Stagflation and Topsy-Turvy Capital Flows

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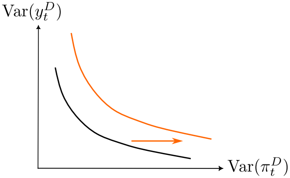
Motivation

- Inflation is back!
  - Phenomenon is broad based, (largely) unexpected, and forcing central banks worldwide to rethink their exit from ZLB/quantitative easing.
- When shock hits, usual for international macro to ask: do open financial accounts facilitate macro adjustment?
- Traditional, classical view is that answer is positive. But recently, views have become more nuanced.
- Yet, discussions of “excessive” capital flows has typically not incorporated notion of *output-inflation trade-off*, which seems relevant in current context.

This paper

- Use baseline open-economy New-Keynesian model to analyze constrained efficiency of free capital mobility regime when policy faces output-inflation trade-off.
- Find that high-inflation country over-borrows and capital flows are *topsy-turvy*.
- Novel macroeconomic externality associated with external borrowing and operating through economy's supply side:
  - Increase in external borrowing shifts up labor supply $\rightarrow$ domestic firms' marginal costs rises.
  - When economy operates below potential as result of central bank's attempt to fight off cost-push shock, externality worsens policy trade-off, hence creating inefficiency.



Relationship to literature

Macroeconomic externality resembles those stressed by two branches of recent literature in monetary and international macro:

1. AD externalities in economies with nominal rigidities
   - Farhi and Werning (2012, 2014, 2016, 2017), Korinek and Simsek (2016), Schmitt-Grohe and Uribe (2016), etc.
   - Constraints on price adjustments and monetary policy prevent goods-specific labor wedges to be closed.
   - Prescription: incentivize agents to shift wealth toward states of nature where their spending is high on goods whose provision is most depressed.
2. Pecuniary externalities under incomplete financial markets
   - Caballero and Krishnamurthy (2001), Korinek (2007, 2018), Bianchi (2011), Jeanne and Korinek (2010, 2019, 2020), Benigno et al. (2013, 2016), etc.
   - Incomplete markets or borrowing constraints prevent equalization of MRS across agents.
   - Prescription: distort financial choices to generate price movements that reduce incomplete markets wedges.

Sketch of model

Baseline open-economy New-Keynesian model

- ◇ Two countries, Armington preferences, no home bias (for presentation) ▸ Details
- ◇ Monopolistic competition and nominal rigidities (Calvo pricing), with producer currency pricing and law of one price ▸ Details
- ◇ Flexible exchange rate, cooperative monetary policy under commitment
- ◇ Complete financial markets, with capital flow taxes as potential welfare enhancing policy
- ◇ Cost-push shocks generating output-inflation trade-off

Equilibrium

- Output determination

$$y_t = \frac{1}{2}\left(c_t + c_t^* + \eta s_t\right). \tag{1}$$

- International risk-sharing

$$c_t = c_t^* + \theta_t. \tag{2}$$

- Inflation and marginal costs

$$\dot{\pi}_{H,t} = \rho \pi_{H,t} - \kappa mc_t, \tag{3}$$

$$mc_t = (1+\phi) y_t - \frac{\eta - 1}{2} s_t + \frac{1}{2}\theta_t + u_t. \tag{4}$$

Optimal monetary policy

- Optimal monetary policy solves

$$\min_{\{y_t^D, \pi_t^D\}} \int_0^\infty e^{-\rho t} \left[\left(\frac{1}{\eta} + \phi \right) (y_t^D)^2 + \frac{\varepsilon}{\kappa} (\pi_t^D)^2 + \frac{1}{4} (\theta_t)^2 \right] dt$$

subject to

$$\rho \pi_t^D = \dot{\pi}_t^D + \kappa \left[\left(\frac{1}{\eta} + \phi \right) y_t^D + \frac{1}{2} \theta_t \right] + \kappa u_t^D. \qquad \text{(NKPC D)}$$

- Optimal plan characterized by targeting rule

$$\dot{y}_t^D + \varepsilon \pi_t^D = 0.$$

- Remark:
  - Monetary policy is “inward looking” regardless of assumption on $\{\theta_t\}$.

▸ Loss function ▸ World and difference formulation

Optimal capital flow management (CFM) policy

◇ Optimal policy now solves

$$\min_{\{y_t^D,\pi_t^D,\theta_t\}} \int_0^\infty e^{-\rho t}\left[\left(\frac{1}{\eta}+\phi\right)(y_t^D)^2+\frac{\varepsilon}{\kappa}(\pi_t^D)^2+\frac{1}{4}(\theta_t)^2\right]dt$$

subject to

$$\rho\pi_t^D=\dot{\pi}_t^D+\kappa\left[\left(\frac{1}{\eta}+\phi\right)y_t^D+\frac{1}{2}\theta_t\right]+\kappa u_t^D. \qquad \text{(NKPC D)}$$

Optimal plan characterized by

$$\theta_t=2y_t^D.$$

Decentralization with tax on CF

$$\tau_t^D=\eta\pi_t^D.$$

◇ Remarks:

- Free capital mobility regime is constrained inefficient.
- Optimal to redirect spending *away* from country with most depressed output.
- High-inflation country over-borrows.

Externality via firms' marginal costs

- Consider marginal reallocation of spending towards Home at t, starting from free capital mobility regime.

- Applying envelope theorem, change in loss function induced by perturbation is

$$\frac{d\mathbb{L}_t}{d\theta_t} = \underbrace{\varphi_t^D}_{\text{multiplier on (NKPC D)}} \times \underbrace{\frac{\partial mc^D(y_t^D, \theta_t)}{\partial \theta_t}}_{+}.$$

- If (NKPC D) binds ($\varphi_t^D \neq 0$), perturbation has first-order welfare effect.

Topsy-turvy capital flows

- How do capital flows behave under free capital mobility vs. optimal CFM?
- Under free capital mobility, two neoclassical motives of inter-temporal trade compete (Cole-Obstfeld, 1991)
  - Low output → incentive to borrow,
  - ToT appreciation → incentive to save.

$$nx_t = \frac{\eta - 1}{\eta} y_t^D .$$

- Under optimal CFM, additional *Keynesian* motive of inter-temporal trade
  - Relax output-inflation trade-off where it is the most stringent → incentive to save.

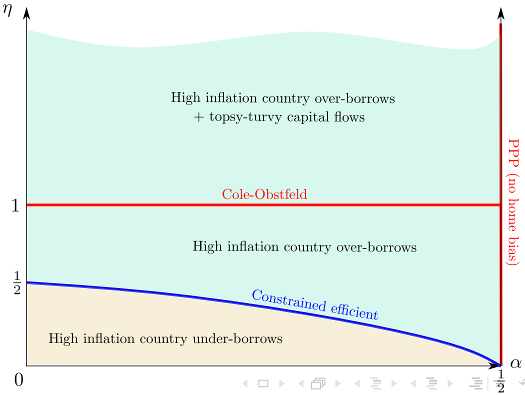
$$nx_t = -\frac{1}{\eta} y_t^D .$$

- When $\eta > 1$, capital flows are *topsy-turvy* under free capital mobility.

Relaxing no home bias assumption ($\alpha < 1/2$)

$$\frac{\partial mc^D(y_t^D,\theta_t)}{\partial \theta_t} = \frac{\alpha\chi}{\eta-(\eta-1)(1-2\alpha)^2}\left[\underbrace{1}_{\text{real wage effect}} - \underbrace{(1-2\alpha)/\chi}_{\text{purchasing power effect}}\right]$$

- ◇ χ is trade elasticity
- ◇ Shifting demand toward Home appreciates ToT, exercising counteracting force on marginal costs.
- ◇ For plausible calibrations, real wage effect dominates.



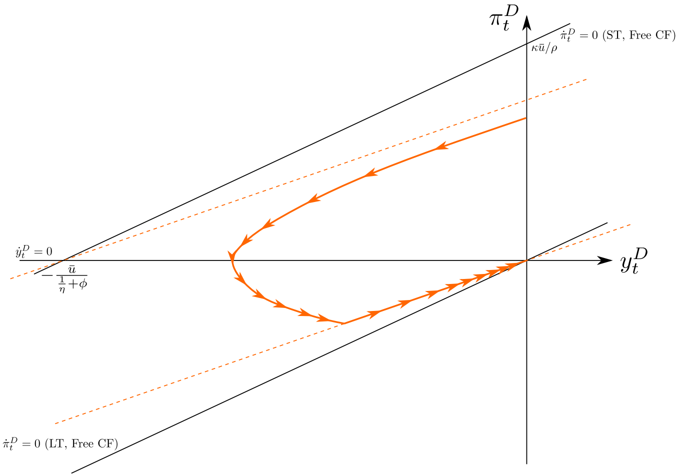
Cost-push shock scenario

- Now consider (unanticipated, temporary) inflationary cost-push shock in Home, starting from symmetric steady-state of model
  - Home: $u_t = 2\bar{u} > 0$ for some $\bar{u} > 0$ for $t \in [0, T)$ and $u_t = 0$ for $t \geq T$
  - Foreign: $u_t^* = 0$ for $t \geq 0$
- In terms of “world” and “differences”:

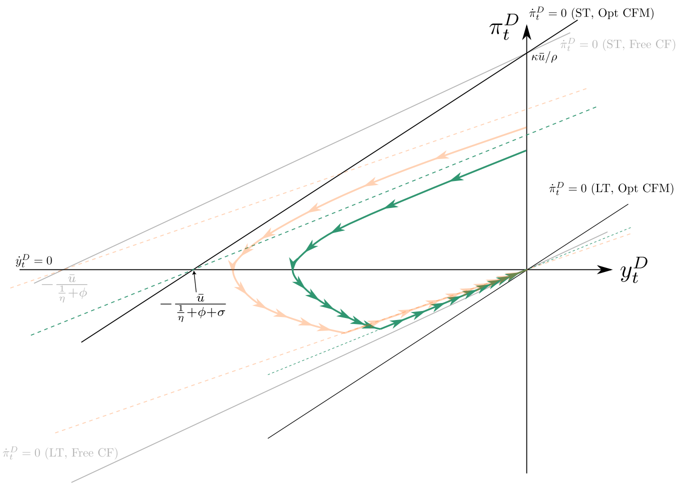
$$u_t^W = u_t^D = \begin{cases} \bar{u} > 0 & \text{for} \quad t \in [0, T) \\ 0 & \text{for} \quad t \geq T. \end{cases}$$

- How does world economy adjust under free capital mobility vs. constrained efficient regime?
- Targeting rules + NKPC D form a dynamical system amenable for phase diagram analysis.

Adjustment under free capital mobility

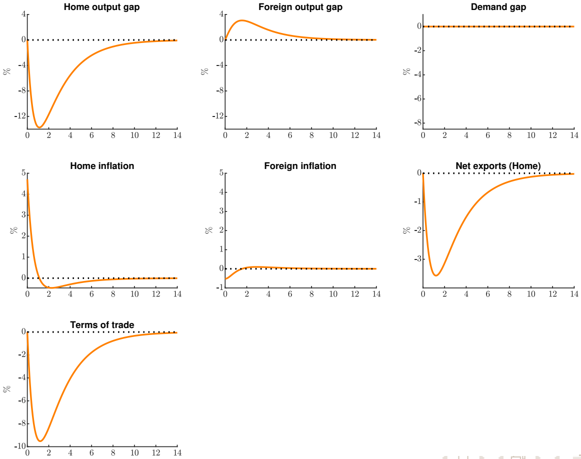


Adjustment under optimal CFM



Impulse responses to cost-push shock in calibrated example

Set $\rho = 0.04$, $\eta = 2$, $\alpha = 0.25$, $\phi = 0$, $\varepsilon = 7.66$, $\rho_\delta = 1 - 0.75^4$, with mean reverting Home cost-push shock matching annual autocorrelation of 0.65 (Groll and Monacelli, 2020).



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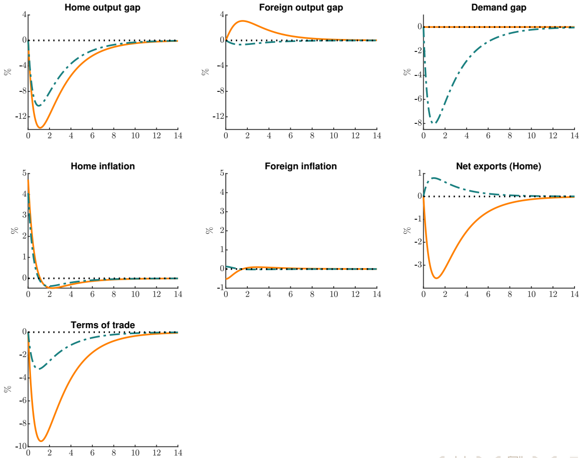
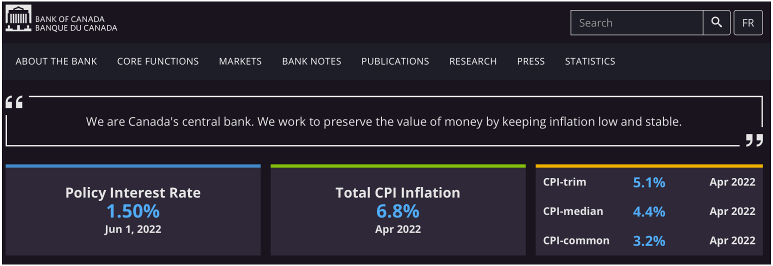


Conclusion

- Point to a macroeconomic externality operating via firms' marginal costs in open-economy model with nominal rigidities.
- When policy faces output-inflation trade-off, externality causes
  - Over-borrowing by high-inflation countries,
  - Topsy-turvy capital flows.
- Casts doubts on classical view that free capital mobility promotes macroeconomic adjustment, esp. in stagflationary context.
- Wider applicability: externality likely matters in other contexts with output-inflation tradeoffs and household heterogeneity (e.g., multi-sector closed economies).

Screen shot from BoC website on June 1st, 2022



Households

- Preferences over consumption and labor supply $u_t = \ln C_t - \frac{N_t^{1+\phi}}{1+\phi}$

- CES consumption $C \equiv \left[(1-\alpha)^{\frac{1}{\eta}} (C_H)^{\frac{\eta-1}{\eta}} + \alpha^{\frac{1}{\eta}} (C_F)^{\frac{\eta-1}{\eta}}\right]^{\frac{\eta}{\eta-1}}$ where
  - α captures trade openness, for presentation focus on $\alpha = 1/2$ (no home bias)
  - C_H, C_F Dixit-Stiglitz aggregates of goods produced in Home and Foreign with ES between varieties of ε.

- Can trade two types of nominal bonds, domestic D_t and international B_t

$$\dot{D}_t + \dot{B}_t = i_t D_t + (\underline{i_t} + \tau_t) B_t + W_t N_t - \int_0^1 P_{H,t}(l) C_{H,t}(l) dl - \int_0^1 P_{F,t}(l) C_{F,t}(l) dl + T_t.$$

Back

Firms + International relative prices

Firms

- Produce differentiated goods with technology $Y_t(l) = N_t(l)$.
- $N_t(l)$ is composite of individual household labor, CES aggregator with ES among varieties ε_t^w, to generate cost-push shocks.
- Calvo (1983) price setting with producer currency pricing. More details

International relative price

- Terms of trade $S_t \equiv P_{F,t}/P_{H,t} = P^*_{F,t}/P^*_{H,t}$.

Back

Details on firms' pricing

- Calvo (1983) price setting, opportunity to reset price $P^r_{H,t}(j)$ when receives price-change signal (Poisson process w. intensity $\rho_\delta \geq 0$). Firm maximizes

$$\int_t^\infty \rho_\delta e^{-\rho_\delta(k-t)} \frac{\lambda_k}{\lambda_t} \left[P^r_{H,t}(j) - P_{H,k} MC_k\right] Y_{k|t} dk,$$

subject to demand $Y_{k|t} = \left(P^r_{H,t}/P_{H,k}\right)^{-\varepsilon} Y_k$, with real marginal cost $MC_k \equiv (1-\tau^N) W_k / P_{H,k}$.

▸ Back

Canonical formulation for "world" and "difference"

- Define
  - "world" variables $y_t^W \equiv (y_t + y_t^*)/2$, $\pi_t^W \equiv (\pi_{H,t} + \pi_{F,t}^*)/2$,
  - "difference" variables $y_t^D \equiv (y_t - y_t^*)/2$, $\pi_t^D \equiv (\pi_{H,t} - \pi_{F,t}^*)/2$.
- Terms of trade satisfies

$$2y_t^D = \eta s_t. \qquad \text{(ToT)}$$

- NKPCs

$$\dot{\pi}_t^W = \rho \pi_t^W - \kappa(1+\phi) y_t^W - \kappa u_t^W, \qquad \text{(NKPC W)}$$

$$\dot{\pi}_t^D = \rho \pi_t^D - \kappa \left[\left(\frac{1}{\eta} + \phi \right) y_t^D + \frac{1}{2} \theta_t \right] - \kappa u_t^D. \qquad \text{(NKPC D)}$$

▸ Back

Welfare criterion

- Assume long-run distortions from monopolistic competition eliminated by labor subsidy.

- 2nd order approximation of (equally weighted) sum of households' utility around efficient steady state:

$$\mathbb{L}_t = \left[(1+\phi)(y_t^W)^2 + \frac{\varepsilon}{\kappa}(\pi_t^W)^2\right] + \left[\left(\frac{1}{\eta}+\phi\right)(y_t^D)^2 + \frac{\varepsilon}{\kappa}(\pi_t^D)^2\right] + \frac{1}{4}(\theta_t)^2 .$$

- Remark: "world" variables separated from "difference" variables in both objective function and constraints, can study determination of both blocks separately

▸ Back ▸ Loss function with home bias

Loss function with home bias

◇ Loss function with $\alpha < 1/2$

$$\mathbb{L}_t = \left[(1+\phi)(y_t^W)^2 + \frac{\varepsilon}{\kappa}(\pi_t^W)^2\right] + \left[(1+\phi)(y_t^D)^2 + \frac{\varepsilon}{\kappa}(\pi_t^D)^2\right]$$
$$+\alpha(1-\alpha)\left[(1-\eta)\eta(s_t)^2 + (\theta_t - (\eta-1)(1-2\alpha)s_t)^2\right].$$

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Details on optimal monetary policy

- Optimal monetary policy solves

$$\min_{\{y_t^W,\pi_t^W,y_t^D,\pi_t^D,s_t\}} \int_0^\infty e^{-\rho t}\Big\{\Big[(1+\phi)(y_t^W)^2+\frac{\varepsilon}{\kappa}(\pi_t^W)^2\Big]+\Big[(1+\phi)(y_t^D)^2+\frac{\varepsilon}{\kappa}(\pi_t^D)^2\Big]$$
$$+\alpha(1-\alpha)\Big[(1-\eta)\eta(s_t)^2+(\theta_t-(\eta-1)(1-2\alpha)s_t)^2\Big]\Big\}dt.$$

subject to

$$\dot{\pi}_t^W=\rho\pi_t^W-\kappa(1+\phi)y_t^W-\kappa u_t^W, \qquad \text{(NKPC W)}$$
$$\dot{\pi}_t^D=\rho\pi_t^D-\kappa\Big[(1+\phi)y_t^D-\frac{\omega-1}{2}s_t+\alpha\theta_t\Big]-\kappa u_t^D, \qquad \text{(NKPC D)}$$
$$2y_t^D=\omega s_t+(1-2\alpha)\theta_t. \qquad \text{(ToT)}$$

- Optimal plan characterized by targeting rules

$$\dot{y}_t^W+\varepsilon\pi_t^W = 0,$$
$$\dot{y}_t^D+\varepsilon\pi_t^D = 0.$$

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