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Capital Flows, Openess and Real Exchange Rate Variability.

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Capital Flows, Openess and Real Exchange Rate Variability

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Abstract

This paper examines the response of real exchange rate to capital flow movements. It shows that countries with a large tradable sector will face smaller variability on their real exchange rate for a given level of capital flows and thus they will need smaller reallocations of real resources.

1. Introduction

Highly protected countries, when they decide to liberalize their economies, face as a central issue if they liberalize first their commercial policy or their capital movements. This question has been named as the sequencing issue on the international economics literature (See McKinnon, 1982 and Frenkel, 1983 among others). This paper addresses the effect of capital movements under trade restrictions and it shows that larger movements on real exchange rate (RER) and hence larger reallocations of resources will be required on economies with trade restrictions.

2. The model

This section develops a simple competitive equilibrium model for a small open economy facing freely capital flows but with restrictions on its trade policy. The economy has three different goods at each period of time. Those goods are a non tradable good, an importable good and an exportable good. There is a representative individual consuming importable and non-tradable goods and firms

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producing non tradable and exportable goods. Finally, there is a government that taxes the transactions on the tradable sector and uses its revenue to purchase non tradable goods.

2.1. The individual

There is a representative individual in this economy. The basic description of her problem is the following. She lives from period t=0 to infinity. At the beginning of each period of time she is endowed with L units of time that are inelastically supplied to the labor market. The individual must allocate those units of time between labor supplied to the non tradable sector (L_{nt}) and labor supplied to the exportable sector (L_{xt}). The wage rate are w_{nt} and w_{xt} respectively. Also, she is endowed with some units of physical capital, k_t, and some units of foreign assets, b_t. Those two types of assets may be used as perfect substitutes on the capital market and they are inelastically supplied on the capital market to the non tradable and exportable sector. Hence k_{xt} units of physical capital and b_{xt} units of foreign capital are supplied to the exportable sector. Both units have a return equal to r_{xt}. In the non tradable sector the notation will be k_{nt},b_{nt} and w_{nt} for physical capital, foreign capital and wage rate, respectively. The main difference between physical capital and foreign capital is that k_t is built on the non tradable sector while b_t depends on the tradable.

The income obtained from the labor and capital market is spent on consumption goods (importable and non-tradable), foreign assets to carry over to the next period and investment on physical capital. Finally, other prices faced by the individual are P_{nt} and P_{mt}(1-τ_m). P_{nt} is the price of non tradable goods at time t, including consumption and investment on physical capital (I_{nt}) while P_{mt}(1-τ_m) is the price of good bought on the tradable market, namely consumption on importables and foreign assets, where τ_m is a tax levied by the government on the importable sector.

The representative individual consumes non tradable goods and importable goods. She has the following CES instantaneous utility function:

$$u(C_{mt}, C_{nt}) = A[\alpha C_{nt}^{-\rho} + (1-\alpha)C_{mt}^{-\rho}]^{-\frac{1}{\rho}}$$

Where C_{mt} and C_{nt} are consumption of importable and non tradable goods while A,$\alpha > 0$ and $\infty > \rho > -1$ are parameters of the utility function. As usual $\frac{1}{1+\rho}$ is the elasticity of substitution between C_{nt} and C_{mt}. Given this utility function the problem faced by the representative agent is:

$$\max_{C_{mt},C_{nt},I_{nt},b_{t+1},L_{xt},L_{nt},k_{xt},k_{nt},b_{xt},b_{nt}} \sum_{t=0}^{\infty} \beta^t A[\alpha c_{nt}^{-\rho} + (1-\alpha)c_{mt}^{-\rho}]^{-\frac{1}{\rho}} \tag{1}$$

s.t

$$\begin{gathered}P_{nt}C_{nt}+\widetilde{P_{mt}}C_{mt}+P_{nt}I_{nt}+\widetilde{P_{mt}}b_{t+1}=\\(1+r_{xt})(b_{xt}+k_{xt})+(1+r_{nt})(b_{nt}+k_{nt})+w_{xt}L_{xt}+w_{nt}L_{nt}\\k_t=k_{nt}+k_{xt}\\b_t=b_{nt}+b_{xt}\\L=L_{xt}+L_{nt}\\k_{t+1}=I_{nt}+k_t\\\lim_{t\to\infty}\lambda_t b_t\geq 0\end{gathered}$$

Where $\widetilde{P_{mt}}$ =P$_{mt}$(1-τ_m). Notice that the constraint holds for any t and the last condition is a transversality condition that eliminate the possibility of a Ponzi-game, where λ_t be the shadow price of the budget constraint. We can characterize the basic properties of the individual's problem through the first order conditions. Some properties are the followings:

$$\frac{\widetilde{P_{mt}}}{P_{nt}} = (\frac{C_{mt}}{C_{nt}})^{-(\rho+1)}(\frac{1-\alpha}{\alpha}) \quad (2)$$

$$w_{xt} = w_{nt}, \qquad r_{xt}=r_{nt} \quad (3)$$

$$\lambda_t P_{nt} = \lambda_{t+1}(1+r_{nt})=\lambda_{t+1}(1+r_{xt})=\lambda_t\widetilde{P_{mt}} \quad (4)$$

Equation 2 is the usual equality between marginal rate of substitution and ratio of prices. The conditions on 3 are just arbitrage conditions on the labor market and the capital market while the conditions on 4 are the first order conditions of physical capital and foreign asset level accumulation[1]. In summary, the individual problem relates relative prices (RER) with the marginal rate of substitution and it provides arbitrage conditions on the labor and capital market plus conditions on foreign asset accumulation.

2.2. The firms

In the non tradable sector and the exportable sector there are a large number of firms with constant return to scale on labor and total capital. The production function on the exportable and non-tradable sector are F(K$^d_{xt}$,L^d_{xt})

[1]Notice that equation 4 implies that $\lambda_t P_{nt}=\lambda_t\widetilde{P_{mt}}$ or relative price of importable good measured in terms of non tradable goods equal to one. However, if in fact $\lambda_t P_{nt}>\lambda_t\widetilde{P_{mt}}$, the individual does not accumulate physical asset and there are incentives to accumulate foreign asset instead. If $\lambda_t P_{nt}<\lambda_t\widetilde{P_{mt}}$, the individual has incentives to disaccumulate foreign assets.

and H(K^d_{nt},L^d_{nt}), where the superscript "d" indicates "demand" and K indicates aggregate capital used on the firms. Also F_K,F_L,F_{LK},H_K,H_L,H_{KL}>0 and F_{KK},F_{LL},H_{LL},$H_{KK} < 0$.

The exportable sector faces a tax imposed by the government at rate τ_x, hence its problem is:

$$\max_{K^d_{xt},L^d_{xt}} \mathrm{P}_{xt}(1\text{-}\tau_x)\mathrm{F}(\mathrm{K}^d_{xt},L^d_{xt}) - r_{x_t}\mathrm{K}^d_{xt} - w_{xt}\mathrm{L}^d_{xt}$$

The non tradable sector faces a similar problem but there are not taxes in this sector. Hence we have:

$$\max_{K^d_{nt},L^d_{nt}} \mathrm{P}_{nt}\mathrm{H}(\mathrm{K}^d_{nt},L^d_{nt}) - r_{n_t}\mathrm{K}^d_{nt} - w_{nt}\mathrm{L}^d_{nt}$$

2.3. The government

The government taxes the tradable sector as explained above. The revenues are completely spent on non tradable goods. Those non tradable goods are however not given back to the individual[2]. In that case the government budget constraint is:

$$P_{xt}\tau_x Y_{xt} + P_{mt}\tau_m(c_{mt} + b_{mt}) = P_{nt}G_{nt} \tag{5}$$

Where G_{nt} is government consumption of non tradable goods at time t and Y_{xt} =F(K_{xt},L_{xt}).

2.4. The determinants of real exchange rate

It is possible to characterize the evolution of relative prices that determines consumption in this economy. We require first, the conditions that clear the markets. The market clearing condition of the non tradable goods is:

$$Y_{nt} = H(K_{nt}, L_{nt}) = C_{nt} + I_{nt} + G_{nt} \tag{6}$$

Where Y_{nt} is the total output on the non tradable sector. We can also obtain a condition for the tradable sector also. In fact, using our using the national account identity, we have[3]:

[2]We may think on them as consume by governement bureaucrats.

[3]The condition can be obtained by using the budget constraint of the individuals' problem, replacing the government budget constraint, the firms' first order condition and using the fact that the production functions are constant returns to scale.

$$TB_t = -CA_t = P_{xt}Y_{xt} - P_{mt}C_{mt} = GNP_t - (PC_t + P_{nt}I_{nt} + P_{nt}G_{nt}) \qquad (7)$$

Where GNP_t is nominal GNP at time t while TB_t, CA_t and PC_t are trade balance, current account balance and nominal private consumption at time t[4].

The characterization of the determinants of the RER is next. Using equations (2), (6) and (7), plus some steps of algebra and the fact that Ln(1+x)≈ x, we finally get:

$$\begin{aligned} ln(\frac{\widetilde{P_{mt}}}{P_{nt}}) &= \beta_0 - \beta_1 \ln(\frac{P_{xt}}{P_{mt}}) - \beta_1 \ln(\frac{Y_{xt}}{Y_{nt}}) - \beta_{2t}(\frac{CA_t}{GNP_t}) - \beta_{3t}(\frac{P_{nt}(G_{nt}+I_{nt})}{GNP_t}) \qquad (8) \\ Where\ \beta_0 &= \ln(\frac{1-\alpha}{\alpha}), \beta_1 = (\rho+1), \beta_{2t} = [\frac{(\rho+1)}{(\frac{P_{xt}Y_{xt}}{GNP_t})}]\ and\ \beta_{3t} = [\frac{(\rho+1)}{(\frac{P_{nt}Y_{nt}}{GNP_t})}] \end{aligned}$$

Equation 8 presents some interesting results about the evolution of the relative prices (RER). First, there are four main variables that have influence on RER. The first one is terms of trade -$\frac{P_{xt}}{P_{mt}}$– which has as elasticity the inverse of the elasticity of substitution. Larger terms of trade produce a positive income effect over the individual's budget constraint that increase demand both for traded and non traded goods. Since the individual faces the prices of the traded goods but prices of non tradable goods are endogenous to the system, there is a direct negative effect over RER. The same argument follows for the variable $\frac{Y_{xt}}{Y_{nt}}$. This variable is similar to the "Harrod-Balassa-Samuelson" effect on the international trade theory. Larger output on the tradable sector, holding constant non tradable output, produces a positive income effect. Notice that elasticity of substitution matters. In fact larger elasticity of substitution is associated with smaller effects on real exchange rate as facing larger non tradable prices, due to increases on demand, the individual substitutes away from non tradable goods.

The third variable influencing RER -$\frac{CA_t}{GNP_t}$– is the traditional "Salter" effect which in this case is written as a function of capital flows. Notice that the effect of larger capital flows affects negatively the RER but the effect depends on the elasticity of substitution and on the size of the exportable sector. The larger is the tradable sector, the smaller will be the non tradable sector and hence larger changes on P_{nt} will be required to accommodate increases on demand. Hence, the effect of capital flows relates to the composition of production between

[4]There are two additional markets that must clear, namely the capital and the labor market. Those conditions are used when solving the firms' problem and they are $k_t+b_t=k_{xt}+k_{nt}+b_{xt}+b_{nt}=K^d_{xt}+K^d_{nt}$ and $L=L_{xt}+L_{nt}=L^d_{xt}+L^d_{nt}$.

sectors. The fourth variable -$\frac{P_{nt}(G_{nt}+I_{nt})}{GNP_t}$– relates to the additional effect of government expenditure and investement on RER. A similar case was stressed before by Rodriguez (1989). This variable has a different and additional effect to the "Salter" effect, since this type of expenditure is relatively more intensive on non tradable goods. Notice that the elasticity depends on the elasticity of substitution as usual but also on the size of the non tradable sector. In fact, given some increase on the level of expenditure on the non tradable sector, the larger is the non tradable sector, the smaller should be the effect of the increase on demand. Hence, this last effect relates to the effect of expenditure within the non tradable sector.

Finally, notice that taxes on the tradable sector do not appear on our above equation. However, there is an effect. From the firms' problem we may determine some implicit demand functions for capital and labor. In the case of the exportable sector, they are $K^d_{xt} = K^d_{xt}(P_{xt}, w_{xt}, r_{xt}, \tau_x)$ and $L^d_{xt} = L^d_{xt}(P_{xt}, w_{xt}, r_{xt}, \tau_x)$. Simply comparative statics shows that $\frac{\partial K^d_{xt}}{\partial \tau_x}, \frac{\partial L^d_{xt}}{\partial \tau_x} \leq 0$[5]. Hence, larger tradable taxes decrease the size of the tradable sector. This last result shows that countries with more restrictions on the tradable sector must have larger fluctuation of their RER due to capital flows.

3. Conclusion

This paper develops a simple competitive equilibrium model that summarizes the effects of different theories of RER determination. The main finding of the model is that highly protected countries will face large variations on their RER for a given level of capital flows.

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[5] $\frac{\partial K_{xt}}{\partial \tau_x} = \frac{P_x^2(1-\tau_x)[F_k F_{LL} - F_L F_{KL}]}{F_{KK}F_{LL}-(F_{LK})^2} < 0$, $\frac{\partial L_{xt}}{\partial \tau_x} = \frac{P_x^2(1-\tau_x)[F_L F_{KK} - F_K F_{LK}]}{F_{KK}F_{LL}-(F_{LK})^2} < 0$

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