Inequality and Optimal Monetary Policy in the Open Economy

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MOTIVATION

- How do aggregate shocks affect domestic inequality in SOE, and how should CB respond?

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- This paper: **normative** perspective on monetary policy in Open-Eco HANK

Main tradeoff and result

Aggregate shocks ⇒ output, national income ⇒ consumption risk & inequality

TRADE-OFF

Stabilizing consumption inequality

vs

$$\underbrace{\underbrace{\text{Closing output gap} + \text{stabilizing inflation}}_{\text{closed-eco RANK}} + \text{manipulating ToT}}_{\text{open-eco RANK}}$$

RESULTS

Conditions for "SOE-HANK divine coincidence"

Plausible calibration ⇒ More output and exch-rate stabilization than in RANK

Literature

1. **Positive** monetary policy analysis in open-economy HANK
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2. Optimal monetary policy analysis in **closed-economy** HANK
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3. Optimal monetary policy in open-economy **RANK** or **TANK**

   - 2-country or SOE models **with** int'al risk sharing

     [Clarida et al. '01, '03, Devereux & Engel '03, Benigno & Benigno '03, '05, Galí & Monacelli '05, Corsetti & Pesenti '05, Faia & Monacelli '08, De Paoli '09a, Corsetti et al. '10, Engel '11, Iyer '16, Chen et al. '23]

   - 2-country or SOE models **without** int'al risk sharing

     [Benigno '09, De Paoli '09b; Farhi & Werning '12 Egorov & Mukhin '23, Corsetti et al. '23]

Model

Households

- SOE à la Galí Monacelli (2005) + incomplete markets
- Perpetual youth demographics with turnover rate $1 - \vartheta$
- 2 groups of HHs:
  - **Unconstrained** (share $1 - \theta$) $\Rightarrow$ trade **non-state contingent** 1-period real actuarial bond
  - **Hand-to-Mouth** (share θ) $\Rightarrow$ cannot access asset markets
- All HHs subject to uninsured idiosyncratic shocks – in addition to aggregate shocks
- **CARA-Normal** structure as in Acharya et al. (2023)

Unconstrained households

Newborn i at date s max

$$\mathbb{E}_s \sum_{t=s}^{\infty} (\beta\vartheta)^{t-s} \left(\quad u\left(c_t^s(i,u)\right) - v\left(n_t\right) \quad \right)$$

s.t.

$$c_t^s(i,u) + (1+\tau^*)\frac{\vartheta}{R_t} a_{t+1}^s(i) = \mathbf{y}_t^s(i,u) + (1-\tau_t^a) a_t^s(i) \qquad a_t^t(i) = a_t$$

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$$\mathbf{y}_t^s(i,u) = (1-\tau^w) w_t n_t e_t^s(i,u) + \mathcal{D}_t + \mathcal{T}_t + \mathbb{T}_t$$

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$$e_t = 1 + \sigma_t \xi_t, \quad \xi_t = \xi_{t-1} + \upsilon_t$$

Unconstrained households

Newborn i at date s max

$$\mathbb{E}_s \sum_{t=s}^{\infty} (\beta\vartheta)^{t-s} \left(-\frac{1}{\gamma} e^{-\gamma c_t^s(i)} - v\left(n_t\right) \right)$$

s.t.

$$c_t^s(i,u) + (1+\tau^*)\frac{\vartheta}{R_t} a_{t+1}^s(i) = \mathbf{y}_t^s(i,u) + (1-\tau_t^a) a_t^s(i)$$

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$$\mathbf{y}_t^s(i,u) = \underbrace{\frac{P_{H,t}}{P_t} y_t}_{\text{national income}} + \mathbb{T}_t + \sigma_{y,t}\xi_t^s(i) \qquad \sigma_{y,t} = \sigma_y e^{-\varphi \widehat{y}_t}$$

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Euler equation:

$$e^{-\gamma c_t^s(i,u)} = \left(\frac{\beta R_t}{1+\tau^\star}\right) \mathbb{E}_t \left[e^{-\gamma c_{t+1}^s(i,u)} \right]$$

Unconstrained households

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- Define

$$c_t(u) = (1-\vartheta)\sum_{s=-\infty}^{t}\vartheta^{t-s}\int c_t^s(i,u)di$$

Unconstrained households

- CARA-Normal structure $\Rightarrow$ linear policy rules $\Rightarrow$ **linear aggregation**

- Define

$$c_t(u) = (1-\vartheta)\sum_{s=-\infty}^{t}\vartheta^{t-s}\int c_t^s(i,u)di$$

- Group-u Euler equation:

$$\Delta c_{t+1}(u) = \underbrace{\frac{1}{\gamma}\ln\left(\frac{\beta R_t}{1+\tau^\star}\right)}_{\text{intertemporal substitution}} + \underbrace{\frac{\gamma}{2}\sigma^2_{c_u,t+1}}_{\text{prec. saving}}$$

where

$$\sigma_{c_u,t} \approx \mu\,\sigma_{y,t} + (1-\mu)\,\sigma_{c_u,t+1}$$

Hand-to-Mouth households

- Consume current income:

$$c_t^s(i,h) = \frac{P_{H,t}}{P_t} y_t + \sigma_{y,t} \xi_t^s(i,h)$$

so that

$$c_t(h) = \frac{P_{H,t}}{P_t} y_t$$

where

$$\frac{P_{H,t}}{P_t} = \left(\frac{1 - \alpha Q_t^{1-\eta}}{1-\alpha} \right)^{\frac{1}{1-\eta}} \equiv p_H(Q_t)$$

- Consumption of HtM highly responsive Q_t

Households: Demand system and labour supply

- Demand system as in Galí-Monacelli with home bias $1-\alpha$ and elasticities details
  - η btw. H vs. F goods
  - ν across countries
  - ε across varieties
- Utilitarian unions set wages and demand uniform labor from HHs details
- Flexible wages + sticky prices as in Galí-Monacelli

- Rotemberg pricing + PCP + optimal payroll subsidy $\Rightarrow$ **NKPC:**

$$\ln \Pi_{H,t} = \frac{\varepsilon}{\Psi}\left[1 - \left(\frac{1}{1-\tau}\right)\left(\frac{\varepsilon-1}{\varepsilon}\right) p_H(Q_t)\frac{z_t}{w_t}\right] + \beta\left(\frac{z_t w_{t+1} y_{t+1}}{z_{t+1} w_t y_t}\right)\ln \Pi_{H,t+1}$$

where

$$1-\tau = \left(\frac{\varepsilon-1}{\varepsilon}\right) \underbrace{\left[\frac{\chi-1+\alpha}{\chi-1}\right]}_{\text{steady-state ToT manip.}}$$

and $\chi = \eta(1-\alpha)+\nu$ is the trade elasticity

Supply side

- Rotemberg pricing + PCP + optimal payroll subsidy ⇒ **NKPC:**

$$\ln \Pi_{H,t} = \frac{\varepsilon}{\Psi}\left[1 - \left(\frac{1}{1-\tau}\right)\left(\frac{\varepsilon-1}{\varepsilon}\right) p_H(Q_t)\frac{z_t}{w_t}\right] + \beta\left(\frac{z_t w_{t+1} y_{t+1}}{z_{t+1} w_t y_t}\right)\ln \Pi_{H,t+1}$$

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- **Output:**

$$y_t = \frac{z_t n_t}{1+\frac{\Psi}{2}\left(\ln \Pi_{Ht}\right)^2}$$

Market clearing and capital flows

- **Home goods:**

$$y_t = c_{Ht}(Q_t, c_t) + c^*_{Ht}(Q_t, c^*)$$

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- **Home savings:**

$$\underbrace{(1-\theta)\vartheta a_{t+1}}_{\text{intermediaries' liabilities}} = R_t[(1-\theta)\vartheta a_t + p_{Ht}y_t - c_t]$$

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- **Fisher parity:**

$$\ln R_t = \ln R^*_t + \ln \frac{Q_{t+1}}{Q_t} - \wp a_{t+1}$$

Optimal policy

Social Welfare Function

Planner maximises

$$\mathbb{W}_0 = \sum_{t=0}^{\infty} \beta^t \Bigg[\underbrace{(1-\vartheta) \sum_{s=-\infty}^{t} \vartheta^{t-s} \int \Big(-\frac{1}{\gamma} e^{-\gamma c_t^s(i)} \Big) di - v(n_t)}_{\text{flow utility to planner at time } t} \Bigg]$$

Social Welfare Function

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Social Welfare Function

Planner maximises

$$\mathbb{W}_0 = \sum_{t=0}^{\infty} \beta^t \left[\underbrace{u(c_t)}_{\text{felicity of notional RA } (<0)} \times \underbrace{\Sigma_t}_{\text{welfare cost of inequality}} - v(n_t) \right]$$

RANK: $\Sigma_t = 1$

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RANK: $\Sigma_t = 1$

HANK: $\Sigma_t > 1$

Welfare cost of inequality Σ_t

- Overall index combines **within** and **between** group inequalities

$$\Sigma_t = (1-\theta)\, e^{-\gamma\theta\Upsilon_t}\Sigma_{u,t} + \theta e^{\gamma(1-\theta)\Upsilon_t}\Sigma_{h,t}$$

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- Within **unconstrained**:

$$\Sigma_{u,t} = e^{\frac{\gamma^2 \sigma^2_{c_u,t}}{2}} \left[1 - \vartheta + \vartheta \Sigma_{u,t-1}\right]$$

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- Within **HtM**:

$$\Sigma_{h,t} = \frac{1-\vartheta}{e^{-\frac{\gamma^2\sigma^2_{y,t}}{2}}-\vartheta}$$

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- **Between**:

$$\Upsilon_t = c_t(u) - c_t(h)$$

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- **Between**:

$$\Upsilon_t = c_t(u) - c_t(h)$$

- If $\Upsilon_t > 0$, put relatively less weight on inequality within group u

Between-group inequality

- Suppose $\widehat{R}_t^* > 0$ but domestic monetary policy does not respond: $\widehat{R}_t = 0$

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$$\Delta \widehat{Q}_{t+1} = \widehat{R}_t - \widehat{R}^*_t = -\widehat{R}^*_t < 0$$

- Cons. growth of each group:

$$\Delta \widehat{c}_{u,t+1} = \underbrace{\frac{1}{\gamma}\widehat{R}_t}_{=0} + \frac{\gamma \sigma^2_{c_u}}{2}\widehat{\sigma}_{c_u,t+1} \qquad \text{and} \qquad \Delta \widehat{c}_{h,t+1} = \underbrace{-\frac{\alpha}{1-\alpha}\Delta \widehat{Q}_{t+1}}_{>0} + \Delta \widehat{y}_{t+1}$$

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- Depending on domestic mon. policy response, $c_{u,t}$ and $c_{h,t}$ can diverge

Policy Instruments

- **Fiscal policy**: $\{\tau, \tau^{\star}, \tau^{w}, \tau_t^{a}\}$ optimally set ex ante and unresponsive to aggregate shocks

- **Monetary policy**: $\{i_t\}$ adjusted optimally in response to aggregate shocks

Policy Instruments

- **Fiscal policy**: $\{\tau, \tau^{\star}, \tau^{w}, \tau_t^{a}\}$ optimally set ex ante and unresponsive to aggregate shocks
  - τ balances monopolistic distortions
  - τ^{w} balances labour-wedge distortions
  - $\tau^{\star}$ kills steady-state capital outflow
  - τ_0^{a} kills unhedged interest-rate exposure
  - results in **constrained-efficient** steady state
- **Monetary policy**: $\{i_t\}$ adjusted optimally in response to aggregate shocks

Domestic productivity shocks

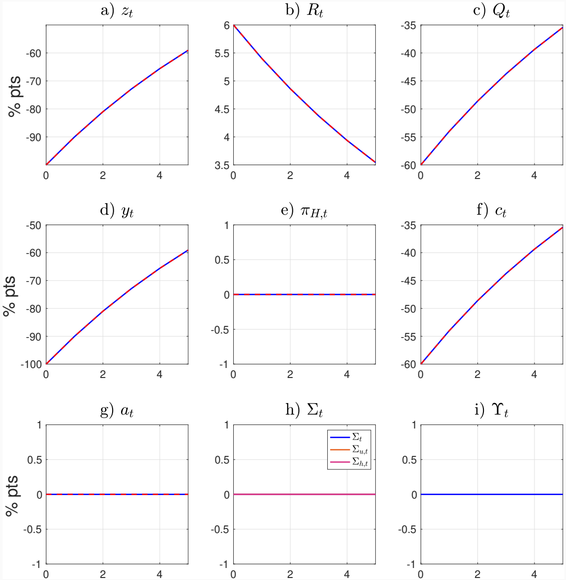
Domestic productivity shock

- **RANK** benchmark: Galì & Monacelli (2005)
- With $\gamma = \eta = \nu = 1$, **domestic PPI stability** is optimal $\Rightarrow$ "inward-looking" policy
- Optimal allocation features

$$c_t = p_H(Q_t)y_t \qquad a_t = 0 \qquad \Pi_{H,t} = 1 \qquad \forall t \geq 0$$

- Implementable by monetary policy **with or without** international risk sharing (in latter case, HHs **choose** not to borrow/lend from abroad)

z_t-SHOCK (RANK)



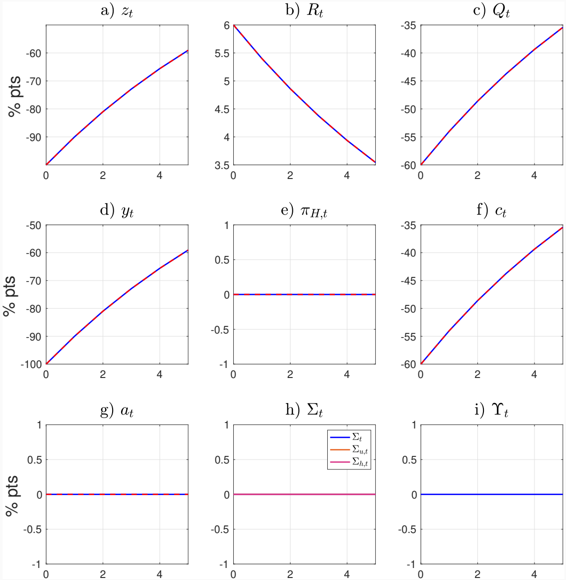
SOE-HANK DIVINE COINCIDENCE

Proposition: Under Cole-Obstfeld elasticities ($\gamma = \eta = \nu = 1$) and acyclical income risk ($\varphi = 0$), optimal monetary policy implements strict producer price stability in SOE-HANK, regardless of the fraction of HtM households (θ) or the size of income risk ($\sigma_{y,t}$).

Sketch of proof:

- Acyclical risk $\Rightarrow$ constant within-group inequality
- Cole-Obstfeld $\Rightarrow$ unconstrained as a whole do not save $\Rightarrow$ no between-group inequality
- The two groups are **equally exposed** to the aggregate shock

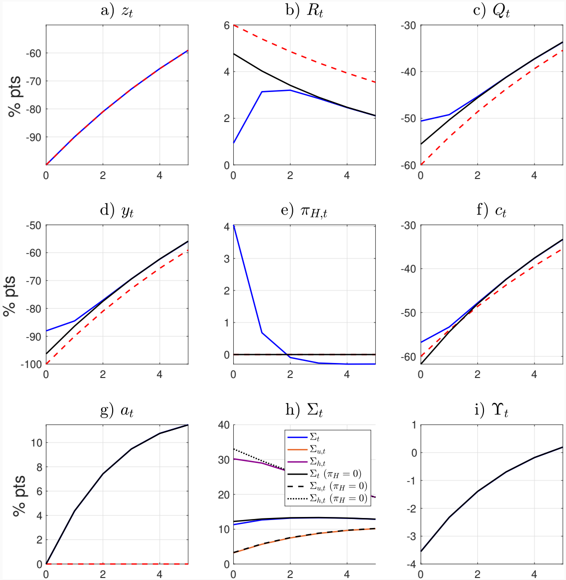
z_t-shock (HANK, Cole-Obstfeld, acyclical risk)



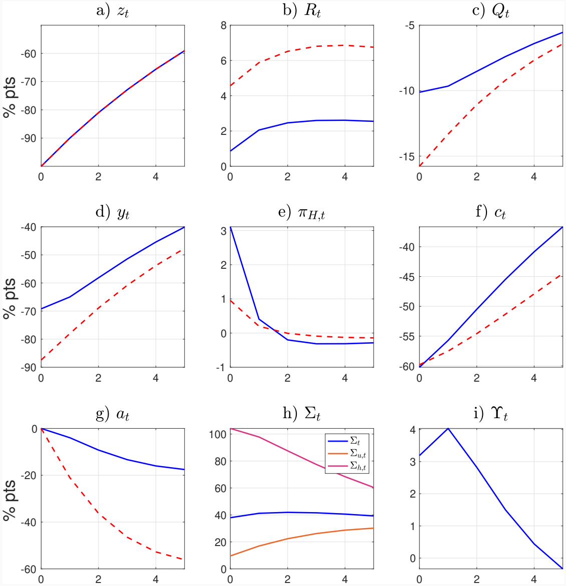
Breakdowns of divine coincidence

- Former calibration is an (unrealistic) **benchmark**
- In reality,
  - risk is countercyclical
    $\Rightarrow \varphi = 5$ as in Acharya et al. (2023)
  - trade elasticities are high, EIS is small
    $\Rightarrow \eta = 1.5, \nu = 4, \gamma = 2$ as in Egorov & Mukhin (2023)
- **Note**: away from Cole-Obstfeld, traditional **ToT manipulation** also plays out

z_t-shock (HANK, CO, countercyclical risk)

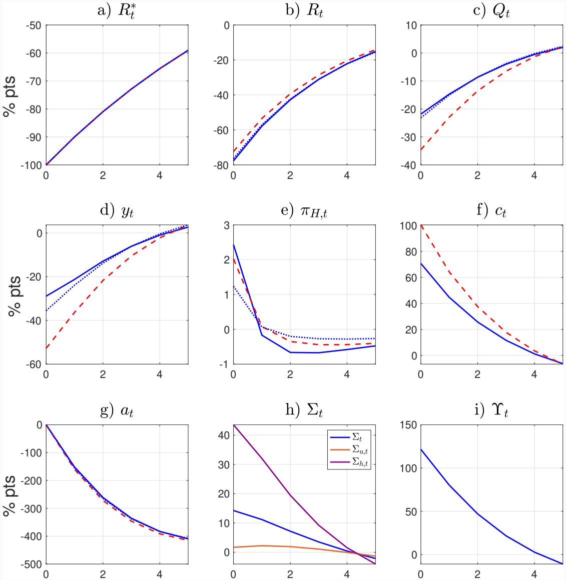


z_t-SHOCK (HANK, NON-CO, COUNTERCYCLICAL RISK)



Capital flow shock

R^*-shock (HANK, non-CO, countercyclical risk)



Conclusion

- Acyclical risk + Cole-Obsftfeld $\Rightarrow$ **SOE-HANK divine coincidence**
  (i.e., Cole-Obstfeld matters for ToT manipulation **and** for inequality)

- Breaks down under more plausible risk (counter)cyclicality and (higher) trade elasticities

- Optimal policy implements **less volatile** exchange rate and output in HANK
  - **[unequal exposures]** $\Rightarrow$ reduces differences in real incomes btw u and h HHs
  - **[countercyclical risk]** $\Rightarrow$ reduces fluctuations of within-group inequality

Demand system

- Final cons. goods produced by competitive retailers aggregating varieties from all countries
- Their production functions are

$$c = \left[\alpha^{\frac{1}{\eta}} c_F^{\frac{\eta-1}{\eta}} + (1-\alpha)^{\frac{1}{\eta}} c_H^{\frac{\eta}{\eta-1}}\right]^{\frac{\eta}{\eta-1}} \quad c_H = \left[\int_0^1 c_H(j)^{\frac{\varepsilon-1}{\varepsilon}} dj\right]^{\frac{\varepsilon}{\varepsilon-1}} \quad c_F = \left[\int_0^1 c_k^{\frac{\nu-1}{\nu}} dk\right]^{\frac{\nu}{\nu-1}}$$

- Let $p_{H,t}, p_{F,t}$ be the prices of the home and foreign baskets in terms of home consumption
- Profit minimisation + zero-profit condition gives the demands

$$c_{H,t} = (1-\alpha) p_{H,t}^{-\eta} c_t \quad c_{F,t} = (1-\alpha) p_{F,t}^{-\eta} c_t$$

where

$$(1-\alpha) p_{H,t}^{1-\eta} + \alpha p_{F,t}^{1-\eta} = 1 \quad \text{and} \quad p_{F,t} = Q_t$$

- Conversely, the demand for home goods by the RoW is

$$c_{Ht}^* = \alpha \left(\frac{p_{H,t}}{Q_t}\right)^{-\nu} c^*$$

back

Labour supply

- Setup similar to Auclert et al. (2023): Each HH supplies a continuum of labour types to a continuum of unions, each of which demands the same number of hours from all members

- Each union is benevolent and utilitarian, and sets wages accordingly

- With flexible wages, the optimality condition boils down to

$$\underbrace{(1-\tau^w)\,w_t}_{\text{post-tax wage}} = \underbrace{\mathcal{M}_w}_{\text{markup}} \times \underbrace{\frac{v'(n_t)}{u'(c_t)\,\Sigma_t}}_{\text{"avg. MRS"}}$$

where

$$\Sigma_t = (1-\vartheta)\sum_{s=-\infty}^{t} \vartheta^{t-s} \int e^{-\gamma[c_t^s(i)-c_t]} di$$

captures the dispersion in marginal utility between the members of every union

back