CREI Lecture I

Ivan Werning

Setting the Stage

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- International Macro: full of tradeoffs
- Events…
  - Globalization, large and volatile capital flows
  - Policy responses; EM; IMF

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- Events…
  - Globalization, large and volatile capital flows
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- Older literature: offered insights, ideas and conjectures
- Modern open macro: better foundations, normative, but narrower analysis
- Lectures approach: **study 2nd best; Macro + Optimal Taxation**
- Based on joint papers with Emmanuel Farhi

Setting the Stage

- Trilemma and OCA literature…
  - Trilemma… Mundell (63), Fleming (62)
  - factor mobility… Mundell (61)
  - openness… McKinnon (63)
  - fiscal integration….Kennen (69)
  - financial integration...Mundell (73)

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- Lecture 1: Capital Controls
- Lecture 2: Fiscal Unions
- Lecture 3: Mobility

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Draw on two papers for today:

Farhi-Werning "Dealing with the Trilemma: Optimal Capital Controls with Fixed Exchange Rates"

Farhi-Werning "Dilemma not Trilemma? Capital Controls and Exchange Rates with Volatile Capital Flows"

Trilemma

- Fixed exchange rates
- Independent monetary policy
- Free capital flows

Trilemma

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John Maynard Keynes…

“In my view the whole management of the domestic economy depends on being free to have the **appropriate rate of interest** without reference to the **rates prevailing elsewhere** in the world**. Capital controls is a corollary to this**.”

“[...] **control of capital** movements, both inward and outward, should be a **permanent feature** of the post-war system.”

“What used to be a heresy is now endorsed as orthodoxy.”

Trilemma

- Fixed exchange rates
- Independent monetary policy
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Trilemma → Dilemma

- **Managed** Exchange Rates
- Independent Monetary Policy
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Trilemma → Dilemma

- **Managed** Exchange Rates
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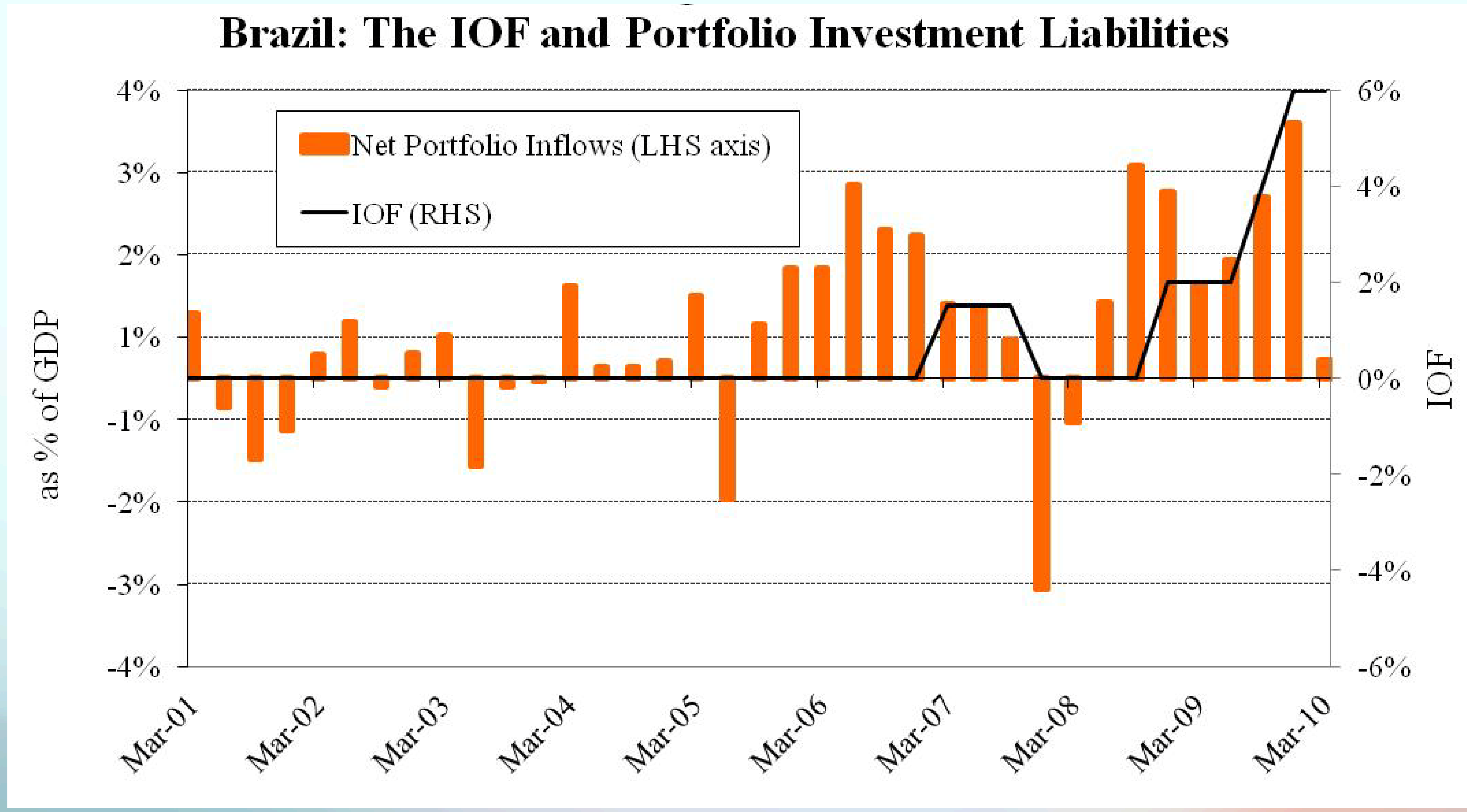
- Emerging Markets…
  - in practice, manage exchange rate
  - capital controls
  - close cousin FX interventions



Source: Forbes et al (2011)

Trilemma → Dilemma

- **Managed** Exchange Rates
- Independent Monetary Policy
- Free Capital Flows

- IMF…
  - “Our views are evolving. In the IMF, in particular, while the tradition had long been that **capital controls** should not be part of the toolbox, we are now **more open to their use** in appropriate circumstances” DSK 2011
  - “While the issue of capital controls is fraught with ideological overtones, it is fundamentally a technical one, **indeed a highly technical one**.” Olivier Blanchard 2011
  - More recently Lipton called to develop: **“Integrated Policy Framework”** (Gopinath 2022)

Why?

- Why care about **Trilemma and Capital Controls**?
  - nowadays few fixed FX regimes: Hong Kong, Ecuador, El Salvador, Zimbabwe, Saudi Arabia, Paraná, Caribbean/Pacific islands, Kosovo, Montenegro, …
  - recent history: Bretton Woods, pervasive for disinflation in 80s (impossible to repeat?)
  - stepping stone → **Dilemma**
- Capital controls *in* currency union (e.g. USA or Euro)…
  - overtly, *not* likely in normal times
  - covertly or in extreme circumstances?
    - ✦ Euro crises: market segmentation, role of member central banks, collateral
    - ✦ possible: regional credit conditions via bank regulation, macroprudential policy
  - understand what we are missing and costs of monetary union
  - stepping stone → **Fiscal Unions** (Lecture 2)
- Future? Private crypto dream? Central Banks losing control of monetary policy? Unlikely but…?

Today

- Optimal monetary policy: well developed theory
- Today: optimal capital controls…
  - Trilemma: fixed exchange rate
  - Dilemma: flexible exchange rate
- Examine…
  - different kinds of shock and persistence
  - degree of price rigidity
  - degree of openness
- Methods: open economy macro models…
  - non-linear (more intuitive) and linearized (integrate to standard DSGE)
  - <u>primal approach</u> to 2nd best planning problem

Households

- Continuum of small open economies $i \in [0,1]$
- Today: focus on single Home country, rest symmetric
- Representative household maximizes

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

subject to

$$P_t C_t + D_{t+1} + E_t D^*_{t+1} \leq W_t N_t + \Pi_t + T_t$$
$$+(1+i_{t-1}) D_t + \qquad E_t (1+i^*_{t-1}) D^*_t$$

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subject to

capital controls

$$P_t C_t + D_{t+1} + E_t D_{t+1}^* \leq W_t N_t + \Pi_t + T_t$$
$$+ (1+i_{t-1}) D_t + (1+\tau_{t-1}) E_t (1+i_{t-1}^*) D_t^*$$

Trilemma

$$1 + i_t = (1 + i_t^*)\frac{E_{t+1}}{E_t}(1 + \tau_t)$$

Trilemma

- No arbitrage (UIP)

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- Fixed exchange rates $E_t = E_{t+1} = \bar{E}$
- Capital control tradeoff...
  - cost: distortion from τ_t
  - benefit: flexiblility in i_t
- Optimal Tradeoff: 2nd best problem

Differentiated Goods

$$C_t = \left[(1-\alpha)^{\frac{1}{\eta}} C_{H,t}^{\frac{\eta-1}{\eta}} + \alpha^{\frac{1}{\eta}} C_{F,t}^{\frac{\eta-1}{\eta}} \right]^{\frac{\eta}{\eta-1}}$$

$$C_{F,t} = \left(\int_0^1 \Lambda_{i,t}^{\frac{1}{\gamma}} C_{i,t}^{\frac{\gamma-1}{\gamma}} di \right)^{\frac{\gamma}{\gamma-1}}$$

Λ_i = Export Demand Shocks

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Differentiated Goods

Price Indices….

$$P_t = [(1-\alpha)P_{H,t}^{1-\eta} + \alpha P_{F,t}^{1-\eta}]^{\frac{1}{1-\eta}}$$

$$P_{F,t} = \left(\int_0^1 \Lambda_{i,t} P_{i,t}^{1-\gamma} di\right)^{\frac{1}{1-\gamma}}$$

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Relative Prices

- Law of one price (PCP = LCP = DCP with FX fixed)

$$P_{F,t} = E_t P_t^*$$

- Terms of trade…

$$S_t = \frac{P_{F,t}}{P_{H,t}} = \frac{E_t P_t^*}{P_{H,t}}$$

- Real exchange rate…

$$\mathcal{Q}_t = \frac{E_t P_t^*}{P_t}$$

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$$\mathcal{Q}_t = \left[(1-\alpha)\left(S_t\right)^{\eta-1} + \alpha\right]^{\frac{1}{\eta-1}}$$

Firms

- Each variety…
  - produced monopolistically
  - technology

$$Y_t(j) = A_{H,t} N_t(j)$$

Nominal Rigidities

1. Flexible Prices
2. Rigid Prices
3. One-Period Ahead Sticky Prices
4. Calvo Pricing

“MIT” Unanticipated Shocks

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1. Productivity $\{A_t\}$

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$$1 + i_t^* = \beta \left(\frac{C_{t+1}^*}{C_t^*} \right)^{-\sigma}$$

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1. Productivity $\{A_t\}$
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4. Net Foreign Asset NFA_0

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5. World interest rate $\{i_t^*\}$ (mix of C_t^* and Λ_t) equivalent to **risk premium shock** $\{\Psi_t\}$...

Main Interest

$$1 + i_t = \Psi_t(1 + \tau_t)(1 + i_t^*)\frac{E_{t+1}}{E_t}$$

Planning Problem

- Study 2nd best planning problem
  - fix exchange rate $E_{t+1} = E_t$
  - optimize capital controls τ_t and monetary policy i_t
  - primal approach: choose equilibrium subject to constraints
- Next task
  - Develop equilibrium conditions
  - Set up planner: get rid of some conditions

Equilibrium Conditions

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$$\left(\Delta_t = \int_0^1 \left(\frac{P_{H,t}(j)}{P_{H,t}}\right)^{-\epsilon} dj\right)$$

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drop τ_t and i_t
drop both equations

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Planner: Flexible Prices

$$\max \sum_{t=0}^{\infty} \beta^t \left[\frac{C_t^{1-\sigma}}{1-\sigma} - \frac{N_t^{1+\phi}}{1+\phi} \right]$$

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Flexible Prices Benchmark

Proposition. Around steady state…
1. No capital controls in response to permanent shocks (or NFA).
2. C-O case: no capital controls in response to $\{A_t, C_t^*\}$, but non zero for $\{\Lambda_t, \Psi_t\}$

- Cole-Obstfeld case…
  - without capital controls… trade is balanced
  - … no incentive to affect terms of trade
- non Cole-Obstfeld ➡ capital controls (Costinot-Lorenzoni-Werning)

Planner: Rigid Prices

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(normalized to 1)

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$$1 = \left[(1-\alpha)(1)^{\eta-1} + \alpha \right]^{\frac{1}{\eta-1}}$$

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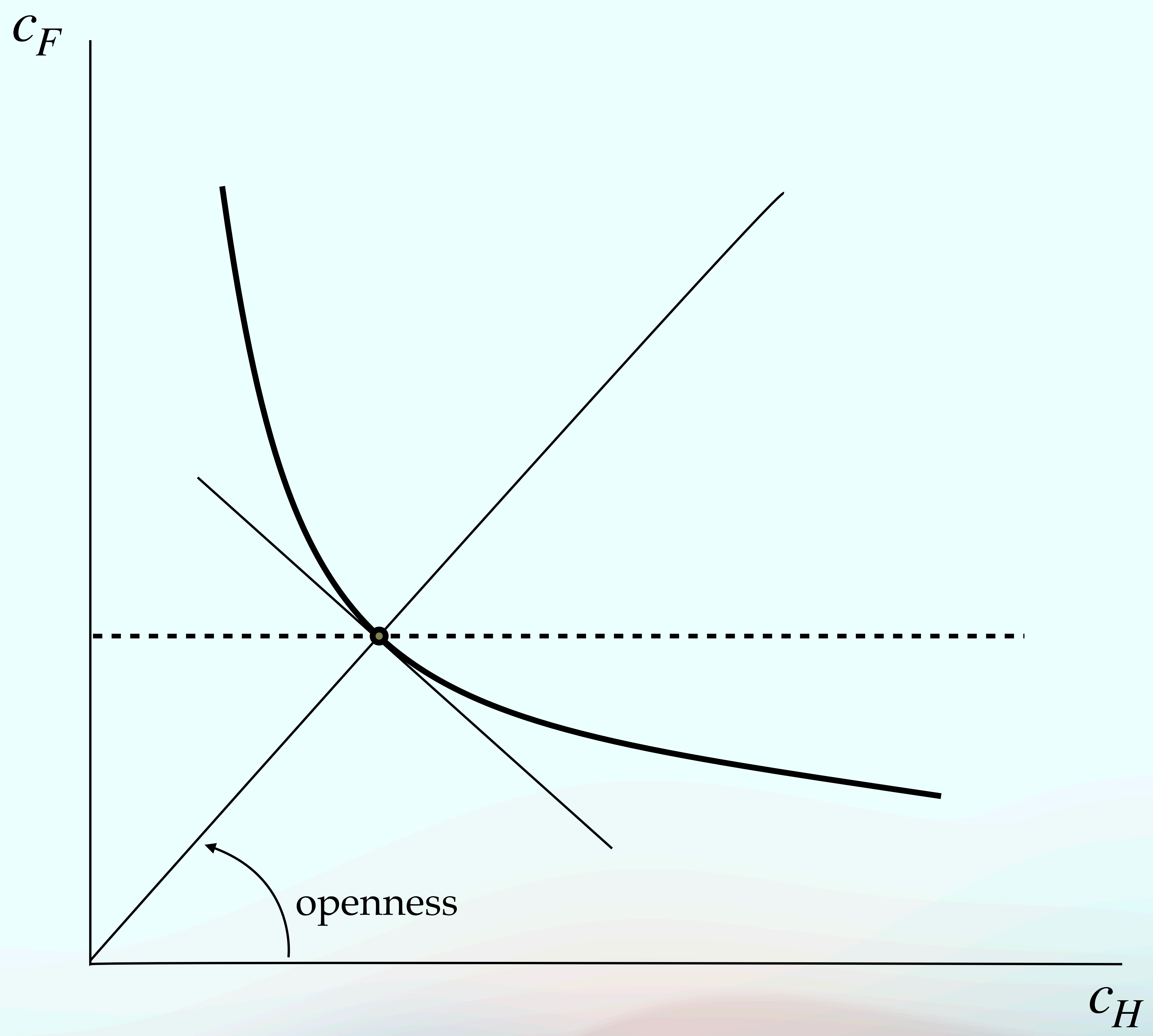
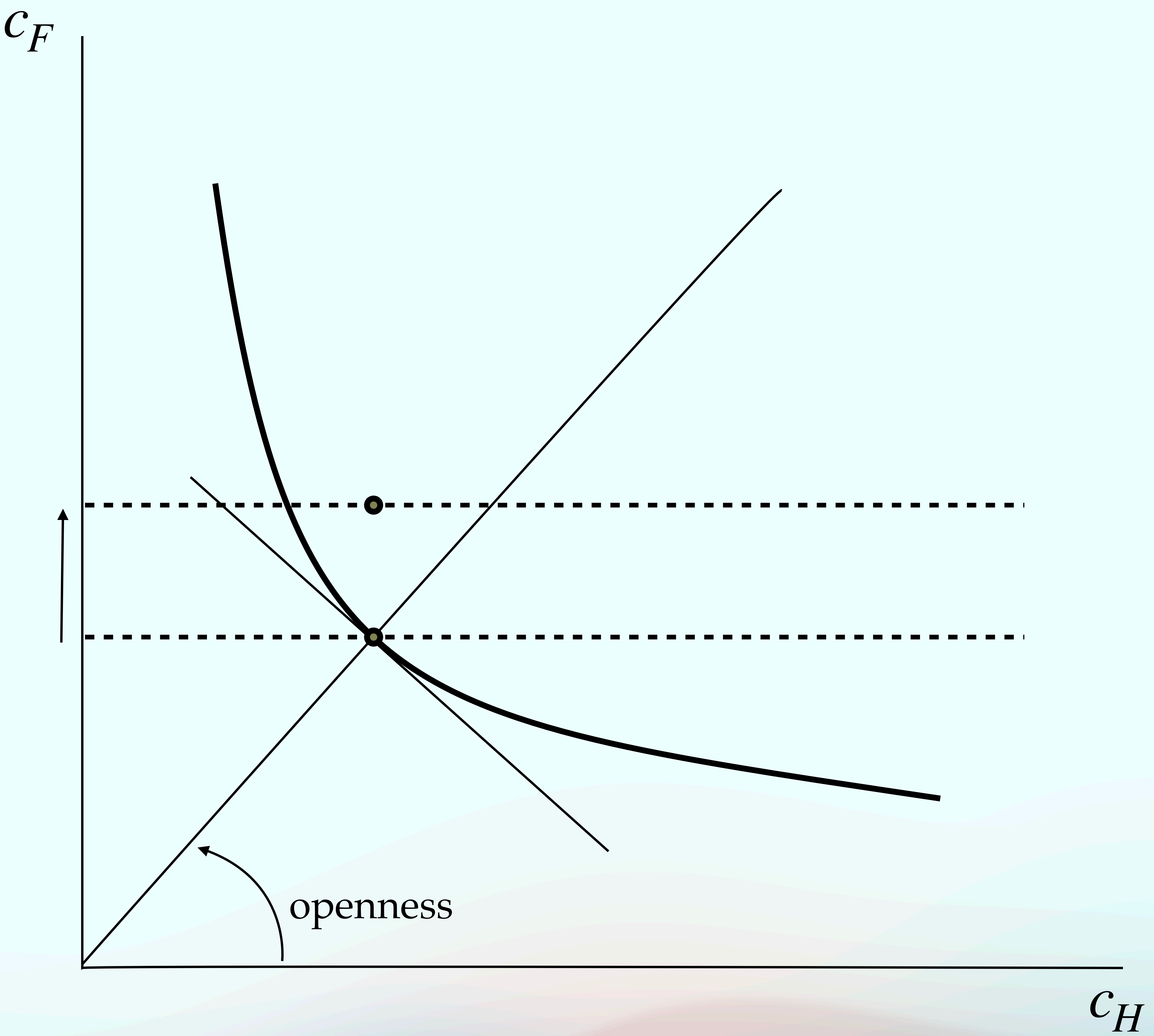
Proposition. Tax on inflows has sign...

1. same $A_{t+1} - A_t$
2. opposite $\Lambda_{t+1} - \Lambda_t$
3. opposite $C_{t+1}^* - C_t^*$
4. opposite ψ_t


c_F
openness
c_H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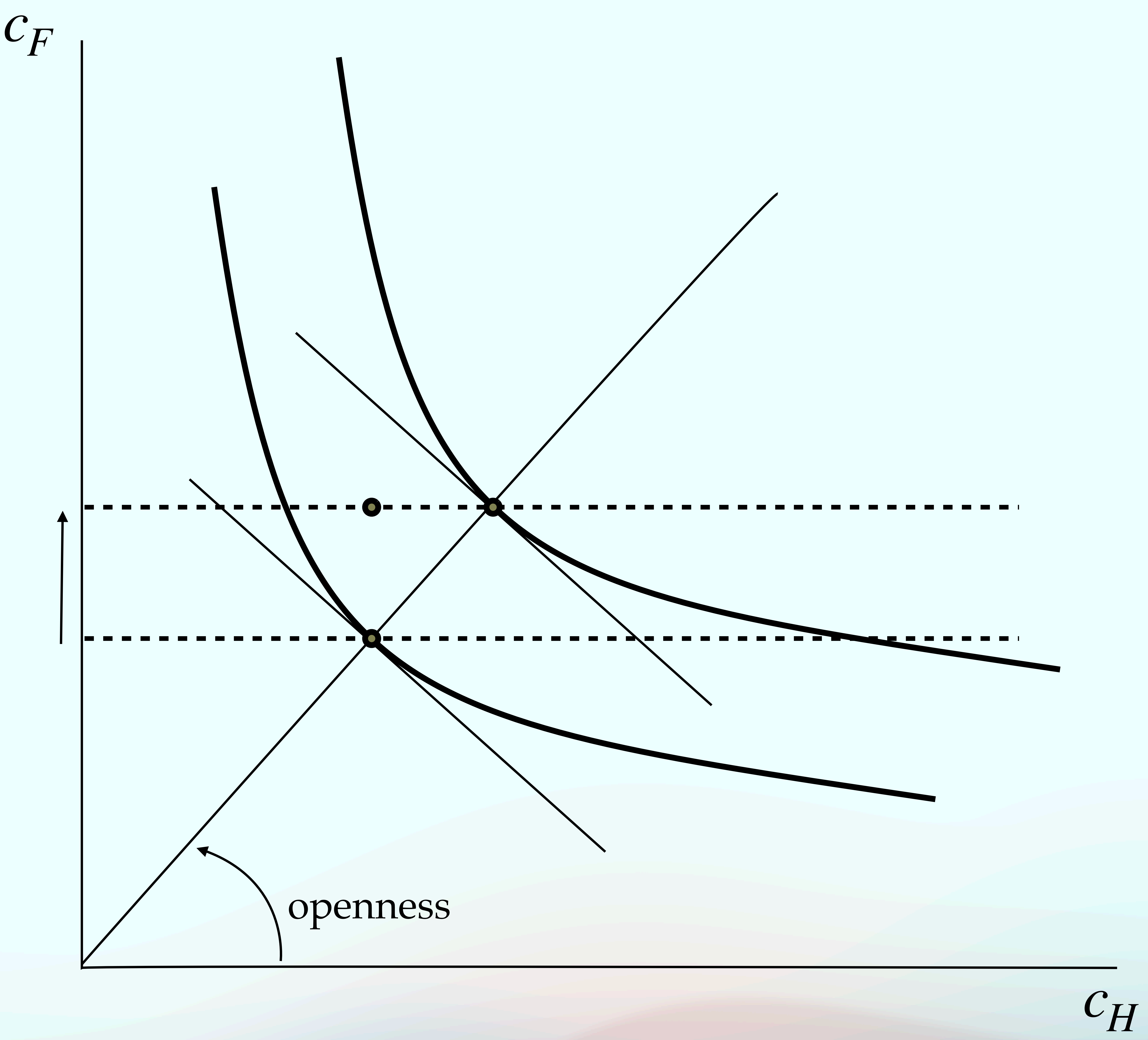
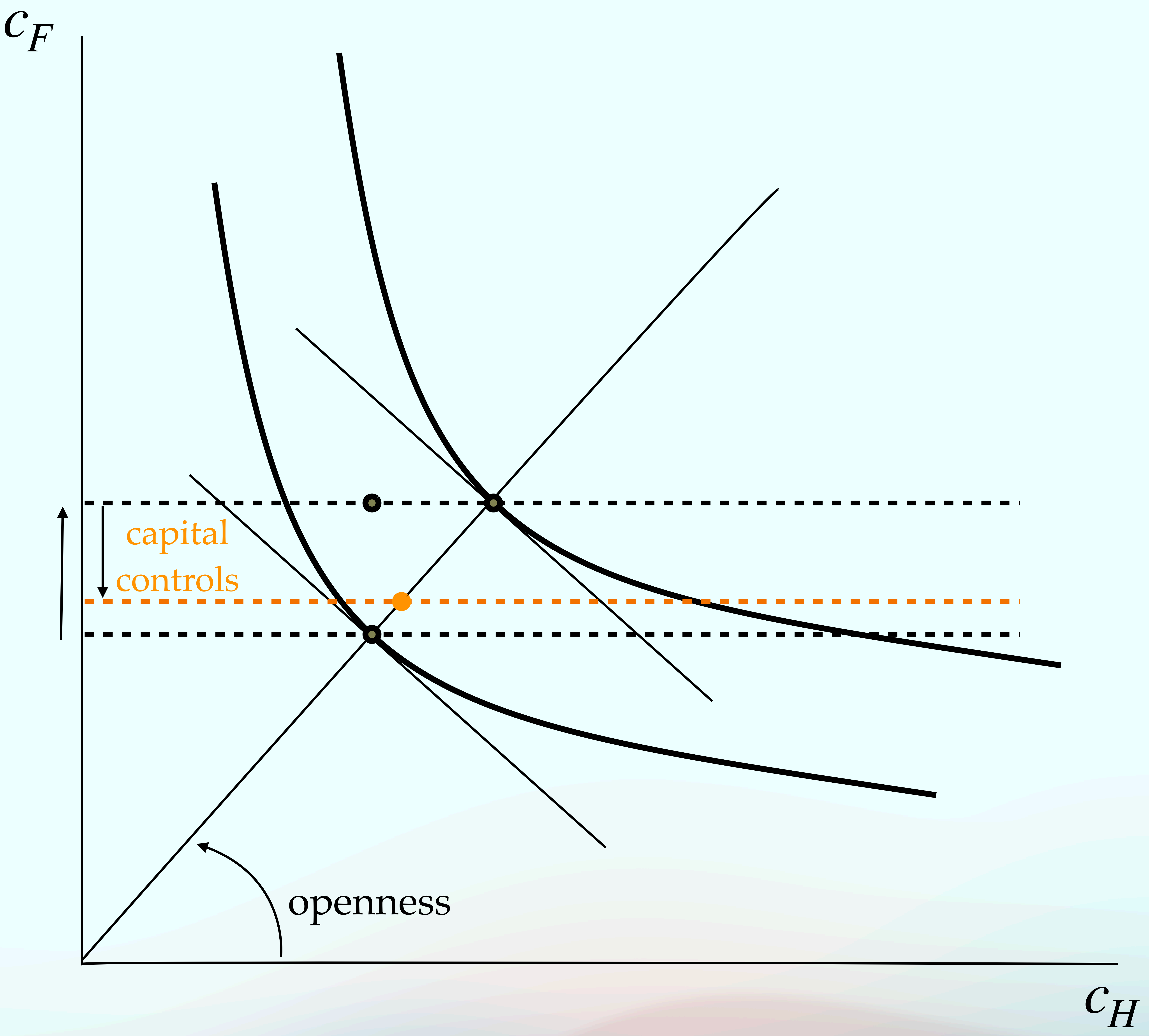

c_F
openness
c_H


c_F
capital
controls
openness
c_H

One-Period Sticky

$$\max_{Y_0, C_0, W_1} \left[\frac{C_0^{1-\sigma}}{1-\sigma} - \frac{N_0^{1+\phi}}{1+\phi} + \beta V(NFA_1) \right]$$

flexible price
value function

$$Y_0 = (1-\alpha) C_0 + \alpha \Lambda_0 C_0^*$$

$$N_0 = \frac{Y_0}{A_0}$$

$$NFA_0 = -C_0^{*-\sigma} (Y_0 - C_0) + \beta NFA_1$$

One-Period Sticky

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Proposition.
Same signs as before but now both…

1. temporary shocks
2. permanent shocks + NFA

How Effective are Capital Controls?

- Closed economy limit $\alpha \to 0$
- Formal results…
  - Zero Capital Controls: No
    intuition: interest rate control still lost!
  - Welfare loss gone?
    - Not in general…
      intuition: subtle,
    - … true for risk premium shocks
      intuition: insulate, cancel the shock
- Conclusion: Capital controls can be very effective

Calvo Pricing

- Calvo Poisson price reset…
  - cost of inflation
  - capital controls affect inflation...
    ... prudential interventions?
    i.e. don't let exchange rate get overvalued, if capital info may reverse
- Log-linearize around symmetric steady state
- Focus on Cole-Obstfeld case: $\sigma = \gamma = \eta = 1$
- Continuous time: convenient, initial prices given (not crucial)

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$$C_t = \Theta_t C_t^* \mathcal{Q}_t^{\frac{1}{\sigma}}$$

Backus Smith condition

Calvo Pricing

- Calvo Poisson price reset…
  - cost of inflation
  - capital controls affect inflation...
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    i.e. don't let exchange rate get overvalued, if capital info may reverse
- Log-linearize around symmetric steady state
- Focus on Cole-Obstfeld case: $\sigma = \gamma = \eta = 1$
- Continuous time: convenient, initial prices given (not crucial)

$$C_t = \Theta_t C_t^* Q_t^{\frac{1}{\sigma}} \longrightarrow \hat{c}_t = \hat{\theta}_t + \hat{c}_t^* + \frac{1}{\sigma}\hat{q}_t$$

Backus Smith condition

Planning Problem

Planning Problem

$$\dot{\hat{y}}_t = (1-\alpha)(i_t - i_t^*) - \pi_{H,t} + i_t^* - \bar{r}_t$$

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$$\int e^{-\rho t}\hat{\theta}_t dt = 0$$

Planning Problem

$$\dot{\pi}_{H,t} = \rho \pi_{H,t} - \hat{\kappa}\hat{y}_t - \lambda\alpha\hat{\theta}_t$$

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$$\hat{y}_0 = (1 - \alpha)\hat{\theta}_0 - \bar{s}_0$$

Planning Problem

$$\min \int e^{-\rho t} \left[\alpha_\pi \pi_{H,t}^2 + \hat{y}_t^2 + \alpha_\theta \hat{\theta}_t^2 \right] dt$$

no $\{\Lambda_t, \Psi_t\}$ shocks
only $\{A_t, c_t^*\}$ shocks

$$\dot{\pi}_{H,t} = \rho \pi_{H,t} - \hat{\kappa} \hat{y}_t - \lambda \alpha \hat{\theta}_t$$

$$\dot{\hat{y}}_t = (1-\alpha)(i_t - i_t^*) - \pi_{H,t} + i_t^* - \bar{r}_t$$

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Planning Problem

with $\{\Lambda_t, \Psi_t\}$ shocks

$\tilde{y}_t \neq 0$

$\tilde{\theta} \neq 0$

$$\min \int_0^\infty e^{-\rho t} \left[\alpha_\pi \pi_{H,t}^2 + (\hat{y}_t - \tilde{y}_t))^2 + \alpha_\theta(\hat{\theta}_t - \tilde{\theta}_t)^2 \right] dt$$

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Risk Premia Shock

- Risk Premia $i_t = i_t^* + \psi_t + \tau_t$
- Consider shock $\psi_t < 0$ (lower rate)
- Natural allocation...
  - appreciation + current account deficit (inflow)
  - efficient output
- Equilibrium with no capital controls...
  - (slower) appreciation via inflation + current account deficit
  - output boom

Rigid Prices

Proposition.

$$\tau_t = -\underbrace{\frac{\frac{1+\phi(1-\alpha)}{1+\phi}}{1-\alpha+\frac{\alpha_\theta}{1-\alpha}}}_{\leq 1}\psi_t$$

- Stabilizes CA
- Lean against the wind...
- ...more effective when economy more closed

Closed Economy Limit

Proposition. Let $\alpha \to 0$

$$\tau_t = -\psi_t$$

$$\hat{y}_t = \pi_{H,t} = 0$$

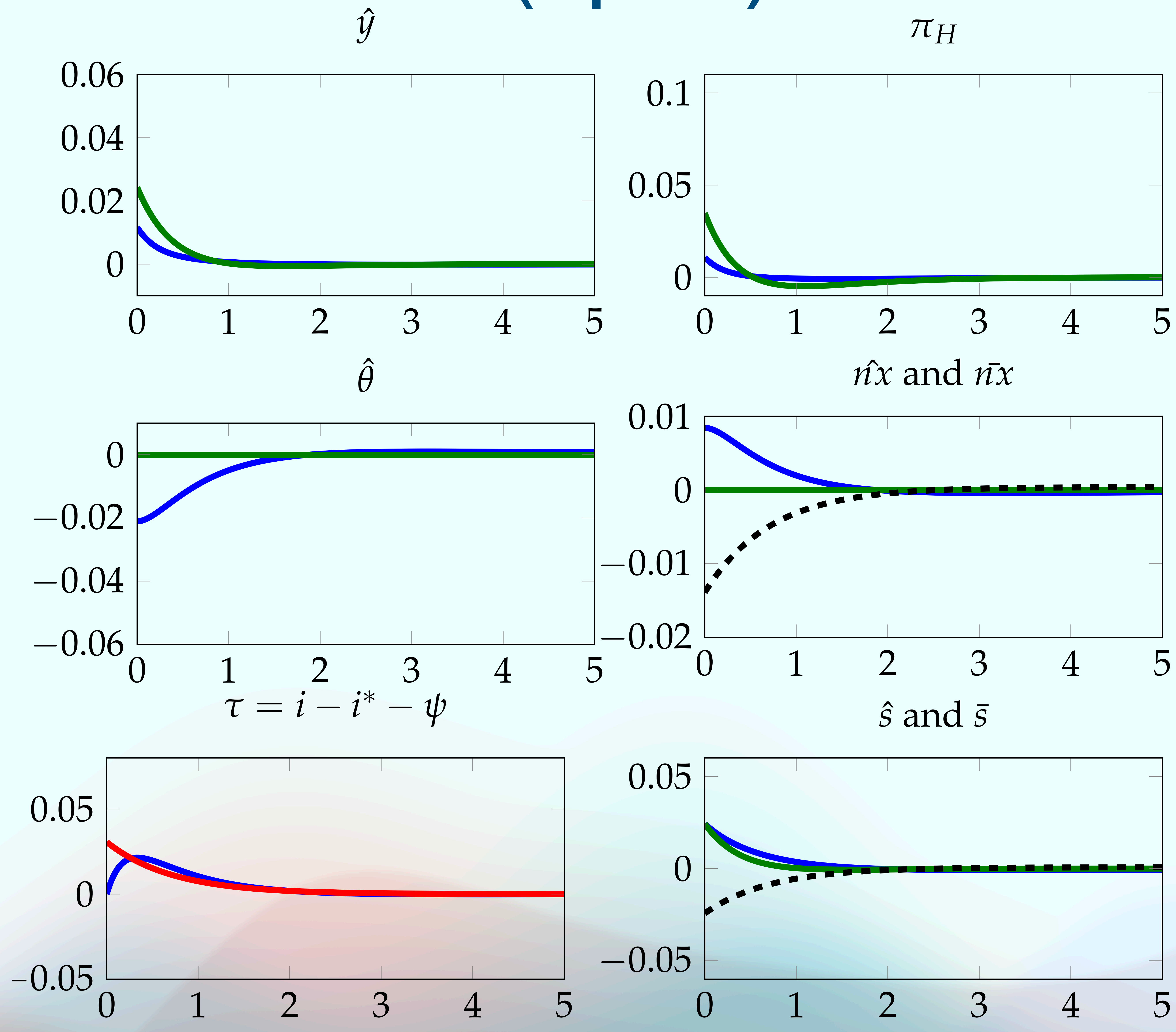
- Note: any price stickiness
- Lean against the wind one-for-one
- Perfectly stabilize economy...
- ...**not** true for other shocks

Risk Premium $\alpha = 0.4$ (open)

No Intervention

vs

Capital Controls

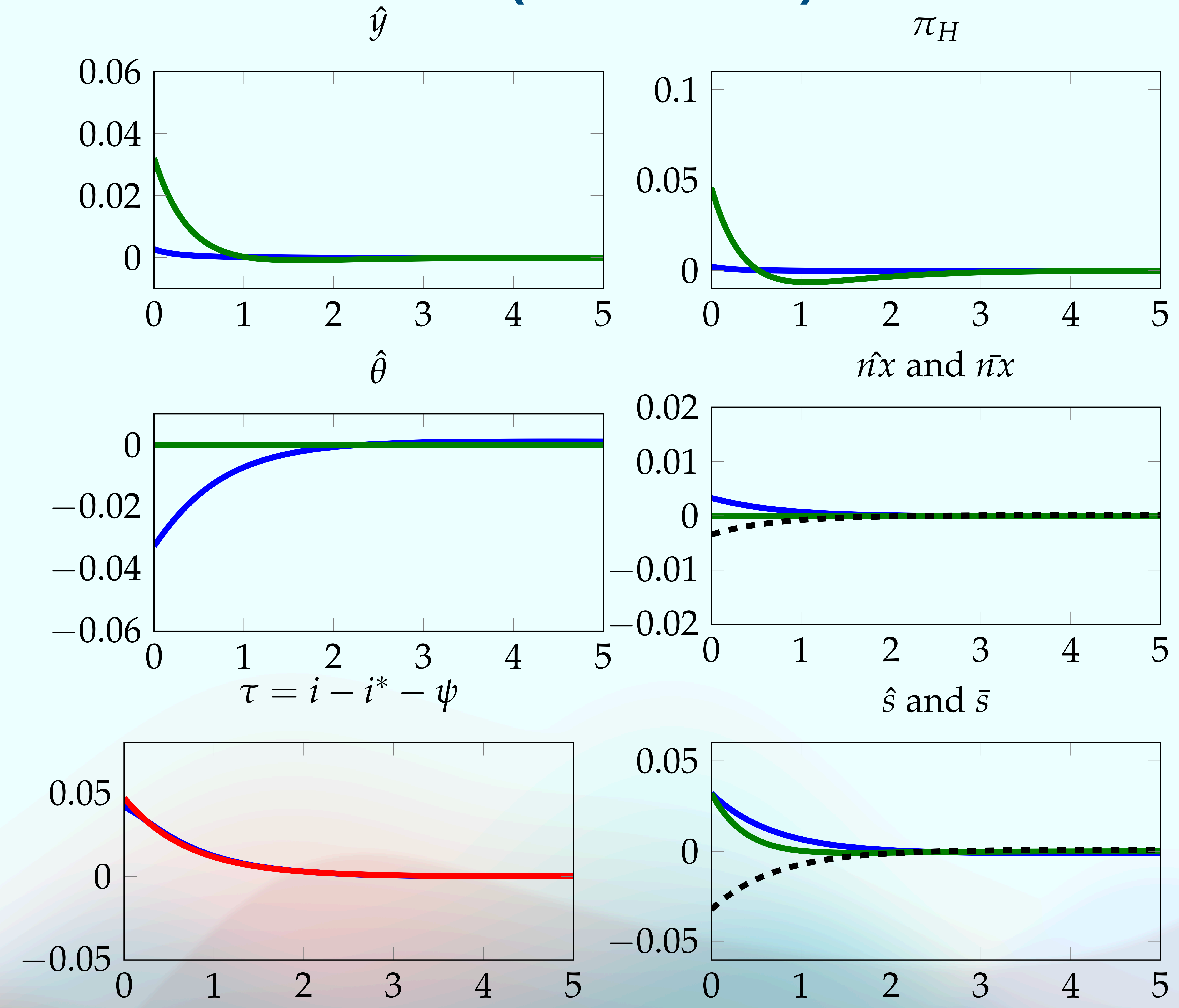


Risk Premium $\alpha = 0.1$ (closed)

No Intervention

vs

Capital Controls



Trilemma → **Dilemma**

- **Managed** Exchange Rates
- Independent Monetary Policy
- Free Capital Flows

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- Capital controls with flexible exchange rates?
  Standard “Mundellian” view: no

Trilemma → Dilemma

- **Managed** Exchange Rates
- Independent Monetary Policy
- Free Capital Flows

- Capital controls with flexible exchange rates?
  Standard “Mundellian” view: no
- Next…
  - joint optimum for **nominal exchange rates** and **capital controls**
  - Result: Role for capital controls even with flexible exchange rates

Dilemma

Dilemma

- Navigate two conflicting objectives…
  - macroeconomic stabilization
  - exchange rate management

Dilemma

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  - macroeconomic stabilization
  - exchange rate management
- Today: flesh out **reasons for exchange rate management…**
  - standard New-Keynesian model…
    terms of trade manipulation (more robust with risk premium shocks)
  - less-standard NK model…
    stable exchange rate for efficient trade

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  - standard New-Keynesian model… Start here
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Dilemma

- Navigate two conflicting objectives…
  - macroeconomic stabilization
  - exchange rate management
- Today: flesh out **reasons for exchange rate management…**
  - standard New-Keynesian model…
    terms of trade manipulation (more robust with risk premium shocks) **Start here**
  - less-standard NK model…
    stable exchange rate for efficient trade
- Not today (but developed)
  - borrowing constraints: financial stability, pecuniary externality
  - incomplete markets and local currency debt

Trilemma Planning Problem

$$\min \int_0^\infty e^{-\rho t}\left[\alpha_\pi \pi_{H,t}^2 + (\hat{y}_t - \tilde{y}_t))^2 + \alpha_\theta(\hat{\theta}_t - \tilde{\theta}_t)^2\right] dt$$

$$\dot{\pi}_{H,t} = \rho \pi_{H,t} - \hat{\kappa}\hat{y}_t - \lambda\alpha\hat{\theta}_t$$

$$\dot{\hat{y}}_t = (1-\alpha)(i_t - i_t^*) - \pi_{H,t} + i_t^* - \bar{r}_t$$

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~~Trilemma~~ Dilemma Planning Problem

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If e_t and i_t free….

$$\dot{\hat{y}}_t = (1-\alpha)(i_t - i_t^*) - \pi_{H,t} + i_t^* - \bar{r}_t$$

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~~Trilemma~~ Dilemma Planning Problem

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If e_t and i_t free….

$$\dot{\hat{y}}_t = (1-\alpha)(i_t - i_t^*) - \pi_{H,t} + i_t^* - \bar{r}_t \; - \alpha\dot{e}_t$$

$$\dot{\hat{\theta}}_t = i_t - i_t^* \; - \dot{e}_t$$

$$\int e^{-\rho t}\hat{\theta}_t dt = 0$$

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~~Trilemma~~ Planning Problem
Dilemma

$$\min \int_0^\infty e^{-\rho t}\left[\alpha_\pi \pi_{H,t}^2 + (\hat{y}_t - \tilde{y}_t))^2 + \alpha_\theta(\hat{\theta}_t - \tilde{\theta}_t)^2\right] dt$$

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Proposition.

$$\tau_t = -\alpha_\psi \psi_t - \frac{\lambda \alpha}{\alpha_\theta} \alpha_\pi \pi_{H,t}$$

Risk Premium $\Psi_t > 0$

No Intervention

vs

Capital Controls

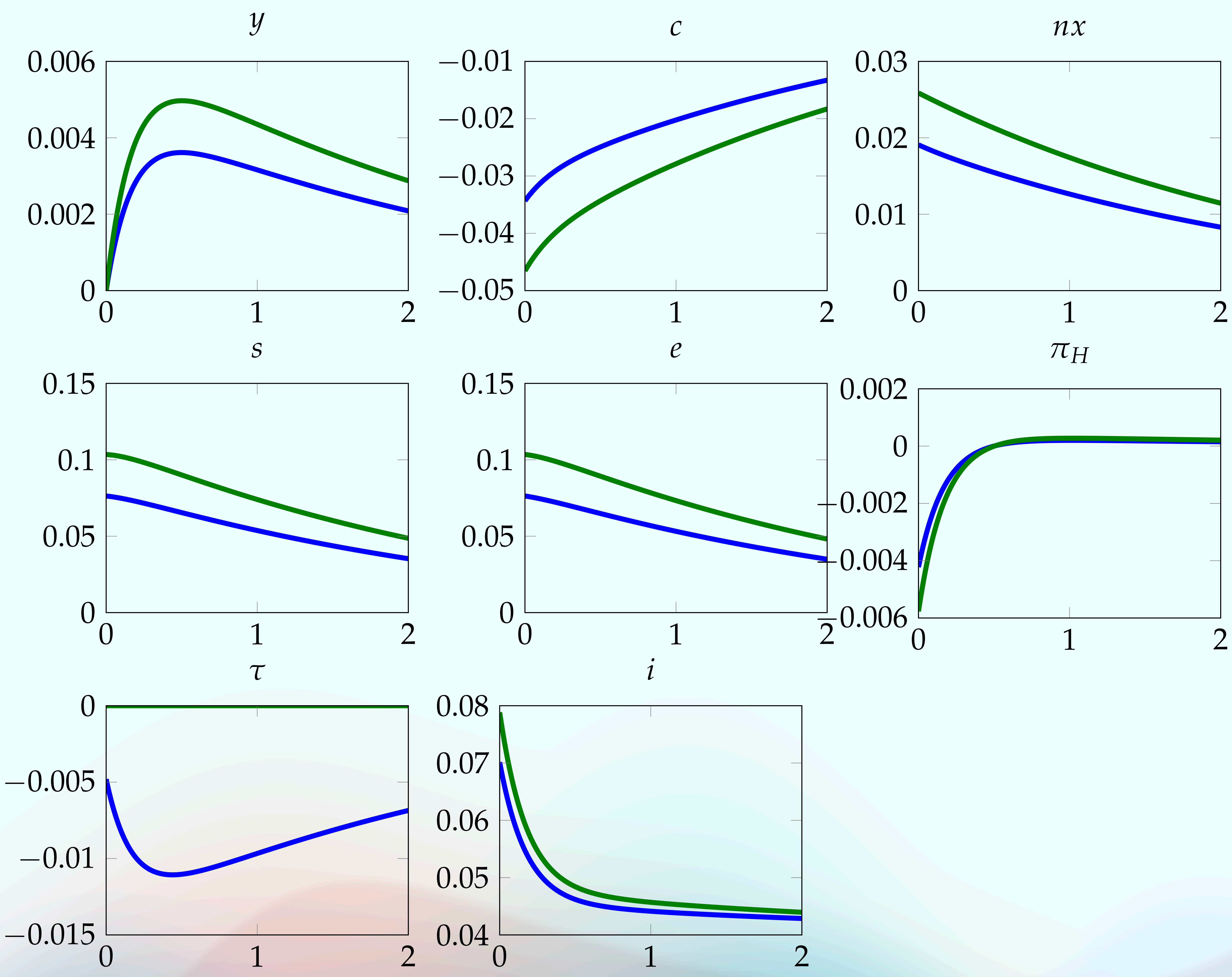


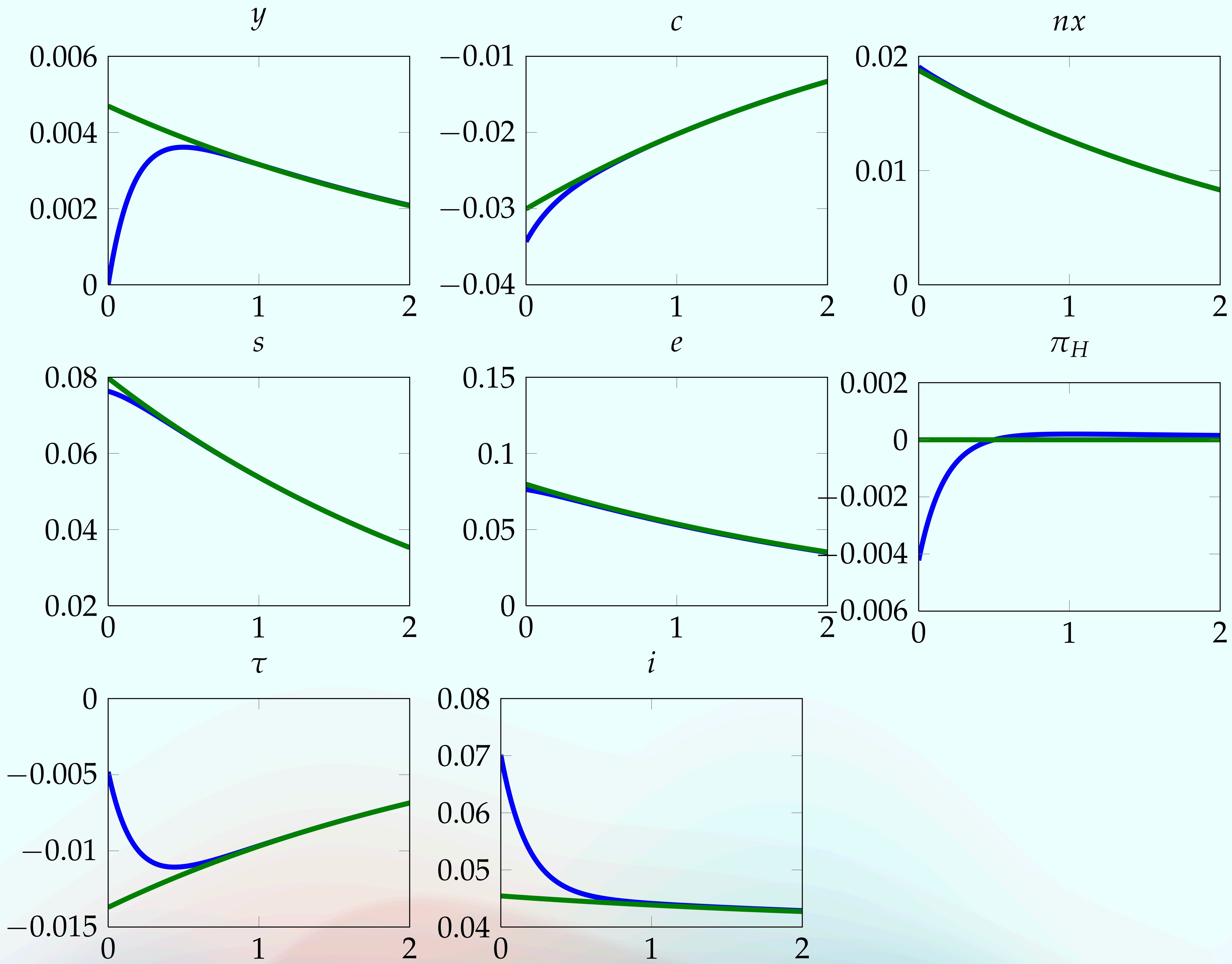
Figure 1: Capital controls (blue) and no capital controls (green) with flexible exchange rates.

Risk Premium $\Psi_t > 0$

Flexible Prices

vs

Sticky Prices



Dilemma II

Next

Dilemma II

- Reasons for exchange rate management…
  - standard New-Keynesian model…
    terms of trade manipulation (more robust with risk premium shocks)
  - less-standard NK model…
    stable exchange rate for efficient trade ← **Next**

Dilemma II

- Reasons for exchange rate management…
  - standard New-Keynesian model…
    terms of trade manipulation (more robust with risk premium shocks)
  - less-standard NK model…
    stable exchange rate for efficient trade ← **Next**
- Provide a simple limit example…
  - optimal to completely fix exchange rate
  - use capital controls to insulate from foreign interest rate
- Conclusion: Dilemma not only about exerting monopolistic power

Dilemma II

- Small open economy with traded and non-traded goods

$$\sum_{t=0}^{\infty} \beta^t [u(c_{N,t}, l_{N,t}) + U(c_{F,t}, l_{x,t})]$$

$$c_{N,t} = F_N(l_{N,t})$$

$$x_t = F_x(l_{x,t})$$

$$\sum_{t=0}^{\infty} \Pi_{s=0}^{t} \left(\frac{1}{1+i_s^*}\right) (c_{F,t} - p_t^* x_t) = 0$$

- **Time-varying** foreign interest rate i_t^*

Dilemma II

- Small open economy with traded and non-traded goods

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$$x_t = D_x\left(p^*_{x,t}\right)$$

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$$x_t = F_x(l_{x,t}) \rightarrow p_t^* x_t = R(l_{x,t}) \quad \text{concave}$$

$$x_t = D_x\left(p_{x,t}^*\right)$$

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Dilemma II

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- **Time-varying** foreign interest rate i_t^*

- First best

$$\max \sum_{t=0}^{\infty} \beta^t [u(c_{N,t}, l_{N,t}) + U(c_{F,t}, l_{x,t})]$$

$$\sum_{t=0}^{\infty} \Pi_{s=0}^{t} \left(\frac{1}{1+i_s^*} \right) (c_{F,t} - R(l_{x,t})) = 0$$

$$c_{N,t} = F_N(l_{N,t})$$

- First best

$$\max u(c_{N,t}, l_{N,t})$$

$$c_{N,t} = F_N(l_{N,t})$$

$$\max \sum_{t=0}^{\infty} \beta^t U(c_{F,t}, l_{x,t})$$

$$\sum_{t=0}^{\infty} \Pi_{s=0}^{t} \left(\frac{1}{1+i_s^*}\right) (c_{F,t} - R(l_{x,t})) = 0$$

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- Nontraded $\rightarrow$ constant allocation
- Traded $\rightarrow$ intertemporal substitution
- Flexible price equilibrium decentralizes optimum

- First best

$$\max u(c_{N,t}, l_{N,t})$$

$$c_{N,t} = F_N(l_{N,t})$$

$$\max \sum_{t=0}^{\infty} \beta^t U(c_{F,t}, l_{x,t})$$

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- Nontraded → constant allocation
- Traded → intertemporal substitution
- Flexible price equilibrium decentralizes optimum
- Kill intertemporal substitution

$$U(c_{F,t}, l_{x,t}) = V(c_{F,t} - h(l_{x,t}))$$ → constant allocation

limit where V is infinitely concave

- Assume perfectly rigid wages → rigid prices

$$p_{x,t} = \bar{p}_x \qquad p_{N,t} = \bar{p}_N$$

- Assume perfectly rigid wages → rigid prices

$$p_{x,t} = \bar{p}_x \qquad p_{N,t} = \bar{p}_N$$

- Exchange rates alone **cannot** replicate first best

$$1 = \beta(1 + i_t^*)\frac{E_{t+1}}{E_t}\frac{U_c(c_{N,t+1}, c_{N,t+1})}{U_c(c_{N,t}, c_{N,t})} \qquad x_t = D_x\left(\frac{p_{x,t}}{E_t}\right)$$

- Assume perfectly rigid wages → rigid prices

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- Tension: one instrument but two goals...
  - macroeconomic stabilization
  - exchange rate

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- Tension: one instrument but two goals...
  - macroeconomic stabilization
  - exchange rate
- Capital controls and exchange rates **can** replicate first best with constant exchange rate $E_t = E^*$

$$1 = \beta(1 + \tau_t)(1 + i_t^*) \qquad x^* = D_x\left(\frac{p_{x,t}}{E^*}\right)$$

Conclusions

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- Similarities and differences with traditional “Mundellian” view
  - key role of exchange rate regime: Trilemma
  - but capital controls even with flexible exchange rates: Dilemma

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Conclusions

- Similarities and differences with traditional “Mundellian” view
  - key role of exchange rate regime: Trilemma
  - but capital controls even with flexible exchange rates: Dilemma
- Capital controls help navigate two objectives…
  - macroeconomic stabilization
  - exchange rate management
- Next Lecture: Fiscal Unions
  - somewhat related: intervene across states, instead of time
  - more palatable in currency union