Optimal Monetary Policy in a Small Open Economy

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EABCN Course

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- Baseline references

- Gali and Monacelli (Restud 2005)

- Faia-Monacelli (JMCB 2008)

- **Optimal Monetary Policy**

1. Ramsey approach (Chari, Christiano and Kehoe 1991, Adao et al. 2003 and Khan et al. 2003)

2. Monetary authority under commitment maximizes the **discounted sum of utility** of the representative agent under the constraints that characterize the competitive economy.

3. **Allocation problem**: the government chooses directly a feasible allocation subject to those constraints that summarize the **competitive equilibrium**.

- **Efficient Allocation**

1. Setup small open economy's social planner problem

2. Assume isoelastic preferences

$$U(C,N) = \frac{1}{1-\sigma}C^{1-\sigma} - \frac{1}{1+\zeta}N^{1+\zeta} \tag{1}$$

which entails $\left(-U_{cc,t}C_t/U_{c,t}\right) = \sigma$ and $\left(U_{nn,t}N_t/U_{n,t}\right) = \zeta$, where ζ and σ are both **constant**.

Social planner's problem:

$$Max_{\{C_t,\, S_t,\, N_t\}}$$

$$E_0 \sum_{t=0}^{\infty} \beta^t \left\{ \frac{1}{1-\sigma} C_t^{1-\sigma} - \frac{1}{1+\zeta} N_t^{1+\zeta} \right\}$$

$$+E_0 \sum_{t=0}^{\infty} \beta^t \varphi(h^t) \ \left(A_t F(N_t) - (1-\alpha) g(S_t)^{\eta} C_t \ - \ \alpha S_t^{\eta} C_t^* \right) \qquad \textbf{(mkt clearing)}$$

$$+E_0 \sum_{t=0}^{\infty} \beta^t \chi(h^t) \ \left(C_t - q(S_t)^{\frac{1}{\sigma}} C_t^* \right) \qquad \textbf{(risk-sharing)}$$

Substitute for C_t from RSH constraint $\longrightarrow$ first order conditions with respect to S_t and N_t yield

$$1 - \alpha = \varphi(h^t) C_t^{\sigma} g(S_t) H(S_t) \tag{2}$$

$$-N_t^{\zeta} + \varphi(h^t) A_t F_{n,t} = 0 \tag{3}$$

where

$$H(S_t) \equiv 1 - \alpha \left\{ 1 - \sigma \left[\eta q(S_t)^{\eta - \frac{1}{\sigma}} + (1-\alpha) \left(\eta - \frac{1}{\sigma} \right) q(S_t)^{1-\eta} \right] \right\}$$

Combine to yield

$$\left[\frac{H(S_t)}{(1-\alpha)}\right] g(S_t) C_t^{\sigma} N_t^{\zeta} = A_t F_{n,t}$$

- Notice: in **closed** economy

$$\alpha = 0$$

$$H(S_t) = g(S_t) = 1$$

Efficiency conditions combine to yield

$$\underbrace{C_t^{\sigma} N_t^{\zeta}}_{MRS_t} = \underbrace{A_t F_{n,t}}_{MPN_t} \tag{4}$$

- **Real marginal cost** (inverse markup) under the **efficient** allocation

$$\Phi_t = \left\{ \frac{1-\alpha}{H(S_t)} \right\} \equiv \Phi_t^e \tag{5}$$

- **Notice**

1. Marginal cost (inverse markup) must be **time-varying**

2. Idea: by resorting to variations in international relative prices (terms of trade and/or real exchange rate), the social planner can **improve upon the flexible-price allocation**, which requires a **constant** markup

3. General nature of **openness**: variations in relative prices can affect consumption *for any given level of output* (and therefore labor effort).

Notice: $\alpha \longrightarrow 0$ **closed** economy

$$H(S_t) = 1$$

$$g(S_t) \equiv \frac{P_t}{P_{H,t}} = 1$$

$$\Phi_t^e = 1$$

- Some intuition from **private sector** equilibrium (under flex. prices)

(i) Households

$$C_t^{\sigma} N_t^{\zeta} = \frac{W_t}{P_t}$$

(ii) Firms

$$A_t F_{n,t} = \frac{W_t}{P_{H,t}} = \frac{W_t}{P_t} g(S_t)$$

Notice: real product wage $W_t/P_{H,t}$ different from real consumption wage W_t/P_t

Combining

$$g(S_t)C_t^{\sigma}N_t^{\zeta} = A_t F_{n,t}$$

$\longrightarrow$Recall planner's condition

$$\left[\frac{H(S_t)}{(1-\alpha)}\right] g(S_t)C_t^{\sigma}N_t^{\zeta} = A_t F_{n,t}$$

- Implications

1. Flexible price allocation **not** efficient due to "open economy" factor $\left[\frac{H(S_t)}{(1-\alpha)}\right]$

2. To achieve first best it is not sufficient to minimize the distortion stemming from the presence of price stickiness

3. It is not the case that the flex price allocation is not feasible: it is just that the planner can **improve** upon that

- Notice

Open economy factor $\left[\frac{H(S_t)}{(1-\alpha)}\right] = 0$ in two cases

$$\alpha = 0 \quad \longrightarrow \quad \left[\frac{H(S_t)}{(1-\alpha)}\right] = 0 \quad \text{(closed economy)}$$

but also..

$$\sigma = \eta^{-1} \;\longrightarrow\; \left[\frac{H(S_t)}{(1-\alpha)}\right] = 0 \quad \text{(closed/open } \textbf{isomorphism}\text{)}$$

- **Constrained efficient (CE) allocation under pre-set prices**

- Sometimes called "Ramsey" allocation: differs from **social planner** (SP) allocation (1st best)

- Idea: max social welfare s.t. constraints that characterize private sector equilibrium $\rightarrow$ Choose "best competitive equilibrium"

- **Three constraints** from competitive equilibrium

1. Market clearing

2. Price setting (under pre-set prices)

3. Risk-sharing

Constrained-efficient allocation $\longrightarrow$ Lagrangian:

$$Max_{\{C_t,\ S_t,\ N_t\}}\ E_0 \sum_{t=0}^{\infty} \beta^t \left\{ \frac{1}{1-\sigma} C_t^{1-\sigma} - \frac{1}{1+\zeta} N_t^{1+\zeta} \right\}$$
$$+E_{-1} \sum_{t=0}^{\infty} \beta^t \lambda(h^{t-1}) \ \left\{ \frac{C_t^{-\sigma}}{g(S_t)} A_t F(N_t) \ - \mu N_t^{\zeta}\ \omega\left(N_t\right) \right\}$$
$$+E_0 \sum_{t=0}^{\infty} \beta^t \varphi(h^t) \ \left(A_t F(N_t) - (1-\alpha) g(S_t)^{\eta} C_t \ - \ \alpha S_t^{\eta} C_t^{*} \right)$$
$$+E_0 \sum_{t=0}^{\infty} \beta^t \chi(h^t) \ \left(C_t - q(S_t)^{\frac{1}{\sigma}} C_t^{*} \right)$$

- To simplify the analysis it is convenient to substitute for C_t from RSH constraint

- After defining $\omega_{n,t} \equiv \partial\omega(N_t)/\partial N_t$, FOCs with respect to S_t and N_t can be written:

$$1 - \alpha = \lambda(h^{t-1})\sigma K(S_t)g(S_t)^{1-\eta} + \ \varphi(h^t)C_t^{\sigma}g(S_t)H(S_t) \tag{6}$$

$$-N_t^{\zeta}+\lambda(h^{t-1})\left\{\frac{C_t^{*-\sigma}A_tF_{n,t}}{S_t} - \mu N_t^{\zeta}\left(\zeta\frac{\omega(N_t)}{N_t} + \omega_{n,t}\right)\right\}+\varphi(h^t)A_tF_{n,t} = 0 \tag{7}$$

- Under what conditions replicating a **constant-markup** allocation coincides with the constrained optimum?

- This corresponds to determining whether the planner problem can sustain the term $\Phi_t \equiv -\frac{U_{n,t}\ g(S_t)}{A_t F_{n,t} U_{c,t}} = \frac{N_t^{\zeta} C_t^{\sigma} g(S_t)}{A_t F_{n,t}}$ as a constant (across time and states).

Specifiy function $F(\bullet)$ (wlog):

$$F(N_t) = N_t^{\xi} \qquad \xi \leq 1 \tag{8}$$

which implies $\omega\left(N_t\right) = \frac{N_t}{\xi}$ and $\omega_{n,t} = \frac{1}{\xi}$.

Substituting for $\varphi(h^t)$ from (7) into (6), and rearranging, one obtains (after some algebra):

$$\Phi_t = \Lambda^{-1}\left\{\lambda + \frac{\left[(1-\alpha) - \lambda\sigma\left(1-\alpha+\alpha q(S_t)^{\eta-\frac{1}{\sigma}}\right)\right]}{H(S_t)}\right\} \equiv \Phi_t^{ce} \qquad (9)$$

where Φ_t^{ce} denotes the real marginal cost in the *constrained-efficient* allocation, λ is compact notation for $\lambda(h^{t-1})$, and $\Lambda \equiv 1 + \lambda\mu\left(\frac{1+\zeta}{\xi}\right)$ is a time-invariant term (under our assumed preferences).

Notice

1. Variations in **international relative prices** are the only source of variation in Φ_t^{ce}.

2. In an open economy with pre-set prices, a constant mark-up is **inconsistent** with constrained efficiency (unless shocks are perfectly correlated across countries)

3. With sticky prices, this stems from monetary (exchange rate) policy exerting a leverage on the **terms of trade**. Hence the domestic policymaker, at the margin and relative to an allocation with constant markup, has an incentive to **use the variability in the terms of trade** to improve upon the flexible-price allocation.

4. Home bias $\longrightarrow$ Variation in the terms of trade produces also a variation in the **real exchange rate** via the risk-sharing condition, thereby affecting domestic consumption through a complementary channel.

- **Closed Economy**

In a *closed* economy $\alpha = 0$, and therefore $H(S_t) = 1$. This implies:

$$\Phi_t = \frac{1 + \lambda(1 - \sigma)}{\Lambda} \equiv \overline{\Phi} \qquad (10)$$

for all t.

Open Economy with PPP: Benigno and Benigno (2003), Corsetti and Pesenti (2003)

- Constant-markup allocation **can** be **constrained-efficient** if either of two conditions holds:

$$\eta = 1$$

or

$$\eta = \sigma^{-1}$$

- With **home bias** conditions for constant markup being optimal are **more restrictive**

1. Case $\eta = 1 \rightarrow$ real marginal cost reads:

$$\Phi_t = \Lambda^{-1} \left\{ \lambda + \frac{(1-\alpha) - \lambda\sigma\left(1-\alpha+\alpha q(S_t)^{1-\frac{1}{\sigma}}\right)}{(1-\alpha)\left(1+\alpha\sigma\left(1-\frac{1}{\sigma}\right)\right)+\alpha\sigma q(S_t)^{1-\frac{1}{\sigma}}} \right\} \tag{11}$$

$\rightarrow$**Unitary** elasticity of substitution between domestic and imported goods **ceases to be a sufficient condition** for a constant-markup allocation to be constrained optimal.

2. Case $\eta = \sigma^{-1} \rightarrow H(S_t) = 1$ (exactly like in a closed economy), which implies:

$$\Phi_t^{ce} = \frac{(1-\alpha) + \lambda\left(1 - \frac{1}{\eta}\right)}{\Lambda} \equiv \Phi_{\eta=\sigma^{-1}}^{ce} \tag{12}$$

Same as GM, Clarida et al. (2002) and Benigno and Benigno (2003): monetary policy is completely **inward-looking** (stabilizes only the domestic marginal cost)

- Optimal Monetary Policy with **Gradual Price Adjustment**

- Quadratic costs of changing prices

- Open economy Phillips curve for domestic inflation becomes

$$\pi_{H,t}(\pi_{H,t}-1)-\beta E_t\left\{\left(\frac{C_{t+1}}{C_t}\right)^{-\sigma}\frac{g(S_t)}{g(S_{t+1})}\pi_{H,t+1}(\pi_{H,t+1}-1)\right\}$$
$$-\frac{\varepsilon\ A_tF(N_t)}{\vartheta}\left(\frac{N_t^{\zeta}C_t^{\sigma}g(S_t)}{A_tF_{n,t}}-\frac{\varepsilon-1}{\varepsilon}\right)$$

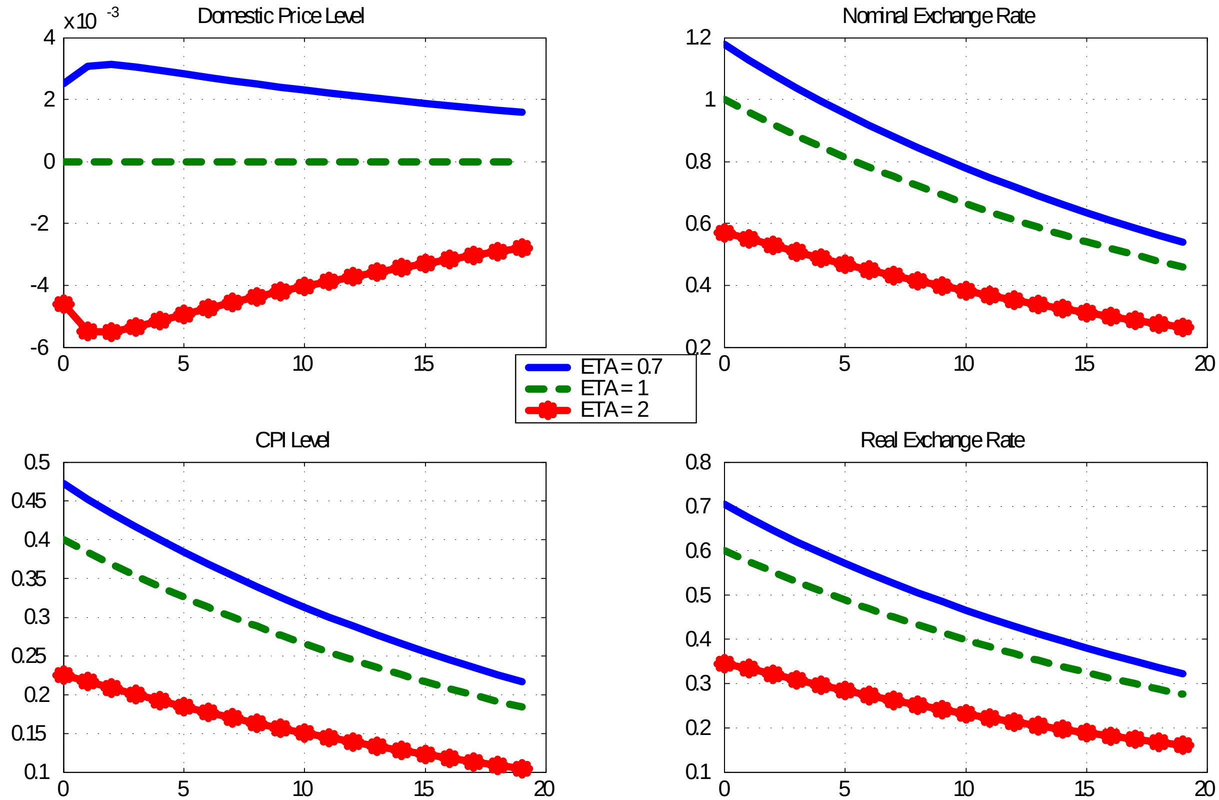
Planner's Problem

$$Max_{\{C_t,\ N_t,\ S_t,\ \pi_{H,t}\}}\ E_0 \sum_{t=0}^{\infty} \beta^t \left\{ \frac{1}{1-\sigma} C_t^{1-\sigma} - \frac{1}{1+\zeta} N_t^{1+\zeta} \right\} \tag{13}$$

$$+E_0 \sum_{t=0}^{\infty} \beta^t \lambda_{p,t} \left[\begin{array}{c} \pi_{H,t}(\pi_{H,t}-1) - \beta E_t \left\{ \left(\frac{C_{t+1}}{C_t}\right)^{-\sigma} \frac{g(S_t)}{g(S_{t+1})} \pi_{H,t+1}(\pi_{H,t+1}-1) \right. \\ -\frac{\varepsilon\ A_t F(N_t)}{\vartheta} \left(\frac{N_t^{\zeta} C_t^{\sigma} g(S_t)}{A_t F_{n,t}} - \frac{\varepsilon-1}{\varepsilon} \right) \end{array} \right.$$

$$+E_0 \sum_{t=0}^{\infty} \beta^t \lambda_{f,t} \left[A_t F(N_t) - (1-\alpha) g(S_t)^{\eta}\, C_t \ -\ \alpha\ S_t^{\eta}\ C_t^* - \frac{\vartheta}{2} \left(\pi_{H,t} - 1 \right)^2 \right]$$

$$+E_0 \sum_{t=0}^{\infty} \beta^t \lambda_{r,t} \left(C_t - q(S_t)^{\frac{1}{\sigma}} C_t^* \right)$$



Impulse Responses to a Rise in Home Productivity: Effect of Varying the Elasticity of Substitution η ($\sigma = 1$).

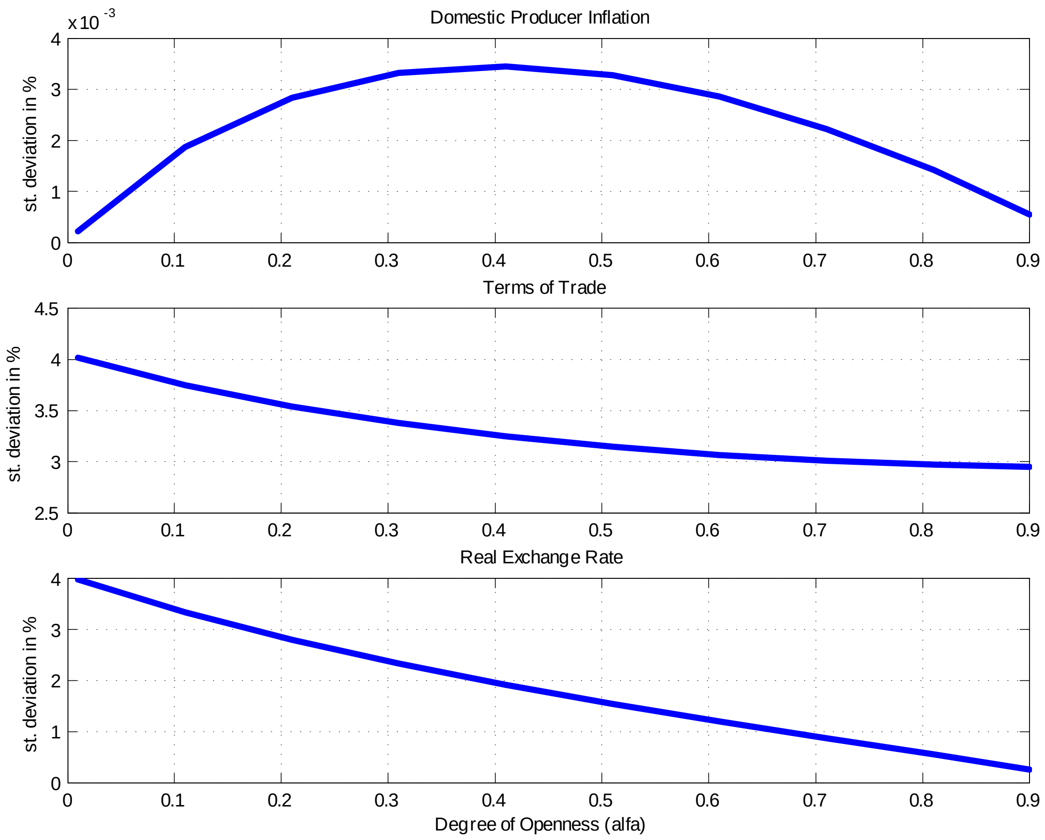


Figure 1: Volatility under the Ramsey Policy: Effect of Varying Openness α (Inverse Degree of Home Bias).