

Trade Policy Uncertainty and Optimal Monetary Policy

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Trade policy has become a prominent source of macroeconomic risk



Key Questions

- How does trade policy uncertainty transmit through the economy?
- What determines the size and direction of the macroeconomic response?
- How does monetary policy affect transmission, and what policy is optimal?

Recent analytical works focus on tariff *level* shocks

⇒ e.g. Bergin & Corsetti '23; Bianchi & Coulibaly '25; Monacelli '25; Kalemli-Özcan, Soylu & Yildirim '25; Werning, Lorenzoni and Guerrieri '25

⇒ Lack of analytical characterization for uncertainty shocks

This Paper

Analytically characterize the transmission of export-tariff uncertainty shocks in SOE:

1. **Closed-form IRFs** with two expectation wedges: **NKPC** vs **UIP**
 - opposing effects on output: can be either expansionary or contractionary
 - same direction on inflation: large deflationary impacts

This Paper

Analytically characterize the transmission of export-tariff uncertainty shocks in SOE:

1. **Closed-form IRFs** with two expectation wedges: **NKPC** vs **UIP**
 - opposing effects on output: can be either expansionary or contractionary
 - same direction on inflation: large deflationary impacts
2. **Ramsey optimal policy** (complete market):
 - strict PPI inflation targeting is optimal
 - at optimal policy, no real impact of uncertainty shocks

Implication: Monetary policy plays a central role in shaping the transmission of tariff uncertainty shocks

Model: SOE NK with Tariff Stochastic Volatility

Small open-economy New Keynesian model (*a la* Galí & Monacelli 2005)

- Rotemberg price adjustment costs, producer currency pricing
- Complete international asset markets (incomplete markets as extension)
- Efficient steady state (subsidy offsets level markup; no level tariff)
- Monetary policy: Taylor rule with PPI inflation ($r_t = \phi_\pi \pi_t + \phi_y y_t$), or Ramsey

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Export tariff τ_t with **stochastic volatility** $\sigma_{T,t}$

$$\tau_t = \rho_\tau \tau_{t-1} + e^{\sigma_{T,t-1}} \varepsilon_{\tau,t}$$

$$\sigma_{T,t} = \rho_\sigma \sigma_{T,t-1} + \varepsilon_{\sigma,t}$$

- Uncertainty shock $\varepsilon_{\sigma,t}$ moves future $\sigma_{T,t}$, while keeping the level fixed ($\varepsilon_{\tau,t} = 0$)

Minimal 2-equation System

- Equilibrium collapses to two forward-looking equations in PPI inflation π_t and the terms of trade q_t (\uparrow means real depreciation)
- Tariff-volatility $\sigma_{T,t}$ affects the economy through two high-order expectation wedges:

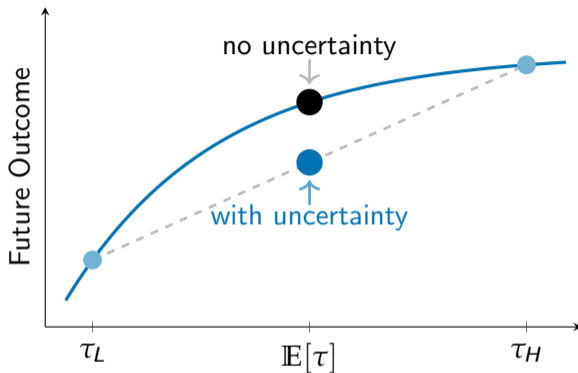
$$\begin{aligned}\pi_t &= \kappa_{mc} mc_t(q_t) + \beta \mathbb{E}_t[\pi_{t+1}] + \Delta_t^{NK} + O(4) \\ r_t(\pi_t, q_t) &= \mathbb{E}_t[(q_{t+1} - q_t) + \pi_{t+1}] + \Delta_t^{UIP} + O(4)\end{aligned}$$

where

$$\Delta_t^{NK} = u^{NK} \sigma_{T,t} + O(4), \quad \Delta_t^{UIP} = u^{UIP} \sigma_{T,t} + O(4)$$

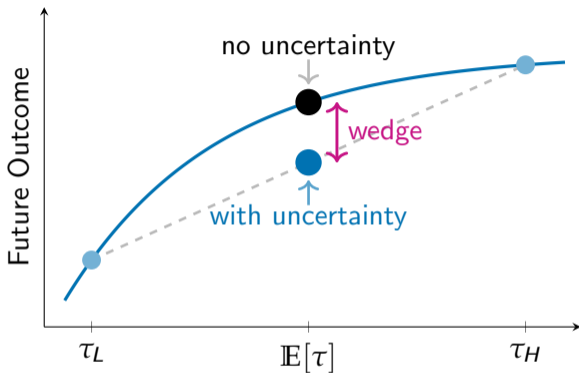
Lemma 1

Intuition: Why Wedges Arise and What They Depend On



- The sign of the wedge depends on how the outcome variable (e.g. inflation) co-moves with tariff **level** states (e.g. whether it is convex or concave)

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Pricing Wedge u^{NK}

How does tariff risk affect pricing incentives?

$$u^{NK} \propto \underbrace{3A_{\pi}^2}_{\text{Rotemberg cost} > 0} + \underbrace{2A_{\pi}s}_{\text{Covariance} < 0} + \underbrace{B_{\pi}}_{\text{Curvature} < 0}$$

where

- $A_{\pi} > 0$ and $B_{\pi} < 0$ govern the response of inflation to a tariff **level** shock:

$$\pi_t = A_{\pi}\tau_t + \frac{1}{2}B_{\pi}\tau_t^2$$

- $A_{\pi}s$ captures how inflation co-variates with discount factor s

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Intuition:

- Risk creates inflation dispersion, raising expected adjustment costs

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Intuition:

- Captures how firms weigh different tariff states
- Low tariffs mean high sales, so price deviations matter more there \Rightarrow higher weight
- Low-tariff states are low price states; higher weight puts downward pressure on prices
- Concavity ($B_{\pi} < 0$) reinforces this

UIP / Risk-Premium Wedge u^{UIP}

How does tariff risk affect exchange rates?

$$u^{UIP} \propto \underbrace{-(A_\pi + A_q)^2}_{\text{Variance} < 0} + \underbrace{(B_\pi + B_q)}_{\text{Curvature} < 0}$$

where (A_π, B_π) and (A_q, B_q) govern the responses of inflation and the terms of trade to tariff **level** shocks:

$$\pi_t = A_\pi \tau_t + \frac{1}{2} B_\pi \tau_t^2 \quad \text{and} \quad q_t = A_q \tau_t + \frac{1}{2} B_q \tau_t^2$$

Intuition:

- ⇒ Tariff risk increases uncertainty about future exchange rates
- ⇒ Foreign-currency assets become riskier in home-currency terms
- ⇒ Appreciation of home currency today to raise expected return

Closed-Form Uncertainty Responses

IRFs to tariff uncertainty shock:

$$\pi_t = \rho_\sigma^t \chi_\pi, \quad q_t = \rho_\sigma^t \chi_q, \quad y_t = \theta_q q_t,$$

where ρ_σ is persistence of uncertainty shock and

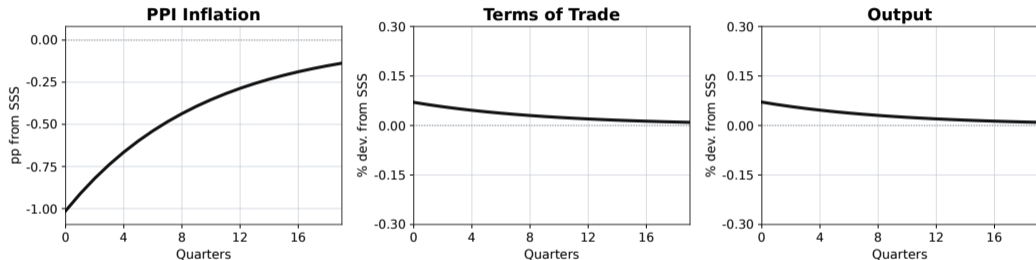
$$\chi_\pi \propto \overbrace{(\phi_y \theta_q + 1 - \rho_\sigma) u^{NK}}^{(-)} + \overbrace{\tilde{\kappa} u^{UIP}}^{(-)} \quad \chi_q \propto \overbrace{-(\phi_\pi - \rho_\sigma) u^{NK}}^{(+)} + \overbrace{(1 - \beta \rho_\sigma) u^{UIP}}^{(-)}$$

- $\theta_q \approx 1$ under baseline calibration
- ϕ_π and ϕ_y are Taylor rule parameters for inflation and output

Responses to Export Tariff Uncertainty

Shock: doubling tariff volatility

— Baseline - - - NK only ($u^{UIP} = 0$) - · - · UIP only ($u^{NK} = 0$)

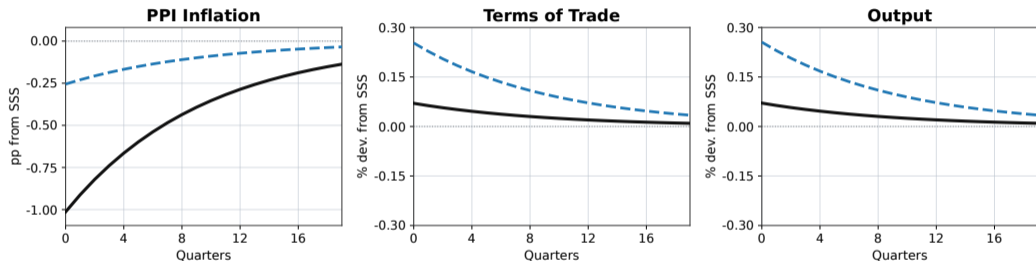


- Large deflationary effects, but small impacts on terms of trade and output

Responses to Export Tariff Uncertainty

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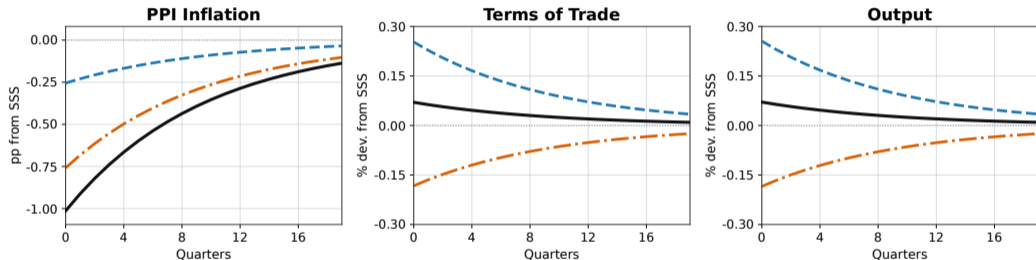


- **NKPC-only:** deflation triggers easing, real depreciation and higher output

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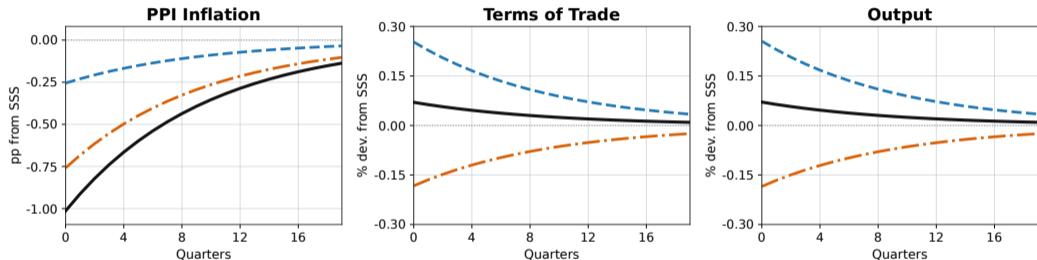


- **NKPC-only:** deflation triggers easing, real depreciation and higher output
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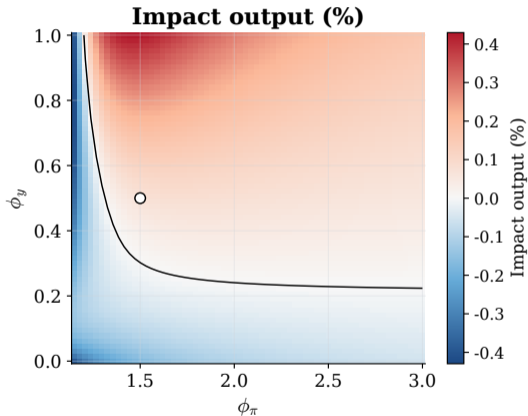
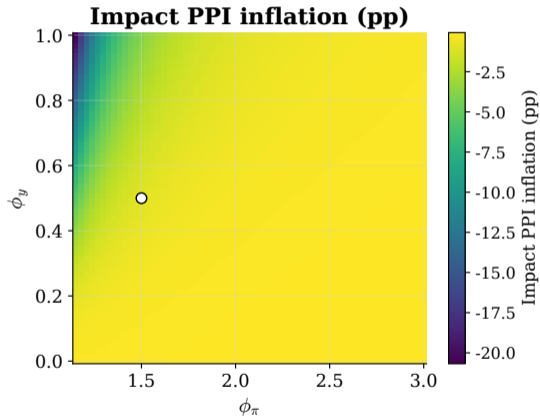
Shock: doubling tariff volatility

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- **NKPC-only:** deflation triggers easing, real depreciation and higher output
- **UIP-only:** asset-pricing effects drive appreciation and lower output
- **Together:** both channels are deflationary, but they offset on the real side

Uncertainty shocks can be expansionary or contractionary depending on monetary policy



- Contractionary when monetary policy looks through uncertainty shocks (low ϕ_π or ϕ_y)

Optimal Ramsey Policy

Divine coincidence for tariff uncertainty

Under standard assumptions in the literature:

- (i) complete markets
- (ii) producer currency pricing
- (iii) efficient steady state (subsidy offsets markup distortion; no level tariff)

In response to an export-tariff volatility shock, we show that

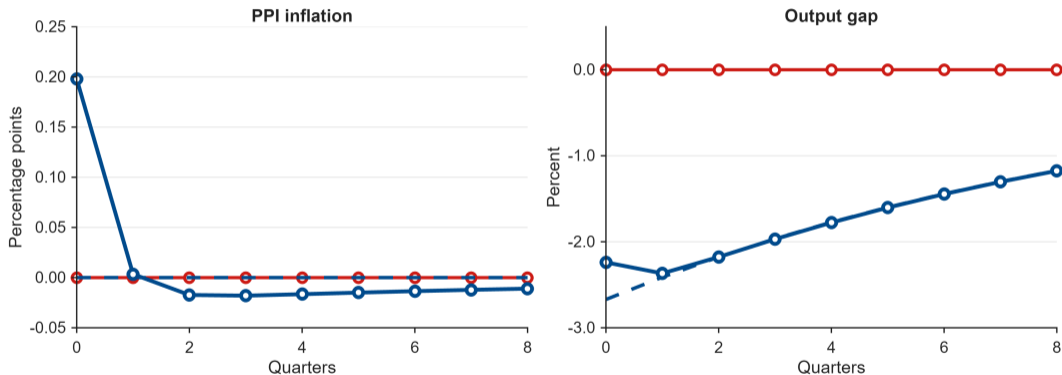
- (1) flexible price allocation is efficient
- (2) **strict PPI inflation targeting** is Ramsey optimal
- (3) at the optimal policy, there is no real effects up to a third order approximation

- Benchmark flexible-price allocation depends on tariff *levels*, not volatility
- Strict PPI inflation targeting fully stabilizes current and future prices $\pi_t = 0$, which eliminates price-adjustment frictions and hence output gap $\tilde{y}_t = 0$

Differential optimal policies for tariff level vs uncertainty shocks

Responses to a 10% rise in export tariffs versus a doubling of tariff uncertainty

○—○ Uncertainty (PPI targeting = Optimal) - - - Level (PPI targeting) ○—○ Level (Optimal)



- Optimal policy is more expansionary for export tariff level shocks
- Trade-off between stabilizing level and uncertainty shocks when both are active

Conclusion

Study the transmission of export-tariff uncertainty shocks in SOE:

1. **Two-wedge system:** NKPC + UIP pin down uncertainty IRFs
⇒ small output effects but large deflationary impacts
2. **Optimal policy:** Complete market ⇒ strict PPI targeting
⇒ trade off in stabilizing level vs uncertainty shocks

Implication: Monetary policy plays a central role in shaping the transmission of tariff uncertainty shocks

Appendix

A1: Baseline Calibration

Parameter	Description	Value
β	Discount factor	0.99
σ	Risk aversion	2
φ	Inverse Frisch elasticity	1
α	Import share (openness)	0.30
γ	Trade elasticity (Armington)	1.5
ε	Elasticity of substitution	10
κ	Rotemberg adjustment cost	40
ϕ_π	Taylor rule: inflation	1.5
ϕ_y	Taylor rule: output gap	0.5
ρ_τ	Tariff persistence	0.9
$\bar{\sigma}_\tau$	Steady-state tariff volatility	0.10
ρ_σ	Volatility persistence	0.9
η_σ	Volatility shock size	$\log 2 \approx 0.693$

A2: Key Equilibrium Conditions

$$\text{NKPC: } \kappa(\Pi_{H,t} - 1)\Pi_{H,t} = (\varepsilon - 1)(mc_t - 1) + \beta\kappa \mathbb{E}_t \left[\frac{C_{t+1}^{-\sigma}}{C_t^{-\sigma}} (\Pi_{H,t+1} - 1)\Pi_{H,t+1} \frac{Y_{t+1}}{Y_t} \right]$$

$$\text{UIP: } \mathbb{E}_t \left[\beta \frac{C_{t+1}^{-\sigma}}{C_t^{-\sigma}} \frac{Q_t}{Q_{t+1}} \frac{1 + r_t}{1 + \pi_{C,t+1}} \right] = 1$$

$$\text{Taylor: } 1 + r_t = \beta^{-1}(1 + \pi_{H,t})^{\phi_\pi} \left(\frac{Y_t}{Y_{SS}} \right)^{\phi_y}$$

$$\text{Tariff SV: } \tau_t = \rho_\tau \tau_{t-1} + \bar{\sigma}_\tau e^{\sigma_\tau, t-1} \varepsilon_{\tau, t}, \quad \sigma_{T, t} = \rho_\sigma \sigma_{T, t-1} + \eta_\sigma \varepsilon_{\sigma, t}$$

Lemma 1: Exact Nonlinear 2×2 System

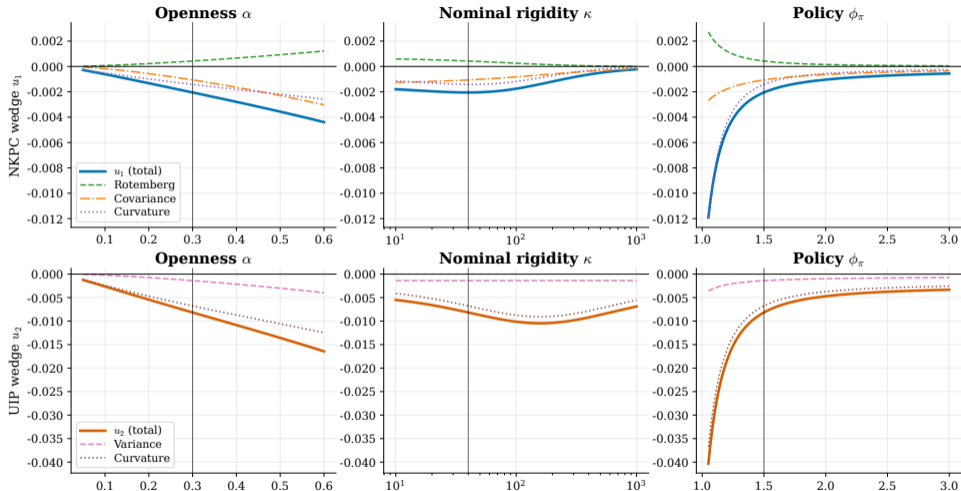
Under CM + PCP + risk sharing, equilibrium reduces to two equations in $(\Pi_{H,t}, Q_t)$:

$$\kappa(\Pi_{H,t} - 1)\Pi_{H,t} = (\epsilon - 1)(mc_t - 1) + \beta\kappa\mathbb{E}_t \left[(\Pi_{H,t+1} - 1)\Pi_{H,t+1} \frac{Y_{t+1}}{Y_t} \frac{Q_t}{Q_{t+1}} \right]$$

$$1 = \Pi_{H,t}^{\phi_\pi} \left(\frac{Y_t}{\bar{Y}} \right)^{\phi_y} e^{\psi_t} \mathbb{E}_t \left[\frac{Q_t}{Q_{t+1} \Pi_{H,t+1}} \right]$$

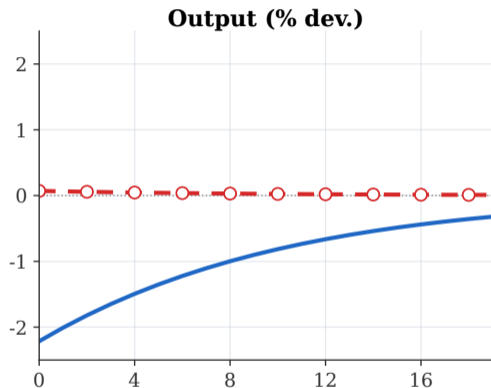
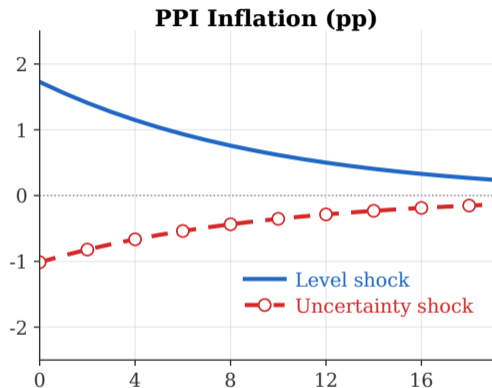
- Output and marginal cost are **static functions** of $(\Pi_{H,t}, Q_t, \tau_t)$
- Risk sharing: $C_t = (G_t/Q_t)^{-1/\sigma}$ eliminates Euler equation

Wedge Component Sensitivity



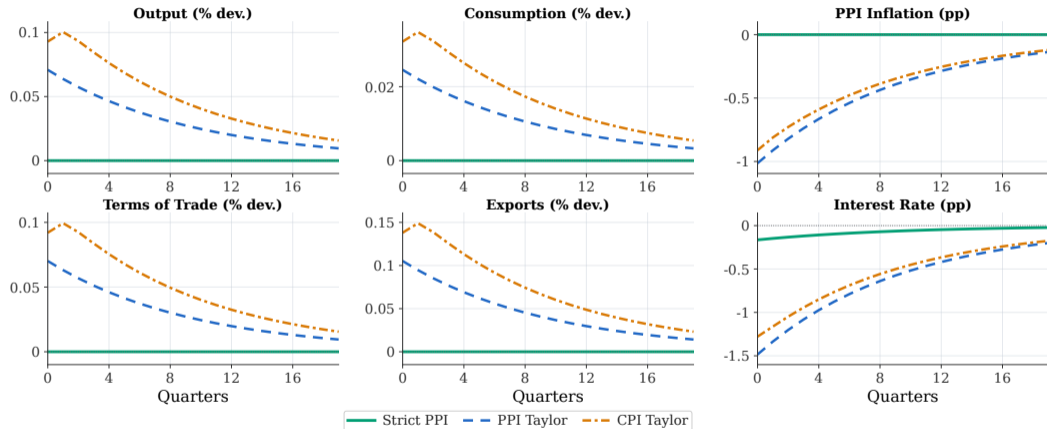
Opposite Effects of Level vs Uncertainty Shocks

Responses to a 10% rise in export tariffs versus a doubling of tariff uncertainty



- Uncertainty can dampen the effects of level shocks

Responses to Tariff Uncertainty Shock under Alternative MP Rules



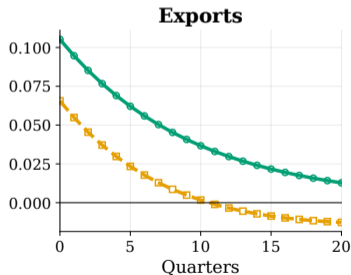
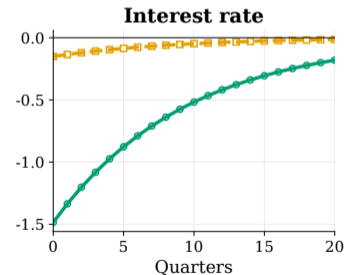
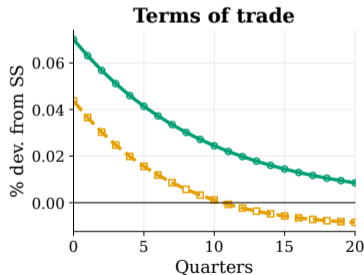
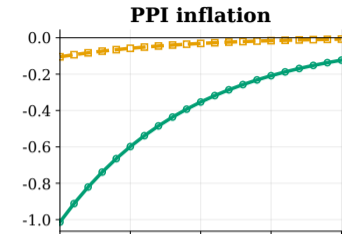
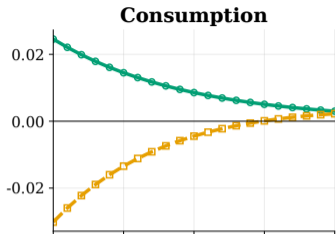
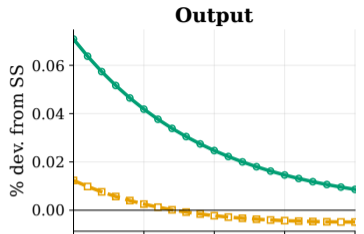
Incomplete Markets: Precautionary-savings Channel

Without risk sharing, the Euler equation gives rise to the *precautionary-savings channel*:

$$\hat{c}_t = \mathbb{E}_t[\hat{c}_{t+1}] - \frac{1}{\sigma}(\hat{r}_t - \mathbb{E}_t[\hat{\pi}_{C,t+1}]) - \frac{1}{\sigma} \tilde{\Delta}_t^E + O(4)$$

- Euler/Jensen wedge: $\tilde{\Delta}_t^E \propto \bar{\sigma}_\tau^2 (e^{2\sigma\tau,t} - 1)$
- 3×3 system: NKPC + UIP + Euler
- Divine coincidence **breaks**: PPI targeting $\not\Rightarrow \tilde{y}_t = 0$ generically

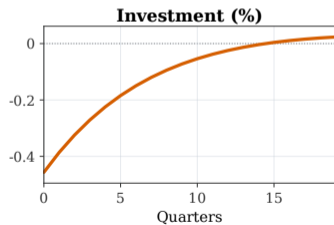
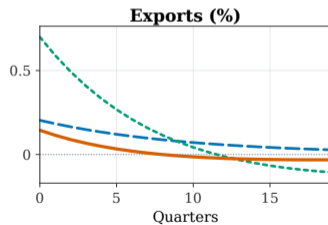
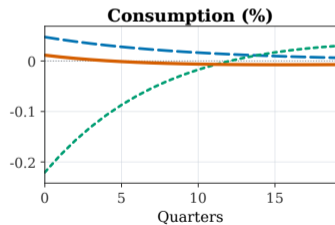
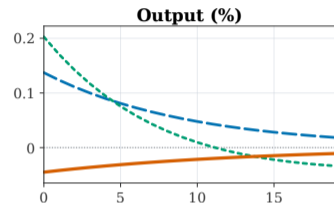
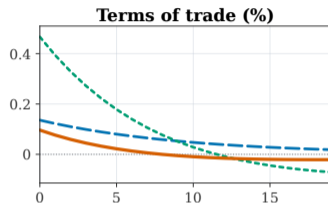
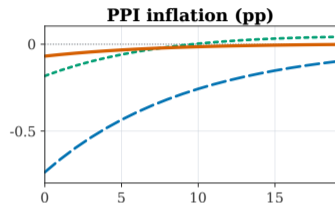
Responses to Uncertainty Shocks: CM vs IM



— CM uncertainty - - - IM uncertainty
○ CM 2-shock fit □ IM 3-shock fit

Incomplete Markets with Investment

--- CM no investment (baseline) -.- IM no investment — IM + investment



LCP Extension: Policy Comparison

— PCP: strict PPI - - - LCP: strict PPI — PCP: PPI Taylor - - - LCP: PPI Taylor

