Journal of Financial Stability 9 (2013) 251–258

Contents lists available at ScienceDirect

Journal of Financial Stability

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

Monetary policy rules, asset prices and adaptive learning

Vicente da Gama Machado *

Central Bank of Brazil, Research Department, Setor Bancário Sul, Quadra 3, 70074-900 Brasília, DF, Brazil

ARTICLE INFO

Article history:
Received 17 September 2012
Received in revised form 21 January 2013
Accepted 2 April 2013
Available online 15 April 2013

JEL classification:
E44
E52

Keywords:
Interest rate rules
Asset prices
Adaptive learning
Expectational stability

ABSTRACT

Following the damaging real effects of asset price fluctuations over the recent financial crisis, the debate on the appropriate role of such prices in a monetary policy context has gained renewed attention. This paper argues that a direct monetary policy response to asset prices is not desirable under common instrumental rate rules. To illustrate this point, we build an adaptive learning model, that extends existing learning models in monetary policy, most notably, Bullard and Mitra (2002). The result remains valid in a context with heterogeneous beliefs and is robust to an optimal monetary policy rule including a weight on asset prices.

1. Introduction

The issue of what role asset prices should play in monetary policy has gained renewed momentum in the aftermath of the recent financial crisis, and this issue remains far from resolved. After a first wave of contributions to this debate in the early 90s, primarily following the conflicting views of Bernanke and Gertler (2001) and Cecchetti et al. (2000), there has been resurgent interest among both policymakers and academic researchers.[1]

Although, as Bernanke (2007) stated, many interesting issues in contemporary monetary theory require an analytical framework that involves learning, the question of how monetary policy should respond to asset price developments has rarely been approached using a framework of adaptive learning.[2] In fact, although expectations play a vital role in modern monetary policy settings, a disproportionately large part of the related literature continues to rely on the rational expectations hypothesis.

This paper shows that a direct monetary policy response to asset prices is not desirable under common interest rate rules. We illustrate this point with three strategies. First, an adaptive learning model is presented that extends the seminal work of Bullard and Mitra (2002) by adding a response to asset prices in the policy rule and generalizing their chief result with regard to the Taylor principle. Building on the work by Carlstrom and Fuerst (2007), an interest rate rule responding to expectations is added, and E-Stability conditions are assessed. A few authors have approached some type of reaction to asset prices using adaptive learning, most notably Pfajfar and Santoro (2012) and Assenza et al. (2011). Diverging from these papers, we focus on a standard new Keynesian macroeconomic model of monetary policy transmission instead of allowing for cost-channel effects.[3] Second, we show that the result is robust to heterogeneity in agents' beliefs using a framework similar to that of Guse (2005), who argues that stability results may differ considerably from the homogeneous case. The introduction of heterogeneity in the formation of expectations is a natural step, as the evidence both on inflation expectation surveys and asset price expectations appears to weaken the representative agent hypothesis.[4] Finally, the paper derives the optimal monetary

* Tel.: +55 61 99492636.
E-mail address: vicente.machado@bcb.gov.br

[1] See Bullard (2010) and Smaghi (2009) for a general idea of the Federal Reserve and the ECB main views. For recent theoretical contributions, see, for example, Pfajfar and Santoro (2012), Assenza et al. (2011), and Ida (2011).

[2] Exceptions are Pfajfar and Santoro (2012) and Assenza et al. (2011), which consider the importance of reacting to asset prices when the cost channel is relevant.

[3] The literature has generally found mixed results regarding the importance of cost channel effects. Using Bayesian methods, Rabanal (2007) concludes that the traditional demand-side effect dominates the supply-side effect represented by the cost channel.

[4] Branch (2007) and Pfajfar and Santoro (2010) claim that heterogeneity is pervasive in the process of expectation formation. Hommes (2006) provides a comprehensive survey of heterogeneous agents in asset pricing.

1572-3089/$ – see front matter
http://dx.doi.org/10.1016/j.jfs.2013.04.002

policy allowing for asset prices, extending the expectations-based rule proposed by Evans and Honkapohja (2003a).

The remainder of this paper is organized as follows. The next section briefly describes the small macroeconomic model of households and firms. Section 3 presents the benchmark learning environment with homogeneous expectations and instrumental rules. In Sections 4 and 5, we allow for heterogeneous beliefs and optimal monetary policy, and Section 6 concludes.

2. Basic model

As a description of the economy, we adapt the theoretical general equilibrium model presented in Carlstrom and Fuerst (2007). The standard sticky price model economy is populated by households and firms. Households form decisions regarding their consumption, asset holdings and labor supply, whereas firms make decisions regarding the pricing of their goods, using labor as input. See Appendix A for more details.

The small macroeconomic model may be formalized into four basic equations. First, a standard new Keynesian Phillips curve:

$$\pi_t = \kappa x_t + \beta E_t \pi_{t+1} \tag{1}$$

To keep notation more aligned with the learning and monetary policy literature, we substitute the real marginal cost using a measure of the output gap, $x_t = (Y_t - Y_t^n)$. Equation (A4) and the resource constraint lead to the intertemporal IS equation:

$$x_t = E_t x_{t+1} - \sigma^{-1}(r_t - r_t^n - E_t \pi_{t+1}) \tag{2}$$

where r_t is the nominal interest rate.[5] As in Carlstrom and Fuerst (2007), we have:

$$d_t = -A z_t \tag{3}$$

where $A = z(1+\sigma+\gamma) - 1/(\sigma+\gamma)(1-z) > 0$ for reasonable calibrations. The negative relationship between dividends and the output gap reflects the typical detrimental effect of marginal costs on firms' profitability. Combining the "no-arbitrage condition" and (3), the result is an equation relating the dynamics of stock price misalignments to their expected values, together with the expected values of inflation and the output gap:

$$q_t = \beta E_t q_{t+1} - A(1-\beta)E_t x_{t+1} - (r_t - r_t^n - E_t \pi_{t+1}) \tag{4}$$

The baseline model is complemented with the interest rate policy. First, we follow Bullard and Mitra (2002) and consider Taylor-type instrumental rules, augmented with a term corresponding to asset price misalignments. The first instrumental rule considers contemporaneous values of the output gap, inflation and asset price deviations:

$$r_t = \varphi_x x_t + \varphi_\pi \pi_t + \varphi_q q_t \tag{5}$$

where φ_y is the policy response to the expected future value of variable y. Unlike Carlstrom and Fuerst (2007), we begin with a more general rule, which includes the output gap. We also extend Carlstrom and Fuerst's (2007) analysis by examining an interest rate rule that responds to forward-looking expectations. Such a rule addresses McCallum's (1999) critique that monetary policy based on current values of inflation and the output gap may fail to be operational due to their non-availability. In our setting, the forward-looking rule may be represented by the following:

$$r_t = \varphi_x E_t x_{t+1} + \varphi_\pi E_t \pi_{t+1} + \varphi_q E_t q_{t+1} \tag{6}$$

3. Determinacy and E-Stability in the benchmark model

This section examines determinacy conditions for the rational expectations equilibrium and, in an adaptive learning environment, the appropriate E-Stability requirements.

Combining Eqs. (1), (2) and (4) with an instrumental interest rate rule such as (5) or (6), we have the reduced form:

$$y_t = \alpha + B E_t y_{t+1} + \chi r_t^n \tag{7}$$

where $y_t = (x_t, \pi_t, q_t)'$ is the vector of endogenous variables forming the system, α and χ are 3×1 parameter vectors and B is a 3×3 parameter matrix, all of which are properly defined for each type of rule in the next subsections.

E-Stability results arise from concepts that are well known in the learning literature, which are represented in Evans and Honkapohja (2001) and Bullard and Mitra (2002). In the present case, the E-Stability of the REE holds, provided that the eigenvalues of B have real parts less than 1.

3.1. Calibrated parameters

Whenever such a treatment is feasible and intuitive, our results are expressed in analytical language. For simplicity reasons, we additionally conduct numerical simulations,[6] which are illustrated in Figs. 1 and 2. We follow Bullard and Mitra's (2002) baseline parameters $\sigma = 0.157$, $\kappa = 0.024$ and $\beta = 0.99$. As for the value of A, we follow Carlstrom and Fuerst (2007) for their case of lower marginal cost sensitivity, i.e., $z = 0.85$ and $\gamma = 0.47$, which yield $A = 4.072$. Importantly, alternative calibrations were also tested and were found not to alter the results significantly.

3.2. Contemporaneous data in the interest rate rule

A quite common policy rule, also analyzed in Bullard and Mitra (2002), is an instrumental interest rate rule, where the central bank responds to contemporaneous values of inflation and the output gap. In our framework, with the addition of stock price misalignments, this rule is precisely reflected in Eq. (5). The economy is then represented in (7), where the parameters are as follows:

$\alpha = 0$, $\chi = (1/1+\varphi_q)(\sigma^{-1}, \kappa\sigma^{-1}, 1-\varphi_\pi\kappa\sigma^{-1})'$ and

$$B = \frac{1}{\sigma + \sigma\varphi_q + \varphi_x + \varphi_\pi\kappa}\begin{bmatrix} -\sigma - \varphi_q(\sigma + A - A\beta) & -1 + \varphi_\pi\beta & -\varphi_q\beta \\ (-\sigma - \varphi_q(\sigma + A - A\beta))\kappa & \kappa\sigma^{-1}(1-\varphi_\pi) + \beta & -\varphi_\pi\beta \\ -\sigma(A - A\beta) - (\varphi_x + \varphi_\pi\kappa)(\sigma + A - A\beta)) & (-1+\varphi_\pi\beta)\sigma & (\varphi_\pi\kappa + \varphi_x + \sigma)\beta \end{bmatrix} \tag{8}$$

Two extreme scenarios are considered, depending on which variable is omitted from the interest rate rule. In the first case, the response to stock price deviations is muted in the reaction function – that is, $r_t = \varphi_x x_t + \varphi_\pi \pi_t$. Through such simplifications, it is possible to analytically assess the questions involved in the introduction

[5] Following Bullard and Mitra (2002), we assume the natural rate of interest to follow the stochastic process $r_t^n = \rho r_{t-1}^n + \varepsilon_t$, where ε_t is an i.i.d. noise with variance σ_ε^2 and $o \le \rho < 1$.

[6] For all numerical calculations and graphs, as well as some cumbersome matrix algebra, the software MAPLE 9.5 was used. Codes are available upon request.