Economic Modelling 28 (2011) 1730–1738

Contents lists available at ScienceDirect

Economic Modelling

journal homepage: www.elsevier.com/locate/ecmod

Estimating monetary policy reaction functions for emerging market economies: The case of Brazil

José R. Sánchez-Fung *

Kingston University, London, UK
ISA, University of London, UK

ARTICLE INFO

Article history:
Accepted 2 March 2011

JEL classification:
E58
F41

Keywords:
Monetary policy
Taylor's rule
Data-rich environment
Excess policy response
Brazil

ABSTRACT

The paper investigates monetary policy in Brazil following a shift to a floating exchange rate alongside inflation targeting adoption. The benchmark reaction function reveals that the Central Bank behaves according to the *Taylor principle* by raising the overnight Selic policy interest rate more than the amount by which expected inflation exceeds the target. The investigation also considers a data-rich environment via an excess policy response containing information from a panel of 45 economic time series. The excess policy response carries a positive and significant coefficient in the reaction function including only an inflation gap variable.

1. Introduction

Understanding monetary authorities' behaviour is fundamental and often appears to be a forlorn task. In reality, central bankers consider a significant amount of statistical information when deliberating on monetary policy's future course of actions, but empirical studies about central bank performance generally limit their scope to analysing a small number of variables (e.g., Taylor, 1993). The practice is gradually changing as research focusing on advanced economies incorporate a data-rich environment in modelling monetary policy (e.g., Bernanke and Boivin, 2003; Favero et al., 2005; Giannone et al., 2005; Shibamoto, 2008). In contrast, there is a paucity of investigations on emerging market economies considering that critical aspect (see Frankel, 2010).

The paper aims at advancing our understanding of monetary policy in emerging market economies by investigating Brazil. The investigation addresses the following questions: Are Taylor-type reaction functions practical for understanding how monetary authorities in Brazil behave following inflation targeting adoption and switching to a floating exchange rate regime? Can considering a data-rich environment lead to a better knowledge about the Central Bank of Brazil's conduct of policy?

Brazil is an interesting case to study, inter alia, because it has made considerable efforts to build credibility on the sustainability of its economic policies (e.g., Giavazzi et al., 2005). Brazil is an early example of a country negotiating the perils of implementing a fully-fledged inflation targeting regime and concomitantly administering an IMF-backed stabilisation programme (Fraga et al., 2004).[1] With reference to Brazil's monetary policy decisions in the crucial years following inflation targeting adoption in 1999, Mishkin (2004, page 20) notes that "The procedure followed by the Central Bank do Brazil was a textbook case for central bank response to shocks in emerging market countries." Therefore the findings in the paper are potentially relevant for Brazil and other economies fostering policy-making institutions and consolidating macroeconomic stability.

The literature on empirical monetary policy reaction functions mostly springs from Taylor's (1993) contribution to policy evaluation (e.g., Clarida et al., 1998). Research findings on emerging market economies generally highlight the potential usefulness of interest rate reaction functions in reaching a systematic understanding about monetary policy behaviour.[2] Along this line of enquiry Minella et al. (2003) estimate Taylor-type reaction functions for Brazil and show

[1] In Brazil the IMF's conditionality involved tracking a 12-month indicator of inflationary developments within the Fund's quarterly monitoring exercises. Additionally, bands were agreed to serve as upper and lower bounds around inflation's deviations from target. The plan's novel criteria were consistent with the broader demands of an inflation targeting regime.

[2] In some countries the monetary base framework advanced by McCallum (e.g., 1988) can be useful as a benchmark for understanding monetary policy behaviour. See, for instance, Burdekin and Siklos (2008) and Mehrotra and Sánchez-Fung (2010) on China's monetary policy.

* School of Economics, Kingston University, London, Penrhyn Road, Kingston-upon-Thames, Surrey, KT1 2EE, UK.
E-mail address: j.sanchez-fung@kingston.ac.uk.

0264-9993/$ – see front matter © 2011 Elsevier B.V. All rights reserved.
doi:10.1016/j.econmod.2011.03.007

that, in addition to the inflation and output gaps, the exchange rate enters significantly (e.g., Taylor, 2001). Minella et al.'s evidence shows that the Central Bank of Brazil reacts in line with the Taylor Principle and that the monetary authorities practise instrument smoothing (e.g., English et al., 2003).[3] Focusing on Brazil and three other Latin American countries, de Mello et al. (2009) explore the relevance of unit roots, co-integration, and non-linearities when estimating monetary policy reaction functions. For Brazil their exercises reveal a positive coefficient on deviations of inflation from target and on the exchange rate depreciation term, but their reaction functions do not contain an output gap measure.

The paper contributes by specifying and estimating alternative dynamic monetary policy reaction functions for Brazil.[4] Estimating a battery of specifications applying automatic econometric model selection techniques helps in addressing the sensitivity of the relationship connecting developments in the economy and subsequent policy actions. The research strategy involves running regressions based on a benchmark Taylor-type reaction function linking monetary policy's interest rate instrument to developments in inflation, output, and the exchange rate. The exercises also investigate a reaction function only considering inflation, and equations incorporating a data-rich environment using a factor synthesising information from a panel of 45 economic time series, in the spirit of Bernanke and Boivin (2003). The investigation discusses the outcome from the battery of models, addressing the role of the exchange rate in estimated monetary policy reaction functions, the use of alternative inflation and output gap measures, and the magnitude of policy responses to the gaps.

The paper finds that the Central Bank adjusts the Selic interest rate in line with the *Taylor principle* but that it does not systematically react to exchange rate developments. The investigation also explores the relevance of considering a data-rich environment via an 'excess policy response' (EPR). The exercises show that the EPR carries a positive and significant coefficient in the reaction function only including an inflation gap. When including an output gap term, the EPR is not statistically significant.

The paper proceeds as follows. Section 2 overviews monetary policy and inflation targeting in Brazil. Section 3 explains monetary policy reaction functions and why considering a data-rich environment is relevant. Section 4 describes the time series data feeding the empirical modelling. Section 5 lays out the econometric specification, and discusses the results from estimating benchmark and alternative monetary policy reaction functions. Section 6 contains concluding remarks.

2. Monetary policy in Brazil following inflation targeting adoption

Brazil formally adopted inflation targeting in 1999 alongside a floating exchange rate regime and other measures, crucially on the fiscal front, aimed at improving monetary policy's design and implementation (e.g., Giavazzi et al., 2005). The exchange rate anchor, a pillar of the stabilisation plan launched in 1994, survived the Mexican, Asian, and Russian crises, but not the systematic current account deficits and the subsequent speculation against the currency. The process led to the country abandoning the crawling exchange rate band regime and to a depreciating currency.

Concerning the institutional mechanics behind the inflation targeting strategy, a National Monetary Council is responsible for setting the inflation targets, i.e. designing the policy strategy. The Council members are the Minister of Finance (who heads the Council), the Minister of Planning, Budget and Management, and the Central Bank Governor. The monetary policy committee (Copom), comprising the Board of Directors of the Central Bank and its Governor, is responsible for implementing the inflation targeting strategy. And that involves deciding on the path for monetary policy's instrument: the target for the overnight nominal Selic interest rate.

Following inflation targeting adoption, and despite significant increases in the exchange rate, inflation was just above 8% in 1999 and around 6% in 2000. Since then, as shown by Minella et al. (2003), the Copom has been trying to build the credibility necessary for reaching its targets. Probably the most testing time for the regime was 2003 when the Central Bank had to increase its mid-point target to 8.5%. It is worth noting that the Open Letter of 1/21/2003 adjusted the targets to 8.5% for 2003 and 5.5% for 2004, even though the original targets set by the National Monetary Council were in place. In spite of the changes, the monetary authorities barely kept inflation within the target's upper band. The policy reaction leading to adjusting the inflation target was partly triggered by sharp *real* depreciations in 2002: during that year presidential elections were held in October alongside a worsening international financial situation and an ensuing stop in capital flows. Uncertainty about the maintenance of the policy regime was a major concern during this period. Brazil successfully manoeuvered around these events, and the episode highlights the importance of policy commitment in aligning the central bank's and the public's expectations regarding macroeconomic conditions.

3. Monetary policy reaction functions in a data-rich environment

Consider the monetary policy reaction function literature springing from Taylor's (1993) seminal article (see also Taylor, 1999). As originally formulated, Taylor's rule advocates setting the target for the US federal funds rate (R) in relation to the rate of inflation (π^*) indicating the implicit inflation target and an equilibrium real funds rate (r^*), which together indicate the long run average funds rate, plus two gaps: the four-quarter moving average of the actual inflation rate given by the GDP deflator ($\overline{\pi}$) less the target rate (π^*), and the percent deviation of real GDP from an estimate of its potential level (y).

In equation form Taylor's rule is

$$R_t = \pi^* + r^* + 1.5(\overline{\pi}_t - \pi^*) + 0.5(y_t). \quad (1)$$

Taylor's original paper proceeds assuming the weights on inflation and output. But Taylor's linear feedback rule has subsequently been shown to arise from solving the problem that a policymaker faces in theoretical optimal monetary policy models. The *Taylor principle*, meaning that the nominal policy interest rate moves more than one-for-one with inflation, is an important feature leading to stability in theoretical models (e.g., Woodford, 2001; Davig and Leeper, 2007).[5]

Also, various papers investigate Eq. (1) empirically. The literature estimates monetary policy's reactions to inflation and output gaps, and it considers lags of the central bank's interest rate to account for instrument smoothing. For instance, Clarida et al. (1998) estimate Taylor-type monetary policy reaction functions for France, Germany, Italy, Japan, the UK, and the US.

In the context of this literature, if additional variables actually matter in central banks' decision-making standard modelling strategies could lead to flawed conclusions and poor policy recommendations. Particularly, empirically estimated monetary policy reaction functions are essential in modern macro-monetary models. For instance, shocks to estimated monetary policy reaction functions usually feed vector autoregressions (VARs). And the VARs are in turn used in estimating monetary policy's effect on key macroeconomic variables like inflation and output (see Christiano et al., 1999).

[3] Minella and Souza-Sobrinho (2009) find similar results for a longer sample.

[4] Woodford (2003, Chapter 1, pages 37–44) notes the relevance of considering dynamic econometric specifications when analysing monetary policy reaction functions.

[5] Cochrane (2007) is critical about the interpretation of estimated Taylor rule coefficients. His arguments are based on the premise that the parameters of a Taylor rule linking interest rates to inflation and other variables are not identified in analytical new-Keynesian models. See also Atkeson et al. (2009).