatsSA

Figure 4, however, is a more complete representation of the Phillips curve over the period 2000–2015. It appears that over the longer term the unemployment rate is

not responsive to inflation whatsoever. In fact, the unemployment rate hovers in a band of 21–31%, with significant clustering around 24–25%, irrespective of the inflation rate. A similar picture emerges when the unemployment rate is plotted against economic growth. Figure 5 shows that the unemployment rate is just as unresponsive to economic growth.

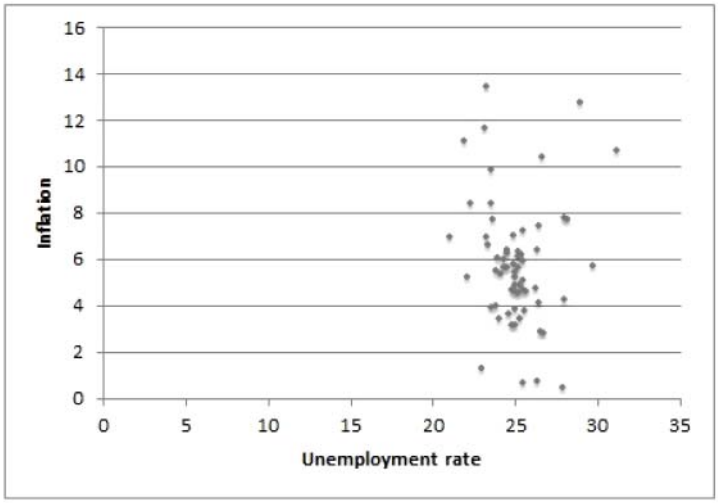

Figure 4: The South African Phillips curve, 2000–2015

Source: StatsSA

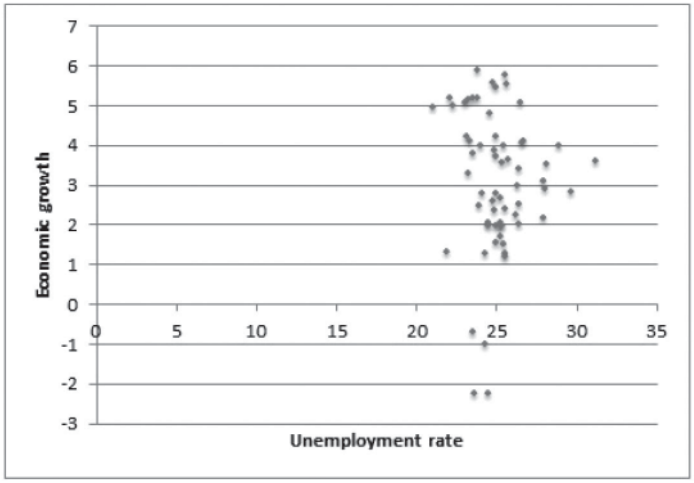

Figure 5: The unemployment rate and economic growth, 2000–2015

Source: StatsSA

Figures 4 and 5 therefore do not support the arguments against inflation targeting at all. It is contended that the absence of inflation targeting would allow for more expansionary monetary policy, which would lead to strong economic growth. In turn, that would lower the unemployment rate, presumably through an increase in the demand for labour. This argument could even be supported by Figure 3, where higher inflation looks to be associated with a lower unemployment rate. The inelasticity of the unemployment rate with respect to both inflation and economic growth over the longer term, however, would show otherwise. Even if inflationary policies succeeded in boosting aggregate demand and economic growth, it would not appear to translate to the unemployment rate.

The relationship between inflation and employment paints a slightly different picture, however. Figure 6 indicates that there might be a weakly positive relationship between inflation and the level of employment. However, there is virtually no correlation between inflation and employment growth, as evidenced in Figure 7.

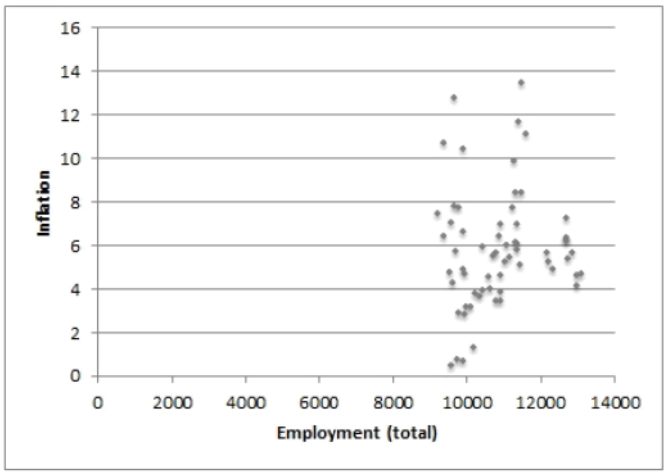

Figure 6: Employment and inflation, 2000–2015

Source: Hodge (2009), StatsSA

Econometric methodology

According to Gordon's (1997) well-known triangle model of estimating the Phillips curve, the inflation rate is dependent on three factors: inertia, aggregate demand and cost-push factors (supply shocks). Inertia occurs because inflation expectations are slow to adjust to past observed inflation. Past values of inflation influence expected future inflation and therefore impact current period inflation through changes in

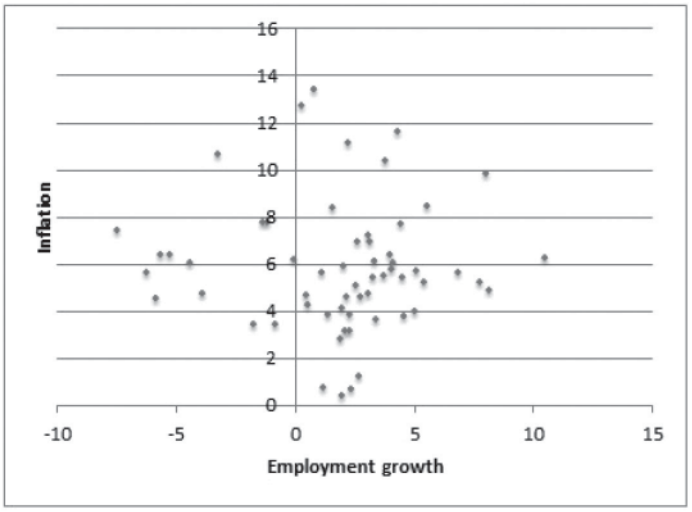

Figure 7: Employment growth and inflation, 2000–2015

Source: Hodge (2009), StatsSA

nominal wages. Furthermore, even if expectations are quick to adjust, prices remain sticky and price adjustments can be delayed, e.g. through wage and price contracts. Aggregate demand is – in the original Phillips curve literature – reflected by the unemployment rate, but is nowadays generally modelled by some measure of the output gap. Hodge (2002) introduces employment growth as another possible measure of aggregate demand. Supply shocks are any variable that can influence inflation over and above inertia and aggregate demand. According to Gordon (1997), not including a supply shock would impart an omitted variable bias to the model. In the South African context, supply shocks were modelled in Gordon's framework using changes in the import price index (Hodge 2002) or the real exchange rate (Fedderke & Schaling 2005) to capture foreign shocks to inflation, whereas Burger and Marinkov (2006) prefer unit labour costs as a measure of domestic supply shocks. Gordon's triangular Phillips curve can therefore be specified as follows:

$$\pi_t = \alpha + \beta_1 \pi_{t-1} + \beta_2 Y_t + \beta_3 Z_t + \epsilon_t \quad (1)$$

where π_t is the inflation rate and π_{t-1} lagged inflation to capture inertia. is some measure of aggregate demand and Z_t is a supply shock. ε_t is a serially uncorrelated error term.

Separate econometric models are estimated using the two aggregate demand variables proposed by Hodge (2002): the unemployment rate and employment

growth. To test the robustness of the results, each model is separately estimated with the three different supply shocks. All variables were tested for stationarity, with the results reported in Table A2. Non-stationary variables were converted to growth rates before being included in the estimation. Following Burger and Marinkov (2006), the explanatory variables are the contemporaneous aggregate demand and supply shocks, as well as a one-period lagged inflation rate.

Short-run results

Table 1 presents the results of estimations using the change in the unemployment rate (ΔU_t) as aggregate demand variable. Z_t^1, Z_t^2, Z_t^3 and denote growth in the import price index, growth in unit labour costs and the real exchange rate, respectively, as different measures of the supply shock.

Table 1: Inflation and the unemployment rate, 2000–2015

Variable	Coefficient	Std. error	t-statistic	Prob.
π_{t-1}	0.950679	0.024190	39.30066	0.0000
ΔU_t	0.021149	2.626893	0.008051	0.9936
Z_t^1	17.51337	3.654415	4.792386	0.0000
Adjusted R^2	0.81			
π_{t-1}	0.937390	0.052199	17.95795	0.0000
ΔU_t	-1.104993	3.088905	-0.357730	0.7218
Z_t^2	0.003670	0.003802	0.965336	0.3384
Adjusted R^2	0.73			
π_{t-1}	0.901084	0.058551	15.38970	0.0000
ΔU_t	-0.814416	3.034470	-0.268388	0.7893
Z_t^3	0.006462	0.004225	1.529648	0.1314
Adjusted R^2	0.74			

Based on 62 quarterly observations.

Source: SARB, StatsSA, own calculations

These results provide no evidence of a trade-off between inflation and the unemployment rate. While a negative sign on the coefficient of unemployment growth was expected, it is only present in two of the three estimations and highly

insignificant at that. This confirms the observations from Figures 4 and 5 above that unemployment is extremely inelastic in response to monetary conditions, and is consistent with Hodge's (2002: 193) assertion that "unemployment in South Africa is structural and not the result of deficient aggregate demand". Furthermore, the drastic growth in the labour force over the past two decades (Hodge 2009), in spite of solid – albeit unspectacular – growth in employment, biases the unemployment rate upwards, providing credence to earlier discussions on Phillips' original hypothesis and preliminary data analysis. Consistent with other studies, a high and significant degree of inflation persistence, or inertia, is detected. Import prices are a significant driver of inflation, echoing Hodge's (2002: 202) finding that "most of the variation in the inflation rate is explained by the inflation lag and by contemporaneous and lagged changes in the import price index". Growth in unit labour costs and the real exchange rate are statistically insignificant. The latter two variables do, however, perform an important controlling function (Gordon 1997) and are therefore retained in the estimation. (Removing these variables does not, however, change the interpretation of the unemployment variable. The coefficient remains negative and insignificant.)

The second group of models is estimated with employment growth (D Et) as the aggregate demand variable, with the results reported in Table 2.

Table 2: Inflation and employment growth, 2000–2015

Variable	Coefficient	Std. error	t-statistic	Prob.
π_{t-1}	0.936121	0.024411	38.34808	0.0000
ΔE_t	8.263133	4.297281	1.922875	0.0596
Z_t^1	13.16482	4.043586	3.255728	0.0019
Adjusted R^2	0.83			
π_{t-1}	0.958597	0.049310	19.44022	0.0000
ΔE_t	15.52326	4.746989	3.270127	0.0019
Z_t^2	-0.001563	0.003894	-0.401382	0.6897
Adjusted R^2	0.79			
π_{t-1}	0.931208	0.054074	17.22104	0.0000
ΔE_t	14.31797	4.393871	3.258623	0.0019
Z_t^2	0.000934	0.004116	0.226902	0.8213
Adjusted R^2	0.79			

Based on 59 quarterly observations.

Source: SARB, Statistics SA, own calculations

While the same results regarding inertia and supply shocks generally apply in the second estimation, there is evidence of a positive short-run relationship between inflation and employment growth. Contrary to the unemployment estimation, the coefficient on employment growth is correctly signed (positive) and significant. Again, of the various supply shocks only import prices are statistically significant, while the results are robust to the presence or absence of the alternative supply shocks.

It should be cautioned, however, that this result does not in itself imply that inflationary policies can boost employment creation. The indication is rather that growth in employment can be a significant driver of inflation (the dependent variable in Equation 1). Intuitively, growth in employment should result in higher aggregate spending in the economy which would transmit some inflationary pressures. This is consistent with the mechanism proposed under the section on causality. This relationship can be further explored by Granger causality tests (Table 3).

Table 3: Pairwise Granger causality tests, 2000–2015

	F-Statistic	Prob.
ΔE_t does not Granger Cause	4.46561	0.0039
π_t does not Granger Cause	3.23990	0.0201

There is strong evidence of a short-run causal relationship from employment growth to inflation which supports the findings from Table 2. However, there is also evidence of causality running from inflation to employment growth, albeit only at the 5% level of significance. This would suggest bidirectional causality where inflation and employment growth could reinforce one another, at least in the short run. This fits the sticky-wage theory discussed earlier, which predicts that inflation would lower real wages, leading to an increase in the demand for labour and subsequently employment growth. The theory, however, only applies in the short run, as nominal wages will inevitably adjust to the higher price level, real wages would rise and employment would return to equilibrium. Whether this feedback effect is sustainable in the long run will be addressed below.

Long-run relationship between inflation and employment

The short-run analysis was limited to the period 2000–2015 due to reliable and high-frequency unemployment data only being available since 2000. The long-run estimation is therefore limited to the relationship between inflation and the level of employment. A graphical analysis of the long-run (annual) data suggests a negative relationship between inflation and employment. Figure 8 plots inflation against employment with a fitted logarithmic regression line. The correlation coefficient

of -0.42 indicates that there is a significant negative relationship between inflation and the number of people employed. Higher levels of inflation coincide with lower levels of employment. This is also consistent with the argument of economic growth leading to employment growth (Figure 1), and the negative relationship between inflation and growth in South Africa detected by the authors mentioned above. To further explore this observation, the relationship between inflation and employment growth is illustrated in Figure 9. The correlation coefficient of -0.17 is supportive evidence of a moderate negative relationship.

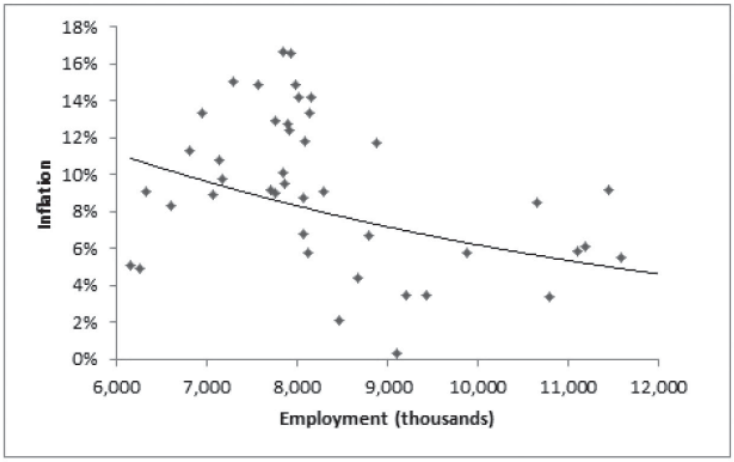

Figure 8: Inflation and employment, 1970–2014

Source: Hodge (2009), StatsSA

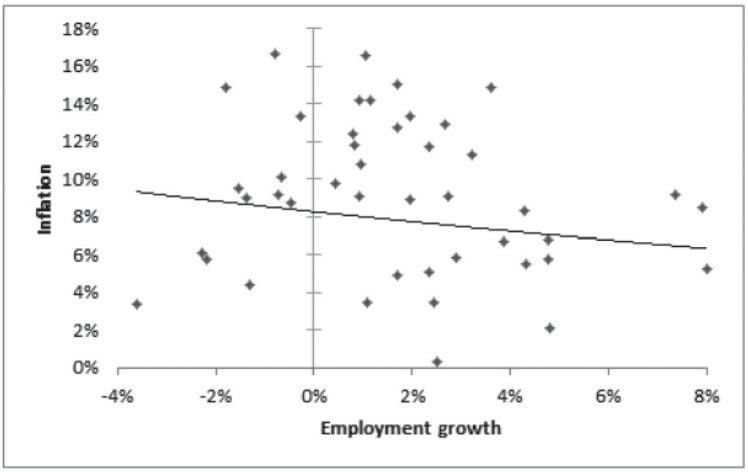

Figure 9: Inflation and employment growth, 1970–2014

Source: Hodge (2009), StatsSA

Given that the time series used here are non-stationary (that is, they contain at least one unit root), the Engle-Granger (EG) error-correction framework (Engle & Granger 1987) is applied to test for the existence of a stable long-run (cointegrating) relationship between inflation and the level of employment. The EG cointegration test involves estimating a long-run ordinary least squares (OLS) regression between two non-stationary (I(1)) variables which are theorised to be cointegrated. Should the residuals of this regression be stationary, i.e. I(0), the two variables are confirmed as cointegrated (Brooks 2008). A significant advantage of the EG approach is that various dynamic disturbances can be introduced into the short-run estimation, in addition to the equilibrium relationship in the long run. The simple long-run relationship to be estimated is

$$\pi_t = \alpha + \beta_1 E_t + \mu_t \tag{2}$$

where π_t is the inflation rate, E_t is the log of the number of people employed and μ_t is a normally distributed error term. Figures 8 and 9 indicate a negative relationship between inflation and employment. It is therefore expected that the cointegration estimation would yield a negative coefficient on the employment variable, with the stability of this relationship described by the error-correction term. The standard short-run error-correction equation for a long-run equation of the format in 2 is given by

$$\Delta\pi_t = \beta_0(\pi_{t-1} - \alpha - \beta_1 E_{t-1}) + \beta_1 \Delta E_t + \beta_2 \mathbf{Z_t} + u_t \tag{3}$$

OR

$$\Delta\pi_t = \beta_0 \mu_{t-1} + \beta_1 \Delta E_t + \beta_2 \mathbf{Z_t} + u_t \tag{4}$$

where $\mathbf{Z}_t$ is a vector of possible short-run disturbances and μ_t is a normally distributed error term μ_{t-1}. is the error-correction term (lagged residual from the long-run equation 2). To remain true to Gordon's triangle model, lagged inflation is included in the short-run estimation. It should be noted that, because inflation is non-stationary over the sample period, the first difference of inflation is included in the short-run estimation similar to Hodge (2002). The inflation term should therefore be interpreted as a change in the inflation rate. Theoretically, if Cashell's (2004) assertion that higher employment could be bought at the cost of higher inflation should hold, a positive change in employment would cause an increase in the inflation rate. Finally, the only significant supply shock variable from the short-run estimations above, changes in the import price index, is included. The vector $\mathbf{Z}_t$ subsequently becomes a scalar Z_t consisting of only this one variable. The final short-run estimation is therefore

$$\Delta\pi_t = \beta_0\mu_{t-1} + \beta_1\Delta E_t + \beta_2 Z_t + \beta_3\Delta\pi_{t-1} + u_t \quad (5)$$

Table 4 gives the results of the EG estimation.

Table 4: Error-correction estimation, 1971–2014

Variable	Coefficient	Std. error	t-statistic	Prob.
Long run (eq.2)				
α	1.804170	0.508731	3.546414	0.0010
E_t	-0.107408	0.031899	-3.367185	0.0016
Adjusted R^2	0.19			
Short run (ECM) (eq.5)				
μ_{t-1}	-0.359628	0.129179	-2.783954	0.0082
ΔE_t	-0.164430	0.176330	-0.932510	0.3568
$\Delta\pi_{t-1}$	-0.312101	0.137099	-2.276459	0.0284
Z_t	0.092214	0.035825	2.574020	0.0140
Adjusted R^2	0.41			

Based on 44 annual observations.

Source: SARB, StatsSA, own calculations (see Table A1)

The long-run estimation establishes a statistically significant and negative relationship between employment and inflation. It would therefore appear that the positive feedback effect suggested under the section on short-run results does not extend to the long run. The residual term is stationary (see Table A2), which confirms that there is a cointegrating relationship between employment and inflation (Burger & Marinkov 2006; Brooks 2008). The statistical significance and negative sign on the equilibrium error term μ_{t-1} in the short-run estimation further supports the cointegration hypothesis. The fact that the coefficient $|\mu_{t-1}| < 1$ indicates a stable adjustment to the long-run equilibrium path. However, contrary to the findings from the quarterly estimation (Table 2), the coefficient on employment growth is negative and statistically insignificant in the short run. The coefficient on lagged inflation growth is positive and statistically significant, indicating that inertia is also present in changes in the inflation rate.

While there was some evidence of a short-run relationship between inflation and employment growth over the inflation-targeting period, this relationship does not appear to hold over a longer period. In fact, there is a statistically significant negative

relationship between inflation and employment in the long run, while there is no evidence of a positive short-run relationship in the EG framework. Previous results in the South African literature also point to this. The negative relationship detected between inflation and economic growth in the long run (Table 4), coupled with Hodge's (2009) assertion that employment creation is largely driven by economic growth, lead to the logical conclusion that higher inflation, through subduing economic growth, is likely to be to the detriment of employment creation in the long run.

Robustness of long-run results

A possible drawback of the EG approach is that only bivariate relationships can be estimated, and that the results might be sensitive to the researcher's decision of which variable to define as the dependent variable. However, in the analysis of economic data, the postulated cointegrating relationship should ideally be supported by some a priori economic theory, making the choice of dependent variable less contentious. Furthermore, by design the long-run econometric specification only includes two variables, which implies a maximum of one possible cointegrating equation. This obviates the need for a more advanced cointegration technique such as the Johansen (1991) approach, which is often viewed as superior to the EG approach due to its ability to detect more than one cointegrating relationship in a multivariate model. Furthermore, the EG estimator was developed to be "asymptotically efficient" (Engle & Granger 1987: 251). As a result, the EG approach loses some of its power when the sample size is small. To this end, the autoregressive distributed lag (ARDL) bounds test, proposed by Pesaran and Shin (1999) and Pesaran, Shin and Smith (2001, hereafter PSS), could be applied to test the robustness of the EG results. The ARDL approach offers some advantages over other cointegration techniques, most notably its superior performance in small and finite samples. It also does not require all variables in the model to be integrated of the same order. The latter does not apply to this long-run EG analysis, as all variables are shown to be I(1); however, it would be appropriate for the analysis of, for example, a certain time period where inflation was relatively stable and determined to be I(0).

The ARDL bounds test in this context involves directly estimating an ARDL(p, q) equation of the form

$$\Delta\pi_t = \alpha + \sum \beta_p \Delta\pi_{t-p} + \sum \gamma_q E_{t-q} + \theta_0 \pi_{t-1} + \theta_1 E_{t-1} + \theta_2 Z_{t-1} + u_t \qquad (6)$$

where and are the number of lags included of the dependent and explanatory variables respectively, and with the optimal lag length informed by the minimum

Akaike (AIC) or other information criteria. Equation (6) is the unrestricted form of equation (4), also called the "conditional ECM" (PSS 2001). The bounds tests involves testing the hypothes H_0: $\theta_0 = \theta_1 = \theta_2 = 0$ is against the alternative that H_0 is not true, using an *F*-test where the critical statistic is evaluated against the PSS upper and lower bound critical values. Their bounds are based on the assumption that all variables are I(0) for the lower bound, and I(1) for the upper bound. If the calculated *F*-statistic exceeds the upper bound the null of no long-run relationship can be rejected and cointegration can be established, whereas if the *F*-statistic is less than the lower bound all variables are I(0) and by definition no cointegration is possible.

An ARDL(3,0) model is estimated based on the minimum AIC (full results reported in Appendix A3). The *F*-statistic is 9.606, which exceeds the PSS upper bound of 5.58 (see Table C1(ii) in PSS 2001: 300). This implies strong rejection of the null hypothesis of no cointegration at the 1% confidence level. The coefficients from the long-run cointegrating equation, normalised on inflation growth, are provided in Table 5.

Table 5: Coefficients from the long-run cointegrating equation

Variable	Coefficient	Std. error	t-statistic	Prob.$^{\infty}$
ΔE_t	0.072533	0.097686	0.742517	0.4626
Z_{t-1}	0.047345	0.032847	1.441384	0.1581
π_{t-1}	-0.137123	0.089899	-1.525297	0.1359
ΔE_{t-1}	-0.023271	0.014748	-1.577847	0.1233
α	0.376963	0.239343	1.574991	0.1240
μ_{t-1}	-1.551998	0.825752	-1.879498	0.0683

The coefficient on the cointegration term μ_{t-1} is negative and statistically significant (albeit only at the 10% confidence level), and therefore provisionally supports the cointegration hypothesis from both the EG and ARDL bounds tests. Contrary to the findings from the EG approach, however, the coefficient on employment growth is highly insignificant. In fact, while all the variables are jointly significant based on the *F*-test, they do not appear to be individually significant in the cointegration equation. While this, coupled with the fact that the coefficient $| \mu_{t-1} | > 1$ which indicates an unstable return to long-run equilibrium, perhaps contradicts the strong rejection of the null of no cointegration by the EG and bounds testing approaches, in no way does it suggest the existence of a positive relationship between inflation and employment creation. It cannot, therefore, be argued that higher inflation

would have a short-run expansionary effect on employment creation, confirming the main result from the EG analysis.

Conclusion

This article has revisited the debate around the appropriateness of an inflation-targeting framework in the South African context, framed against the theoretical environment of the Phillips curve. It discussed the theoretical background to the Phillips curve and the suggested trade-off between inflation and the unemployment rate, as well as some misconceptions and misinterpretations. Extending previous work in the South African literature, a number of different Phillips curve models were estimated over the inflation targeting period (2000–2015), using newer data on employment and the unemployment rate. The main difference between this approach and that of previous studies is that it does not rely on aggregate demand or an output gap proxy for the unemployment rate, now that a sufficiently reliable and long enough unemployment series is available. The analysis found no evidence of a trade-off between inflation and the unemployment rate. The unemployment rate is in fact extremely unresponsive to monetary conditions and aggregate demand factors. Monetary policy can, however, only influence the demand-for-labour side of the unemployment equation, and this to a limited degree. While the South African economy has steadily been creating jobs over the past two decades, the fact that the unemployment rate has not come down sufficiently is perhaps due to the continual entry of inadequately skilled workers to the labour force – a variable that monetary policy has no influence over.

It is widely believed that higher inflation might have a short-run expansionary effect on output and employment, and this analysis found mixed evidence of a weak positive relationship between inflation and employment growth in the short run. However, caution should be exercised when suggesting that this relationship could be exploited in favour of sustainable employment creation. In the long run, a negative cointegrating relationship was detected between inflation and employment in the EG framework, while no relationship was detected in the ARDL framework. One argument against inflation targeting suggests that it limits the economic growth necessary to bring about employment creation. The overwhelming consensus in the literature, however, is that higher inflation harms economic growth. The negative long-run relationship between inflation and employment detected here should therefore come as no surprise. If employment is indeed driven by economic growth, and economic growth is hindered by higher inflation, it is only logical that high inflation will, by extension, hinder employment creation. While some measure of a Phillips curve might therefore exist in the very short run, on the balance of evidence

the long-run impact of inflation on employment is undeniably negative. In the long run, therefore, as Keynes might have remarked, the Phillips curve is quite dead.

This study was framed by the long-running debate around the efficacy of inflation targeting in the context of economic growth and employment creation. The data and findings confirm that South African unemployment is structural, as is argued by many other observers, and not responsive to monetary conditions and aggregate demand. While the unemployment problem is a significant issue in South Africa, it can unfortunately not be resolved by allowing inflation to increase. To bring down the unemployment rate, employment opportunities – which should ideally match the skills available in the labour market – simply need to be created faster than the rate at which the labour force grows. For this to happen the SARB cannot afford a higher inflation environment, given its undeniably adverse effect on economic growth which might well slow down the pace of job creation. Furthermore, even if the demand for labour could be boosted through expansionary monetary policy or otherwise, significant skills shortages in the South African labour market unfortunately leave many labour market participants and potential new entrants structurally unemployable. Sound macroeconomic policies, including an institutional commitment to price stability, in addition to targeted interventions in the labour market to address the skills shortage problem, will form the bedrock of employment growth in the years to come.

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Appendix

A1 Data

The short-run econometric models are estimated using quarterly data spanning 2000Q1–2015Q3. Formal sector employment and unemployment rates were extracted from StatsSA's Labour Force Survey (LFS) (2000Q1–2007Q4) and Quartely Labour Survey (QLS) (2008Q1–2015Q3). Since the LFS was only published bi-annually (in March and September), the LFS data were linearly interpolated to obtain a full series of quarterly observations. Estimating the models using a nonlinear (cardinal spline) interpolation technique, however, yields virtually identical outcomes.

An annual series on South African formal sector employment was constructed and updated by various authors, the latest version of which could be found in Hodge (2009). The data in Hodge (2009) spans the period 1946–2007 and was constructed from the Standardised Employment Series, originally estimated by Roukens de Lange and Van Eeghen (1984, updated and revised in 1993), and extended with data from various editions of the South African Labour Statistics (1990–1995), the October Household Survey (1995–1999) and the LFS (2000–2007). This series was further updated for this article with employment data from the QLS up to 2014. Figures 1 and 2 are based on these data. The full series is reported in Table A1.

Other data used in this analysis are annual and quarterly values of real GDP, the import price index, unit labour costs and the real exchange rate, which were extracted from the SARB's Quarterly Bulletin online database, and the inflation rate, extracted from the IMF's International Financial Statistics (IFS) database.

Table A1: Complete series on employment

1961	4 852 200	**1976**	5 607 700	**1991**	7 988 000	**2006**	9 876 000
1962	4 960 700	**1977**	5 723 900	**1992**	7 866 000	**2007**	10 658 000
1963	5 011 500	**1978**	5 844 700	**1993**	7 758 000	**2008**	10 544 750
1964	5 190 200	**1979**	6 023 000	**1994**	7 702 000	**2009**	10 502 500
1965	5 439 800	**1980**	6 164 100	**1995**	8 069 000	**2010**	10 146 250
1966	5 607 700	**1981**	6 268 700	**1996**	8 291 000	**2011**	10 480 000
1967	5 723 900	**1982**	6 326 300	**1997**	8 111 000	**2012**	10 905 750
1968	5 844 700	**1983**	6 596 900	**1998**	8 074 000	**2013**	11 760 000
1969	6 023 000	**1984**	6 809 300	**1999**	8 462 000	**2014**	12 052 250
1970	4 651 700	**1985**	6 941 900	**2000**	8 790 000		

1971	4 852 200	**1986**	7 077 900	**2001**	8 674 000		
1972	4 960 700	**1987**	7 145 400	**2002**	8 878 000		
1973	5 011 500	**1988**	7 175 700	**2003**	9 101 000		
1974	5 190 200	**1989**	7 297 600	**2004**	9 199 000		
1975	5 439 800	**1990**	7 560 400	**2005**	9 425 000		

Sources: 1961–2007: Hodge (2009); 2008–2014: Author's update from StatsSA's QLFSs (simple averages over the four quarters each year of total number of formal and private employed).

A2 Stationarity tests

Traditional measures of testing for stationarity, such as the Augmented Dickey-Fuller (ADF) or Phillips-Perron (PP) unit root tests have low power against I(0) series that are close to being I(1). In such instances, the ADF and PP tests might lead to different conclusions regarding the order of integration of a series. For example, using the unemployment rate from this analysis, the ADF test finds it to be non-stationary while the PP test finds it to be stationary. To this end, Elliot, Rothenberg and Stock (1996) developed the modified Dickey-Fuller Generalised Least Squares (DF-GLS) test, shown to be superior to the traditional ADF and PP tests in terms of size and size-adjusted power. Results from the stationarity tests are detailed in Table A2 below. Where there is ambiguity between the ADF and PP tests, the DF-GLS test was used.

Table A2: Stationarity tests

Quarterly (2000–2015)	**ADF**	**PP**	**DF-GLS**
π	I(0)	I(0)	
E	I(1)	I(1)	
U	I(1)	I(0)	I(1)
Z^1	I(1)	I(1)	
Z^2	I(1)	I(1)	
Z^3	I(0)	I(1)	I(0)
Annual (1970–2014)	**ADF**	**PP**	**DF-GLS**
π	I(1)	I(1)	
E	I(1)	I(1)	
Z^1	I(1)	I(1)	
μ	I(0)	I(0)	

A3 ARDL bounds test

Table A3: ARDL lag selection

Model	LogL	AIC*	BIC	HQ	Adj. R-sq	Specification
10	100.562252	-4.207375	-3.882977	-4.087073	0.357497	ARDL(3, 0)
3	103.247420	-4.193065	-3.747017	-4.027649	0.379621	ARDL(4, 2)
8	102.065985	-4.184817	-3.779320	-4.034439	0.364648	ARDL(3, 2)
5	100.878488	-4.176295	-3.811347	-4.040955	0.348571	ARDL(4, 0)
9	100.684962	-4.167498	-3.802550	-4.032158	0.342815	ARDL(3, 1)
2	103.641096	-4.165504	-3.678907	-3.985051	0.371581	ARDL(4, 3)
20	97.591086	-4.163231	-3.919933	-4.073004	0.303298	ARDL(1, 0)
7	102.090250	-4.140466	-3.694418	-3.975050	0.346117	ARDL(3, 3)
4	101.046055	-4.138457	-3.732959	-3.988079	0.334500	ARDL(4, 1)
1	103.739563	-4.124526	-3.597379	-3.929034	0.354206	ARDL(4, 4)
19	97.698080	-4.122640	-3.838792	-4.017375	0.287940	ARDL(1, 1)
15	97.596212	-4.118010	-3.834161	-4.012745	0.284635	ARDL(2, 0)
6	102.091276	-4.095058	-3.608461	-3.914604	0.325714	ARDL(3, 4)
18	98.038541	-4.092661	-3.768263	-3.972358	0.279399	ARDL(1, 2)
14	97.715421	-4.077974	-3.753576	-3.957671	0.268737	ARDL(2, 1)
17	98.217363	-4.055335	-3.690387	-3.919994	0.264810	ARDL(1, 3)
13	98.039157	-4.047234	-3.682287	-3.911894	0.258831	ARDL(2, 2)
16	98.391224	-4.017783	-3.612285	-3.867405	0.249144	ARDL(1, 4)
12	98.220029	-4.010001	-3.604504	-3.859623	0.243279	ARDL(2, 3)
11	98.403519	-3.972887	-3.526840	-3.807471	0.226823	ARDL(2, 4)

Table A4: ARDL(3,0) output, 1971–2014

Variable	Coefficient	Std. error	t-statistic	Prob.*
$\Delta\pi_{t-1}$	-0.501114	0.205883	-2.433972	0.0200
$\Delta\pi_{t-2}$	-0.162657	0.184448	-0.881859	0.3837
$\Delta\pi_{t-3}$	-0.318641	0.139788	-2.279454	0.0287
ΔE_t	0.143791	0.201414	0.713907	0.4799
Z_{t-1}	0.093857	0.070381	1.333560	0.1907
π_{t-1}	-0.271835	0.148934	-1.825203	0.0763
E_{t-1}	-0.046132	0.026665	-1.730036	0.0922
α	0.747297	0.429813	1.738657	0.0906
Adjusted R^2	0.36			

Table A5: Breusch-Godfrey Serial Correlation LM Test

F-statistic	0.070901^{0000}	Prob. F(4,32)	0.9904
Obs*R-squared	0.386531^{0000}	Prob. Chi-Square(4)	0.9836

Failure to reject H_0 indicates the absence of serial correlation in the residuals.

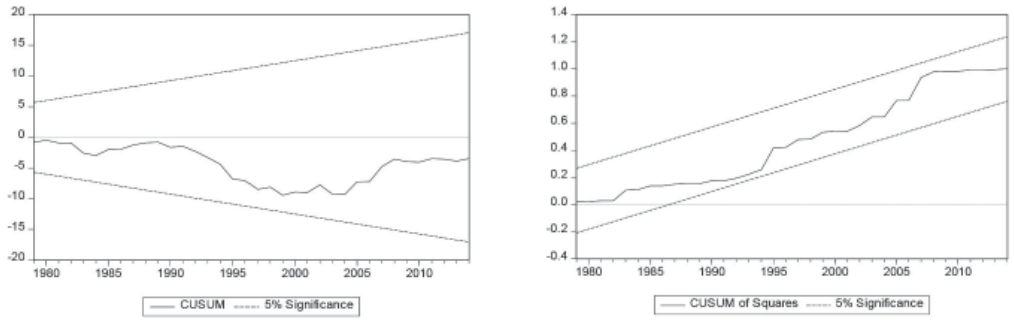

Figure A1: CUSUM and CUSUM of Squares recursive stability tests