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Monetary policy of a small open economy in the world production chain ☆

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ABSTRACT

In the world production chain there is a small economy that outsources production to its upstream, sells intermediate goods to its downstream and consumes imported final goods. It is shown that in responding to shocks from demand for intermediate goods, from the wage rate in the upstream and from the currency exchange rate between the upstream and downstream countries, the monetary policy of the small country is insignificant in the sense that any attempt of changing its monetary stance to raise national welfare will be offset by the movements of exchange rates.

1. Introduction

That an economic environment with imperfect competitions and nominal rigidities renders monetary policy influential on welfare has been shown by theoretical analyses and the optimal monetary policy is subject to characteristics of the environment.[1] As world production and trade patterns evolve toward vertical integration as analyzed by Hummels et al. (1998) and Yi (2003), several articles, such as Obstfeld (2002), Chu (2005) and Shi and Xu (2007), have incorporated manufacturing and trading intermediate goods into the study. Though taking vertical integration of production into consideration, these articles share one common feature—they model countries with symmetric production, consumption and trading patterns, therefore, countries are not distinguishable according to their roles played in the world production chain.[2] In contrast, I intend to build a model which contains a three-stage world production chain—the very upstream stage offers cheap labor services, the middle stage manufactures semi-finished goods, and the very downstream sells final products to feature asymmetry among countries. In particular, the country that serves the middle stage is the focus.

This article employs a small-county specification for the middle-stage county and does not explicitly model interactions among countries in the same stage of the production chain which has been done more or less in the literature. Different from the literature that emphasizes the productivity shocks incurred at home and/or from the similar trading partner, this article considers other types of shocks which originate from the rest of the world and are exogenous to the small country. Due to its position in the world production chain, the middle-stage country might be affected by shocks from demand for intermediate goods, from the wage rate in the upstream and from the currency exchange rate between the upstream and downstream countries. In reality, those countries that employ cheap labor from China and/or India to produce semi-finished products sold to the USA and/or West Europe are similar to the middle-stage countries described in this model. International trade is important for the growth and welfare of those countries which are sensitive to the changes in the world economic environment but they have limited influences on the changes. For example, a small middle-stage country, such as Taiwan, Singapore and Korea, has negligible influence on the exchange rate between Dollar and Reminibi but the country's production and consumption may significantly depend on the variation of this exchange rate. Similar argument goes for the wage rates in China and/or India and for the world demand for the semi-finished products.

Considering intermediate goods yields new results. For example, Obstfeld (2002) emphasizes that to achieve optimal inflation-targeting the monetary authority should not attempt to offset exchange rate fluctuations when intermediate goods are tradable but final goods are nontradable. Chu (2005) shows that whether an expansionary monetary policy or fiscal policy is beggar-thy-neighbor and welfare-improving depends on the extent of employing foreign labor force to produce semi-finished goods. Shi and Xu (2007)

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[1] For example, as the key factor that determines the optimal policy, Obstfeld and Kenneth (1995) and Corsetti and Pesenti (2001) feature in openness to trade, Obstfeld and Kenneth (1995) also point out the elasticity of substitution between goods, and Devereux and Engel (2003) refer to the currency of export pricing.

[2] Some studies in this line of literature also consider intermediate goods but employ numerical methods, for example, Corsetti et al. (2008), Huang and Liu (2005), and Devereux and Engel (2007). These studies also build upon symmetric countries.

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construct intermediate-good sector so as to investigate how stage-specific productivity shocks affect optimal monetary policy. They argue that each monetary authority should respond positively and partly to both home and foreign productivity shocks. In contrast, in this paper the monetary policy of the small middle-stage country is insignificant in the sense that any attempt of changing the monetary stance to raise welfare will be offset by the movements of exchange rates and no real effect will be generated by adjusting monetary stance. Therefore, this paper suggests an economic environment that significantly reduces the importance of monetary policy in response to the shocks from the rest of the world. The asymmetry among countries and the trade-off between blending with the world production chain and the influence of monetary policy might deserve further investigation.

The article is structured as follows. Section 2 introduces the model. Section 3 derives the equilibrium given a monetary policy. Section 4 discusses the monetary policy. Section 5 concludes.

2. The model

Consider three countries named 1, F and G in the world economy. The latter two are called the rest of the world to the former one, particularly, they are large countries to the small country 1. The main roles played by the large countries are that country G offers cheaper labor force for outsourcing from abroad and country F offers international bond B and consumption good m to the world. Country 1 is small in the sense that the wage rate of country G, the price of good m, the interest rate on B and the currency exchange rate between G and F are all exogenous to country 1.

Two types of tradable goods, x and m, are associated with the small country. Country 1 exports good x to the rest of the world and imports good m from the rest of the world. In country 1 the industry x is monopolistically competitive and each firm j produces a distinct brand j of good x using labor services at home and in country G. The demand for good x from the rest of the world is exogenous to country 1. In country 1 there is a continuum of measure one of consumers who supply labor services in a perfectly competitive labor market.

Let ε_{ab} be the exchange rate of country a's currency to country b's and let w_a be the wage rate of country a. Denote ε_{GF} by $\tilde{\varepsilon}$, w_G by $\tilde{w}$, w_1 by w, ε_{1F} by ε^f and ε_{1G} by ε^g. All of w, ε^f and ε^g are endogenously determined in the model while $\tilde{\varepsilon}$ and $\tilde{w}$ are exogenous. In the following, a subscript t attached to a variable denotes time. We assume that bilateral exchange rates can be simply computed from triangular relationships:

$$\varepsilon_t^f/\varepsilon_t^g = \tilde{\varepsilon}_t, \tag{1}$$

which yields no arbitrage opportunity for trading different currencies. The condition of $\varepsilon_t^g\tilde{w}_t \le w_t$ is required.

2.1. Households

Country 1 is inhabited by households defined over a continuum of unit mass. A representative household h maximizes

$$U(h) = E_0\sum_{t=0}^{\infty}\beta^t[\ln C_t(h) - \kappa L_t(h)], \kappa > 0,$$

where $0<\beta<1$ is the discount factor, t denotes time, $C_t(h)$ is consumption and $L_t(h)$ is labor effort. Let $P_{m,t}^f$ denote the price of good m prevailed in the world in terms of the currency of country F. Assuming the law of one price holds, we can write

$$P_{m,t} = \varepsilon_t^f P_{m,t}^f. \tag{2}$$

It is assumed that an agent h faces a convex cost of holding international bonds in quantities different from some steady-state level $B(h)$ which is a constant and depends on parameters of the model.[3] For the agent h, maximization of $U(h)$ is then subject to a sequence of budget constraints,

$$\begin{aligned} &P_{m,t}C_t(h) + b_{t+1}(h) + \varepsilon_t^f B_{t+1}(h) + \varepsilon_t^f\frac{\psi}{2}[B_{t+1}(h) - B(h)]^2 \\ &\le (1+i_t)b_t(h) + \left(1+i_t^f\right)\varepsilon_t^f B_t(h) + w_t L_t + \Pi_t(h), \end{aligned} \tag{3}$$

where $b_t(h)$ is national bond holding at time $t-1$ that only traded at home, $B_t(h)$ is international bond holding at time $t-1$, $\Pi_t(h)$ is profits from ownership of productions, ψ is a constant, i_t and i_t^f are respectively the interest rate at home and in the world. The nominal yields i_t and i_t^f are paid at the beginning of period t and are known at time $t-1$.

Utility maximization yields the optimal labor supply condition,

$$\kappa C_t(h)P_{m,t} = w_t. \tag{4}$$

In addition, choices on consumption, holdings of domestic bond and international bond yield

$$\beta\frac{P_{m,t}C_t(h)}{E_t\left[P_{m,t+1}C_{t+1}(h)\right]} = \frac{1}{1+i_{t+1}} \text{ and} \tag{5}$$

$$\frac{\left(\varepsilon_t^f\right)^{-1}E_t\left[Q_{t,t+1}(h)\varepsilon_{t+1}^f\right]}{1+\psi\left[B_{t+1}(h) - B(h)\right]} = \frac{1}{1+i_{t+1}^f}. \tag{6}$$

Define

$$Q_{t,t+1}(h) \equiv \beta\frac{P_{m,t}C_t(h)}{P_{m,t+1}C_{t+1}(h)},$$

which can be interpreted as the agent h's stochastic discount rate.

2.2. Firms

2.2.1. Demand for good x

Products of good x are exported to the rest of the world given the demand function

$$D_{x,t} = \left(\int_0^1 D_{x,t}(j)^{\frac{\sigma_x-1}{\sigma_x}}dj\right)^{\frac{\sigma_x}{\sigma_x-1}} = X\left(\frac{P_{x,t}^f}{\overline{P}_x}\right)^{-\theta} = \chi\left(P_{x,t}^f\right)^{-\theta}, \sigma_x > 1, X > 0, \chi > 0 \text{ and } \theta > 1,$$

where $D_{x,t}(j)$ is the quantity demanded of brand-j good x, σ_x is the elasticity of substitution between different brands of good x and θ reflects the competition from good x's substitutes which are made abroad. The demand function depends on the relative price of $P_{x,t}^f/\overline{P}_x$ which implies that country 1's products compete with some composite commodity $\overline{x}$ priced at $\overline{P}_x$ in the world market. This competition is not explicitly specified and we assumed that $\overline{P}_x$ is constant to the small country 1, but a larger θ implies a more intensive international competition. Since country 1 is small we assume that export prices are set in terms of the currency of country F. Therefore, the exact location of exporting does not matter (x can be exported from

[3] Since the rate of return and supply of the international bond are exogenous to country 1, without the adjustment cost, the variable of international bond holding will not appear in the Euler equations of asset choices, which leads to indeterminacy of the bond-holding choices. This kind of problems has been explained by Schmitt-Grohé and Uribe (2003) and they show that one way of solving it is to apply a convex portfolio adjustment cost of asset holding which implies a steady-state level of asset holding that depends only on parameters of the underlying model. Recently, Benigno (2009) that studies asymmetries of positions of two large countries in the international bond markets also resorts to a convex portfolio adjustment cost to resolve a problem of indeterminacy in bond holdings.