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Does the South African Reserve Bank follow a nonlinear interest rate reaction function?

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ABSTRACT

This paper analyses the descriptive power of the different extensions of the Taylor rule. It also investigates whether monetary policy in South Africa can indeed be described by a linear Taylor rule or, instead, by a nonlinear rule. In particular, we extend the linear Taylor rule to a regime-switching framework, where the transition from one regime to another occurs in a smooth way, using a logistic smooth transition regression (LSTR) approach. The purpose of this paper is to evaluate the behaviour of monetary authorities in emerging countries, particularly in South Africa, in response to changes in macroeconomic variables over time based on LSTR model. In this sense, we empirically analyse Taylor-type equations for short-term interest rate in South Africa using quarterly data covering the period 1995:Q3–2011:Q4. Our results show that the nonlinear approach leads to the reduction of the measurement errors by 150 basis points in 1998 and 40 basis points in 2009. Moreover, the South Africa's monetary policy exhibits nonlinear patterns that better capture special events and unexpected contingencies and may contain relevant information rendering it applicable only to unusual conditions i.e., recession. Additionally, the presence of asymmetries in the reaction function of the South African Reserve Bank (SARB) requires disconnection from its automatic pilot rule and use of judgement to make decisions.

1. Introduction

It is widely agreed that the main problems involved in monetary policies are uncertainty, unexpected events and special contingencies. However, despite these problems, most studies of monetary policy rely on simple rules. The Taylor (1993) rule is the most recognized specification of central banks' reaction function in the related literature. This rule assumes that central banks account for inflation and output gaps when establishing their policy rates. However, there remains an ongoing debate regarding how to model these decisions empirically.

Several studies have developed different versions of the Taylor rule reaction function. Some studies include a lagged interest rate term to model the monetary policy inertia or interest rate smoothing behaviour (Clarida et al., 1998). Other studies consider an augmented version of the linear Taylor rule by including other variables in the conduction mechanism of monetary policy. For instance, Svensson (2003) proposes an extension of the Taylor rule by incorporating the exchange rate in a rule designed for small open economies. His conclusion is consistent with that of Batini et al. (2001), who show that the descriptive power of the Taylor rule augmented by the exchange rate is higher than the standard Taylor rule for small open economies (i.e., the UK). Similarly, Ghadha et al. (2004) present evidence of the reaction of central banks to deviations from the average exchange rate. Their results show that asset prices and exchange rates are useful to offset deviations from equilibrium levels. The common feature of these previous studies in literature is the use of linear Taylor rules.

Although these linear interest rate rules have gained renewed interest, they have not been fully adapted to the highly uncertain environments characterizing the informational bases on which reaction functions are designed. In fact, this type of Taylor rule is insufficient to provide practical assistance in building an accurate monetary policy, especially with financial liberalization and the advent of financial crises in which central banks tend to behave differently and adjust their reaction functions to respond to bubbles and recessions.

Additionally, the financial imbalances and economic instabilities that are associated with misalignments of asset prices and exchange rates have posed significant challenges for monetary policymakers. Indeed, in the case of increasing openness to trade and capital flows, it would be difficult for a central bank to adjust its interest rate to achieve its internal objectives. Therefore, a structural change in monetary policy should occur to cushion the effect of the high economic uncertainty that accompanies large financial shocks.

The work of Peterson (2007) studies the original Taylor rule for the monetary policy of the Fed during the 1985–2005 period using the logistic smooth transition regression (LSTR) model that was developed earlier by Teräsvirta (1998). The study notes the presence of nonlinearity and,

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more importantly, argues that once inflation approaches a certain threshold, the Fed begins to react aggressively to inflation.

Consistent with Peterson (2007), Castro (2011) includes other variables, such as inflation and output gap, in the Taylor rule. He extends the Taylor rule to include monetary policy inertia and the financial condition index (computed as a weighted average of the real effective exchange rate (REER), real share prices and real property prices as well as credit spread and futures interest rate spread). Castro (2011) argues that there is a growing tendency to use nonlinear models because central banks have increasingly tended to have asymmetric preferences in their loss functions, which implies that central banks may assign different weights (positive or negative) to inflation and to the output gap in loss functions. For instance, the reactions of central banks may be more aggressive when inflation is above the target than when it is below the target. Moreover, the evaluation of monetary policy over a long period may entail structural changes in the behaviour of monetary authorities. The failure to consider these changes may yield a misleading analysis of monetary policy.

The above reasons demonstrate the importance of modelling nonlinearities and asymmetries in assessing monetary policy. Taylor (2008) suggests that the nonlinearity in the Taylor rule results from either the nonlinearity of the structure of the economy or the preference of the central bank. Thus, the structure of the economy is also a source of time-varying parameters. In fact, during an expansionary phase of the business cycle, the monetary authorities may be more aggressive on inflation, whereas stabilizing production is a greater concern in a recessionary phase. Additionally, expansions are significantly shorter than recessions.

In view of the above analysis, the linear model is unable to capture changes in the relative preferences of monetary authorities over time or to accurately describe the structure of the economy. In addition, most recent studies focused on nonlinear Taylor rules are limited to industrialized countries, especially the US (Conrad and Eife, 2012; Lee and Son, 2013; Olsen et al., 2012), the UK, ECB, Japan and Canada (Kempa and Wilde, 2011; Kolman, 2013).

This paper contributes to the current monetary debates by examining the various extensions of the Taylor rule to analyse the movement of the nominal short-term interest rate of the South African Reserve Bank (SARB) and to determine whether its monetary concerns have changed after episodes of financial instability. In other words, we will investigate how the process of interest rate decision making has been adapted to the presence of instability. To the best of our knowledge, there are only two previous attempts to estimate South Africa's linear and nonlinear monetary policy rules (Naraida and Paya, 2012; Ncube and Tshuma, 2010). Indeed, South Africa has experienced numerous specific events and contingencies emerging from the structural changes of the SARB's concerns that may drive its monetary policy. The main events that have occurred in South Africa include the abolishment of apartheid, the transition to a new democratic regime, the establishment of a new inflation targeting regime and, as in other emerging countries, the effect of the Asian and Russian crises (the flight-to-quality phenomenon) as well as the subprime and recent financial crises.

Moreover, this time span coincides with periods in which monetary policymakers had to address unexpected contingencies. For example, the 1998–1999 period was marked by the worst recession in the history of South Africa. The democratic transition government was the consequence of the international crisis of 1998 following the contagion effect observed in most emerging countries. After recording a considerable acceleration in capital inflows (35 billion rand investment portfolio during the first four months of 1998) following the abolition of apartheid and the resulting discontinuation of international sanctions against South Africa, the country witnessed massive capital flight following the risk aversion of international investors. In the middle of this year, the rand was subject to speculative attacks that eventually led to a devaluation of approximately 20% of its value against the dollar. The previous events support the idea that South Africa's economy behaves differently according to the state of a transition variable relative to a threshold value.

Our study employs the two main streams of monetary policy literature: the linear Taylor rule and the nonlinear Taylor rule. First, we consider two specifications of the linear Taylor rule augmented, respectively, by the lagged interest rate (Clarida et al., 1998) and the lagged interest rate and REER simultaneously. Batini et al. (2001), Svensson (2003) and Ghadha et al. (2004) augmented the linear Taylor rule by adding the exchange rate. Second, we estimate a nonlinear Taylor rule by including the same determinants of the linear rule using a LSTR model (Ncube and Tshuma, 2010).

Compared to the above-mentioned literature, our results are consistent with those of Ncube and Tshuma (2010), who argue that the nonlinear Taylor rule holds for the SARB's reaction function, and contradicts previous findings that the SARB monetary policy is better described by a linear Taylor rule. In fact, these studies divide the sample period into two subperiods based on a structural break date and estimate a linear Taylor rule in each subsample. Moreover, our results are consistent with previous findings regarding the Fed, the European Central Bank and the Bank of England in that the nonlinear Taylor rule holds. Moreover, the forecasting results reported by Naraida and Paya (2012) support the nonlinearity that we found in the monetary policy conduct of the SARB.

The remainder of the paper is organized as follows. In Section 2, we briefly present the simple linear Taylor rule and its augmented versions as well as the nonlinear version of the Taylor rule that is adopted in this paper. The data and preliminary analysis are presented in Section 3. Section 4 reports the estimation results and discussion as well as the robustness check analysis and misspecification tests of the nonlinear model. Section 5 summarizes the main conclusions of this paper and their policy implications.

2. Empirical methodology

2.1. Baseline Taylor rule

In this section, we focus exclusively on the baseline linear specification of the Taylor rule. We estimate the original linear Taylor rule in the following form:

$$i_t = \alpha + b_\pi \pi_t + b_y y_t + u_{1t}, \tag{1}$$

with $\alpha = r - \phi\pi^*$ and $b_\pi = 1 + \phi$.

i_t represents the nominal short term interest rate, and r represents the equilibrium real interest rate.

π_t is the inflation rate at time t calculated from the year-on-year Consumer Price Index (CPI). This year-on-year figure is much easier to interpret than the simple variation, which may be more volatile even in the absence of seasonal fluctuations.

y_t refers to the output gap, defined as the difference between actual output and potential output, which is measured using the Hodrick–Prescott (1997)'s filter.

ϕ indicates the sensitivity of the interest rate policy to deviations of inflation from its target.

b_y represents the coefficient of the reaction of the central bank to the output gap.

In South Africa, monetary policy is primarily focused on the price stability objective. Since February 2000, the SARB has adopted an inflation targeting policy with an inflation target range from 3% to 6%. When inflation exceeds the upper bound of the range, the SARB increases the interest rate to bring inflation to the target; therefore, the interest rate is the primary tool for achieving the objective of monetary policy.

South Africa's monetary policy has undergone three monetary policy phases: a liquid asset ratio system, a cash reserve system and monetary accommodation (Aron and Muellbaver, 2007; Aziakprono and Wilson, 2010). The liquid asset ratio system is based on the quantitative control of interest rates and credit, and this system operated until early 1980. In