Trade Policy Uncertainty and Optimal Monetary Policy

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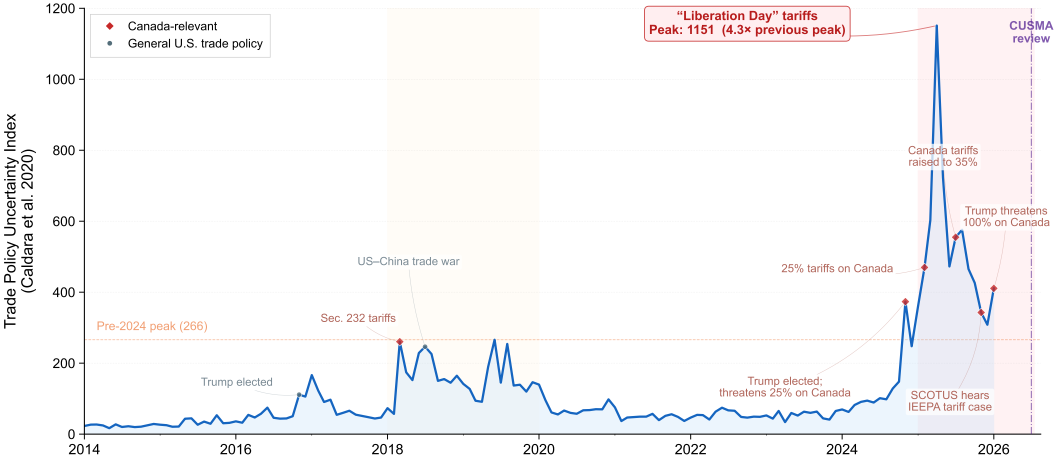
Trade policy has become a prominent source of macroeconomic risk



Key Questions

- How does trade policy uncertainty transmit through the economy, and how does monetary policy affect this transmission?
- What is the optimal monetary policy response to trade policy uncertainty?

Existing work on uncertainty shocks typically relies on numerical simulations

$\Rightarrow$ limited analytical characterization of transmission and optimal policy

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 markets):
   - 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 ($\varepsilon_{\tau,t} = 0$)

Calibration Equations

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:

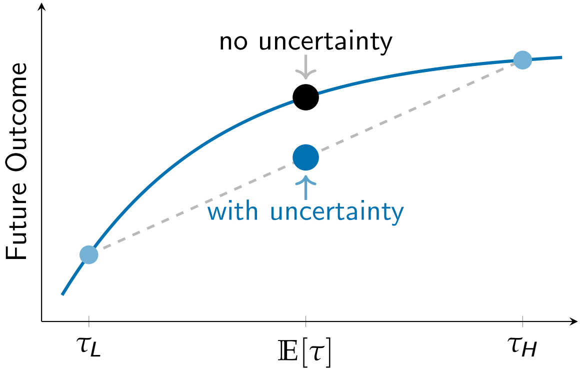
$$\pi_t = \kappa_{mc} mc_t(q_t) + \beta \mathbb{E}_t[\pi_{t+1}] + \Delta_t^{NK} + O(4)$$
$$r_t(\pi_t, q_t) = \mathbb{E}_t\left[(q_{t+1} - q_t) + \pi_{t+1}\right] + \Delta_t^{UIP} + O(4)$$

where

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

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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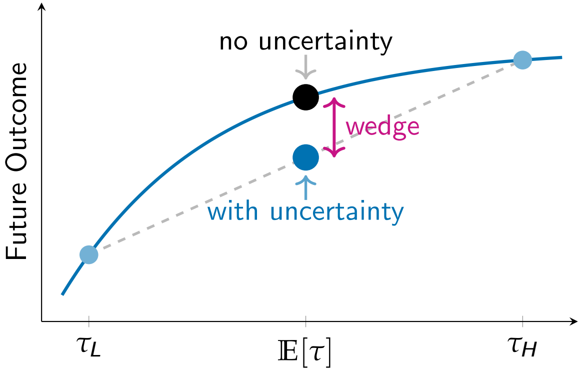

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Pricing Wedge u^{NK}

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-varies with discount factor s

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Intuition:

- Risk creates inflation dispersion, raising expected adjustment costs

Wedge Sensitivity

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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

Wedge Sensitivity

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:

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

Intuition:

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

Wedge Sensitivity

Closed-Form Uncertainty Responses

IRFs to tariff uncertainty shock:

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

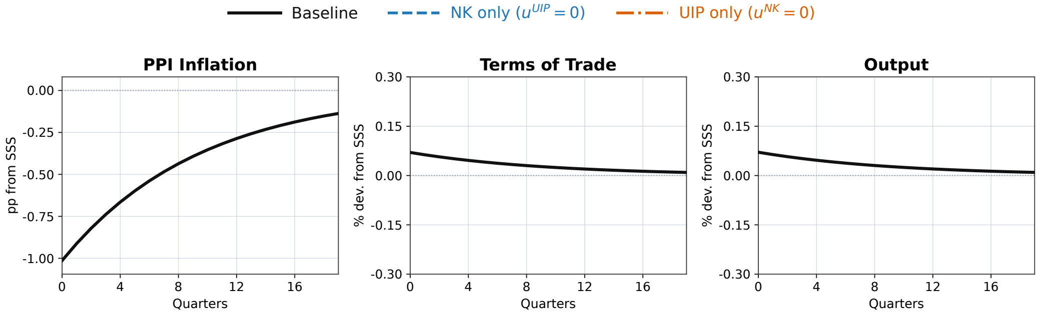
where ρ_σ is persistence of uncertainty shock and

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

- $\theta_q \approx 1$ 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



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

Level vs uncertainty shocks
CPI vs PPI Taylor

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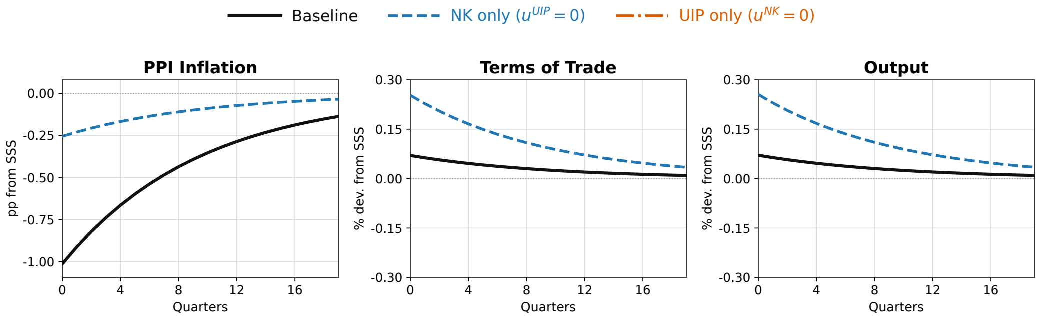

- NKPC-only: deflation triggers easing, real depreciation and higher output

Level vs uncertainty shocks | CPI vs PPI Taylor

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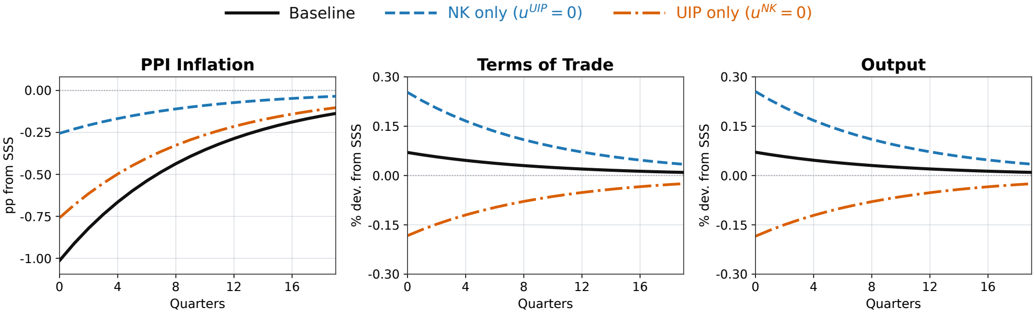

- NKPC-only: deflation triggers easing, real depreciation and higher output
- UIP-only: asset-pricing effects drive appreciation and lower output

Level vs uncertainty shocks CPI vs PPI Taylor

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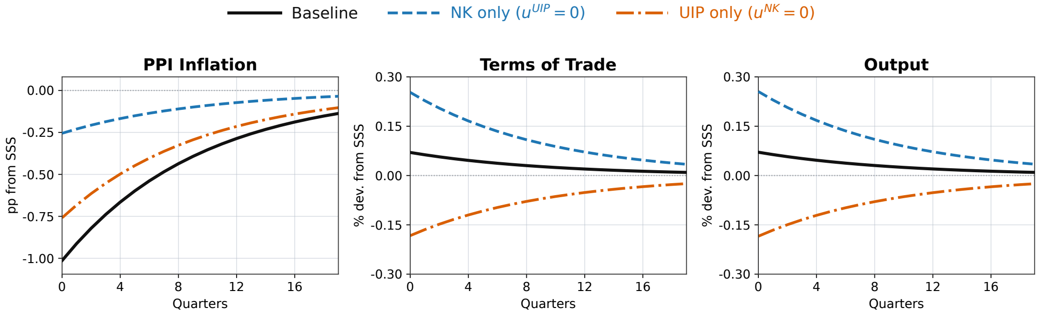
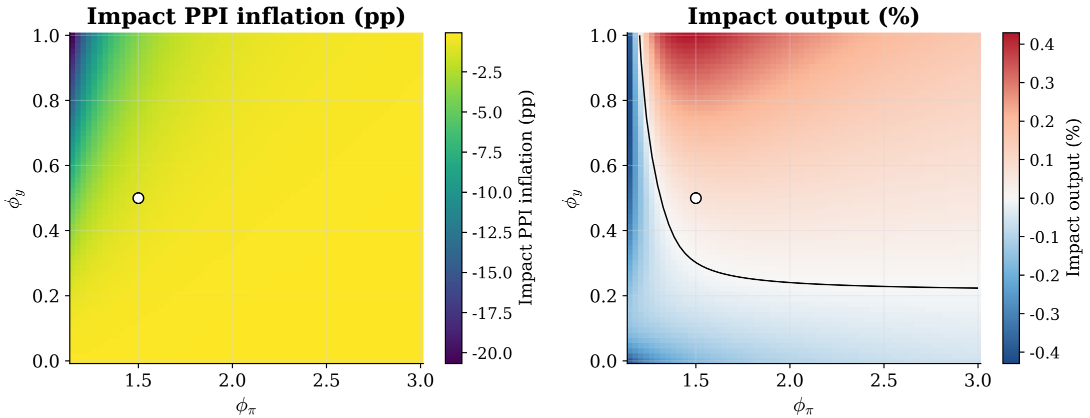


- NKPC-only: deflation triggers easing, real depreciation and higher output
- UIP-only: asset-pricing effects drive appreciation and lower output
- Together: both channels are deflationary, but they offset on the real side

Level vs uncertainty shocks CPI vs PPI Taylor

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

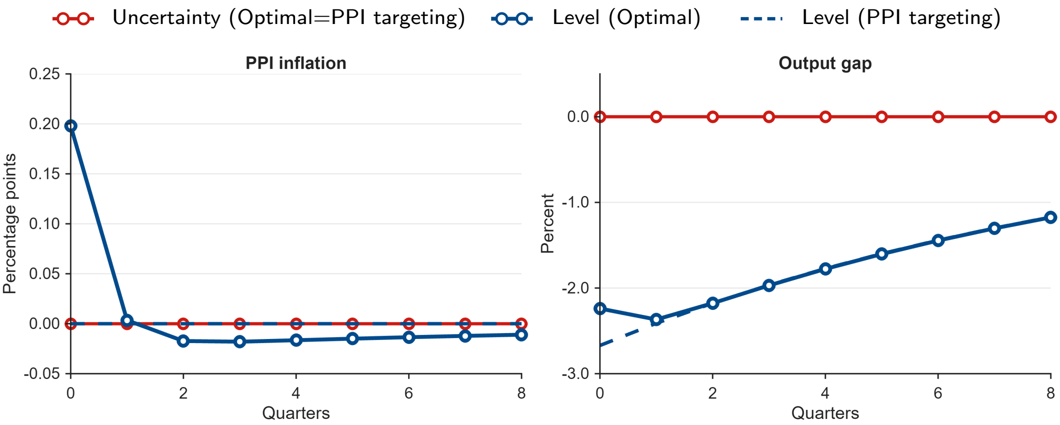
We show that, in response to an export-tariff volatility shock:
(1) the flexible price allocation is efficient
(2) strict PPI inflation targeting is Ramsey optimal
(3) at the optimal policy, real allocations are unchanged to third order

- 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 $\tilde{y}_t = 0$

Incomplete Markets

Optimal policy differs for tariff level and uncertainty shocks

Responses to a 10% export-tariff increase versus a doubling of tariff uncertainty



- For level shock, optimal policy is more expansionary than PPI targeting
- When both shocks are active ⇒ level–uncertainty policy trade-off

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 markets ⇒ 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

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

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

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

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

Model

Lemma 1: Exact Nonlinear 2×2 System

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

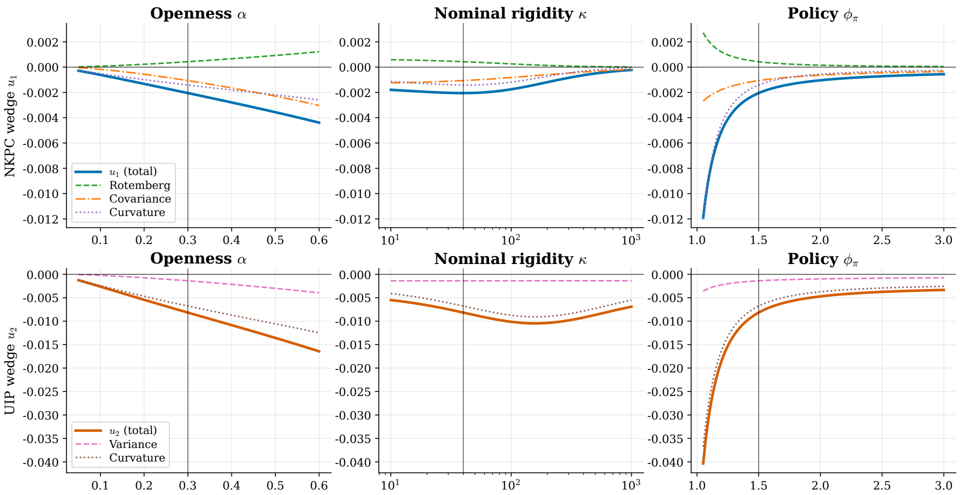
$$\kappa(\Pi_{H,t}-1)\Pi_{H,t} = (\epsilon-1)(mc_t-1) + \beta\kappa\mathbb{E}_t\left[(\Pi_{H,t+1}-1)\Pi_{H,t+1}\frac{Y_{t+1}}{Y_t}\frac{Q_t}{Q_{t+1}}\right]$$

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

- 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

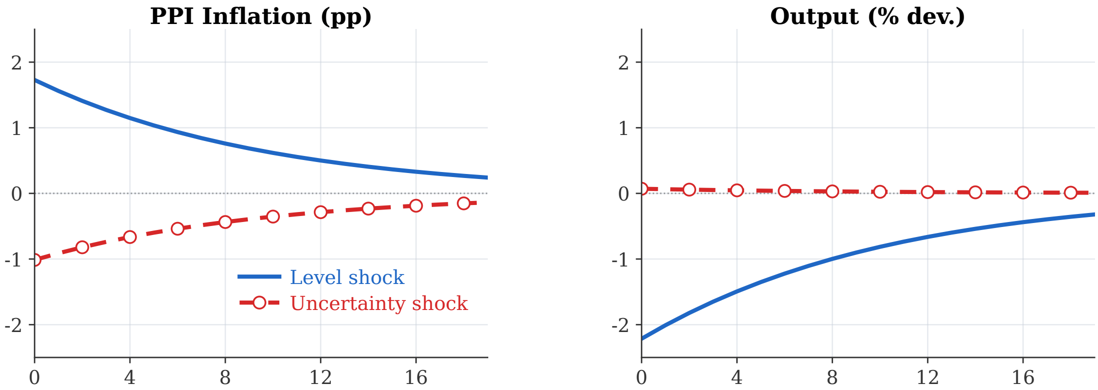
System

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

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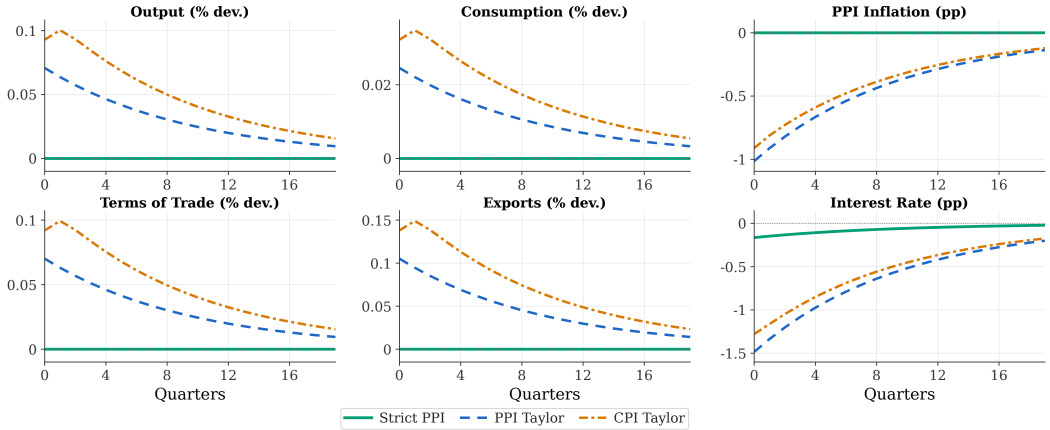
Responses to Tariff Uncertainty Shock under Alternative MP Rules



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Incomplete Markets: Precautionary-savings Channel

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

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

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

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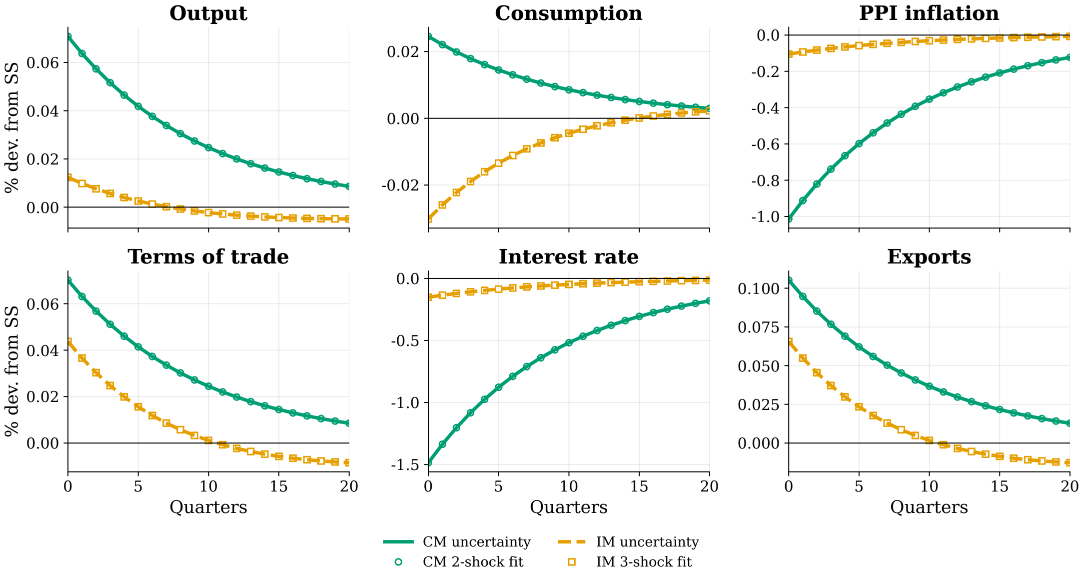
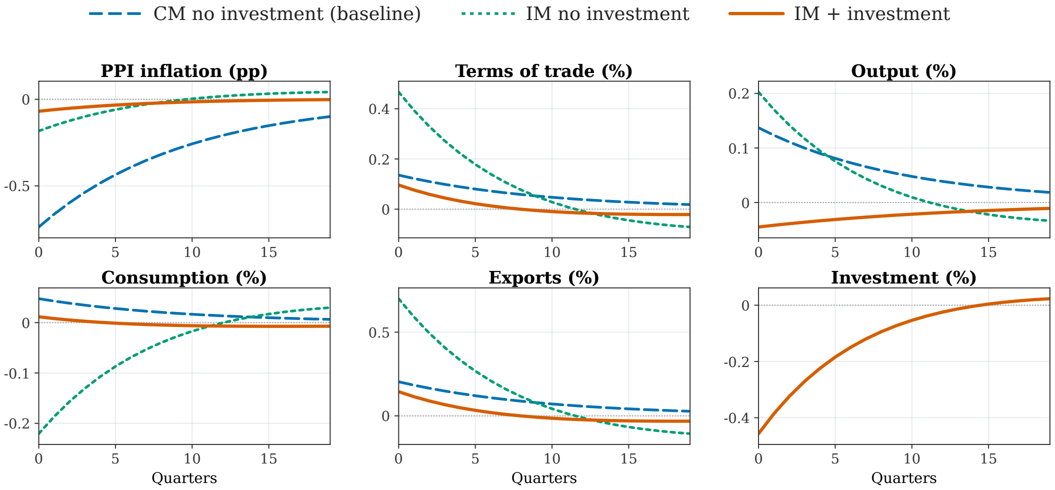
Responses to Uncertainty Shocks: CM vs IM



Incomplete Markets with Investment



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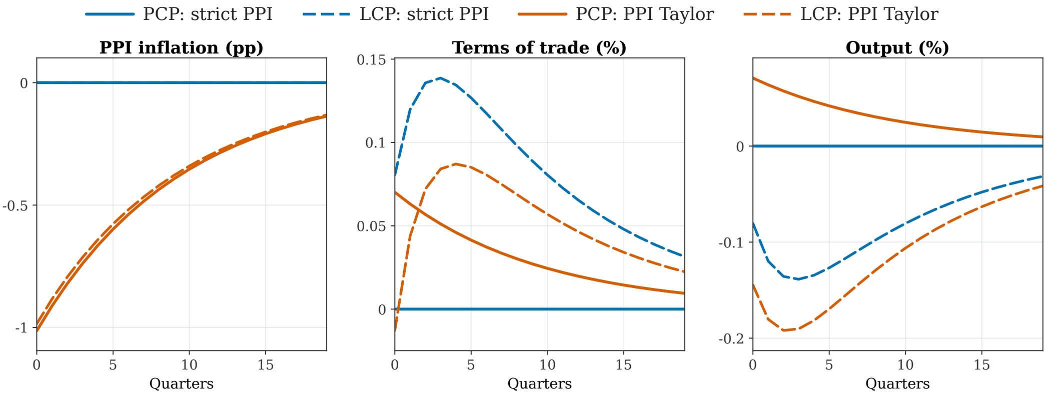
LCP Extension: Policy Comparison



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