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Optimal monetary policy reaction function in a model with target zones and asymmetric preferences for South Africa

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ABSTRACT

This paper estimates the optimal response of the SARB to deviations of inflation and output from their target values over the inflation targeting era. This is achieved using an empirical framework that allows the central bank's policy preferences to be zone-like and asymmetric. The first major finding is that the monetary authorities' response towards inflation is zone symmetric. That is, they react in a passive manner when inflation is within the target band whereas they become increasingly aggressive when it deviates from the target band. The monetary authorities also react with the same level of aggressiveness regardless of whether inflation overshoots or undershoots the inflation target band. The second major finding is that the monetary authorities' response to output fluctuations is asymmetric. That is, they react more aggressively to negative deviations of output from the potential so that they weigh business cycle recessions more than expansions.

1. Introduction

Policy makers around the world have sought to improve transparency and accountability of their policy objectives by specifying explicit targets for variables such as inflation and output. An important development in the recent past has been the adoption of the inflation targeting framework by a growing number of developed and developing countries (Mishkin and Schmidt-Hebbel, 2001). Under this framework, monetary policy authorities make public announcements of the target inflation rate and use of interest rates to steer actual inflation towards the target with the objective of achieving price stability. This monetary policy framework is characterised by point targeting, which permits inflation to fluctuate by some margin around the specified target. Other central banks, including the South African Reserve Bank (SARB), have adopted a zone targeting monetary policy framework that allows some toleration to the fluctuation of inflation within a specified target range.

When the monetary authorities are endowed with inflation and output stabilisation, they may have an inflation bias when inflation overshoots the target and an output bias during productivity declines (Orphanides and Wilcox, 2002). Thus the monetary authorities may behave in ways that reflect asymmetries when confronted by numerous competing objectives. This implies that their responses to inflation and output may be different depending on whether these variables undershoot or overshoot their target values. The monetary authorities may also exhibit zone-like behaviours by penalising more when inflation moves out of the target range and being passive when it is within the target range. Thus an empirical framework that allows for target zones and asymmetries in monetary policy preferences is more relevant to evaluate the monetary authorities' actual practice of monetary policy setting. However, as argued by Orphanides and Wieland (2000), the quantitative evaluations of monetary policy that are based on linear models that use the Taylor (1993) rule and its extensions by Clarida et al. (2000) may not fully capture the actual practice of inflation targeting.

Empirical work on the analysis of monetary policy is dominated by studies that use the linear Taylor rule with relatively few studies that have estimated asymmetric monetary policy reaction functions. Cukierman and Gerlach (2003), Ruge-Murcia (2003), Dolado et al. (2004, 2005), and Surico (2007a,b) have shown evidence supporting asymmetries by adopting a monetary policy reaction function that feature asymmetries in either inflation or the output gap for the US, UK, EU and OECD countries. Boinet and Martin (2008) also implemented a monetary policy reaction function that feature asymmetries and zone-like behaviours for the UK and found the evidence of zone-like responses to inflation.

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This paper estimates the monetary authorities' response to deviations of inflation and output from their target values using an empirical framework which allows central bank's policy preferences to be zone-like and asymmetric. Of particular interest is whether the monetary authorities' preferences are such that they react differently to deviations in inflation and output when they overshoot or are below their target values and/or when inflation is within or outside the target range. The modelling strategy is an adaptation of the New Keynesian framework, which is the intertemporal optimisation problem where the central bank minimises a loss function subject to the constraints given by the structure of the economy. The study is important in that it allows the evaluation of the SARB's monetary policy outcomes using an analytical framework that captures the authentic inflation target band monetary policy practice under which the SARB operates. The attempt to model South Africa's monetary policy using an optimal monetary policy reaction function with zone-like and asymmetric preferences is the first to our knowledge. This monetary policy reaction function is in line with the actual practice of inflation zone targeting by the SARB where the inflation target is 3 to 6%.[2]

The paper is organised as follows. The next section details the theoretical model where the optimal monetary policy rule is derived from the monetary authorities' optimisation problem. Section 3 discusses the data. In Section 4, the optimal monetary policy rule is estimated and the results are reported and discussed. Section 5 concludes.

2. Theoretical model

The central bank's monetary policy design problem is a targeting rule following Svensson (1999) and draws from Boinet and Martin (2008). The monetary policy reaction function is an adaptation of the New Keynesian setup that is modelled as an intertemporal optimisation problem where the central bank is assumed to use all available information available at any point in time to bring the target variables in line with their desired values.

2.1. Central bank's preferences

The central bank sets the interest rate at the beginning of period t based on the information, which is available at the end of period t–1. The following timing mechanism captures this intertemporal criterion as in Clarida et al. (1999):

$$\underset{\{i_t\}}{Min}\, E_{t-1} \sum_{\tau=0}^{\infty} \delta^{\tau} L_{t+\tau} \tag{1}$$

where δ and L is the discount factor and the period loss function, respectively.

The period loss function is a linex specification and was first introduced in the monetary policy literature by Nobay and Peel (2003). It departs from the conventional quadratic specification in that the central bank is allowed to treat differently the positive and negative deviations of inflation and output from their targets. The central bank is also indifferent between inflation rates and output within these target zones as in Boinet and Martin (2008). It extends on Surico (2007a,b) in that the linex specification is general because it approximates a number of different functions. The range of values for the rate of inflation for which the loss function is constant forms the target zone for inflation. The period loss function is specified as follows:

$$L_t = \frac{e^{\alpha_\pi(\pi-\pi^*)^{\beta_\pi}} - \alpha_\pi(\pi_t-\pi^*)^{\beta_\pi} - 1}{\beta_\pi \alpha_\pi^2} + \lambda\left(\frac{e^{\alpha_y(y_t)^{\beta_y}} - \alpha_y(y_t)^{\beta_y} - 1}{\beta_y \alpha_y^2}\right) + \frac{\mu}{2}(i-i^*)^2 \tag{2}$$

where α_π and α_y capture the asymmetries, while β_π and β_y capture the zone-like properties in the central bank's preferences. i^* is the desired level of interest rate, while π^* is the inflation target. $\lambda>0$ is a coefficient that measures the central bank's aversion to output level fluctuation relative to the potential level, while $\mu>0$ is a coefficient that measures the central bank's aversion to interest rate fluctuations around the desired level. The policy preference towards inflation stability is normalised to 1 so that λ and μ are expressed in relative terms.

The loss function embodies numerous characteristics of linearities, asymmetries and zone-like central bank's preferences depending on the values of α_π, α_y, β_π and β_y. As special cases, whenever β_π and β_y approach one, the period loss function generalises to a linex function. Applying L'Hopital's rule on the loss function allowing α_π and α_y approach zero and β_π and β_y approach one simultaneously achieves a quadratic loss function. Fig. 1 illustrates the monetary authorities' preferences assuming that the central bank is more concerned about inflation overshooting its target and output undershooting its potential. Under these assumptions, high inflation relative to the target is more costly to the monetary authorities than low inflation. On the other hand, low output relative to the potential is weighted more severely than higher output.

As illustrated in Fig. 1(a) and (b), when α_π and α_y approach zero, the loss function is symmetric so that the deviations of inflation from its target and output from its potential are weighted equally by the monetary authorities. The loss function exhibits zone-like properties when β_π and β_y are greater than one. Given a positive value of α_π, whenever π_t is greater than zero, the linear component of the loss function is dominated by the exponential component as illustrated in Fig. 1(c) and (d). Thus the central bank penalises higher inflation relative to the target more severely than lower inflation. In similar manner, given the negative value of α_y, the exponential component dominates the linear component of the loss function whenever y_t is less than zero, while the opposite is true for output values greater than zero as illustrated in Fig. 1(e) and (f). Thus, the central bank weighs output contraction relative to the potential level more heavily than output expansions of the same level.

Whenever β_π and β_y are greater than one, the central bank's preferences are zone-like. this feature was introduced by Orphanides and Wieland (2000). Within the target zones, the central bank's marginal loss is zero. Whenever β_π and β_y are even, the inflation and output targets are symmetric so that the loss from inflation and output outside the targets are symmetric. Both the inflation and output target zone and the loss from inflation and output outside the target zone are asymmetric whenever β_π and β_y are odd. Higher values of β_π and β_y widen the target zone. The responses to inflation and output gaps may be different so that β_π and β_y may not be equal.

The shape of the linex specification depends on the signs of α_π and α_y such that if the central bank weigh deflation more severely than inflation, then α_π would be negative. α_y can also be positive in which case the central bank is averse to output contractions than expansions. Thus under asymmetric setting, the central bank is concerned about the magnitudes as well as the signs whereas under the symmetric setting, the only concern is the magnitude of deviations of target variables from their reference values. For a detailed discussion on all the possible configurations of the loss function, see Boinet and Martin (2008).

[2] The only piece of work that have attempted estimating nonlinear monetary policy rule in the context of South Africa is Naraidoo and Gupta (2008) who make use of a smooth transition model with a quadratic logistic function to capture inflation zone targeting practice. However the approach taken in the present paper is different as the analysis is based on the optimal monetary policy rule.