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Optimal monetary policy for a small open economy ☆

Jose Angelo Divino *

Catholic University of Brasilia, SGAN 916, Modulo B, Office A-116. Zip 70.790-160, Brasilia — DF, Brazil

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ABSTRACT

This paper focuses on the design of monetary policy rules for a small open economy. The model features optimizing behavior, general equilibrium and price stickiness. The real exchange rate is shown to affect the firm's real marginal cost, aggregate supply and aggregate demand. The welfare objective depends on the openness of the economy, and the optimal policy rule differs from that which obtains in a closed economy. The inflation versus output gap stabilization trade-off is caused by the real exchange rate. The implied optimal monetary policy regime is domestic inflation target coupled with controlled floating of the real exchange rate.

1. Introduction

It is widely recognized that the exchange rate plays an important role in the transmission of the monetary policy in open economies. Recent studies on this issue include Benigno and Benigno (2000), Benigno (2004), Devereux (2004), Gali and Monacelli (2005), Taylor (2001), Svensson (2000), among others. Differently from the closed economy framework, however, where there are some stylized results concerning to an optimal policy built on interest rate rules, several questions remain object of analysis in the open economy. Specifically, there lacks a precise answer as to whether the monetary authority should respond to exchange rate movements.

The open economy environment yields additional complications to the optimal monetary policy problem. To see this, assume that the monetary authority follows an interest rate rule, as it is the common practice among central banks of developed countries, and the target variables are inflation and output gap. Exchange rate movements have a direct effect on both aggregate demand (switching demand effect) and prices (consumer price effect) and so have an indirect effect on the monetary policy instrument. On its turn, the exchange rate itself, by no arbitrage in international financial markets, is sensible to interest rate differentials. Thus, the exchange rate channels of transmission affect both private agents' expectations of future variables and optimal response of the monetary policy to stabilize the economy.

The goal of this paper is to analyze the role of the exchange rate in the design of monetary policy rules for a small open economy. In the model economy, private agents are forward looking and the monetary policy affects economic activity through an interest rate rule. Nominal product prices are set by individual firms in a staggered manner, *a la* Calvo (1983). The channels of transmission imply that changes in the country's exchange rate affect firms' marginal cost, aggregate supply, and aggregate demand.

The model provides a theoretical background for the inflation versus output gap stabilization trade-off. It is caused by the real exchange rate. The implied policy regime is domestic inflation target, coupled with a dirty floating of the exchange rate. Because of the exchange rate channels, neither the canonical representation, proposed by Gali and Monacelli (2005), nor the isomorphic solution for the interest rate rule, suggested by Clarida, Gali, and Gertler (2001), holds in the present model. In addition, in the welfare loss, the monetary authority places a higher weight on output gap stabilization than in the closed economy counterpart, as derived by Woodford (2003). This finding suggests that an overly aggressive inflation stabilization policy might cause undesirable instability in the small open economy.

Previous works, including Aoki (2001), Kollmann (2002), Devereux and Engel (2003), and Svensson (2000), show different findings. Aoki

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* Tel.: +55 61 3448 7192; fax: +55 61 3347 4797.
E-mail address: jangelo@pos.ucb.br.

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(2001) does not find stabilization trade-off under the optimal policy of complete domestic inflation stabilization. When prices are set in local currency and the law of one price does not hold, Kollmann (2002) also argues that it is optimal to stabilize domestic inflation by assuming a Taylor type of policy rule, though it implies significant exchange rate volatility. Devereux and Engel (2003) claim that prices set in producer's currency (PCP) lead to fully flexible exchange rate. This result also does not hold here because of the terms of trade distortion and exchange rate channels of transmission, which are not considered by those authors. Contrary to the previous findings, Svensson (2000) suggests to target CPI inflation because this regime produces small to moderate variability in inflation, output and exchange rate. This result, however, is determined by the *ad hoc* structure of Svensson's model, which assumes a variety loss functions. In the present model, where welfare loss is utility-based, the optimal policy is domestic inflation target.

The paper is organized as follows. The next section presents the model economy. The structural equations for aggregate demand and aggregate supply are derived in Sections 3 and 4, respectively. Section 5 defines the rational expectations equilibrium. Section 6 derives the welfare objective and the optimal monetary policy rule. Finally, Section 7 is dedicated to the concluding remarks.

2. Open economy model

2.1. Household side

The world economy is made up of two asymmetric countries, represented by a small open economy, which will be qualified latter, and a foreign country (or the rest of the world economy). The small open economy is inhabited by infinitely-lived consumer–producer agents, whose total is normalized to one. There are $j\in[0,1]$ imperfect substitute goods, each one being produced by a different producer in a monopolistic competitive basis.[1] The representative agent's utility function is specialized to be:

$$E_t\left\{\sum_{k=0}^{\infty}\beta^k\left[U\left(C_{t+k},\frac{M_{t+k}}{P_{t+k}}\right)-V(N_{t+k})\right]\right\} \tag{1}$$

with $U\left(C_{t+k},\frac{M_{t+k}}{P_{t+k}}\right)=\frac{C_{t+k}^{1-\sigma}}{1-\sigma}+\frac{\chi(M_{t+k}/P_{t+k})^{1-\gamma_m}}{1-\gamma_m}$ and $V(N_{t+k})=\frac{(N_{t+k})^{1+\gamma_n}}{1+\gamma_n}$, where $\beta\in[0,1]$, σ,χ,γ_m, $\gamma_n>0$, and E_t is the expectations operator conditional on time t information set. The particular form of $V(N_{t+k})$ reflects the assumption that there is no friction in the labor market and, because wages are flexible, all workers earn the same wage and work the same number of hours.

The small open economy consumption index is a composite of home- and foreign-country-produced goods, given by:

$$C_t=\left[(1-\alpha)^{\frac{1}{\eta}}C_{H,t}^{\frac{\eta-1}{\eta}}+\alpha^{\frac{1}{\eta}}C_{F,t}^{\frac{\eta-1}{\eta}}\right]^{\frac{\eta}{\eta-1}} \tag{2}$$

where $C_{H,t}$ is the domestic consumption of the home-produced good, $C_{F,t}$ is the domestic consumption of the foreign-country-produced good, and $\eta>0$ is the elasticity of substitution between home- and foreign-country goods. The parameter $\alpha\in[0,1]$ measures the share of the total consumption of the foreign-country-produced goods in the home country total consumption and α is referred to as the degree of openness of the small open economy.

The consumption subindexes are given by CES aggregators according to Dixit and Stiglitz (1977). Specifically, one has that $C_{H,t}=\left[\int_0^1 C_{H,t}(j)^{\frac{\varepsilon-1}{\varepsilon}}dj\right]^{\frac{\varepsilon}{\varepsilon-1}}$ and $C_{F,t}=\left[\int_0^1 C_{F,t}(j)^{\frac{\varepsilon-1}{\varepsilon}}dj\right]^{\frac{\varepsilon}{\varepsilon-1}}$, where $\varepsilon>1$ is the elasticity of substitution across goods produced within a country.

In a similar fashion, the home price of the home-produced good and the home price of the foreign-produced good are expressed as $P_{H,t}=\left[\int_0^1 P_{H,t}(j)^{1-\varepsilon}dj\right]^{\frac{1}{1-\varepsilon}}$ and $P_{F,t}=\left[\int_0^1 P_{F,t}(j)^{1-\varepsilon}dj\right]^{\frac{1}{1-\varepsilon}}$ respectively. $P_{H,t}$ is referred to as producer price index (PPI). The consumer price index (CPI) is defined equivalently to the total home consumption as $P_t=\left[(1-\alpha)P_{H,t}^{1-\eta}+\alpha P_{F,t}^{1-\eta}\right]^{\frac{1}{1-\eta}}$.

Demand functions, resulting from the household's optimal decision of allocating a fixed amount of nominal income within each category of goods, are given by $C_{H,t}(j)=\left(\frac{P_{H,t}(i)}{P_{H,t}}\right)^{-\varepsilon}C_{H,t}$ and $C_{F,t}(j)=\left(\frac{P_{F,t}(i)}{P_{F,t}}\right)^{-\varepsilon}C_{F,t}$.

Using Eq. (2), one can express the total demand for the home- as well as foreign-produced goods as $C_{H,t}=(1-\alpha)\left(\frac{P_{H,t}}{P_t}\right)^{-\eta}C_t$ and $C_{F,t}=\alpha\left(\frac{P_{F,t}}{P_t}\right)^{-\eta}C_t$, respectively.

The home-currency nominal budget constraint faced by the representative household can be written as:

$$P_tC_t+D_{t,t+1}B_t+M_t+\varsigma_tD_{t,t+1}^{*}B_t^{*}\leqslant W_tN_t+\Pi_t+B_{t-1}+M_{t-1}+\varsigma_tB_{t-1}^{*}+\mathrm{TR}_t \tag{3}$$

The notation is home country bond (B_t), money balances (M_t), total wages (W_tN_t), profits from the ownership of the firm (Π_t), and total lump-sum transfers from the government (TR_t). In addition, one has that P_t is the CPI, $D_{t,t+1}$ is the price of the one-period domestic bond,[2] and ς_t is the nominal exchange rate, defined as the home price of the foreign country currency. As usual, an asterisk indicates a foreign country variable.

It is assumed that there is a complete set of state-contingent claims in the international financial markets. The household's optimization problem is standard and the solution yields, after taking expectations conditional on period t information set, a stochastic consumption Euler, Eq. (4), an optimal decision rule relating consumption versus saving in one-period foreign bond, Eq. (5), a money demand, Eq. (6), and the household's optimal labor supply schedule, Eq. (7).[3]

$$D_{t,t+1}C_t^{-\sigma}=\beta\left(C_{t+1}^{-\sigma}\frac{P_t}{P_{t+1}}\right) \tag{4}$$

$$D_{t,t+1}^{*}\varsigma_tC_t^{-\sigma}=\beta\left(C_{t+1}^{-\sigma}\varsigma_{t+1}\frac{P_t}{P_{t+1}}\right) \tag{5}$$

$$C_t^{-\sigma}=\chi\left(\frac{M_t}{P_t}\right)^{-\gamma_m}+\beta\left(C_{t+1}^{-\sigma}\frac{P_t}{P_{t+1}}\right) \tag{6}$$

$$C_t^{-\sigma}\frac{W_t}{P_t}=N_t^{\gamma_n} \tag{7}$$

There is no arbitrage in international financial markets. One can then combine consumption Euler equations to get a nominal version of the uncovered interest rate parity (UIP). In log-linear form, it can be expressed as:

$$e_t-E_te_{t+1}=i_t^{*}-i_t+\xi_t \tag{8}$$

where $e_t=\log(\varsigma_t)$, $i_t\simeq\log(1+i_t)$, and $i_t^{*}\simeq\log(1+i_t)$, and ξ_t is the risk-premia.

[1] The model framework follows Gali and Monacelli (2000, 2005). This modeling strategy is based in the tradition of Obstfeld and Rogoff (1995, 1999) and similar versions include Clarida, Gali, and Gertler (2001), Benigno and Benigno (2000), and Monacelli (2005). See Lane (2001) for an extensive survey.

[2] Formally, $D_{t,t+1}=\frac{1}{R_t}$, where R_t is the gross nominal interest rate, i.e., $R_t=1+i_t$.

[3] To save space, the derivations are omitted. A technical appendix is available upon request.