International Economics EUI 2010

The classical view: open economy divine coincidence

This lecture considers optimal policy in economies behaving according to the classical model of international monetary transmission:

- exchange rate movements as a substitute for product price flexibility in fostering efficient international relative price adjustment vis-à-vis macroeconomic shocks.

This requires 2 conditions CM+PCP

- For relative price adjustment to be efficient, markets must be complete.

- Exchange rate pass-through on import prices must be high.

In this environment, we will derive an instance of divine coincidence in open economy. The optimal policy prescription will be identical to the one derived in closed-economy.

With **complete pass-through**, a monetary expansion which causes nominal depreciation raises the price of imports in domestic currency, and translates into weaker terms of trade $\mathcal{T}_t = \mathcal{E}_t P^*_{F,t}/P_{H,t} = P_{F,t}/P_{H,t}$: as both $P^*_{F,t}$ and $P_{H,t}$ are sticky, $\mathcal{T}_t$ and $\mathcal{E}_t$ move in the same direction.

With **complete market**, the equilibrium relation between the terms of trade and relative output is identical to the one derived under the first-best allocation. Combine the two log-linearized equations for demand for goods produced in each country to obtain:

$$\begin{aligned} \widehat{Y}_{H,t} - \widehat{Y}_{F,t} &= 4a_{\mathsf{H}}\left(1-a_{\mathsf{H}}\right)\phi\widehat{\mathcal{T}}_t + \left(2a_{\mathsf{H}}-1\right)\left(\widehat{C}_t - \widehat{C}_t^*\right) \\ &= 4a_{\mathsf{H}}\left(1-a_{\mathsf{H}}\right)\phi\widehat{\mathcal{T}}_t + \left(\frac{2a_{\mathsf{H}}-1}{\sigma}\right)\left(\widehat{\mathcal{D}}_t + \widehat{\Theta}_t + \left(\widehat{\zeta}_{C,t} - \widehat{\zeta}_{C,t}^*\right)\right) \end{aligned}$$

From this, using the perfect risk sharing condition $\widehat{\mathcal{D}}_t = 0$ and eliminating deviations from the law of one price consistent with the PCP assumption, we get

$$\left[4a_{\mathsf{H}}\left(1-a_{\mathsf{H}}\right)\sigma\phi + \left(2a_{\mathsf{H}}-1\right)^2\right]\widehat{\mathcal{T}}_t = \sigma\left(\widehat{Y}_{H,t} - \widehat{Y}_{F,t}\right) - \left(2a_{\mathsf{H}}-1\right)\left(\widehat{\zeta}_{C,t} - \widehat{\zeta}_{C,t}^*\right) \tag{1}$$

It follows that, once monetary policy closes output gaps, international prices will correspondingly align to their efficient level too. This will not be true, in general, if the PCP assumption is not complemented by the complete-market assumption, so that $\widehat{\mathcal{D}}_t \neq 0$.

'Expenditure switching effects:' In the classical view, a property of nominal exchange-rate movement: by making domestic products cheaper worldwide, a depreciation switches domestic and foreign demand in favor of them.

- However, *cheaper import prices are not necessarily associated with an increase in consumption*. To wit: using again aggregate demand and imposing the risk sharing condition, Home consumption is

$$\widehat{C}_t = \widehat{Y}_{H,t} - \frac{1 - a_{\mathsf{H}}}{\sigma} \left[\left[2a_{\mathsf{H}} \left(\sigma\phi - 1 \right) + 1 \right] \widehat{\mathcal{T}}_t - \left(\widehat{\zeta}_{C,t} - \widehat{\zeta}^*_{C,t} \right) \right] \qquad (2)$$

  where we have used the fact that $\widehat{\Theta}_t = \left(2a_{\mathsf{H}} - 1 \right) \widehat{\mathcal{T}}_t$. A nominal appreciation increases consumption above output via its effect on the terms of trade (a fall in $\widehat{\mathcal{T}}_t$) only if $\sigma\phi > 1 - \frac{1}{2a_{\mathsf{H}}}$. Observe that this inequality is always satisfied if there is no home bias (the case analyzed by BB), or $\phi = 1$ and $\sigma > 1$ (the focus of CGG analysis).

The Phillips Curves under CM+PCP:

$$\pi_{H,t} - \beta E_t \pi_{H,t+1} = \frac{(1-\alpha\beta)(1-\alpha)}{\alpha(1+\theta\eta)} \cdot \left[(\eta+\sigma)\left(\widehat{Y}_{H,t} - \widetilde{Y}^{fb}_{H,t}\right) + \widehat{\mu}_t - (1-a_{\mathsf{H}})\, 2a_{\mathsf{H}}(\sigma\phi - 1)\left(\widehat{\mathcal{T}}_t - \widetilde{\mathcal{T}}^{fb}_t\right)\right]$$

$$\pi^*_{F,t}, -\beta E_t \pi^*_{F,t+1} = \frac{(1-\alpha^*\beta)(1-\alpha^*)}{\alpha^*(1+\theta\eta)} \cdot \left[(\eta+\sigma)\left(\widehat{Y}_{F,t} - \widetilde{Y}^{fb}_{F,t}\right) + \widehat{\mu}^*_t + (1-a_{\mathsf{H}})\, 2a_{\mathsf{H}}(\sigma\phi - 1)\left(\widehat{\mathcal{T}}_t - \widetilde{\mathcal{T}}^{fb}_t\right)\right]$$

By improving the Home terms of trade, an increase in foreign output can increase or reduce Home marginal costs (the term in squared brackets) and thus Home inflation, depending on whether $\sigma\phi \lesseqgtr 1$. Why?

Rewrite marginal costs

$$\left[\sigma \widehat{C}_t - \widehat{\zeta}_{C,t} + \eta \left(\widehat{Y}_{H,t} - \widehat{\zeta}_{Y,t}\right) + \widehat{\mu}_t + (1 - a_{\mathsf{H}}) \widehat{\mathcal{T}_t}\right]$$

CGG 2002: an improvement in the terms of trade means a fall in the price of imports — everything else equal, this reduces Home wages. Under perfect risk sharing, however, a higher foreign output translate into higher Home consumption for given relative prices — this raises marginal costs, as it increases the marginal rate of substitution between consumption and leisure. The second effect prevails if the two goods are substitute: higher foreign output raises home marginal costs.

The flexible price allocation is feasible, but not necessarily optimal. Using

$$\widehat{Y}_{H,t} - \widetilde{Y}_{H,t}^{nr} = \widehat{Y}_{H,t} - \left[\widetilde{Y}_{H,t}^{fb} + \widehat{\mu}_t / (\eta + \sigma)\right]. \quad (3)$$

rewrite the Phillips Curves in terms of the natural output gaps. Closing the natural gaps at all times in both countries yields the flexible price allocation. E.g. monetary policy expands in response to a positive productivity shock or to a negative markup shock (hitting symmetrically all firms in a country), the exchange rate depreciates exactly as much as it is required to move the international relative price of Home output to its flexible price level (see (1), — This is the classical adjustment mechanism envisaged in the well-known contribution by Friedman (1953).

Note however

- the exchange rate does not stabilize prices independently of the way monetary policy is conducted. Specifically, the international relative prices adjust to their flexible-price allocation level only if monetary policy leans against (natural) output gaps.

- a flex-price equilibrium is not necessarily efficient — e.g. it will not be so in the presence of markup shocks. We will explore these issues in greater detail below.

Optimal policy

We now analyze cooperative policies maximizing an equally weighted average of welfare in both countries. assuming

- commitment (discretion easily follows as a special case)

- a 'timeless perspective'. This approach involves involves ignoring the conditions that prevail at the policy regime's inception—say, by imagining that the optimal policy has been adopted in the distant past.

- no monopolistic distortions in production $=>$ subsidies make the steady stat efficient, so that a quadratic approximation of the objective function can be derived without using second order approximations to competitive equilibrium conditions (see Benigno and Woodford 2006).

The purely quadratic loss in each period is proportional to:

$$\propto -\frac{1}{2}\left\{\begin{array}{c}(\sigma+\eta)\left(\widetilde{Y}_{H,t}^{fb}-\widehat{Y}_{H,t}\right)^2+(\sigma+\eta)\left(\widetilde{Y}_{F,t}^{fb}-\widehat{Y}_{F,t}\right)^2+\\ \frac{\theta\alpha\left(1+\theta\eta\right)}{\left(1-\alpha\beta\right)\left(1-\alpha\right)}\pi_{H,t}^2+\frac{\theta\alpha^*\left(1+\theta\eta\right)}{\left(1-\alpha^*\beta\right)\left(1-\alpha^*\right)}\pi_{F,t}^{*2}+\\ -2a_{\mathsf{H}}\left(1-a_{\mathsf{H}}\right)\frac{\left(\sigma\phi-1\right)}{\sigma}\left(4\left(1-a_{\mathsf{H}}\right)a_{\mathsf{H}}\phi\sigma+\left(2a_{\mathsf{H}}-1\right)^2\right)\left(\widetilde{\mathcal{T}}_t^{fb}-\widehat{\mathcal{T}}_t\right)^2\end{array}\right\}, \quad (4)$$

If $a_{\mathsf{H}}=\frac{1}{2}$, no deviations from PPP, same as BB (2007): the coefficient of $\widehat{\mathcal{T}}_t^{gap}$ simplifies to $\frac{\sigma\phi-1}{2}$.

FOCs for the optimal policy problem under commitment

Let γ_t and γ_t^* denote the multipliers on the Phillips curves. The focs are, with respect to **inflation**:

$$\begin{aligned} \pi_{H,t} &: \quad 0 = -\theta \frac{\alpha\left(1+\theta\eta\right)}{\left(1-\alpha\beta\right)\left(1-\alpha\right)} \pi_{H,t} - \gamma_t + \gamma_{t-1} \qquad (5) \\ \pi_{F,t}^* &: \quad 0 = -\theta \frac{\alpha^*\left(1+\theta\eta\right)}{\left(1-\alpha^*\beta\right)\left(1-\alpha^*\right)} \pi_{F,t}^* - \gamma_t^* + \gamma_{t-1}^*, \end{aligned}$$

(recall: multipliers' lags appear reflecting the assumption of commitment);

with respect to **output:**

$$\widehat{Y}_{H,t} \quad : \quad 0 = \left[(\sigma+\eta)\left(\widetilde{Y}_{H,t}^{fb} - \widehat{Y}_{H,t}\right) - 2a_{\mathsf{H}}\left(1-a_{\mathsf{H}}\right)(\sigma\phi - 1)\left(\widetilde{\mathcal{T}}_t^{fb} - \widehat{\mathcal{T}}_t\right) \right] + \tag{6}$$

$$\left[\eta + \sigma - \frac{2a_{\mathsf{H}}\left(1-a_{\mathsf{H}}\right)(\sigma\phi-1)\sigma}{4\left(1-a_{\mathsf{H}}\right)a_{\mathsf{H}}\phi\sigma + \left(2a_{\mathsf{H}}-1\right)^2} \right] \frac{(1-\alpha\beta)(1-\alpha)}{\alpha(1+\theta\eta)}\gamma_t +$$

$$\frac{2a_{\mathsf{H}}\left(1-a_{\mathsf{H}}\right)(\sigma\phi-1)\sigma}{4\left(1-a_{\mathsf{H}}\right)a_{\mathsf{H}}\phi\sigma + \left(2a_{\mathsf{H}}-1\right)^2} \frac{(1-\alpha^*\beta)(1-\alpha^*)}{\alpha^*(1+\theta\eta)}\gamma_t^*$$

$$\widehat{Y}_{F,t} \quad : \quad 0 = \left[2a_{\mathsf{H}}\left(1-a_{\mathsf{H}}\right)(\sigma\phi - 1)\left(\widetilde{\mathcal{T}}_t^{fb} - \widehat{\mathcal{T}}_t\right) + (\sigma+\eta)\left(\widetilde{Y}_{F,t}^{fb} - \widehat{Y}_{F,t}\right) \right] +$$

$$\left[\eta + \sigma - \frac{2a_{\mathsf{H}}\left(1-a_{\mathsf{H}}\right)(\sigma\phi-1)\sigma}{4\left(1-a_{\mathsf{H}}\right)a_{\mathsf{H}}\phi\sigma + \left(2a_{\mathsf{H}}-1\right)^2} \right] \frac{(1-\alpha^*\beta)(1-\alpha^*)}{\alpha^*(1+\theta\eta)}\gamma_t^* +$$

$$\frac{2a_{\mathsf{H}}\left(1-a_{\mathsf{H}}\right)(\sigma\phi-1)\sigma}{4\left(1-a_{\mathsf{H}}\right)a_{\mathsf{H}}\phi\sigma + \left(2a_{\mathsf{H}}-1\right)^2}\gamma_t,$$

where we have used the equilibrium relation (1) between $\widehat{\mathcal{T}}_t$ and relative Y.

Sum and difference Targeting rules

Summing and subtracting the focs as to eliminate multipliers. In the tradition of open-economy macro, the targeting rules are expressed in **cross-country sum** (world output gaps and world GDP deflator inflation, which under PCP is equal to CPI inflation)

$$0 = \left[\left(\widehat{Y}_{H,t} - \widetilde{Y}^{fb}_{H,t}\right) - \left(\widehat{Y}_{H,t-1} - \widetilde{Y}^{fb}_{H,t-1}\right)\right] + \left[\left(\widehat{Y}_{F,t} - \widetilde{Y}^{fb}_{F,t}\right) - \left(\widehat{Y}_{F,t-1} - \widetilde{Y}^{fb}_{F,t-1}\right)\right] \quad (7)$$

$$+ \theta \left(\pi_{H,t} + \pi^{*}_{F,t}\right)$$

and **cross-country differences:**

$$0 = (\sigma+\eta)\left\{\begin{array}{c}\left[\left(\widehat{Y}_{H,t}-\widetilde{Y}_{H,t}^{fb}\right)-\left(\widehat{Y}_{H,t-1}-\widetilde{Y}_{H,t-1}^{fb}\right)\right]\\ -\left[\left(\widehat{Y}_{F,t}-\widetilde{Y}_{F,t}^{fb}\right)-\left(\widehat{Y}_{F,t-1}-\widetilde{Y}_{F,t-1}^{fb}\right)\right]\\ +\theta\left(\pi_{H,t}-\pi_{F,t}^{*}\right)\end{array}\right\}$$

$$+4a_{\mathsf{H}}\left(1-a_{\mathsf{H}}\right)\left(\sigma\phi-1\right)\left\{\begin{array}{c}\frac{4\left(1-a_{\mathsf{H}}\right)a_{\mathsf{H}}\phi\sigma+\left(2a_{\mathsf{H}}-1\right)^{2}}{\sigma}\left[\begin{array}{c}\left(\widehat{\mathcal{T}}_{t}-\widetilde{\mathcal{T}}_{t}^{fb}\right)\\ -\left(\widehat{\mathcal{T}}_{t-1}-\widetilde{\mathcal{T}}_{t-1}^{fb}\right)\end{array}\right]\\ +\theta\left(\pi_{H,t}-\pi_{F,t}^{*}\right)\end{array}\right\} \quad (8$$

However, from (1) and its first best counterpart:

$$\frac{4\left(1-a_{\mathsf{H}}\right)a_{\mathsf{H}}\phi\sigma+\left(2a_{\mathsf{H}}-1\right)^{2}}{\sigma}\left[\left(\widehat{\mathcal{T}}_{t}-\widetilde{\mathcal{T}}_{t}^{fb}\right)\right]=\left(\widehat{Y}_{H,t}-\widetilde{Y}_{H,t}^{fb}\right)-\left(\widehat{Y}_{F,t}-\widetilde{Y}_{F,t}^{fb}\right)$$

implying no trade-off between stabilizing international relative prices and stabilizing output gaps across countries. This is an important open-economy instance of 'divine coincidence' among potentially contrasting objectives.

Indeed, combining the above expressions, the optimal cooperative policy can be decentralized in terms of two targeting rules expressed in domestic objectives only:

$$\begin{aligned}\left(\widehat{Y}_{H,t}-\widetilde{Y}_{H,t}^{fb}\right)-\left(\widehat{Y}_{H,t-1}-\widetilde{Y}_{H,t-1}^{fb}\right)+\theta\pi_{H,t} &= 0 \\ \left(\widehat{Y}_{F,t}-\widetilde{Y}_{F,t}^{fb}\right)-\left(\widehat{Y}_{F,t-1}-\widetilde{Y}_{F,t-1}^{fb}\right)+\theta\pi_{F,t}^{*} &= 0.\end{aligned} \tag{9}$$

The same as in closed economy! These rules suggest a key result:

- foreign shocks are relevant to domestic policymaking only to the extent that they influence domestic output gap and inflation.

- In conjunction with the Phillips curves the optimal policy prescription in this benchmark CM + PCP open-economy is identical to the one in the baseline closed-economy one-sector model with flexible wages.

  - In response to **efficient shocks**, such as productivity and preference shocks, the flex-price allocation is efficient: policymakers optimally sett GDP-deflator inflation to zero, as to keep the (welfare-relevant) output gap closed at all times. The nominal and real exchange rates fluctuate with these shocks and adjust international relative prices without creating any policy trade-off: the terms of trade are at their (efficient) flexible price level.

  - By way of example, under the optimal policy a positive productivity gains in one country is matched by an expansion of domestic monetary policy, stabilizing domestic prices while in turn causing nominal and real depreciation — the country's terms of trade weakens exactly as they would under flexible prices.

– Conversely, in response to **inefficient** — such as markup — shocks, the optimal policy reflects fundamental trade-offs between output gap, inflation and relative price stabilization. Markup shocks create a wedge between efficient and natural output.

– In the closed-economy counterpart of our model, the optimal policy prescribes partial accommodation, letting output fall and inflation rise temporarily in the short run, while simultaneously committing to a persistent contractionary policy in the future (see Galí 2007, BB 2002). The same is true in open economies.

How does economic interdependence work?

Consider a favorable markup shock in the Home economy, $\widehat{\mu}_t < 0$.

- By accommodating in part such a shock, the Home policymakers let domestic output increase (and domestic GDP inflation fall), causing the Foreign country's terms of trade to depreciate.

- These domestic developments affect the Foreign economy. If goods are substitute, i.e., $\sigma\phi > 1$, the Home terms-of-trade depreciation driven by higher Home output raises the marginal costs of foreign producers. The Home expansion then translates into the equivalent of an adverse cost-push shock abroad – Foreign output falls, opening a negative output gap, while Foreign producer prices rise.

- Under the optimal policy, the Foreign monetary authorities counteract the rise in inflation, with the result of feeding the Home terms of trade appreciation.

- The comovements between national output gap, inflation and monetary stance are negative (see BB 2002).

Figure I.1. International Transmission of a Decline in Home Markups
Optimal Policy Under Producer Currency Pricing