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Deviations from the classical view: LCP economies

Empirical studies document that, contrary to the tenets of the classical view of monetary transmission, import prices are quite stable in local currency, plausibly depending on real factors (namely, local costs and destination-specific markup adjustment), as well as nomimal factors.

In this lecture, we reconsider monetary transmission and optimal policy under the extreme assumption that the classical view fails exclusively because of nominal factors : Import prices are subject to nominal-pricing distortions in the currency of the market of destination — an hypothesis commonly labelled 'local currency pricing' or LCP.

Implications:

- The relative price of imports faced by national consumers, $P_{F,t}/P_{H,t}$ and $P^*_{F,t}/P^*_{H,t}$, are unresponsive to exchange rate movements $=>$ no or limited 'expenditure switching effects' from ER movements..

- The law of one price generally fails $\Delta_{\mathsf{H},t} = \mathcal{E}_t P^*_{\mathsf{H},t}/P_{\mathsf{H},t} \neq 0$.

  – Under symmetry in the Calvo parameters $\alpha = \alpha^*$, up to a first-order approximation, deviations from the law of one price will be symmetric across countries $\widehat{\Delta}_{\mathsf{H},t} = \widehat{\Delta}_{\mathsf{F},t} = \widehat{\Delta}_t$ (see Engel 2009).

- Exchange-rate pass-through is incomplete *on average*: **positive** for the firms which re-optimize prices during the period (as these optimally pass some of the marginal cost movements onto local prices, compensating for exchange rate movements); it is **zero** for the firms, which do not re-optimize.

- *Nominal depreciation* is real depreciation, but *may improve the terms of trade of the country*, depending on the degree of price stickiness. Why? For non-adjusting firms, nominal depreciation raises the local-currency revenue from selling goods abroad at an unchanged price.

- The real exchange rate and the terms of trade no longer proportional to each other, as nominal depreciation also causes deviations from the law of one price

$$\widehat{\Theta}_t = (2a_{\mathsf{H}} - 1)\,\widehat{\mathcal{T}}_t + a_{\mathsf{H}}\left(\widehat{\Delta}_{\mathsf{H},t} + \widehat{\Delta}_{\mathsf{F},t}\right) = (2a_{\mathsf{H}} - 1)\,\widehat{\mathcal{T}}_t + 2a_{\mathsf{H}}\widehat{\Delta}_t, \qquad (1)$$

- Even if markets are complete, the equilibrium relation between relative output and international prices is not identical to the first best:

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

$$-\left[4a_{\mathsf{H}}\left(1-a_{\mathsf{H}}\right)\sigma\phi+2a_{\mathsf{H}}\left(2a_{\mathsf{H}}-1\right)\right]\widehat{\Delta}_{t}$$

  To wit: if positive productivity shocks are matched by monetary expansion, nominal depreciation does not bring international prices to their efficient (let alone flex-price) level.

- A corollary is that the flex-price allocation is generally unattainable.

- Cross-border monetary spillovers on consumption:

$$\widehat{C}_t = \widehat{Y}_{H,t} - \frac{1 - a_{\mathsf{H}}}{\sigma}\left[2a_{\mathsf{H}}\phi\sigma\left(\widehat{\mathcal{T}}_t + \widehat{\Delta}_t\right) - \widehat{\Theta}_t - \left(\widehat{\zeta}_{C,t} - \widehat{\zeta}^*_{C,t}\right)\right] \qquad (3)$$

Nominal appreciation strengthens the real exchange rate, but tends to weaken the terms of trade, with opposite effects on consumption. Consumption spillovers are less positive than under PCP. Second, consumption responds to international relative prices even when $\sigma\phi = 1$. In other words, monetary spillovers play an important role in shaping macroeconomic interdependence, independently of the distinction between goods complementarity and substitutability, which is instead central to understanding spillovers in the PCP economy.

Relevant NK Phillips Curves are 4:, one for each combination of goods (H or F) and destination market:

$$\pi_{H,t} - \beta E_t \pi_{H,t+1} = \frac{(1-\alpha\beta)(1-\alpha)}{\alpha(1+\theta\eta)} \cdot$$
$$\left[(\sigma+\eta)\left(\widehat{Y}_{H,t} - \widetilde{Y}^{fb}_{H,t}\right) + \widehat{\mu}_t - (1-a_{\mathsf{H}})\left[2a_{\mathsf{H}}(\sigma\phi-1)\left(\widehat{\mathcal{T}_t} - \widetilde{\mathcal{T}}^{fb}_t + \widehat{\Delta}_t\right) - \widehat{\Delta}_t\right]\right] \tag{4}$$
$$= \pi^*_{H,t} - \beta E_t \pi^*_{H,t+1} - \frac{(1-\alpha\beta)(1-\alpha)}{\alpha(1+\theta\eta)}\widehat{\Delta}_t$$

$$\pi^*_{F,t} - \beta E_t \pi^*_{F,t+1} = \frac{(1-\alpha\beta)(1-\alpha)}{\alpha(1+\theta\eta)} \cdot \tag{5}$$
$$\left[(\sigma+\eta)\left(\widehat{Y}_{F,t} - \widetilde{Y}^{fb}_{F,t}\right) + \widehat{\mu}^*_t + (1-a_{\mathsf{H}})\left[2a_{\mathsf{H}}(\sigma\phi-1)\left(\widehat{\mathcal{T}_t} - \widetilde{\mathcal{T}}^{fb}_t + \widehat{\Delta}_t\right) - \widehat{\Delta}_t\right]\right]$$
$$= \pi_{F,t} - \beta E_t \pi_{F,t+1} + \frac{(1-\alpha\beta)(1-\alpha)}{\alpha(1+\theta\eta)}\widehat{\Delta}_t$$

In addition inflation at consumer level for different goods is constrained by:

$$\pi_{F,t} - \pi_{H,t} = \widehat{\mathcal{T}}_t - \widehat{\mathcal{T}}_{t-1} + \widehat{\boldsymbol{\Delta}}_t - \widehat{\boldsymbol{\Delta}}_{t-1}. \tag{6}$$

To see differences with PCP,

- consumer price inflation vs. GDP deflator

- posit a zero inflation target for domestically produced goods $\pi_{H,t} = 0$, $=>$ no change in producers' marginal costs under all contingencies. The NKPCs suggest that closing output gap is ineffective: a zero inflation target requires variability in output gaps and inefficient misalignment/ price dispersion (including Δ) across all categories of goods.

- Asymmetric effect of depreciation on price dynamics in domestic and foreign currency. A Home depreciation also makes foreign inflation (π^*_H and π^*_F) larger than the domestic one (π_H and π_F.)

Period-by-period loss function under LCP:

$$\propto -\frac{1}{2}\left\{\begin{array}{c} (\sigma+\eta)\left(\widetilde{Y}^{fb}_{H,t}-\widehat{Y}_{H,t}\right)^2+(\sigma+\eta)\left(\widetilde{Y}^{fb}_{F,t}-\widehat{Y}_{F,t}\right)^2+ \\ \frac{\theta\alpha(1+\theta\eta)}{(1-\alpha\beta)(1-\alpha)}\left[a_{\mathsf{H}}\pi^2_{H,t}+(1-a_{\mathsf{H}})\pi^{*2}_{H,t}+a_{\mathsf{H}}\pi^{*2}_{F,t}+(1-a_{\mathsf{H}})\pi^2_{F,t}\right]+ \\ -\frac{2a_{\mathsf{H}}(1-a_{\mathsf{H}})(\sigma\phi-1)\sigma}{4a_{\mathsf{H}}(1-a_{\mathsf{H}})\phi\sigma+(2a_{\mathsf{H}}-1)^2}\left[\left(\widetilde{Y}^{fb}_{H,t}-\widehat{Y}_{H,t}\right)-\left(\widetilde{Y}^{fb}_{F,t}-\widehat{Y}_{F,t}\right)\right]^2+ \\ \frac{2a_{\mathsf{H}}(1-a_{\mathsf{H}})\phi}{4a_{\mathsf{H}}(1-a_{\mathsf{H}})\phi\sigma+(2a_{\mathsf{H}}-1)^2}\widehat{\Delta}^2_t \end{array}\right\}. \tag{7}$$

Relative to the PCP case,

- inflation rates are at consumer level, and thus differ across domestic goods and imports.

- loss includes deviations from the law of one price.

Supply and demand dimension of the welfare loss.

- The four terms in inflation in the loss are related to supply inefficiencies, due to price dispersion in the domestic and in the export markets. The quadratic inflation terms are weighted according to shares in the consumption basket (consequence of symmetry).

- Deviations from the law of one price lead to inefficiencies in the level and composition of global consumption demand, as stressed by LCP literature assuming one-period preset prices — see e.g. Devereux and Engel (2003) and Corsetti and Pesenti (2005).

Optimal policy. Min loss s.t. constraints.

Let $\gamma_{H,t}$ and $\gamma^*_{H,t}$ ($\gamma_{F,t}$ and $\gamma^*_{F,t}$) are the multiplier associated with the Home (Foreign) Phillips curves, and γ_t is the multiplier associated with the constraint (6). First order conditions for **inflation**

$$\begin{aligned}
\pi_{H,t} &: \quad 0 = -\theta \frac{\alpha (1+\theta\eta)}{(1-\alpha\beta)(1-\alpha)} a_{\mathsf{H}} \pi_{H,t} - \gamma_{H,t} + \gamma_{H,t-1} - \gamma_t \qquad (8) \\
\pi^*_{H,t} &: \quad 0 = -\theta \frac{\alpha (1+\theta\eta)}{(1-\alpha\beta)(1-\alpha)} (1-a_{\mathsf{H}}) \pi^*_{H,t} - \gamma^*_{H,t} + \gamma^*_{H,t-1} \\
\pi_{F,t} &: \quad 0 = -\theta \frac{\alpha (1+\theta\eta)}{(1-\alpha\beta)(1-\alpha)} (1-a_{\mathsf{H}}) \pi_{F,t} - \gamma_{F,t} + \gamma_{F,t-1} + \gamma_t \\
\pi^*_{F,t} &: \quad 0 = -\theta \frac{\alpha (1+\theta\eta)}{(1-\alpha\beta)(1-\alpha)} a_{\mathsf{H}} \pi^*_{F,t} - \gamma^*_{F,t} + \gamma^*_{F,t-1},
\end{aligned}$$

for **output**

$$\widehat{Y}_{H,t} \quad : \quad 0 = -\left(\sigma+\eta\right)\widetilde{Y}^{gap}_{H,t} + \frac{2a_{\mathsf{H}}\left(1-a_{\mathsf{H}}\right)\left(\sigma\phi-1\right)\sigma}{4a_{\mathsf{H}}\left(1-a_{\mathsf{H}}\right)\phi\sigma+\left(2a_{\mathsf{H}}-1\right)^{2}}\left[\widetilde{Y}^{gap}_{H,t}-\widetilde{Y}^{gap}_{F,t}\right] + \quad (9)$$

$$+\left[\left(\sigma+\eta\right)\left(\gamma_{H,t}+\gamma^{*}_{H,t}\right)\right]$$

$$-\frac{2a_{\mathsf{H}}\left(1-a_{\mathsf{H}}\right)\left(\sigma\phi-1\right)\sigma}{4a_{\mathsf{H}}\left(1-a_{\mathsf{H}}\right)\phi\sigma+\left(2a_{\mathsf{H}}-1\right)^{2}}\frac{\left(1-\alpha\beta\right)\left(1-\alpha\right)}{\alpha\left(1+\theta\eta\right)}\left[\begin{array}{c}\left(\gamma_{H,t}+\gamma^{*}_{H,t}\right)\\-\left(\gamma_{F,t}+\gamma^{*}_{F,t}\right)\end{array}\right]+$$

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

$$
\begin{aligned}
\widehat{Y}_{F,t} \quad : \quad 0 = & -(\sigma+\eta)\,\widetilde{Y}_{F,t}^{gap} + \frac{2a_{\mathsf{H}}\,(1-a_{\mathsf{H}})\,(\sigma\phi-1)\,\sigma}{4a_{\mathsf{H}}\,(1-a_{\mathsf{H}})\,\phi\sigma+(2a_{\mathsf{H}}-1)^{2}}\left[\widetilde{Y}_{H,t}^{gap}-\left(\widetilde{Y}_{F,t}^{gap}\right)\right]+ \\
& +\left[(\sigma+\eta)\left(\gamma_{F,t}+\gamma_{F,t}^{*}\right)\right]+ \\
& +\frac{2a_{\mathsf{H}}\,(1-a_{\mathsf{H}})\,(\sigma\phi-1)\,\sigma}{4a_{\mathsf{H}}\,(1-a_{\mathsf{H}})\,\phi\sigma+(2a_{\mathsf{H}}-1)^{2}}\frac{(1-\alpha\beta)\,(1-\alpha)}{\alpha\,(1+\theta\eta)}\left[\begin{array}{c}\left(\gamma_{H,t}+\gamma_{H,t}^{*}\right)\\ -\left(\gamma_{F,t}+\gamma_{F,t}^{*}\right)\end{array}\right]+ \\
& -\frac{\sigma\left(\beta E_{t}\gamma_{t+1}-\gamma_{t}\right)}{4a_{\mathsf{H}}\,(1-a_{\mathsf{H}})\,\phi\sigma+(2a_{\mathsf{H}}-1)^{2}},
\end{aligned}
$$

and for **deviations from the LOOP**:

$$\widehat{\Delta}_t \quad : \quad 0 = -\frac{2a_{\mathsf{H}}\left(1-a_{\mathsf{H}}\right)\phi}{4a_{\mathsf{H}}\left(1-a_{\mathsf{H}}\right)\phi\sigma+\left(2a_{\mathsf{H}}-1\right)^2}\widehat{\Delta}_t + \tag{10}$$

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

$$\frac{1}{2}\left[\begin{array}{c}\left(4\left(1-a_{\mathsf{H}}\right)a_{\mathsf{H}}\phi\sigma+\left(2a_{\mathsf{H}}-1\right)^2\right)\left(\gamma_{H,t}+\gamma_{F,t}-\left(\gamma^*_{F,t}+\gamma^*_{H,t}\right)\right)+\\ -\left(2a_{\mathsf{H}}-1\right)\left(\gamma_{H,t}+\gamma^*_{H,t}-\gamma_{F,t}-\gamma^*_{F,t}\right)\end{array}\right]$$

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

Targeting rules: The sum rule

$$0 = \left[\left(\widehat{Y}_{H,t} - \widetilde{Y}_{H,t}^{fb} \right) - \left(\widehat{Y}_{H,t-1} - \widetilde{Y}_{H,t-1}^{fb} \right) + \left(\widehat{Y}_{F,t} - \widetilde{Y}_{F,t}^{fb} \right) - \left(\widehat{Y}_{F,t-1} - \widetilde{Y}_{F,t-1}^{fb} \right) \right] + \tag{11}$$

$$\theta \left[a_{\mathsf{H}} \pi_{H,t} + (1 - a_{\mathsf{H}}) \pi_{F,t} + (1 - a_{\mathsf{H}}) \pi^*_{H,t} + a_{\mathsf{H}} \pi^*_{F,t} \right].$$

is a function of world output and global inflation, with LCP at consumer level.

The difference /relative rule is complex, but for either the case of linear disutility of labor ($\eta = 0$) or PPP ($a_H = 1/2$). In either case the Lagrangian multiplier γ_t drops out from the problem.

Difference targeting rule:

$$0 = \sigma^{-1}\left[\left(\widehat{\mathcal{Q}}_t - \widetilde{\mathcal{Q}}_t^{fb}\right) - \left(\widehat{\mathcal{Q}}_{t-1} - \widetilde{\mathcal{Q}}_{t-1}^{fb}\right)\right] + \theta \left[\begin{array}{c} \left(a_{\mathsf{H}}\pi_{H,t} + (1 - a_{\mathsf{H}})\,\pi_{F,t}\right) \\ -\left((1 - a_{\mathsf{H}})\,\pi^*_{H,t} + a_{\mathsf{H}}\pi^*_{F,t}\right) \end{array}\right] \tag{12}$$

which can also be written:

$$0 = \left[\left(\left(\widehat{Y}_{H,t} - \widetilde{Y}_{H,t}^{fb}\right) - \left(\widehat{Y}_{H,t-1} - \widetilde{Y}_{H,t-1}^{fb}\right)\right) - \left(\left(\widehat{Y}_{F,t} - \widetilde{Y}_{F,t}^{fb}\right) - \left(\widehat{Y}_{F,t-1} - \widetilde{Y}_{F,t-1}^{fb}\right)\right)\right] \tag{13}$$

$$+ \theta\left[\left(a_{\mathsf{H}}\pi_{H,t} + (1 - a_{\mathsf{H}})\,\pi_{F,t}\right) - \left((1 - a_{\mathsf{H}})\,\pi^*_{H,t} + a_{\mathsf{H}}\pi^*_{F,t}\right)\right] +$$

$$- 2\,(1 - a_{\mathsf{H}})\,\sigma^{-1}\left[\begin{array}{c} \left(\widehat{\mathcal{T}}_t - \widetilde{\mathcal{T}}_t^{fb}\right) - \left(\widehat{\mathcal{T}}_{t-1} - \widetilde{\mathcal{T}}_{t-1}^{fb}\right) + \\ 2a_{\mathsf{H}}\,(\phi\sigma - 1)\left(\left(\widehat{\mathcal{T}}_t - \widetilde{\mathcal{T}}_t^{fb}\right) - \left(\widehat{\mathcal{T}}_{t-1} - \widetilde{\mathcal{T}}_{t-1}^{fb}\right) + \widehat{\Delta}_t - \widehat{\Delta}_{t-1}\right) \end{array}\right]$$

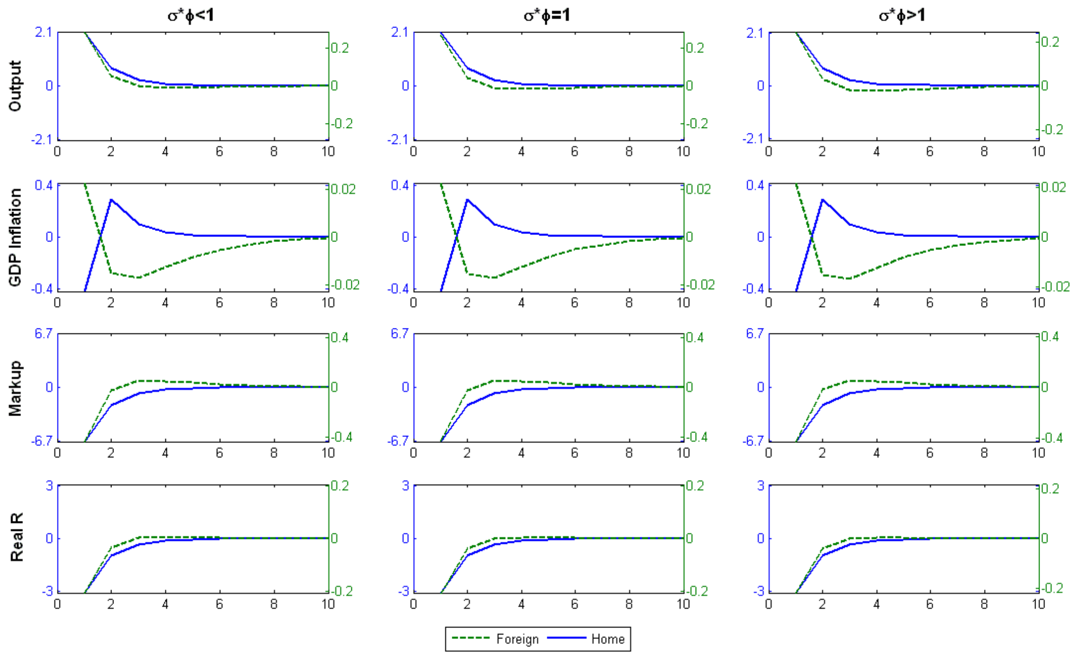
Lesson: with LCP, cross-country output gap stabilization no longer translates into relative price stabilization. In response to productivity shocks, for instance, stabilizing marginal costs of domestic producers neither coincides with stabilizing their markups in all markets, nor is sufficient to realign international prices. As a result, LCP breaks the 'divine coincidence' in open economy: the flexible-price allocation is unattainable under LCP.

With either $\eta = 0$ or $a_H = 1/2$, policy prescriptions are clearcut:

- in response to efficient shocks, stabilize global welfare-relevant output gap and all inflation terms, $=>$ no CPI inflation at national level! To see this, rearrange the Phillips Curves into global CPI inflation and cross-country CPI inflation differentials and substitute the two targeting criteria.

- With zero inflation, in turn, satisfying the relative target criterion coincides with correcting misalignments in the real exchange rate.

- Not an efficient allocation however: cross-country output gap differentials, terms of trade misalignments and deviations from the law of one price.



In general $\eta \neq 0$, prescriptions are more complicated. Example of stabilization of markup shocks (note monetary transmission!)

Assessing claims in the literature: (a) 'under LCP policymakers should be concerned with stabilizing relative consumption'

To understand the root of this claim, using the perfect risk-sharing condition, the relative target criterion with $\eta = 0$ or $a_H = 1.2$ becomes:

$$0 = \theta \left[\left(a_{\mathsf{H}} \pi_{H,t} + (1 - a_{\mathsf{H}}) \pi_{F,t} \right) - \left((1 - a_{\mathsf{H}}) \pi^*_{H,t} + a_{\mathsf{H}} \pi^*_{F,t} \right) \right] + \left[\left(\widehat{C}_t - \widetilde{C}^{fb}_t \right) - \left(\widehat{C}_{t-1} - \widetilde{C}^{fb}_{t-1} \right) - \left[\left(\widehat{C}^*_t - \widetilde{C}^{*fb}_t \right) - \left(\widehat{C}^*_{t-1} - \widetilde{C}^{*fb}_{t-1} \right) \right] \right] \quad (14)$$

In response to efficient shocks, the optimality of strict (national) CPI inflation targeting implies that cross-country consumption differentials are also stabilized (Corsetti and Pesenti 2005). BUT this is not strictly so with $\eta \neq 0$, or home bias or incomplete markets!

Claim in the literature: (b) under LCP, exchange rate movements do not play the stabilizing role envisioned by the classical theory, hence should be kept fixed.'

- Verify that the optimal policy implies a fixed exchange rate under the special condition of (a) purchasing Power Parity ($2a_{\mathsf{H}} = 1$) (b) efficient shocks and (c) complete markets. Under PPP the 'efficient' real exchange rate is obvioulsy constant and, in the second targeting criterion (14), consumption deviations from the first best are simply equal to $\widehat{\Delta}_t$. So, keeping the nominal exchange rate fixed corrects exchange rate misalignment (in this environment the sole cause of deviations from the law of one price), at the same time ruling out cross-country misallocation in consumption.

- This does not apply to markup shocks and (most importantly) when PPP does not hold (a point stressed by Obstfeld and Duarte 2008; see also Corsetti 2006). Same: incomplete markets!

Claim in the literature: (c) under LCP, inflation targets should be defined in terms of CPI rather than GDP deflator

- Under LCP the targeting rules aggregate inflation terms at consumer level as a function of relative consumption basket weights. However, the weights do not coincide outside the special case of $\eta = 0$ and symmetry in Calvo parameters!

Summing up: in general LCP does NOT provide an argument in favor of fixed exchange rates and strict CPI inflation targeting. It thus supports the notion that policymakers should pay attention to consumer-level inflation and contain terms of trade variability. See numerical examples below.

Table. Benchmark parameter values

Benchmark Model	
Preferences and Technology	
Risk aversion	$\sigma = 2$
Calvo parameter	$\alpha = 0.75$
Frisch labor supply elasticity (inverse of)	$\eta = 1.5$
Elasticity of substitution between:	
Home and Foreign traded goods	$\phi = 1$
Home traded goods	$\theta = 6$
Share of Home Traded goods	$a_{\mathsf{H}} = 0.90$
Shocks	
Productivity	$\rho_z = 0.95, \ \ \sigma_z = 0.001$
Preference	$\rho_\zeta = 0.95, \ \ \sigma_\zeta = 0.001$
Markup	$\sigma_\zeta = 0.001$

Table. Volatilities Under Optimal Policy (Complete Market Economies)

Statistics	With PCP: Productivity and Preference Shocks	With PCP: With Markup Shocks	With LCP: Productivity and Preference Shocks	With LCP: With Markup Shocks
Standard deviation (in percent)				
CPI Inflation	0.11	0.12	0.02	0.03
GDP Deflator Inflation	0.00	0.03	0.03	0.04
Output Gap	0.00	0.16	0.14	0.19
Markup	0.00	0.52	0.14	0.53
Standard deviation (Relative to Output)				
Real Exchange Rate	2.71	2.75	2.99	2.59
Terms of Trade	3.39	3.43	2.56	1.60