7

Monetary Policy and the Open Economy

All the models analyzed in earlier chapters assumed a closed economy: households and firms were not able to trade in goods or financial assets with agents located in other economies. This chapter relaxes that assumption by developing an open economy extension of the basic New Keynesian model analyzed in chapter 3. The framework introduces explicitly the exchange rate, the terms of trade, exports, and imports, as well as international financial markets. It also implies a distinction between the consumer price index—that includes the price of imported goods—and the price index for domestically produced goods. Such a framework can in principle be used to assess the implications of alternative monetary policy rules for an open economy. Because the framework nests as a limiting case the closed economy model of chapter 3, it allows the exploration of the extent to which the opening of the economy affects some of the conclusions regarding monetary policy obtained for the closed economy model: in particular, the desirability of a policy that seeks to stabilize inflation (see chapter 4). It is also worth analyzing what role, if any, the exchange rate plays in the optimal design of monetary policy and/or what is the measure of inflation that the central bank should seek to stabilize. Finally, the framework can be used to determine the implications of alternative simple rules, as was done in chapter 4 for the closed economy.

The analysis of a monetary open economy raises a number of issues that a modeler needs to confront, and which are absent from its closed economy counterpart. First, a choice needs to be made between the modelling of a "large" or "small" economy, i.e., between allowing or not, respectively, for repercussions in the rest of the world of developments (including policy decisions) in the economy being modelled. Second, the existence of two or more economies subject to imperfectly correlated shocks generates an incentive to trade in assets between residents of different countries in order to smooth their consumption over time. Hence, a decision must be made regarding the nature of international asset markets and, more specifically, the set of securities that can be traded in those markets, with

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This chapter is based on Galí and Monacelli (2005), with the notation modified for consistency with earlier chapters. Section 7.3 on the transmission of monetary policy shocks contains original material.

possible assumptions ranging from financial autarky to complete markets. Third, one needs to make some assumption about firms' abilities to discriminate across countries in the price they charge for the goods they produce ("pricing to market" versus "law of one price"). Furthermore, whenever discrimination is possible and prices are not readjusted continuously, an assumption must be made regarding the currency in which the prices of exported goods are set ("local currency pricing," i.e., prices are set in the currency of the importing economy versus "producer currency pricing," i.e., prices are set in the currency of the producer's country). Other dimensions of open economy modelling that require some choices include the allowance or not of nontradeable goods, the existence of trading costs, the possibility of international policy coordination, and so on.

A comprehensive analysis of those different modelling dimensions and how they may affect the design of monetary policy would require a book of its own, thus it is clearly beyond the scope of this chapter. The modest objective here is to present an example of a monetary open economy model to illustrate some of the issues that emerge in the analysis of such economies and which are absent from their closed economy counterparts. In particular, a small open economy model is developed, with complete international financial markets, where the law of one price holds. Then, in the discussion of the model's policy implications and in the notes on the literature in section 7.6, there is reference made to a number of papers that adopt different assumptions and briefly discuss the extent to which this leads their findings to differ from those obtained here.

The framework below, originally developed in Galí and Monacelli (2005), models a small open economy as one among a continuum of (infinitesimally small) economies making up the world economy. For simplicity, and in order to focus on the issues brought about by the openness of the economy, the possible presence of either cost-push shocks or nominal wage rigidities is ignored. The assumptions on preferences and technology, combined with the Calvo price-setting structure and the assumption of complete financial markets, give rise to a highly tractable model and to simple and intuitive log-linearized equilibrium conditions. The latter can be reduced to a two-equation dynamical system consisting of a New Keynesian Phillips curve and a dynamic IS-type equation, whose structure is identical to the one derived in chapter 3 for the closed economy, though its coefficients depend on parameters that are specific to the open economy while the driving forces are a function of world variables (that are taken as exogenous to the small open economy). As in its closed economy counterpart, the two equations must be complemented with a description of how monetary policy is conducted.

After describing the model and deriving a simple representation of its equilibrium dynamics, section 7.3 analyzes the transmission of monetary policy shocks, emphasizing the role played by openness in that transmission. Section 7.4 turns to the issue of optimal monetary policy design, focusing on a particular case for

which the flexible price allocation is efficient. Under the same assumptions it is straightforward to derive a second-order approximation to the consumer's utility, which can be used to evaluate alternative policy rules. Section 7.5 assesses the merits of two different Taylor-type rules, a policy that fully stabilizes the CPI, and an exchange rate peg. Section 7.6 concludes with a brief note on the related literature.

7.1 A Small Open Economy Model

The world economy is modelled as a continuum of small open economies represented by the unit interval. Since each economy is of measure zero, its performance does not have any impact on the rest of the world. Different economies are subject to imperfectly correlated productivity shocks, but it is assumed that they share identical preferences, technology, and market structure.

Next, the problem facing households and firms located in one such economy will be described in detail. Before doing so, a brief remark on notation is in order. Because the focus is on the behavior of a single economy and its interaction with the world economy, and in order to lighten the notation,variables are used *without* an i-index to refer to the small open economy being modelled. Variables with an $i \in [0, 1]$ subscript refer to economy i, one among the continuum of economies making up the world economy. Finally, variables with an *asterisk superscript* (*) correspond to the world economy as a whole.

7.1.1 Households

A typical small open economy is inhabited by a representative household who seeks to maximize

$$E_0 \sum_{t=0}^{\infty} \beta^t \, U(C_t, N_t) \tag{1}$$

where N_t denotes hours of labor, and C_t is a composite consumption index defined by

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

where $C_{H,t}$ is an index of consumption of domestic goods given by the constant elasticity of substitution (CES) function

$$C_{H,t} \equiv \left(\int_0^1 C_{H,t}(j)^{\frac{\varepsilon-1}{\varepsilon}} \, dj \right)^{\frac{\varepsilon}{\varepsilon-1}}$$

where $j \in [0, 1]$ denotes the good variety.[1] $C_{F,t}$ is an index of imported goods given by

$$C_{F,t} \equiv \left(\int_0^1 (C_{i,t})^{\frac{\gamma-1}{\gamma}} \, di \right)^{\frac{\gamma}{\gamma-1}}$$

where $C_{i,t}$ is, in turn, an index of the quantity of goods imported from country i and consumed by domestic households. It is given by an analogous CES function

$$C_{i,t} \equiv \left(\int_0^1 C_{i,t}(j)^{\frac{\varepsilon-1}{\varepsilon}} \, dj \right)^{\frac{\varepsilon}{\varepsilon-1}}.$$

Note that parameter $\varepsilon > 1$ denotes the elasticity of substitution between varieties produced within any given country.[2] Parameter $\alpha \in [0, 1]$ can be interpreted as a measure of openness.[3] Parameter $\eta > 0$ measures the substitutability between domestic and foreign goods from the viewpoint of the domestic consumer, while γ measures the substitutability between goods produced in different foreign countries.

Maximization of (1) is subject to a sequence of budget constraints of the form

$$\int_0^1 P_{H,t}(j)\, C_{H,t}(j)\, dj + \int_0^1 \int_0^1 P_{i,t}(j)\, C_{i,t}(j)\, dj\, di + E_t\{Q_{t,t+1} D_{t+1}\} \leq D_t + W_t N_t + T_t \quad (3)$$

for $t = 0, 1, 2, \ldots$ where $P_{H,t}(j)$ is the price of domestic variety j. $P_{i,t}(j)$ is the price of variety j imported from country i. D_{t+1} is the nominal payoff in period $t+1$ of the portfolio held at the end of period t (and which includes shares in firms), W_t is the nominal wage, and T_t denotes lump-sum transfers/taxes. The previous variables are all expressed in units of domestic currency. $Q_{t,t+1}$ is the stochastic discount factor for one-period-ahead nominal payoffs relevant to the domestic household. Assume that households have access to a complete set of contingent claims, traded internationally.

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[1] As discussed below, each country produces a continuum of differentiated goods, represented by the unit interval.

[2] Notice that it is irrelevant to think of integrals like the one in (2) as including or not the corresponding variable for the small economy being modelled, because its presence would have a negligible influence on the integral itself (in fact, each individual economy has a zero measure). The previous remark also applies to many other expressions involving integrals over the continuum of economies (i.e., over i) that the reader will encounter below.

[3] Equivalently, $1 - \alpha$ is a measure of the degree of home bias. Note that in the absence of some home bias the households in the small open economy would attach an infinitesimally small weight to local goods, and consumption expenditures would be allocated to imported goods (except for an infinitesimally small share allocated to domestic goods).