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Original Article

Stabilizing inflation in a simple monetary policy model with heterogeneous agents

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Abstract

We study a simple monetary model in which a central bank faces a boundedly rational private sector and has the goal of stabilizing inflation. The system's dynamics is generated by the interaction of the expectations about inflation of the various agents involved. A modest degree of heterogeneity in such expectations is found to have interesting consequences, in particular when the central bank is uncertain about the relevant behavioral parameters. We find that a simple heuristic based on mean and variance of the distribution of behavioural parameters stabilizes the system for a wide parametric region.
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1. Introduction

In recent years the ability of central banks to control inflation by way of inflation targeting policies has generally increased and their credibility has improved accordingly. The issue of whether monetary authorities are also actually able (and therefore should commit themselves) to tackle full employment at the same time is controversial, however (see e.g. [9]). More recently the worldwide crises has also put forward the issue of the zero lower bound constraint on nominal interest rates reaching effectiveness, with implications on the range of policy instruments which remain viable for monetary policy (see [10]).

In this paper, we study a simple model in which an inflation targeting monetary policy is carried out by a Central Bank (CB henceforth), using money supply as its sole instrument. We assume bounded rationality for both the monetary authority and the private sector. The model builds on Bischi and Marimon [1] who rank a number of different policies according to the size of the basin of attraction associated with meaningful steady state equilibria. Also, they posit bounded rationality for the private sector, which is in turn modelled as a representative agent but do not especially focus on the CB's forecasts of relevant variables. In contrast, here the CB is supposed to know the functional form underlying the private sector's inflation expectations but not its specific parameters. Besides, the private sector is assumed to be a collection of heterogeneously adaptive agents. This behavioural assumption is motivated by previous

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experimental evidence (see e.g. [7,3,6]). The criterion of judging policies according to the probability of reaching the target is maintained, in the context of an exercise about parametric uncertainty for the CB. The authorities are assumed to have correct information about the sample moments of the distribution of behavioural parameters characterizing the private sector, while ignoring the fine detail of the actual realization of such parameters.

The results are as follows: within the representative agent framework we show how local stability depends on the interaction between money demand elasticity to inflation, the inflation target and the parameters involved. We also document the relative ranking of this policy with various alternatives, given a criterion based on the probability of a stable outcome for the dynamics of inflation. With heterogeneous agents we study the effect of the number of different types of agents playing a role within the private sector and find a phenomenon of polarization: the larger such number the less uncertain becomes the issue of whether stability will prevail, with the actual answer depending on the money demand slope and the inflation target. In this context a significant role is played by the dispersion of the private sector's key parameters, which proxies the amount of behavioural heterogeneity. We describe a heuristic for the optimal choice of an adaptive parameter for the CB, in terms of the expected long-run outcome.

2. The baseline model

We consider a deterministic monetary model of inflation targeting, which in its basic structure parallels that of Bischi and Marimon [1]. It is assumed that the government faces the intertemporal budget constraint

$$M^S_{t+1} + B^S_{t+1} = p_t g_t - p_t \tau_t + M^S_t + B^S_t I_t \tag{1}$$

where M^s is the money supply, B^S is the government bonds supply, I is the nominal rate of return on bonds, g are real expenditures, τ a lump-sum tax and p the price level. By defining the real term balance deficit as

$$d_t = g_t - \tau_t + \frac{B^S_t}{p_t} I_t - \frac{B^S_{t+1}}{p_t} \tag{2}$$

and using (1), we have that the money supply evolves according to

$$M^s_{t+1} = M^s_t + d_t p_t \tag{3}$$

i.e. the real term balance deficit equals the expansion of the money supply.

Let m^d the money demand in real terms. The monetary equilibrium condition, $M^s_{t+1} = m^d_{t+1} p_t$, implies that

$$m^d_{t+1} p_t = m^d_t p_{t-1} + d_t p_t. \tag{4}$$

Such condition can be rewritten as

$$\pi_t = \frac{m^d_t}{m^d_{t+1} - d_t} \tag{5}$$

where $\pi_t = \frac{p_t}{p_{t-1}}$ is the gross inflation rate at time t.

The money demand is of the Cagan type, i.e. a function of the expected inflation rate, taking the linear form

$$m^d_{t+1} = b - \pi^e_{t+1} \tag{6}$$

where $b > 0$, and π^e_{t+1} is the private sector forecast at time t of the inflation rate at time $t+1$.

The CB sets an inflation target, embedded in the price index π^* (with $\pi^* < b$ to ensure nonnegative demand at the target) and determines d_t given the information set at time t so as to achieve the target. In practice, expansions/contractions of the money supply could be the outcome of different policy interventions (e.g. open market operations or interest rate management), but in the model this aspect does not affect the dynamics of the economy.

From (5) it follows that the optimal policy, conditional on the bank's expectations being correct, is

$$d_t = E^c_t[m^d_{t+1}] - \frac{m^d_t}{\pi^*} \tag{7}$$

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