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Contents

Page

1. Dispersion of Inflation Expectations

   Shakill Hassan and Siobhan Redford ……………………………………………………………………………………1

2. The end of global reserve accumulation and its implications

   Jean-François Mercier………………………………………………………………………………………………13

3. Sacrifice Ratio Based on the Time-Varying Phillips Curve for South Africa

   Alain Kabundi……………………………………………………………………………………………………22

4. To zero and beyond? Estimating South Africa's structural trade balance

   Theo Janse van Rensburg and Erik Visser ……………………………………………………………………27

5. Going green is good for private fixed investment

   Nkhetheni Nesengani ……………………………………………………………………………………………40

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Enquiries
Head: Research Department
South African Reserve Bank
P O Box 427
Pretoria 0001

Tel. no.: +27 12 313-3911
0861 12 SARB (0861 12 7272)

Sacrifice Ratio Based on the Time-Varying Phillips Curve for South Africa – October 2016

Alain Kabundi

Abstract

This analysis estimates the sacrifice ratio for the South African economy using quarterly data of annual inflation rate and unemployment rate from 1994Q4 to 2014Q4. The sacrifice ratio is derived from a time-varying Phillips curve. The results show that the estimated time-varying sacrifice ratio depends on the slope of the Phillips curve and the inflation persistence. The flatter the Phillips curve, higher is the sacrifice ratio. In addition, higher the persistence of inflation, lower is the sacrifice ratio. The decline in the sacrifice ratio observed in 2000s is caused by the two factors, whereas the recent increase is mainly due to the decline in inflation persistence.

1 Introduction

The consensus in the literature is that there is a trade-off between inflation and the real activity (or output gap) over the short-term, but the relationship is less evident in the long run. The Phillips curve is an important channel through which monetary policy affects inflation. Monetary policy affects inflation mainly through its impact on the output gap, inflation expectations, and the exchange rate. To reduce inflation permanently policymakers should try to minimise output loss, also known as sacrifice ratio. This note estimates the sacrifice ratio for South Africa using a time-varying Phillips curve.

2 The Model

Assume the Phillips curve, using the unemployment rate, is of the form

$$\pi_t = \pi_t^e - \alpha_t(u_t - u_t^n) + \varepsilon_t \tag{1}$$

where π_t is the inflation rate between time $t-1$ and t, π_t^e is expected inflation, u_t is the time t unemployment rate, α_t is the slope of the Phillips curve, and ε_t is a residual capturing other factors such as supply (cost-push) shocks. Here is the natural rate of unemployment that prevails when inflation is equal to expected inflation ($\pi_t = \pi_t^e$) and when shocks are absent ($\varepsilon_t = 0$).

Assume the inflation expectation is a weighted average of past inflation and the inflation target, given by

$$\pi_t^e = \rho_t \pi_{t-1} + (1-\rho_t)\pi_t^* \tag{2}$$

The derivations in the appendix yield the sacrifice ratio

$$SR = \frac{1}{\alpha_t \sum_{i=1}^{\infty} \rho_t^i} \tag{3}$$

From (3) it follows that the SR associated with a percentage point increase in inflation for k periods is

$$SR = \frac{1}{\alpha_t \sum_{i=1}^{k} \rho_t^i} \tag{4}$$

It is clear from (4) that the SR depends on the slope of the Phillips curve (α), which captures the degree of the response of inflation to excess demand factors and the extent of the short run trade-off faced by policymakers, and the inflation persistence (ρ), which measures the degree to which current inflation depends on past inflation. The SR increases when the Phillips curve is flat, i.e. when α is low. Similarly, the SR tends to increase with less inflation persistence (or low ρ). A flat Phillips curve requires a larger output gap for a permanent reduction in inflation of one percentage point. However, with a steep Phillips curve, small changes in the output gap are required to achieve a larger reduction in inflation. In this instance the cost of disinflating is low.

It is essential to highlight that there are positive and negative policy implications associated with the SR and the inflation persistence. They depend largely, on the one hand, on the relationship between the inflation persistence and monetary policy, and the other hand, on the relationship between the inflation persistence and negative supply shocks.

First, consider the relationship between inflation persistence and monetary policy. When inflation responds weakly to policy, lowering inflation is costly, and the SR is large. In this instance monetary policy has temporary effects on inflation. It therefore requires more episodes of interest rate increases to bring inflation permanently down because the impact of monetary policy shock on inflation is short-lived. But if inflation responds fully and over time to initial interest rate increase, then fewer policy changes are needed to bring inflation down.

Second, the opposite is true when we consider the relationship between the inflation persistence and negative supply shocks. In this case a less responsive inflation, i.e. inflation anchored to the official target, is positive for the economy in that policymakers do not need to react when the economy is affected by negative supply shocks since these shocks are temporary. They can just wait until the effects of shock dissipate and then inflation reverts back to the level before the shock. But with high inflation persistence, negative supply shocks have long-lasting effects on inflation. It means that policymakers are compelled to react to prevent inflation from rising more rapidly, and they may lose credibility if they don't.

3 Sacrifice Ratio for South Africa

Figure 1 depicts the sacrifice ratio for South Africa estimated with equation (4). The SR is estimated using $k = 4$, in other words we increase inflation permanently by 13 for a year. It is evident from Figure 1 that the sacrifice ratio in South Africa has been changing over time. It declines steadily from the highest value of 3.1 in 1995Q4 to around 1 in 2003, and stays relatively constant until the recent Global Financial Crisis (GFC). It then increases and stabilises since 2011 at roughly 1.5. The results indicate high costs of disinflating in the 1990s compared with the 2000s. Since the GFC the output gap needs to widen by 1.53 for a permanent fall in inflation by 13. The question arises as to which of the two factors, namely, the slope of the Phillips curve and the inflation persistence, explains movements in the SR.

It is evident from Figure 2 that both factors contribute to changes in the SR. Higher values of the SR recorded in the beginning of the sample can mainly be due to a flatter Phillips curve. And both factors contribute to persistent decline in the SR and lower values attained prior to the crisis. However, from 2008 onward, the slope portrays a mild decline whereas the fall in inflation persistence is somewhat noticeable. It suggests that the rise in the *SR* in the post-crisis period is caused by the decline in the inflation persistence.

To assess the robustness of these results, we estimate the Phillips curve using the output gap instead of the unemployment gap. We divide the sample size into two periods, namely, the pre-crisis period from 2000Q1 to 2008Q1, and the post-crisis sample covering the period ranging from 2008Q1 to 2014Q1. The results of the estimation are depicted in Table 1. They are in line with the estimation using the unemployment gap. Overall, the inflation persistence is high, even though it has declined lately. And the Phillips curve is flat with a mild increase in the latter period. The sacrifice ratio is 1.18 for the pre-crisis period and 1.15 after the crisis. According to this specification the sacrifice ratio is low and remains unchanged. These numbers are extremely low when compared with the most recent *SR* for the OECD, which varies between 3.33 and 5.43.[1] The rising *SR* in most of OECD countries is owing to both the flattening of the Phillips curve and the stabilisation of inflation. These outcomes sway Gillitszer and Simon to title their recent work "Inflation Targeting: A Victim of its own success?"[2]

4 Conclusion

This note estimates the sacrifice ratio for South Africa from 1994Q4 to 2014Q4 with a time-varying Phillips curve. The results show that the sacrifice ratio has changed considerably from 3.1 in the 1990s to between 1 and 1.5 most recently. The movement in the sacrifice ratio depends on the slope of the Phillips curve and the inflation persistence. The slope of the Phillips curve largely explains the movement in the sacrifice ratio at the beginning of the sample. The decline in the sacrifice ratio observed in the 2000s is caused by both factors. Finally, the inflation persistence is the main driving force behind the recent increase in the sacrifice ratio since the financial crisis.

[1] See Blanchard, O., Cerutti, E. and Summers, L. (2015), "Inflation and Activity - Two Explorations and their Monetary Policy Implications", IMF Working Paper 15/230
Blanchard, O. (2016), "The Phillips Curve: Back to the '60s?" American Economic ReviewReview: Papers fl3 Proceedings, 106(5): 31-34.

[2] Gillitzer, . and Simon, J. (2015), "Inflation Targeting: A Victim of Its Own Success", International Journal of Central Banking, 11(1): 259-287.

Figure 1: Sacrifice Ratio from a Time-Varying Phillips Curve

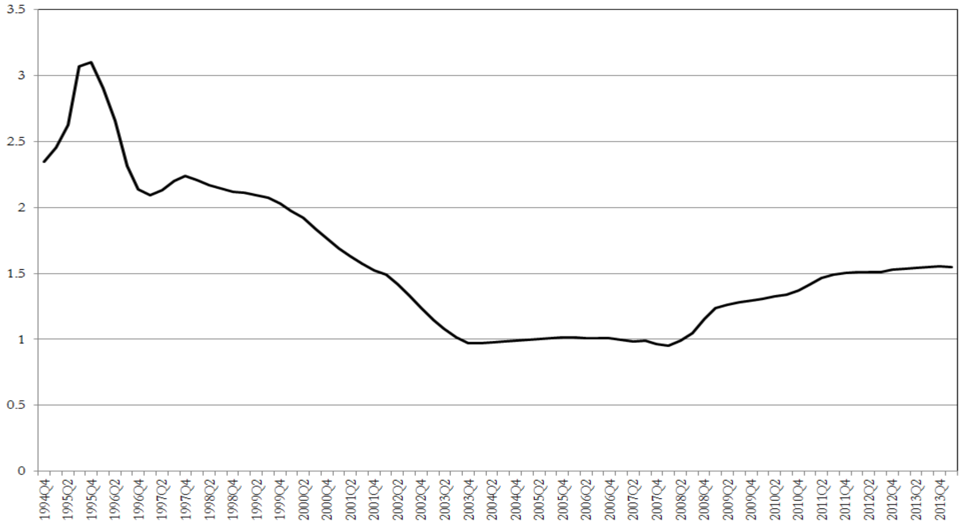

Figure 2: Slope of the Phillips Curve and Inflation Persistence

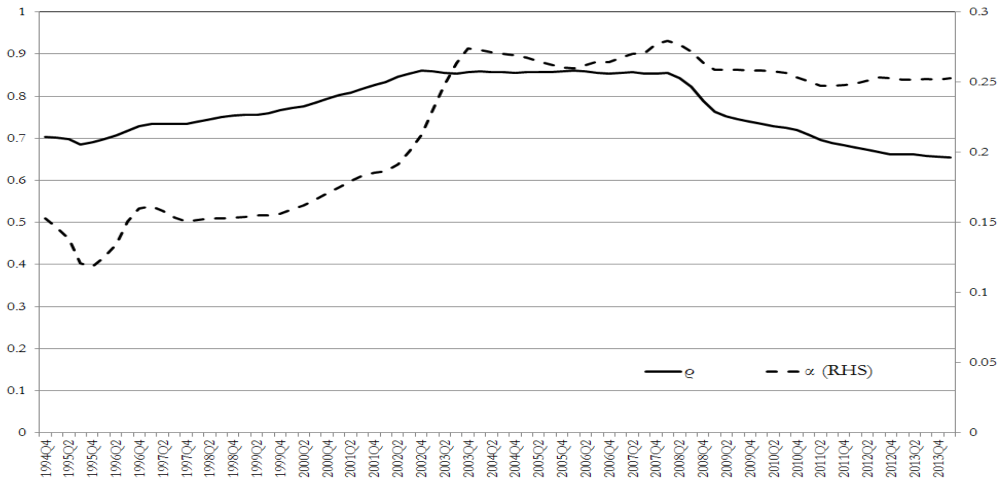

Table 1: Phillips Curve using the output gap

	2000Q1 to 2008Q1	2008Q1 to 2014Q1
ρ	0.88	0.75
α	0.24	0.29

Appendix

Combining equations (1) and (2) yields

$$\pi_t = \rho_t \pi_{t-1} + (1-\rho_t)\pi_t^* - \alpha_t (u_t - u_t^n) + \varepsilon_t \tag{A.1}$$

or

$$\pi_t = \rho_t L \pi_t + (1-\rho_t)\pi_t^* - \alpha_t (u_t - u_t^n) + \varepsilon_t$$

where L is the lag operator, such that $L\pi_t = \pi_{t-1}$.

We can derive the sacrifice ratio from (A.1) as follows

$$\begin{aligned} \pi_t(1-\rho_t L) &= (1-\rho_t)\pi_t^* - \alpha_t(u_t - u_t^n) + \varepsilon_t \\ \pi_t &= (1-\rho_t L)^{-1}\left[(1-\rho_t)\pi_t^* - \alpha_t(u_t - u_t^n)\right] \\ \pi_t &= (1-\rho_t L)^{-1}(1-\rho_t)\pi_t^* - \alpha_t(1-\rho_t L)^{-1}(u_t - u_t^n) \end{aligned} \tag{A.2}$$

We can represent $(1-\rho_t L)^{-1}$ using the Taylor series as follows

$$\frac{1}{1-\rho_t L} = \sum_{i=0}^{\infty} \rho_t^i L^i \tag{A.3}$$

Hence, equation (A.2) becomes

$$\pi_t = \sum_{i=0}^{\infty} \rho_t^i L^i (1-\rho_t)\pi_t^* - \alpha_t \sum_{i=0}^{\infty} \rho_t^i L^i (u_t - u_t^n) \tag{A.4}$$

or

$$\pi_t = \sum_{i=0}^{\infty} \rho_t^{i^i} (1-\rho_t)\pi_{t-i}^* - \alpha_t \sum_{i=0}^{\infty} \rho_t^i (u_{t-i} - u_{t-i}^n)$$

From (A.4) we obtain the sacrifice ratio

$$SR = \frac{1}{\alpha_t \sum_{i=1}^{\infty} \rho_t^i} \tag{A.5}$$