Appendix A. The Model Economies (for online publication)

The framework is a two region open economy DSGE model where both regions are large and they are linked through the trade of goods and risk-free bonds. In this appendix I describe the agents in the economy and their optimization problems, and then I derive the corresponding first order conditions for only the domestic economy. I do this for brevity since the foreign economy is symmetrically modelled and it has the same agents who face similar constraints.

A.1. Households

The economy is populated by a continuum of households with infinite lives. In each period, the households, indexed by *j*, decide how much labor to supply and how much to save and consume by maximizing the following life-time utility function:

$$U_t(j) = E_0 \sum_{t=0}^{\infty} \widetilde{\beta}^t \frac{\varepsilon_{c,t}}{1-\sigma}\left[\left(C_t(j) - \lambda C_{t-1}(j)\right)\exp\left(-\xi \frac{L_t(j)^{1+\sigma_l}}{1+\sigma_l}\right)\right]^{1-\sigma} N_t \tag{A.1}$$

Here the variables $C_t(j)$ and $L_t(j)$ denote consumption and labor supply and σ and σ_l are the intertemporal elasticity of substitution and the inverse elasticity of labor supply, respectively. The utility of the consumers exhibits external habit persistence that is governed by the parameter λ, and ξ is a level parameter that is calibrated to ensure that the steady-state value of labor is equal to 1. $\widetilde{\beta}$ is the population growth rate adjusted time discount parameter. The variable $\varepsilon_{c,t}$ is a consumption shock that follows an AR(1) process given by $\varepsilon_{c,t} = \rho_c \varepsilon_{c,t-1} + \eta_{c,t}$ where ρ_c is the persistence parameter, and $\eta_{c,t}$ is the shock innovation which is distributed *i.i.d.* normal with mean 0 and standard deviation σ_c. For the remaining shocks in the model, I use a similar parameterization with different subscripts and I assume that they similarly follow an AR(1) process. The mass of the households is represented by N_t and it grows at the rate of η. In maximizing their utility function, the households face the following budget constraint:

$$N_t C_t(j) + \frac{D_t(j)}{P_t} + \frac{B_{h,t}(j)}{R_t P_t} + E_t \frac{B_{f,t}(j)}{\varepsilon_{d,t} R_t^* P_t} + \frac{T_t}{P_t} \le \frac{W_t(j)}{P_t} N_t L_t(j) + \frac{B_{h,t-1}(j)}{P_t} + E_t \frac{B_{f,t-1}(j)}{\varepsilon_{d,t} P_t}$$
$$R_t^d \frac{D_{t-1}(j)}{P_t} + \Pi_{h,t} + \Pi_{f,t} + \frac{\kappa_w}{2}\left(\frac{W_t(j)/W_{t-1}(j)}{\gamma \pi_{t-1}^{\iota_w} \pi^{1-\iota_w}} - 1\right)^2 \frac{W_t}{P_t} N_t L_t \tag{A.2}$$

where P_t is the aggregate price level, W_t and $W_t(j)$ are the aggregate wage rate and the wage rate received by household *j*, respectively and E_t is the exchange rate quoted as national currency per US Dollar. Besides their final goods consumption, the households hold one period nominally denominated domestic and foreign bonds, $B_{h,t}(j)$ and $B_{f,t}(j)$, that pay interest at the rate of R_t and R_t^* -- also the central bank policy rates in the two economies --, make bank deposits, D_t, that pay interest at the rate of R_t^d, and pay lump-sum taxes, T_t, to the government. These expenditures are financed by their labor income, returns from previous period's bond holdings and deposits, and profits, $\Pi_{h,t}$ and $\Pi_{f,t}$ collected from domestic firms and importers (I describe these firms below). To include wage-stickiness in the model, I assume, similar to the formulation in Rotemberg (1982), that households incur quadratic wage adjustment costs given by the last term on the right hand side. In this expression, the level parameter κ_w is given by $\kappa_w = (1-\xi_w)(1-\xi_w\widetilde{\beta})/6\xi_w$ with ξ_w denoting the probability that wages are not adjusted in a given period, ι_w is the wage indexation parameter, γ is the economy's steady state per-capita growth rate, and π_t is the inflation rate,

P_t / P_{t-1}.[1] The variable $\varepsilon_{d,t}$ is a domestic currency depreciation shock that can also be interpreted as a shock to the risk of holding domestic bonds.

The households have a monopoly over their labor supply, $L_t(j)$, and their services are hired by a perfectly competitive labor intermediary that transforms them into a composite labor service, L_t, according to the following Dixit and Stiglitz (1977) aggregator,

$$L_t = \left[\int_0^1 L_t(j)^{\frac{\Theta_{L,t}}{\Theta_{L,t}-1}} dj \right]^{\frac{\Theta_{L,t}-1}{\Theta_{L,t}}} \tag{A.3}$$

and maximizes, $W_t L_t - \int_0^1 W_t(j) L_t(j) dj$. This maximization problem generates the following labor demand curve:

$$L_t(j) = \left[\frac{W_t(j)}{W_t} \right]^{-\Theta_{L,t}} L_t \quad . \tag{A.4}$$

where $\Theta_{L,t}$ regulates the elasticity of substitution between the different labor services. To include cost push shocks that operate through wages, I assume that the time varying mark-up variable, $\varepsilon_{w,t} = \dfrac{\Theta_{L,t}}{\Theta_{L,t} - 1}$, is governed by the following AR(1) process:

$$\log \varepsilon_{w,t} = (1 - \rho_w) \log \phi_w + \rho_w \log \varepsilon_{w,t-1} + \eta_{w,t} \tag{A.5}$$

where ϕ_w is the gross mark-up of real wages over the marginal rate of substitution between consumption and leisure.

[1] The number 6 in the denominator of the expression for κ_w is from the Kimball aggregator function in Smets and Wouters (2007).

A.2. Producers of Intermediate, Final and Capital Goods, and the Importers

Intermediate goods producers, indexed by *i*, are monopolistically competitive and they combine capital and labor to produce output according to the following Cobb-Douglas function:

$$Y_t(i) = \varepsilon_{a,t}\left[Z_t(i)K_t(i)\right]^{\alpha}\left[A_t N_t L_t(i)\right]^{1-\alpha} - (\eta\gamma)^t f \qquad \text{(A.6)}$$

where $\varepsilon_{a,t}$ is an aggregate productivity shock, $Y_t(i)$, $K_t(i)$, $L_t(i)$ and $Z_t(i)$ are the firm-specific output, capital, labor and the capital utilization rate, A_t is the trend level of productivity that grows at the rate of γ and f is the fixed cost of production that grows at the rate of $\eta\gamma$, the balanced growth rate of output.[2]

The capital hired by intermediate goods producers evolves according to the following function:

$$K_t(i) = (1-\delta)K_{t-1}(i) + \left[1 - \frac{\varphi}{2}\left(\frac{I_t(i)}{\eta\gamma I_{t-1}(i)} - 1\right)^2\right]\varepsilon_{i,t} I_t(i) \qquad \text{(A.7)}$$

where φ regulates investment adjustment costs, $I_t(i)$ denotes the amount of firm-specific investment and $\varepsilon_{i,t}$ is an investment-specific technology shock.

Capital is produced by perfectly competitive firms that convert undepreciated capital and final goods into new capital. In doing so, they purchase undepreciated capital from entrepreneurs -- the capital owners in the model -- at the price of Q_t and final goods (investment) from final

[2] The parameter *f* is set equal to $(\theta - 1)Y_t / (\eta\gamma)^t$. This condition ensures that the intermediate goods producers' profits are equal to zero along the balanced growth path.

goods producers at the price of $P_{i,t}$, and they sell the new capital to entrepreneurs again at a price of Q_t. Their life-time profits are given by,

$$E_t \sum_{t=0}^{\infty} \widetilde{\beta}^t \Lambda_t \left[Q_t K_t - Q_t (1-\delta) K_{t-1} - \frac{P_{i,t}}{P_t} I_t \right] \tag{A.8}$$

The stochastic discount factor, Λ_t, is identical to the Lagrange multiplier corresponding to the households' budget constraint and it is given by,

$$\Lambda_t = \frac{\varepsilon_{c,t}}{N_t} (C_t - \lambda C_{t-1})^{-\sigma} \exp\left(\frac{\sigma - 1}{1 + \sigma_l} \xi L_t^{1+\sigma_l} \right) \tag{A.9}$$

Intermediate goods producers sell their products to perfectly-competitive final goods producers who combine the intermediate goods to form the final good, Y_t, as follows:

$$Y_t = \left(\int_0^1 Y_t(i)^{\left(\frac{\Theta_{h,t}-1}{\Theta_{h,t}}\right)} di \right)^{\frac{\Theta_{h,t}}{\Theta_{h,t}-1}} \tag{A.10}$$

The cost minimization problem of the final goods producers then yields the following firm-specific demand curve:

$$Y_t(i) = \left(\frac{P_t(i)}{P_t} \right)^{-\Theta_{h,t}} Y_t \tag{A.11}$$

Here $\Theta_{h,t}$ is the time-varying mark-up parameter which is subject to a cost-push shock according to the following process:

$$\log \varepsilon_{h,t} = (1 - \rho_h) \log \phi_p + \rho_h \log \varepsilon_{h,t-1} + \eta_{h,t} \tag{A.12}$$

where $\varepsilon_{h,t} = \Theta_{h,t} / (\Theta_{h,t} - 1)$ and ϕ_p is the steady state mark-up rate and $\eta_{h,t}$ is the cost push shock that follows an AR(1) process.

Given the demand function for their goods, the intermediate goods producers choose the price of their goods, $P_{h,t}(i)$, the amount of inputs and output that maximizes the following profit function:

$$\pi_t(i) = P_{h,t}(i) Y_t(i) - W_t N_t L_t(i) - \left[MPK_t - \frac{\kappa_z}{1+\varpi} \left(z_t(i)^{1+\varpi} - 1 \right) \right] K_t(i)$$
$$- \frac{\kappa_{ph}}{2} \left(\frac{P_{h,t}(i) / P_{h,t-1}(i)}{\pi_{h,t-1}^{\iota_h} \pi^{1-\iota_h}} - 1 \right)^2 \frac{P_{h,t}}{P_t} Y_t \qquad \text{(A.13)}$$

where MPK_t is the marginal product of capital (and also its rental rate). The formulation in equation (12) adds two frictions to the model. These frictions are added to enhance the model's ability to account for the empirical persistence in inflation through marginal cost and price stickiness. The first friction is generated by time-varying capacity utilization ratio, $z_t(i)$, and the costs incurred by adjusting this ratio and κ_z and ϖ capture the fixed costs and the elasticity of the cost of adjusting capacity utilization, respectively. The second friction is caused by the quadratic costs incurred by intermediate goods producers when the increase in their prices deviates from past inflation. Here, $\kappa_{ph} = (1 - \xi_h)(1 - \xi_h \widetilde{\beta}) / 3.5 \xi_h$ is the fixed costs parameter with ξ_h similarly denoting the probability that domestic goods prices are not adjusted during the current period and ι_h is the Calvo parameter that regulates the indexation to past inflation.

The importers in the economy are similar to the intermediate goods producers. They are monopolistically competitive, their products are combined to form a final good by perfectly competitive firms and they face costs of deviating from past inflation. Unlike intermediate goods producers, however, they do not produce. They purchase their goods from abroad, in foreign currency, differentiate their goods and sell them at a mark-up in the domestic market. The demand for imported goods, $Y_{f,t}(k)$ for importer *k*, is given by

$$Y_{f,t}(k)=\left(\frac{P_{f,t}(k)}{P_{f,t}}\right)^{-\Theta_{f,t}}Y_{f,t} \tag{A.14}$$

where $P_{f,t}(k)$ and $P_{f,t}$ are the firm-specific and the aggregate price of imports, $Y_{f,t}$ is the aggregate amount of imports, and the time-varying mark-up parameter, $\Theta_{f,t}$, is similarly subject to cost-push shocks according to:

$$\log\varepsilon_{f,t}=(1-\rho_f)\log\phi_f+\rho_f\log\varepsilon_{f,t-1}+\eta_{f,t} \tag{A.15}$$

where $\varepsilon_{f,t}=\Theta_{f,t}/(\Theta_{f,t}-1)$ and ϕ_f and $\eta_{f,t}$ represent the steady state mark-up rate and a cost push shock that follows an AR(1) process.

The importers choose their prices and the amount of imports to maximize their life-time profits:

$$E_t\sum_{t=0}^{\infty}\Lambda_t\left[\left(P_{f,t}(k)-E_tP_{h,t}^{*}\right)Y_{f,t}(k)-\frac{\kappa_{pf}}{2}\left(\frac{P_{f,t}(k)/P_{f,t-1}(k)}{\pi_{f,t}^{\iota_f}\pi_f^{1-\iota_f}}-1\right)^2P_{f,t}Y_{f,t}\right] \tag{A.16}$$

where $\kappa_{pf}=(1-\xi_f)(1-\xi_f\tilde{\beta})/6\xi_f$ with ξ similarly denoting the probability that import prices are not adjusted, ι_f is the indexation parameter, respectively, and $\pi_{f,t}$ is the inflation rate for imported goods.

A.3. Financial Market

The financial market in the economy operates through a single risk-neutral bank that lends, in nominal terms, to the entire population of entrepreneurs (mass of 1). The entrepreneurs are also risk neutral, and they collect the returns from capital and pay back their loans, B_t, with interest. Besides bank loans, the entrepreneurs finance their expenditures internally by using their net worth, N_t, so that $Q_t K_t = N_t + B_t$. In each period their returns to capital, $R_{k,t}(m)$ for entrepreneur *m*, is subject to an idiosyncratic shock, $w_t(m)$, so that $R_{k,t}(m) = w_t(m) R_{k,t}$, where $R_{k,t}$ is the aggregate returns to capital. w_t is lognormally distributed with standard deviation $\sigma_{w,t}$ and mean $\mu_{w,t} = \sigma^2_{w,t}$ and its cumulative distribution is denoted by $F(w)$. Given this shock, the bank's participation condition for its contract with entrepreneur *m* is given by,

$$[1 - F(\overline{w}_{t+1}(m))] R_{e,t+1}(m) B_t(m) + (1-\mu) \int_0^{\overline{w}_{t+1}(m)} w_{t+1} dF(w) P_{t+1} R_{k,t+1} Q_t K_t(m) = R_{d,t} B_t(m) \qquad \text{(A.17)}$$

where $B_t(m)$ and $R_{e,t}(m)$ denote the amount of loans extended to entrepreneur *m* and the interest rate on these loans, and $\overline{w}_t(m)$ is the cutoff value of the idiosyncratic shock below which entrepreneur *m* defaults on her loan. If there is default the bank seizes the entrepreneur's assets and pays monitoring costs, μ per unit of assets. These costs are the source of financial friction in the model. The funds recovered by the bank in case of default are given by the second term on the right hand side of equation (16). The cutoff value of the technology shock is defined as,

$$\overline{w}_t(m) P_{t+1} R_{k,t+1} Q_t K_t(m) = R_{e,t+1}(m) B_t(m) \qquad \text{(A.18)}$$

where the aggregate returns to capital is defined as,

$$R_{k,t} = \frac{(1-\delta) Q_t + MPK_t}{Q_{t-1}} \qquad \text{(A.19)}$$

Notice here that the bank, by lending to the entire population of entrepreneurs, is able to diversify the idiosyncratic risk and receive the deposit rate of return. In doing so, it sets lending rates, $R_{e,t}$ above the deposit rate to compensate for the costs incurred when monitoring bad loans.

Given the financial contract the entrepreneur *m*'s net worth, $N_t(m)$ evolves according to:

$$N_t(m) = \gamma_{e,t}\left[1 - F(\overline{w}_t(m))\right]\left[R_{k,t}(m)Q_{t-1}K_{t-1}(m) - R_{e,t}(m)(Q_{t-1}K_{t-1}(m) - N_{t-1}(m))\right] + (1 - \gamma_{e,t}) \quad \text{(A.20)}$$

where $\gamma_{e,t}$ is the survival rate of entrepreneurs that is set to a number less than one to ensure that the entrepreneurs do not accumulate enough net worth to become self-financing. If the entrepreneur dies, it is replaced by a new entrepreneur who begins with a unit of net worth that is obtained from households.

In the financial market there are two types of shocks. The first shock, denoted by $\varepsilon_{k,t}$, is transmitted to the economy through returns to capital and it is modelled as a shock (following an AR(1) process) to the standard deviation of w_t as follows:

$$\log \sigma_{w,t} = (1 - \rho_k)\sigma_w + \rho_k \log \sigma_{w,t-1} + \varepsilon_{k,t} \quad \text{(A.21)}$$

The second shock, denoted by $\varepsilon_{n,t}$, is transmitted through entrepreneurs' net worth by impacting their survival rate. The process governing this impact is similar to that in equation (21).

A.4. Monetary Policy and Fiscal Balance

The monetary policy in the economy is formulated according to the following Taylor-rule:

$$R_t = \rho R_{t-1} + (1 - \rho)\left(\log R + \gamma_\pi \log \frac{\pi_t}{\pi} + \gamma_y \log \frac{Y_t}{(\gamma\eta)^t Y} + \gamma_{\Delta y} \log \frac{Y_t}{\gamma\eta Y_{t-1}}\right) + \varepsilon_{r,t} \quad \text{(A.22)}$$

where γ_π, γ_y and $\gamma_{\Delta y}$ are the relative weights of inflation, output gap and output growth, R is the steady state level of the nominal policy rate, ρ is the interest rate smoothing parameter, and the policy shock variable, $\varepsilon_{r,t}$, similarly follows an AR(1) process.

The government finances its real expenditures, G_t, and debt payments by collecting lump-sum taxes from households and issuing new discount bonds:

$$P_t G_t + B_{h,t-1} + B^*_{f,t-1} = T_t + \frac{B_{h,t}}{R_t} + \frac{B^*_{f,t}}{R_t} \tag{A.23}$$

where $B^*_{f,t}$ is the amount of domestic government bonds held by foreign households.

A.5. Composite Goods and Market Clearing Conditions

Consumption and investment goods are the following CES aggregates of domestic and foreign goods, $C_{h,t}$ and $C_{f,t}$ for consumption goods and $I_{h,t}$ and $I_{f,t}$ for investment goods,

$$C_t = \left(\gamma_c^{1/\lambda_c} C_{h,t}^{(\lambda_c-1)/\lambda_c} + (1-\gamma_c)^{1/\lambda_c} C_{f,t}^{(\lambda_c-1)/\lambda_c}\right)^{\lambda_c/(\lambda_c-1)} \tag{A.24}$$

$$I_t = \left(\gamma_i^{1/\lambda_i} I_{h,t}^{(\lambda_i-1)/\lambda_i} + (1-\gamma_i)^{1/\lambda_i} I_{f,t}^{(\lambda_i-1)/\lambda_i}\right)^{\lambda_i/(\lambda_i-1)} \tag{A.25}$$

where γ_c and γ_i are the share of domestic goods in aggregate consumption and investment, respectively, and λ_c and λ_i determine the elasticity of substitution between home and foreign goods in the consumption and investment aggregators, respectively. The demand functions for home and foreign goods and the aggregate price indices that correspond to equations (24) and (25) are given by,

$$C_{h,t} = \left(\frac{P_{h,t}}{P_t}\right)^{-\lambda_c} \gamma_c C_t \quad \text{and} \quad C_{f,t} = \left(\frac{P_{f,t}}{P_t}\right)^{-\lambda_c} (1-\gamma_c) C_t \tag{A.26}$$

$$I_{h,t} = \left(\frac{P_{h,t}}{P_{i,t}}\right)^{-\lambda_i} \gamma_i I_t \quad \text{and} \quad I_{f,t} = \left(\frac{P_{f,t}}{P_{i,t}}\right)^{-\lambda_i} (1-\gamma_i) I_t \tag{A.27}$$

$$P_t = \left(\gamma_c P_{h,t}^{1-\lambda_c} + (1-\gamma_c) P_{f,t}^{1-\lambda_c}\right)^{1/(1-\lambda_c)} \tag{A.28}$$

$$P_{i,t} = \left(\gamma_i P_{h,t}^{1-\lambda_i} + (1-\gamma_i) P_{f,t}^{1-\lambda_i}\right)^{1/(1-\lambda_i)} \tag{A.29}$$

The production of each economy equals the sum of home goods consumption and investment expenditures, government expenditures and the foreign economy's imports of consumption and investment goods,

$$Y_t = N_t C_{h,t} + I_{h,t} + G_t + N_t^* C_{f,t}^* + I_{f,t}^*$$

where the foreign imports, $Y_{f,t}$, are only used for consumption and investment so that,

$$Y_{f,t} = N_t C_{f,t} + I_{f,t} \tag{A.30}$$

Bank loans in each economy are financed by the deposits of local households so that,

$$B_t = D_t \tag{A.31}$$

A.6. Optimality Conditions

The maximization of the households' utility function with respect to deposit holdings yields the following conventional Euler condition:

$$E_t\left[\widetilde{\beta} \frac{\Lambda_{t+1}}{\Lambda_t} \frac{R_t^d}{\pi_{t+1}}\right] = 1 \tag{A.32}$$

where the Lagrange multiplier Λ_t measures the marginal utility and the marginal budget costs of consumption. There is arbitrage between deposit rates and domestic bond holdings so that,

$R_t = R_t^d$, and the arbitrage between the domestic and foreign bond is represented by the following uncovered interest parity condition:

$$E_t\left[\tilde{\beta}\frac{\Lambda_{t+1}}{\Lambda_t\pi_{t+1}}\left(R_t - \varepsilon_{d,t}\frac{E_{t+1}}{E_t}R_t^*\right)\right] = 0 \tag{A.33}$$

Labor supply decisions and wage setting behavior are governed by the following optimality conditions:

$$\varepsilon_{c,t}\left[(C_t - \lambda C_{t-1})\exp\left(-\xi\frac{L_t^{1+\sigma_l}}{1+\sigma_l}\right)\right]^{1-\sigma}\xi L_t^{\sigma_l} = \Lambda_t\Omega_t\frac{W_t}{P_t} \tag{A.34}$$

$$\begin{aligned}\left(\frac{\pi_{w,t}}{\gamma\pi_{t-1}^{\iota_w}\pi^{1-\iota_w}} - 1\right)\frac{\pi_{w,t}}{\gamma\pi_{t-1}^{\iota_w}\pi^{1-\iota_w}} = E_t\left[\left(\tilde{\beta}\frac{\Lambda_{t+1}}{\Lambda_t}\right)\left(\frac{\pi_{w,t+1}}{\gamma\pi_t^{\iota_w}\pi^{1-\iota_w}} - 1\right)\frac{\pi_{w,t+1}}{\gamma\pi_t^{\iota_w}\pi^{1-\iota_w}}\frac{\pi_{w,t+1}}{\pi_{t+1}}\frac{N_{t+1}}{N_t}\frac{L_{t+1}}{L_t}\right] \\ + \Omega_t\frac{(\Theta_{L,t}-1)}{\kappa_w}\varepsilon_{w,t}\end{aligned} \tag{A.35}$$

where $\Omega_t = W_t(i)\left(\frac{L_t(i)}{L_t}\right)^{1/\Theta_{L,t}}$ is the Lagrange multiplier corresponding to the labor intermediaries budget constraint.

The optimization problem of the bank, as in Bernanke et al. (1999) and Fernandez-Villaverde (2010), produces a relationship between entrepreneurs' leverage and their borrowing premium:

$$\frac{Q_t K_t}{N_t} = \nu_E\left(\frac{E_t\pi_{t+1}R_{k,t+1}}{R_{d,t}}\right) \tag{A.36}$$

where an increase leverage causes the wedge between the borrowing rate and the deposit rate to grow.

The intermediate goods producers maximize profits subject to the final goods producers' demand for their goods. Profit maximization with respect to labor, capital and the utilization rate generates the following conditions:

$$\Omega_{h,t} P_{h,t} (1-\alpha)\left(Y_t + (\eta\gamma)^t f\right) = W_t L_t \tag{A.37}$$

$$\Omega_{h,t} \frac{P_{h,t}}{P_t} \alpha \left(\frac{Y_t + (\eta\gamma)^t f}{K_t} \right) = MPK_t + \frac{\kappa_z}{1+\varpi}\left(Z_t^{1+\varpi} - 1\right) \tag{A.38}$$

$$\Omega_{h,t} \frac{P_{h,t}}{P_t} \alpha \left(\frac{Y_t + (\eta\gamma)^t f}{K_t} \right) = \kappa_z Z_t^{1+\varpi} \tag{A.39}$$

where $\Omega_{h,t}$ is the Lagrange multiplier corresponding to the final goods producers budget constraint.

Price setting behavior of the intermediate goods producers and the imports are given by the following equations that demonstrate rigidity similar to equation (35):

$$\left(\frac{\pi_{h,t}}{\pi_{t-1}^{\iota_h} \pi^{1-\iota_h}} - 1 \right) \frac{\pi_{h,t}}{\pi_{t-1}^{\iota_h} \pi^{1-\iota_h}} = E_t \left[\left(\tilde{\beta} \frac{\Lambda_{t+1}}{\Lambda_t} \right) \left(\frac{\pi_{h,t+1}}{\pi_t^{\iota_h} \pi^{1-\iota_h}} - 1 \right) \frac{\pi_{h,t+1}}{\pi_t^{\iota_h} \pi^{1-\iota_h}} \frac{Y_{t+1}}{Y_t} \right] + \Omega_{h,t} \frac{\left(\Theta_{h,t} - 1\right)}{\kappa_{ph}} \varepsilon_{h,t} \tag{A.40}$$

$$\begin{aligned} \left(\frac{\pi_{f,t}}{\pi_{f,t-1}^{\iota_f} \pi^{1-\iota_f}} - 1 \right) \frac{\pi_{f,t}}{\pi_{f,t-1}^{\iota_f} \pi^{1-\iota_f}} = E_t &\left[\left(\beta \frac{\Lambda_{t+1}}{\Lambda_t} \right) \left(\frac{\pi_{f,t+1}}{\pi_{f,t}^{\iota_f} \pi^{1-\iota_f}} - 1 \right) \frac{\pi_{f,t+1}}{\pi_{f,t}^{\iota_f} \pi^{1-\iota_f}} \frac{\pi_{f,t+1}}{\pi_{t+1}} \frac{Y_{f,t+1}}{Y_{t+1}} \right] \\ &+ \frac{\left(\Theta_{f,t} - 1\right) e_t P_{h,t}^*}{\kappa_{pf} P_{f,t}} \varepsilon_{f,t} \end{aligned} \tag{A.41}$$

where $\pi_{f,t} = P_{f,t} / P_{f,t-1}$ denotes import price inflation.

Capital producers' maximization of their life-time profits with respect to investment goods produces the following condition:

$$q_t\varepsilon_{i,t}\left(1-\varphi\left(\frac{I_t}{\eta\gamma I_{t-1}}-1\right)\frac{I_t}{\eta\gamma I_{t-1}}-\frac{\varphi}{2}\left(\frac{I_t}{\eta\gamma I_{t-1}}-1\right)^2\right)+E_t\left[\frac{\beta\varphi\Lambda_{t+1}}{\Lambda_t}q_{t+1}\varepsilon_{i,t+1}\left(\frac{I_{t+1}}{\eta\gamma I_t}-1\right)\frac{I_{t+1}^2}{\eta\gamma I_t^2}\right]=\frac{P_{i,t}}{P_t} \quad \text{(A.42)}$$

A.7. The log-linearized model

In this Appendix I report the log-linearized equations of the model. The variables in these equations, denoted by lower case letters, represent deviations from steady state values and variables without time subscripts represent the steady state values. The equations that form the model can be classified under four general categories.

Demand for domestic and foreign consumption and investment goods:

$$c_t=\frac{\lambda/\gamma}{1+\lambda/\gamma}c_{t-1}+\frac{1}{1+\lambda/\gamma}E_tc_{t+1}+\frac{(1-\lambda/\gamma)}{\sigma(1+\lambda/\gamma)}\left[(\sigma-1)\xi(l_t-E_tl_{t+1})-(r_t-E_t\pi_{t+1})\right]+\varepsilon_{c,t} \quad \text{(A.43)}$$

$$c_t=\gamma_c c_{h,t}+(1-\gamma_c)c_{f,t} \quad \text{(A.44)}$$

$$c_{h,t}-c_{f,t}=\lambda_c\left(p_{f,t}-p_{h,t}\right) \quad \text{(A.45)}$$

$$i_t=\frac{1}{1+\widetilde{\beta}}i_{t-1}+\frac{\widetilde{\beta}}{1+\widetilde{\beta}}E_ti_{t+1}+\frac{1}{(1+\widetilde{\beta})\varphi}(q_t-p_{i,t})+\varepsilon_{i,t} \quad \text{(A.46)}$$

$$i_t=\gamma_i i_{h,t}+(1-\gamma_i)i_{f,t} \quad \text{(A.47)}$$

$$i_{h,t}-i_{f,t}=\lambda_i\left(p_{f,t}-p_{h,t}\right) \quad \text{(A.48)}$$

Domestic and foreign goods price and wage inflation:

$$\pi_t=\gamma_c\pi_{h,t}+(1-\gamma_c)\pi_{f,t} \quad \text{(A.49)}$$

$$p_{i,t}=\gamma_i p_{h,t}+(1-\gamma_i)p_{f,t} \quad \text{(A.50)}$$

$$\pi_{w,t}-\iota_w\pi_{t-1}=\widetilde{\beta}\left(E_t\pi_{w,t+1}-\iota_w\pi_t\right)-\frac{(1-\xi_w)(1-\xi_w\widetilde{\beta})}{6\xi_w}\left\{w_t-\left[\sigma_l l_t+\frac{1}{1-\lambda/\gamma}\left(c_t-\frac{\lambda}{\gamma}c_{t-1}\right)\right]\right\}+\varepsilon_{w,t} \quad \text{(A.51)}$$

$$\pi_{w,t} = w_t - w_{t-1} + \pi_t \tag{A.52}$$

$$\pi_{h,t} = \frac{\iota_h}{1+\iota_h\widetilde{\beta}}\pi_{h,t-1} + \frac{\widetilde{\beta}}{1+\iota_h\widetilde{\beta}}\pi_{h,t+1} - \frac{(1-\xi_h)(1-\xi_h\widetilde{\beta})}{3.5\xi_h(1+\iota_h\widetilde{\beta})}\left[p_{h,t} + \varepsilon_{a,t} + \alpha(z_t + k_t - l_t) - w_t\right] + \varepsilon_{h,t} \tag{A.53}$$

$$\pi_{h,t} - \pi_t = p_{h,t} - p_{h,t-1} \tag{A.54}$$

$$\pi_{f,t} = \frac{\iota_f}{1+\iota_f\widetilde{\beta}}\pi_{f,t-1} + \frac{\widetilde{\beta}}{1+\iota_f\widetilde{\beta}}\pi_{f,t+1} - \frac{(1-\xi_f)(1-\xi_f\widetilde{\beta})}{3.5\xi_f(1+\iota_f\widetilde{\beta})}\left(p_{f,t} - rer_t - p^*_{h,t}\right) + \varepsilon_{f,t} \tag{A.55}$$

Production and market clearing:

$$y_t = \phi_p\left[\varepsilon_{a,t} + \alpha(z_t + k_t) + (1-\alpha)l_t\right] \tag{A.56}$$

$$mpk_t = -(z_t + k_t - l_t) + w_t \tag{A.57}$$

$$z_t = \frac{1}{\varpi}mpk_t, \tag{A.58}$$

$$k_t = ((1-\delta)/\eta\gamma)k_{t-1} + (1-(1-\delta)/\eta\gamma)(i_t + (1+\widetilde{\beta})\varphi\varepsilon_{i,t}), \tag{A.59}$$

$$r_{k,t} = ((1-\delta)\widetilde{\beta}/\eta\gamma)q_t + (1-(1-\delta)\widetilde{\beta}/\eta\gamma)mpk_t - q_{t-1}. \tag{A.60}$$

$$y_t = \gamma_c\frac{C}{Y}c_{h,t} + \gamma_i\frac{I}{Y}i_{h,t} + \frac{G}{Y}g_t + (1-\gamma_c)\frac{C}{Y}c^*_{f,t} + (1-\gamma_i)\frac{I}{Y}i^*_{f,t} \tag{A.61}$$

The financial economy:

$$E_t r_{k,t+1} = r_t - E_t\pi_{t+1} + \chi(q_t + k_t - n_t) + \varepsilon_{k,t} \tag{A.62}$$

$$n_t = \frac{\gamma_e}{\gamma\eta}r_k\left(r_{k,t} + n_{t-1}\right) + \varepsilon_{n,t} \tag{A.63}$$

$$r_t = \rho r_{t-1} + (1-\rho)\left[r_\pi\pi_t + r_y y_t + r_{\Delta y}(y_t - y_{t-1})\right] + \varepsilon_{r,t} \tag{A.64}$$

$$rer_t - rer_{t-1} = d_t + \pi_t^* - \pi_t \tag{A.65}$$