Does the transmission monetary policy shocks change when inflation is high?

Fabio Canova and Fernando Pérez Forero

Norwegian Business School and Banco Central Reserva Peru

The views and opinions expressed in this document are those of the author and do not necessarily reflect the official policy or position of the BCRP.

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Motivation I: Policy viewpoint

- After 40 years high inflation was back in 2021-2023. Average EU inflation 10%. Netherland, Estonia close or above 20%. US inflation around 7.5%.
- Big headache for policymakers around the world. Causes?
- Is the propagation of monetary policy shocks different?
- Is monetary policy less powerful to affect the real economy?
- Should we care designing new policy actions in this state?

Motivation II: Academic viewpoint

- Menu costs (e.g. Alvarez and Lippi, 2020) high inflation, more price changes. Monetary policy shocks should have larger effect on inflation and smaller effect on real activity and unemployment.
- Rational Inattention (e.g. Sims, 2010): higher inflation, agents pay more attention to inflation news. Potential for hyperinflation or higher persistence in high inflation state. Larger effects on inflation expectations, less real effects of monetary policy shocks.
- Slanted-L (Benigno and Eggertsson, 2023): higher inflation related to high vu ratio (higher production costs). Monetary policy shocks should have larger effects on inflation and smaller effects on real activity and unemployment.

Purpose of the paper and methodology

- **Compare the transmission of monetary policy shocks in the US in high and low inflation regimes.**
- Identify conventional monetary policy and liquidity shocks.
- Draw implications for theories of inflation/output tradeoffs.
- Use a Bayesian threshold vector autoregressive model with stochastic volatility and volatility feedback.
- Add to the posterior sampler a zero-sign restriction identification scheme and a reparameterization to make sampling more efficient, see Canova and Perez Forero, 2015.

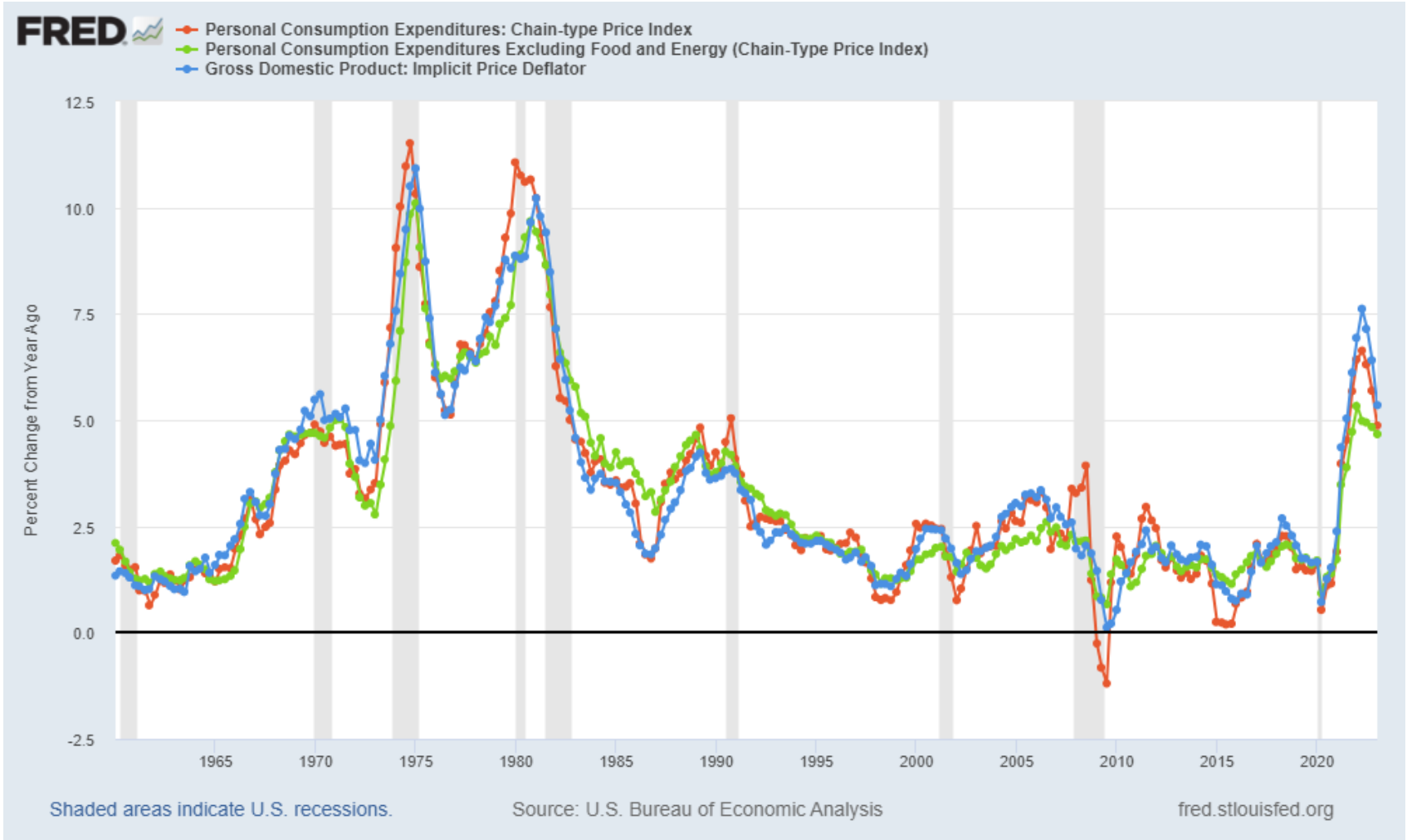
Results

- Conventional shocks produce a weaker peak effect but more persistent dynamics in the high inflation regime.
- Conventional shock perceived by private agents as providing information in the **low** inflation regime (slope inversion)
- Liquidity shocks are more expansionary in the short term in the high inflation regime.
- Liquidity shock perceived by private agents as providing information in the **high** inflation regime (future stock profitability boost).
- Evidence inconsistent with popular monetary policy transmission theories.

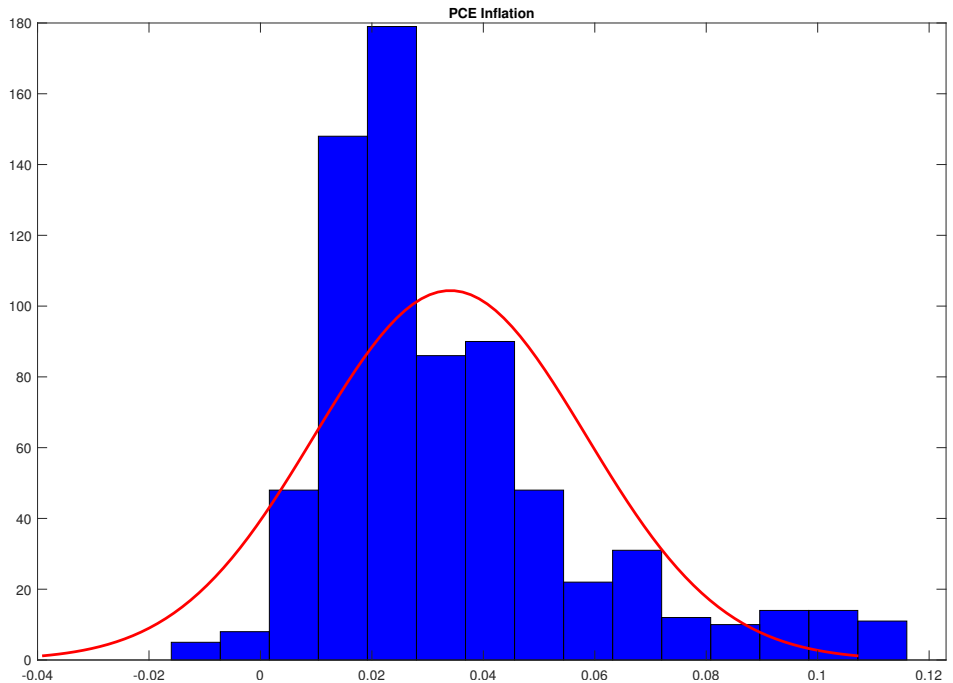
Relationship with the literature

- TBVAR: Alessandri and Mumtaz (2019), **Gargiulo et al. (2024)**, De Santis et al. (2023), Castelnuovo et al. (2024), Rossi et al. (2024), Degasperi et al (2024).
- Nonlinear models. TVC-VAR: Canova and Gambetti (2009), Primiceri (2005); Markov switching: Sims and Zha, (2009); smooth transition VAR Ascari and Haber, (2021), TVC-IV Inouer et al (2024).
- Nonlinear effects: Ravn and Sola (1996), Weise (1999), Tenreyro and Thwaites (2016), Pellegrino (2021), Ascari and Haber (2021), DeBortoli et al. (2023), Benigno and Eggertsson (2023), Merikull and Rottner (2024).
- **Signaling effects of monetary policy** :Melosi (2017), Jarocinski (2020), Miranda Agrippino and Ricco (2021), Fisher et al. (2024).

US inflation:1960-2023



US PCE Inflation 1960-2023: not normally distributed



Inflation Distribution

Mean and Median

0.0341	0.0263

Skewness and Kurtosis

1.3395	4.6256

Inter-Quartile Range

0.0176	0.0438

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Two-states threshold-BVAR Model I

$$Z_t = \left(c_1 + \sum_{j=1}^{P} \beta_1 Z_{t-j} + \sum_{j=0}^{J} \gamma_1 ln\lambda_{t-j} + \Omega_{1t}^{1/2} e_t \right) \tilde{S}_t + \left(c_2 + \sum_{j=1}^{P} \beta_2 Z_{t-j} + \sum_{j=0}^{J} \gamma_2 ln\lambda_{t-j} + \Omega_{2t}^{1/2} e_t \right) \left(1 - \tilde{S}_t\right) \quad (1)$$

$Z_t = (Y_t, P_t, U_t, R_t, Yield\ Slope_t, M_t, Pcom_t, SP500_t)'$.

Y_t is industrial Production (YoY growth), P_t is the YoY inflation rate, U_t is the Unemployment Rate, R_t is the Federal Funds Rate, $Yield\ Slope_t$ is the Yield Curve Slope (10 years - 3 months), M_t is the M2 YoY growth rate, $Pcom_t$ is the commodity price index YoY growth rate, and $SP500_t$ is the SP500 YoY growth rate.

• The volatility variable λ_t is unobservable; interpreted as an uncertainty measure (specification similar to a GARCH-M).

Two-states threshold-BVAR Model II

- The regime indicator $\tilde{S}_t$ is defined by

$$\tilde{S}_t = 1 \iff P_{t-d} \leq P^* \tag{2}$$

where the delay d and the threshold level P^* are unknown parameters.

- The covariance matrix of e_t is:

$$\Omega_{it} = A_i^{-1} H_t (A_i^{-1})', \quad i = 1, 2 \tag{3}$$

where A_i are non-recursive matrices such that

$$vec\,(A_i) = S_A \alpha_i + s_A$$

where S_A and s_A are matrices with 0's and 1's, see Canova and Perez Forero, 2015

Two states threshold-BVAR Model III

- The volatility process is defined by:

$$H_t = \lambda_t \Sigma \tag{4}$$

$$\Sigma = diag\left(\sigma_1^2, \ldots, \sigma_8^2\right) \tag{5}$$

$$ln\lambda_t = \mu + F\left(ln\lambda_{t-1} - \mu\right) + \eta_t \tag{6}$$

  where η_t is an i.i.d. process with variance Q.

- There is a single scalar process governing the time varying volatility of the system as in Carriero et al. (2016).

Two states threshold-BVAR Model IV

Variable	Conventional MP shock	Liquidity shock
Econ. Activity	0	0
PCE Inflation	≤ 0	0
Unemployment	0	0
Interest Rate	> 0	0 (24 periods)
Yield Curve Slope		≤ 0
Money Growth	< 0	> 0
Commodity Prices		
SP 500		

Table: Contemporaneous identification restrictions

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Estimation

- Use Bayesian approach. Want to calculate the posterior distribution of $\Theta = \left\{P^*, d, \Phi_{1:2}, \alpha_{1:2}, \sigma^2_{1:8}, \lambda^T, \mu, F, Q\right\}$.

- Use the Bayes theorem:

$$p\left(\Theta \mid Y\right) \propto p\left(Y \mid \Theta\right) p\left(\Theta\right) \tag{7}$$

- Draw K=100000 samples from the conditional posterior using a Gibbs sampler (plus an Adaptive Metropolis step for P^*).

- Use 5000 draws for inference.

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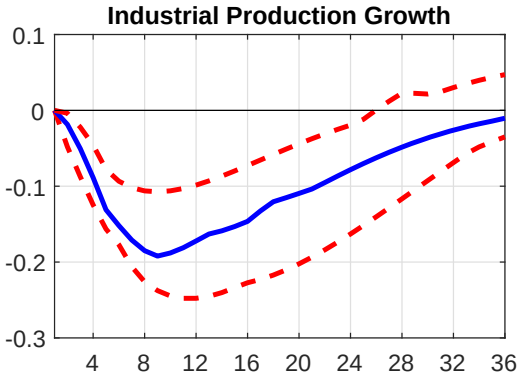
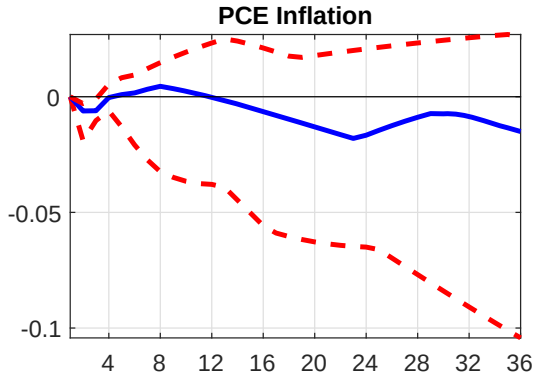
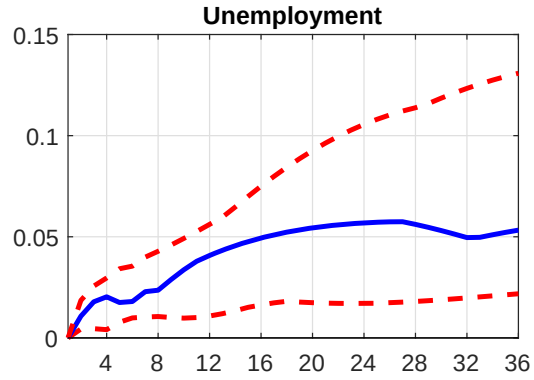
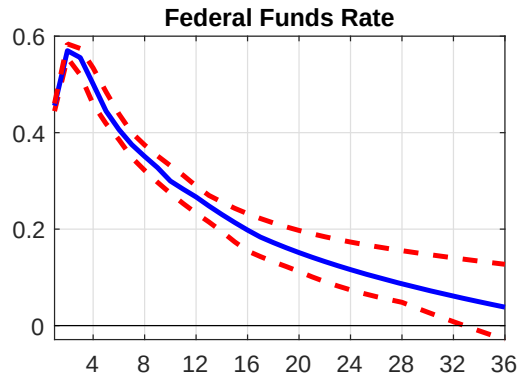
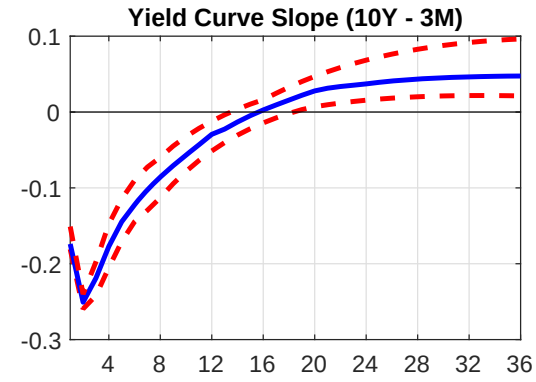
Linear model: contractionary conventional MP shocks

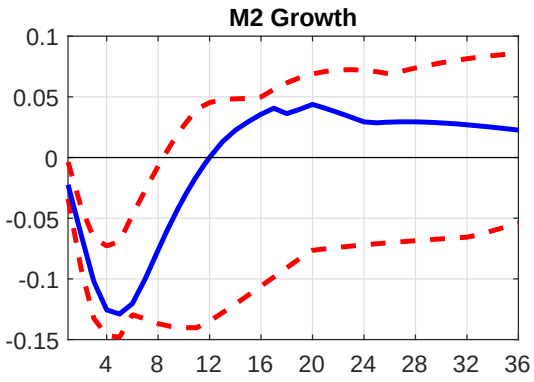


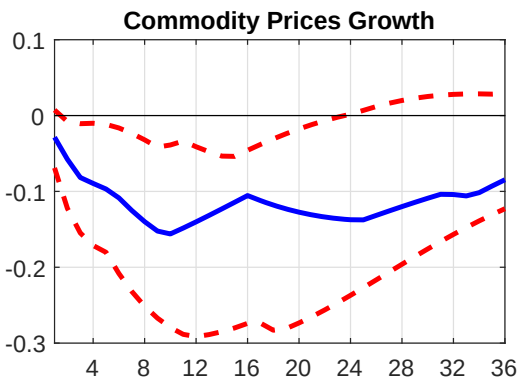


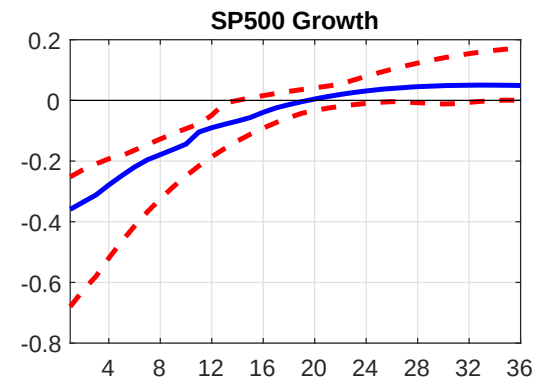




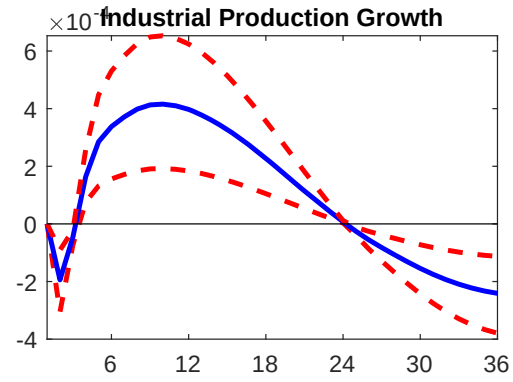


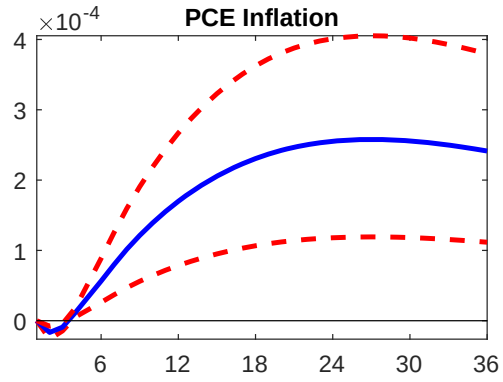


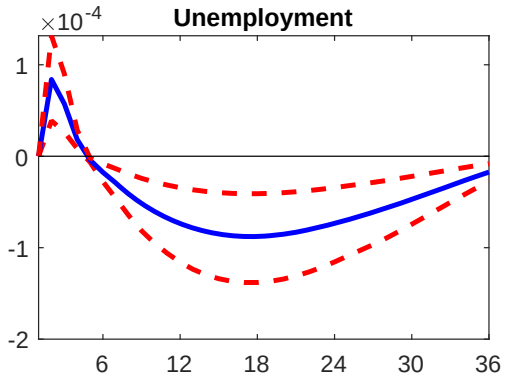


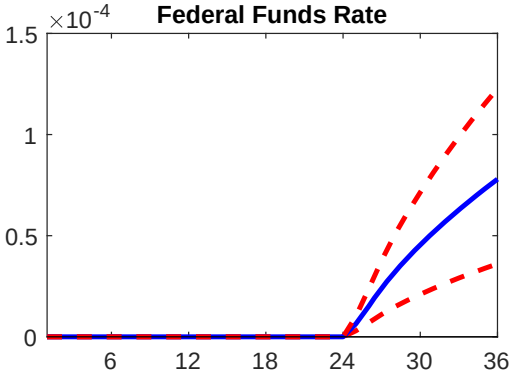


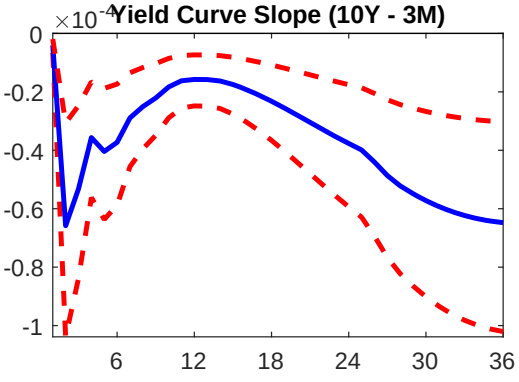
Linear model : expansionary liquidity shocks

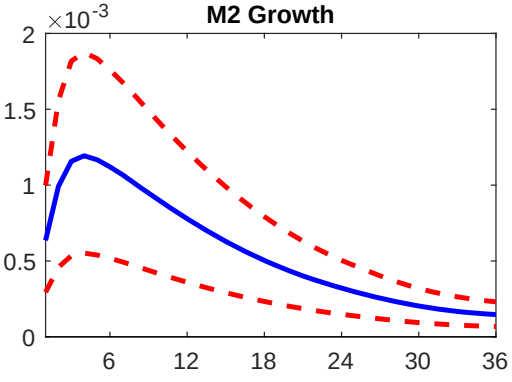


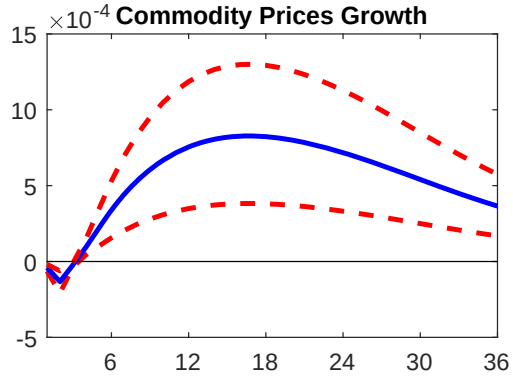


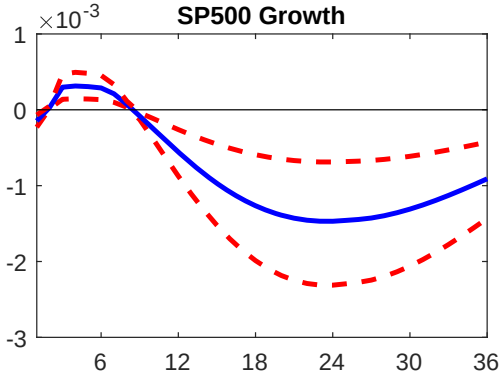




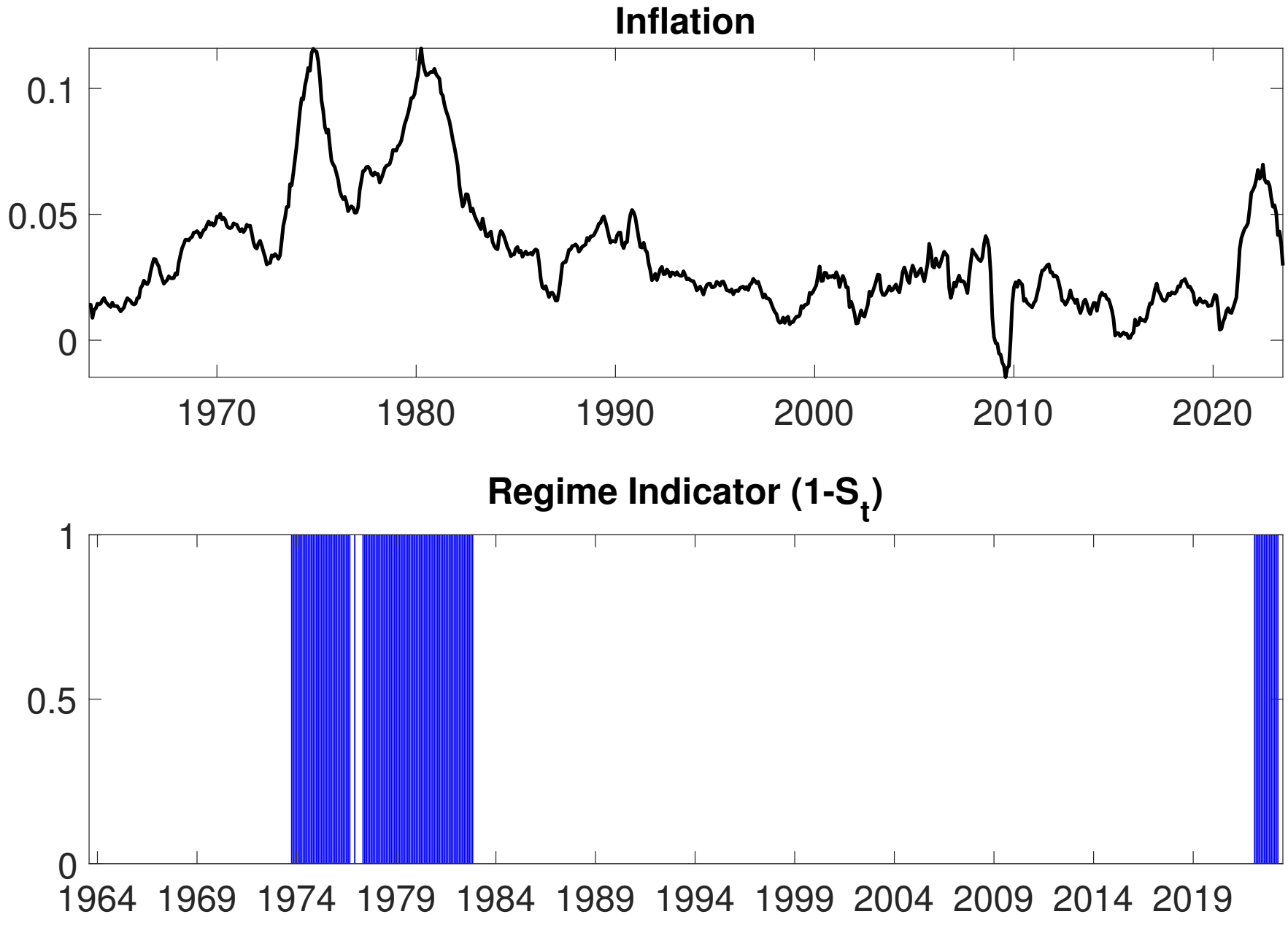




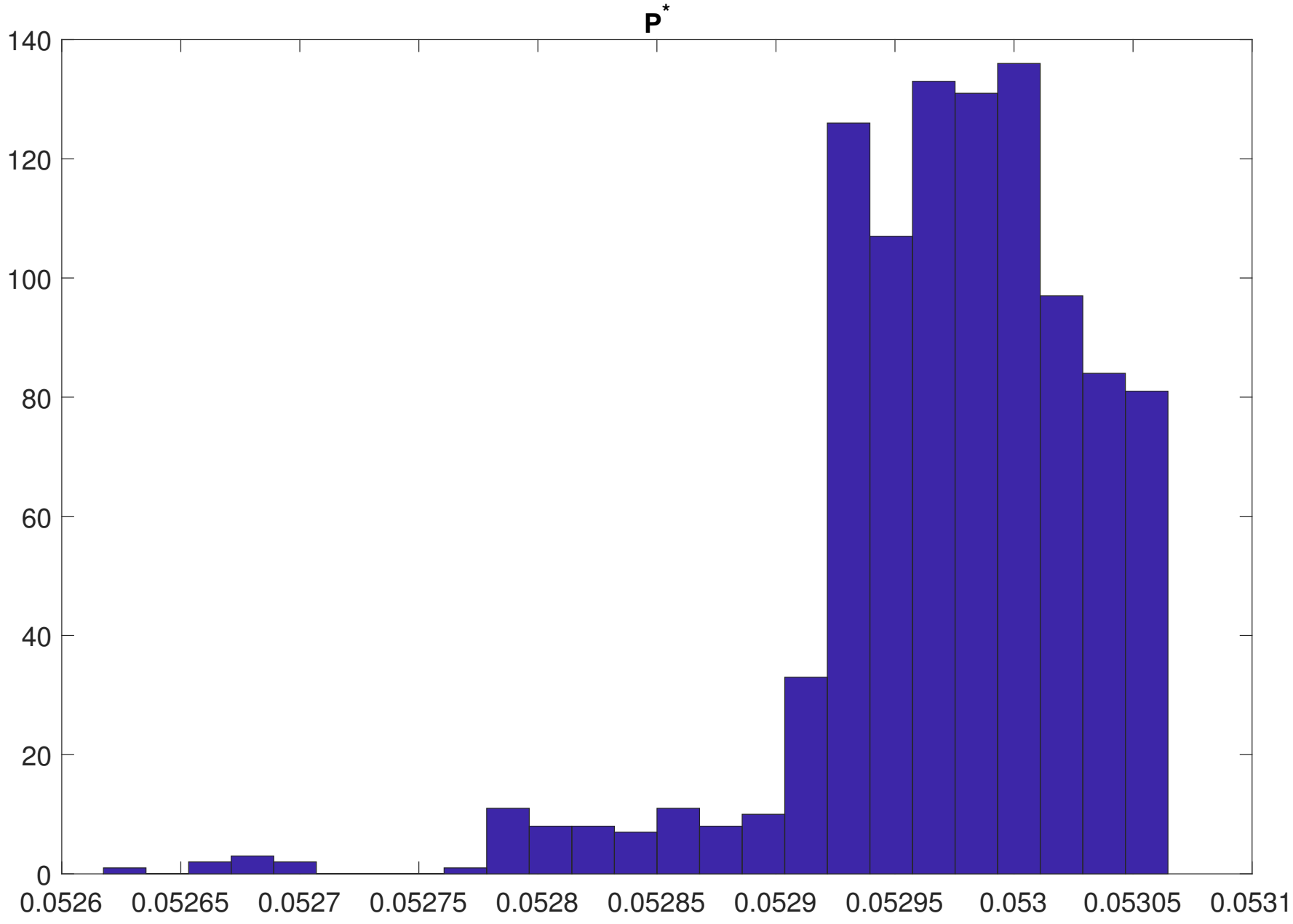




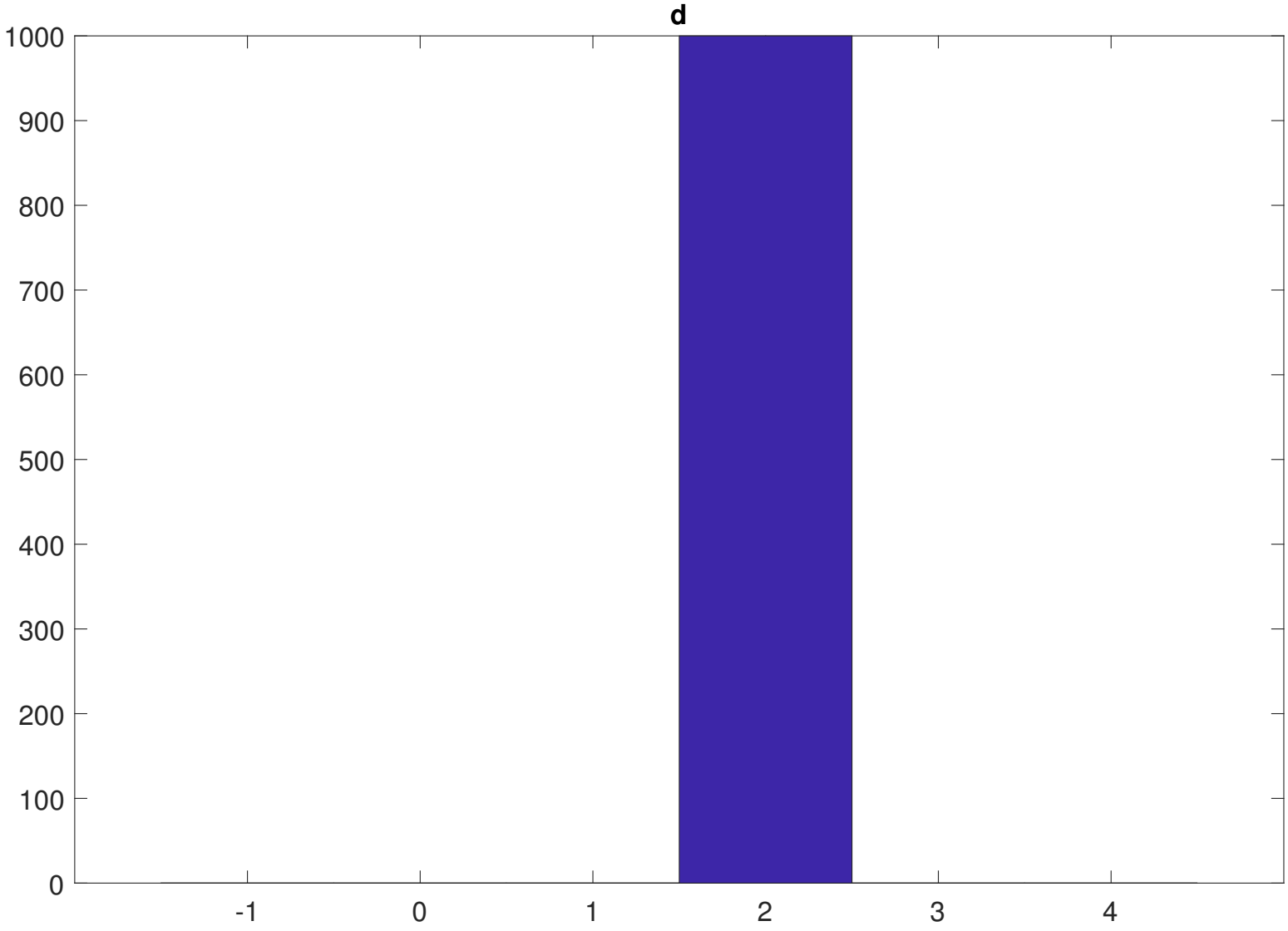
US inflation and the regime indicator



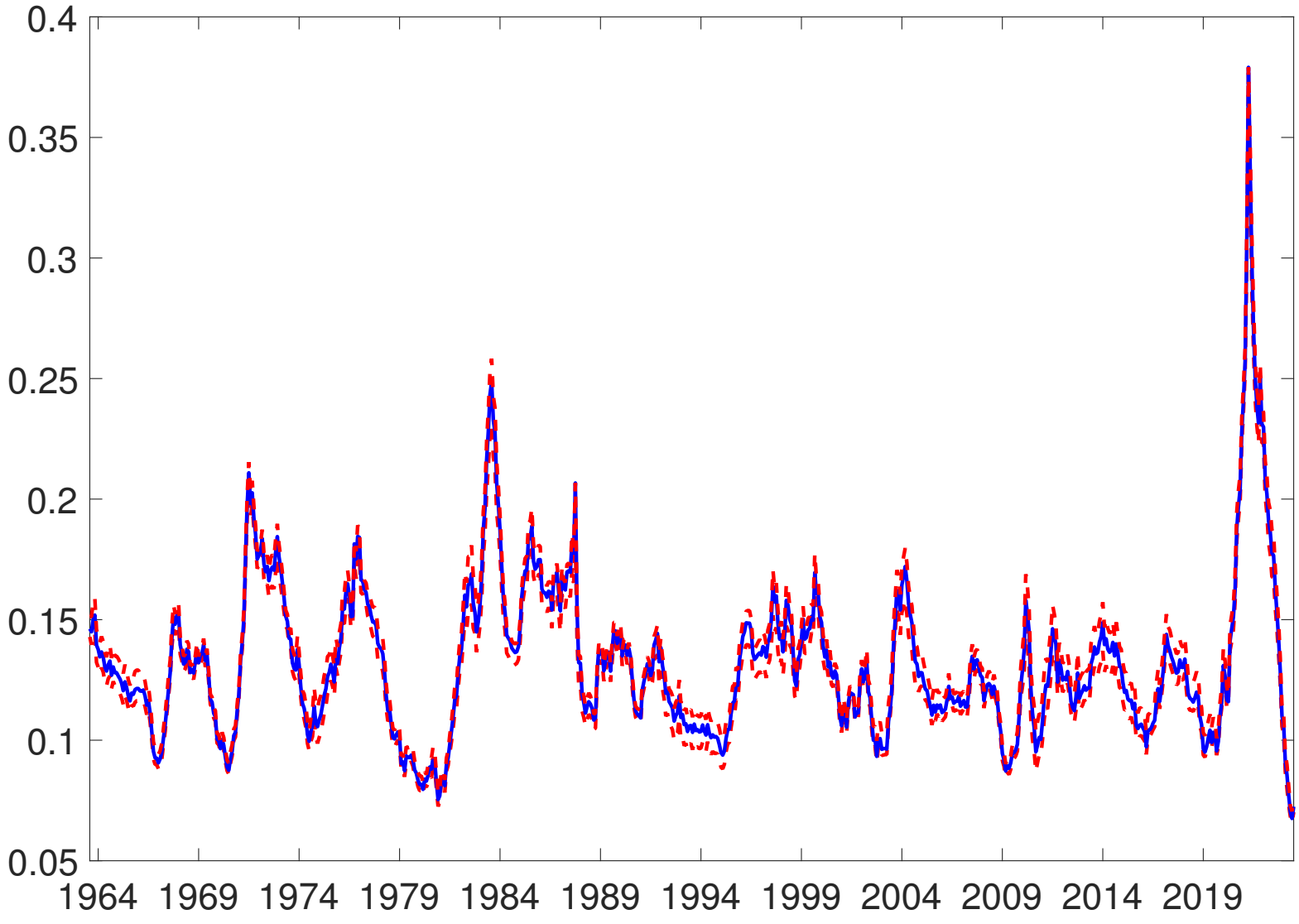
The posterior of the threshold parameter



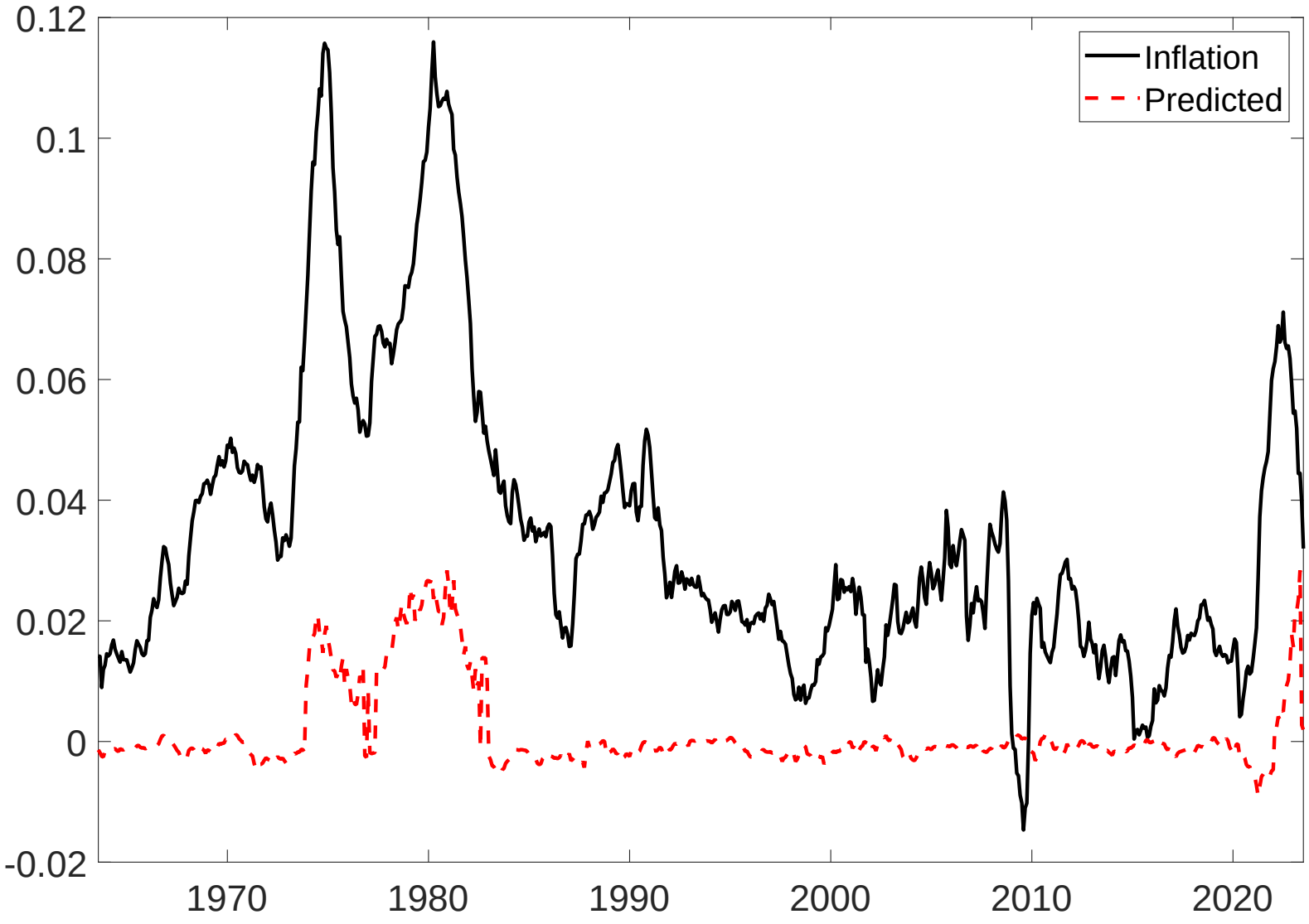
The posterior of the delay parameter



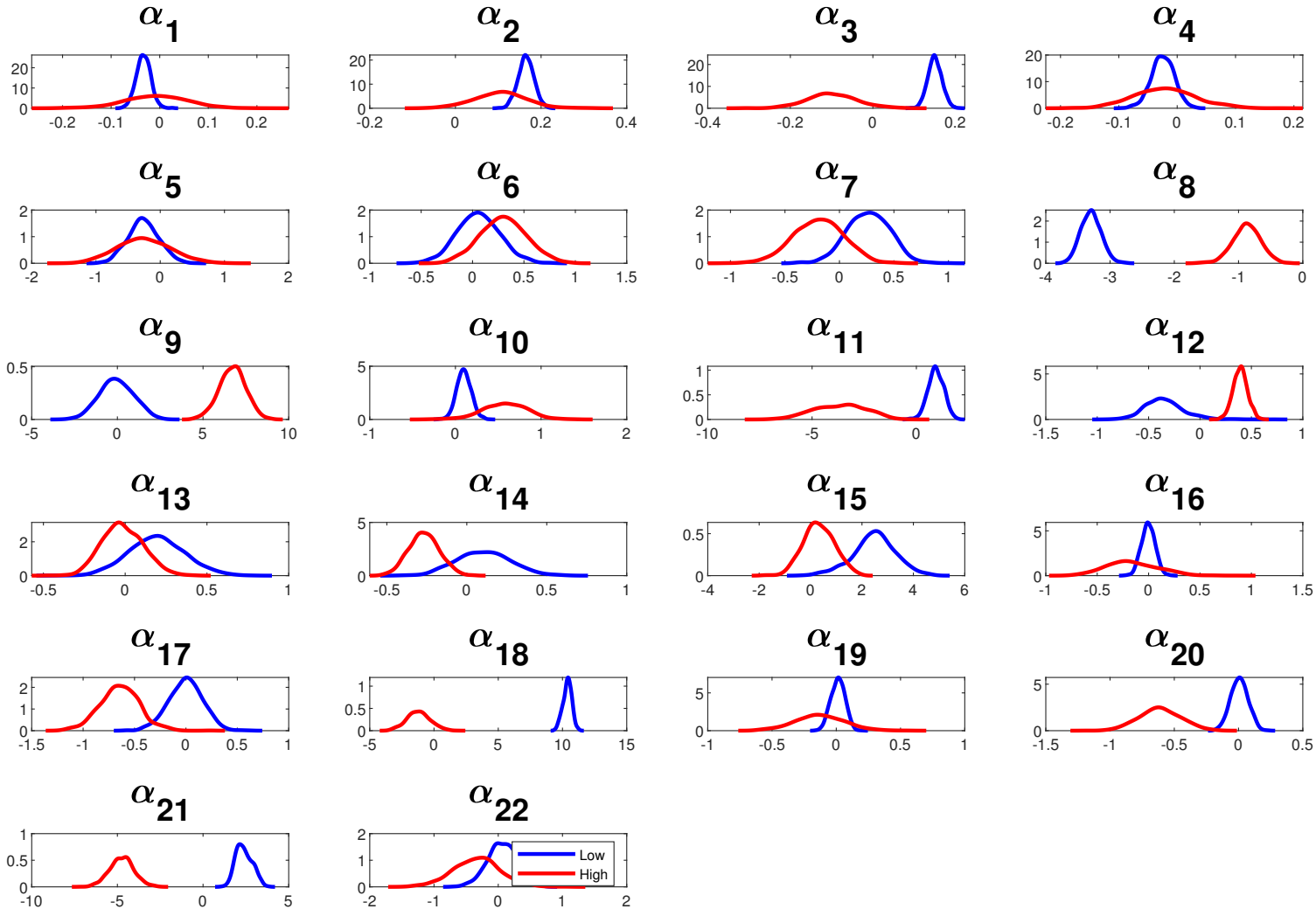
The uncertainty indicator λ_t



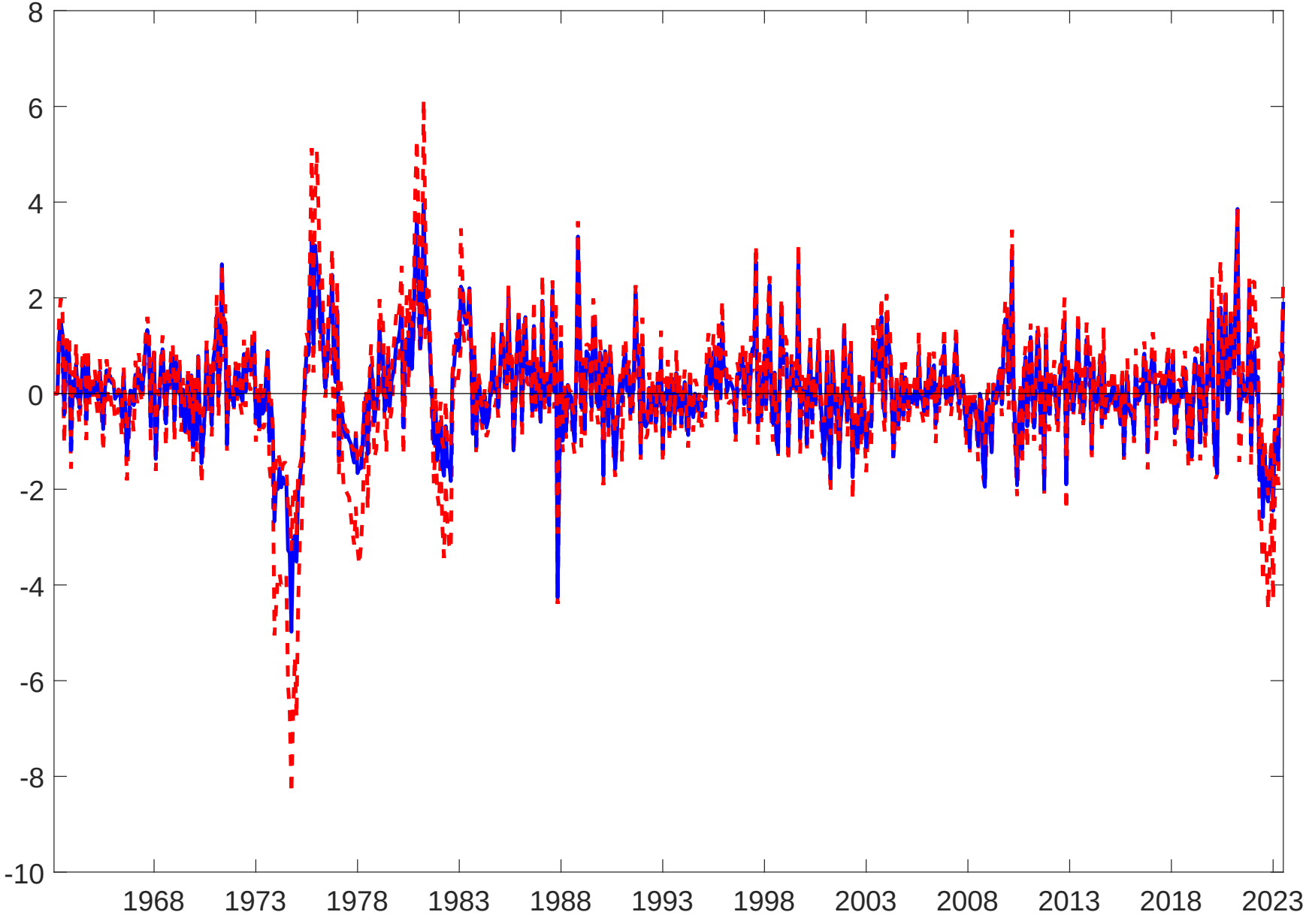
US inflation and λ_t-based predictions



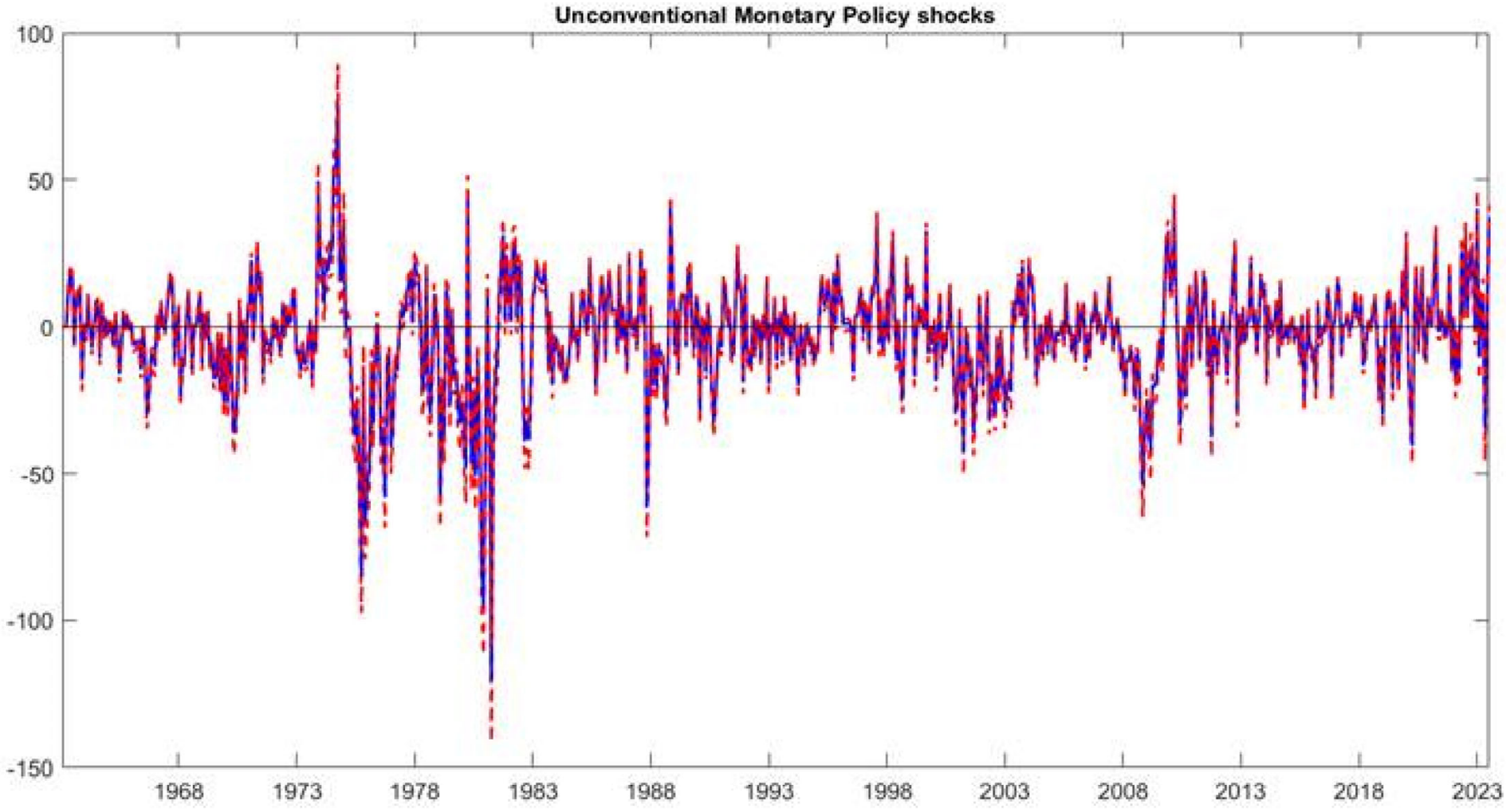
The posteriors of contemporaneous structural parameters



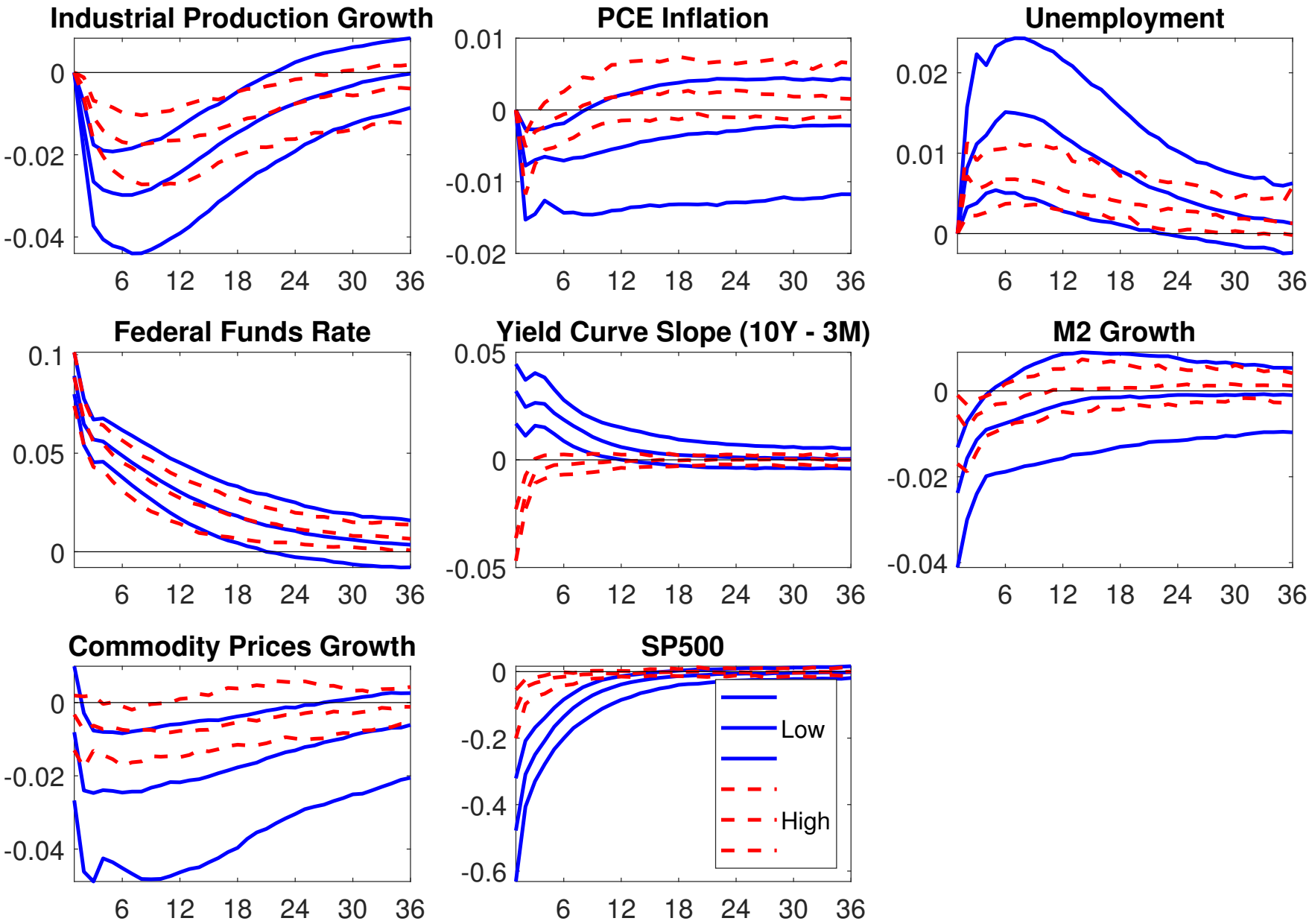
Posterior distribution: conventional policy shocks



Posterior distribution: liquidity shocks



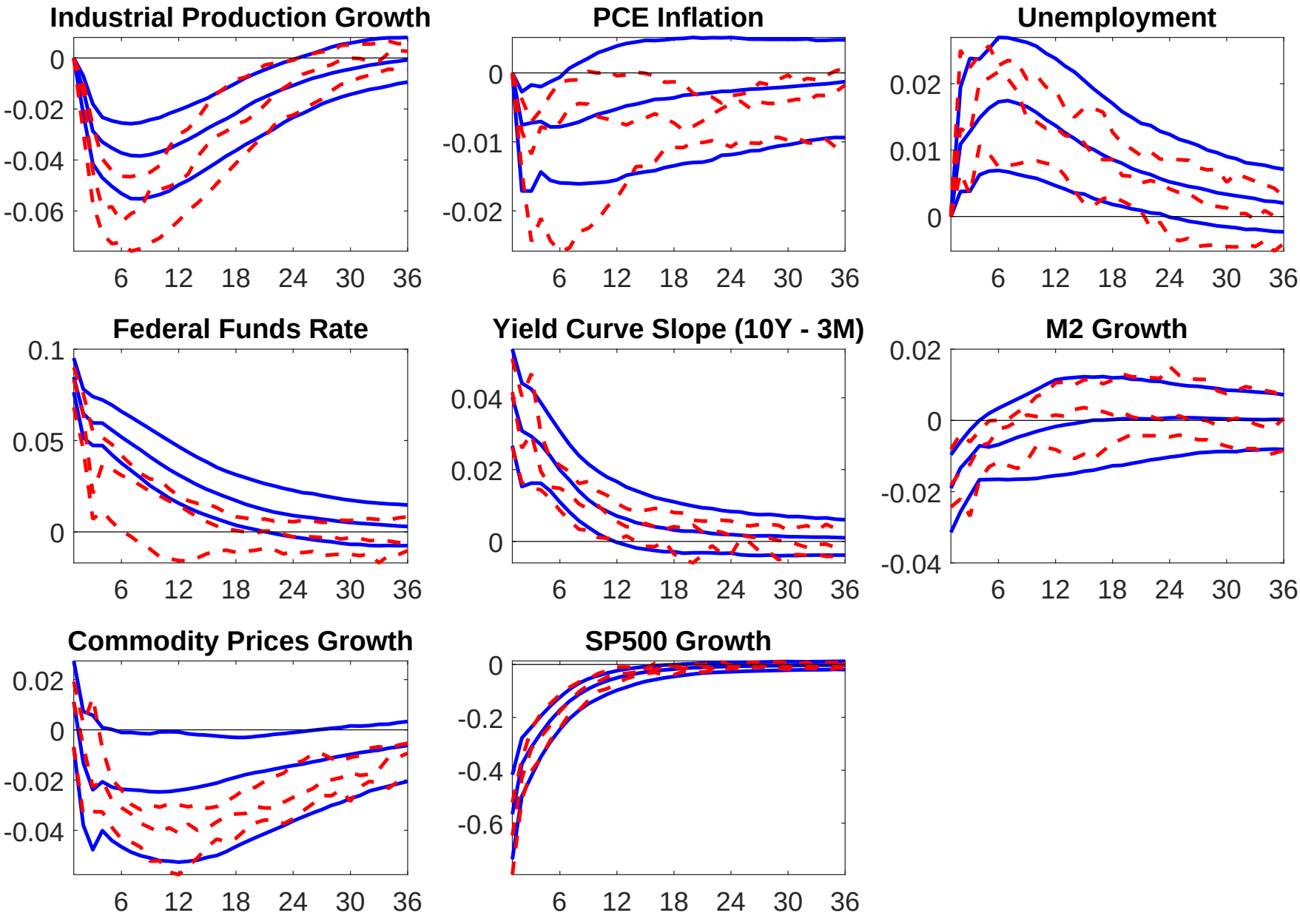
Dynamics in response to CMP



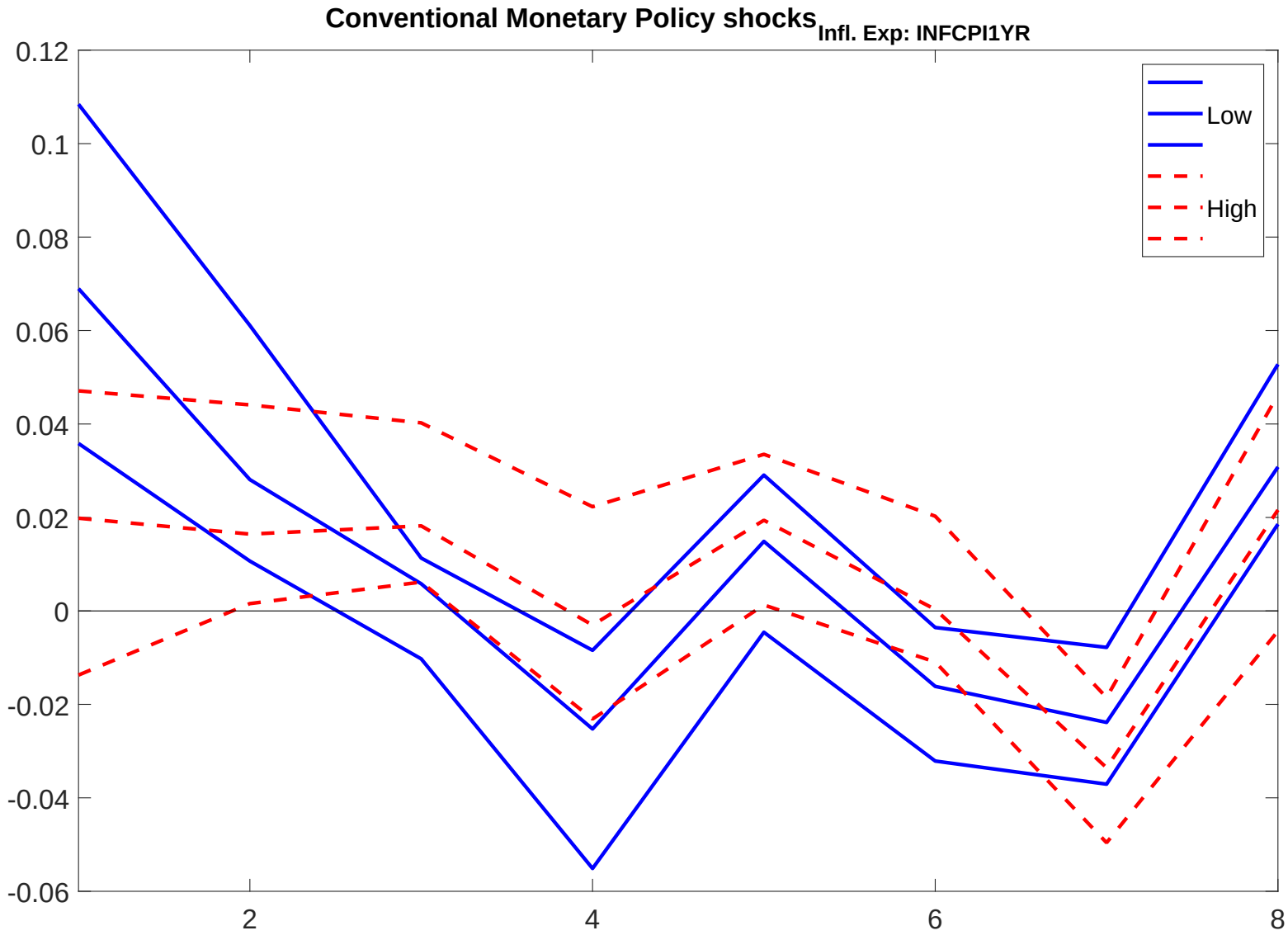
Interpretation

- Yield slope response inversion in **low** state: signaling effect?
- Run a counterfactual: fix the response of the slope in low regime. Check the responses of production growth, unemployment and inflation. Are they similar?
- Do inflation expectations react more to conventional shocks only in the **low** regime?

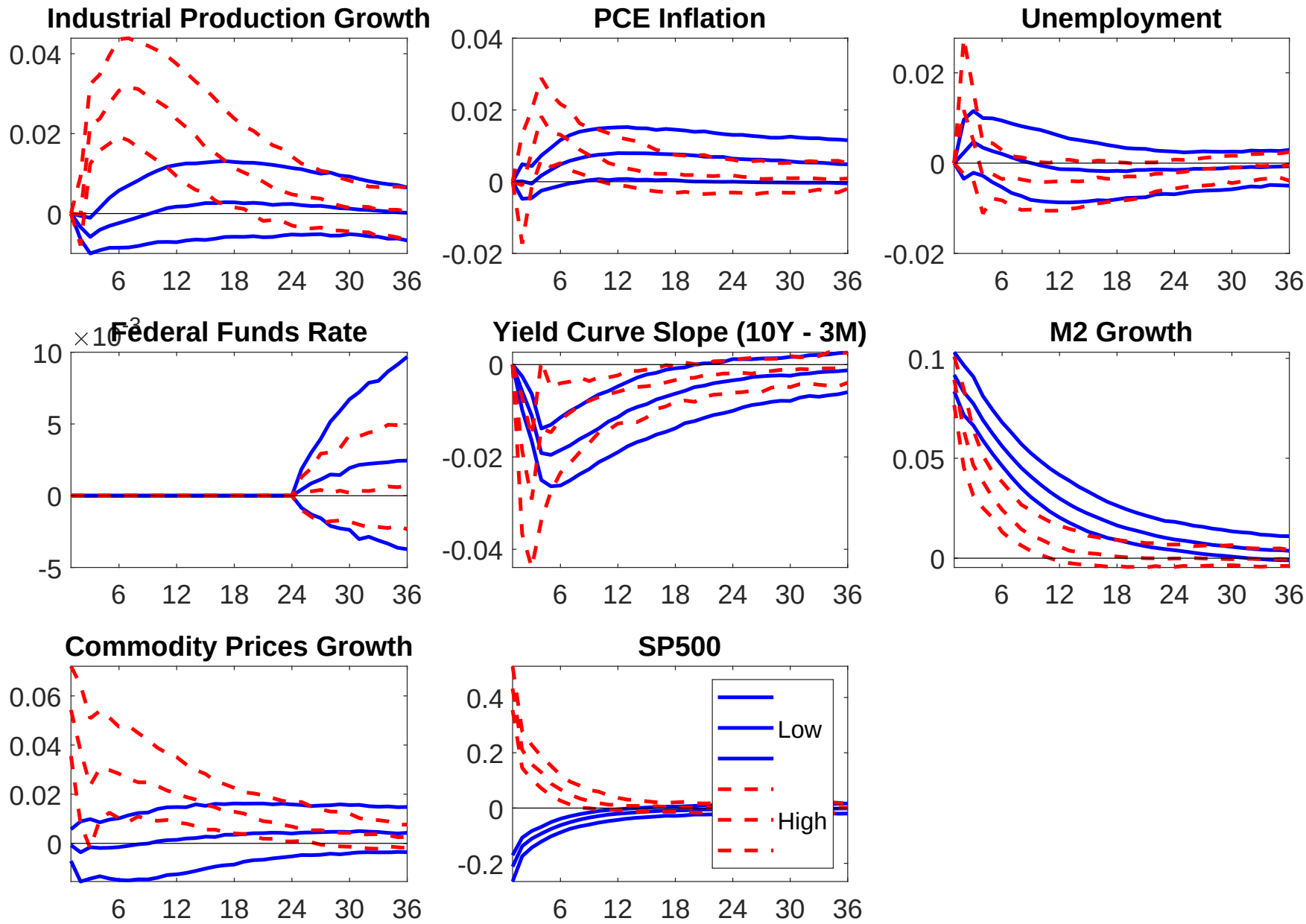
Counterfactual dynamics in response to CMP



Dynamics of inflation expectations in response to CMP



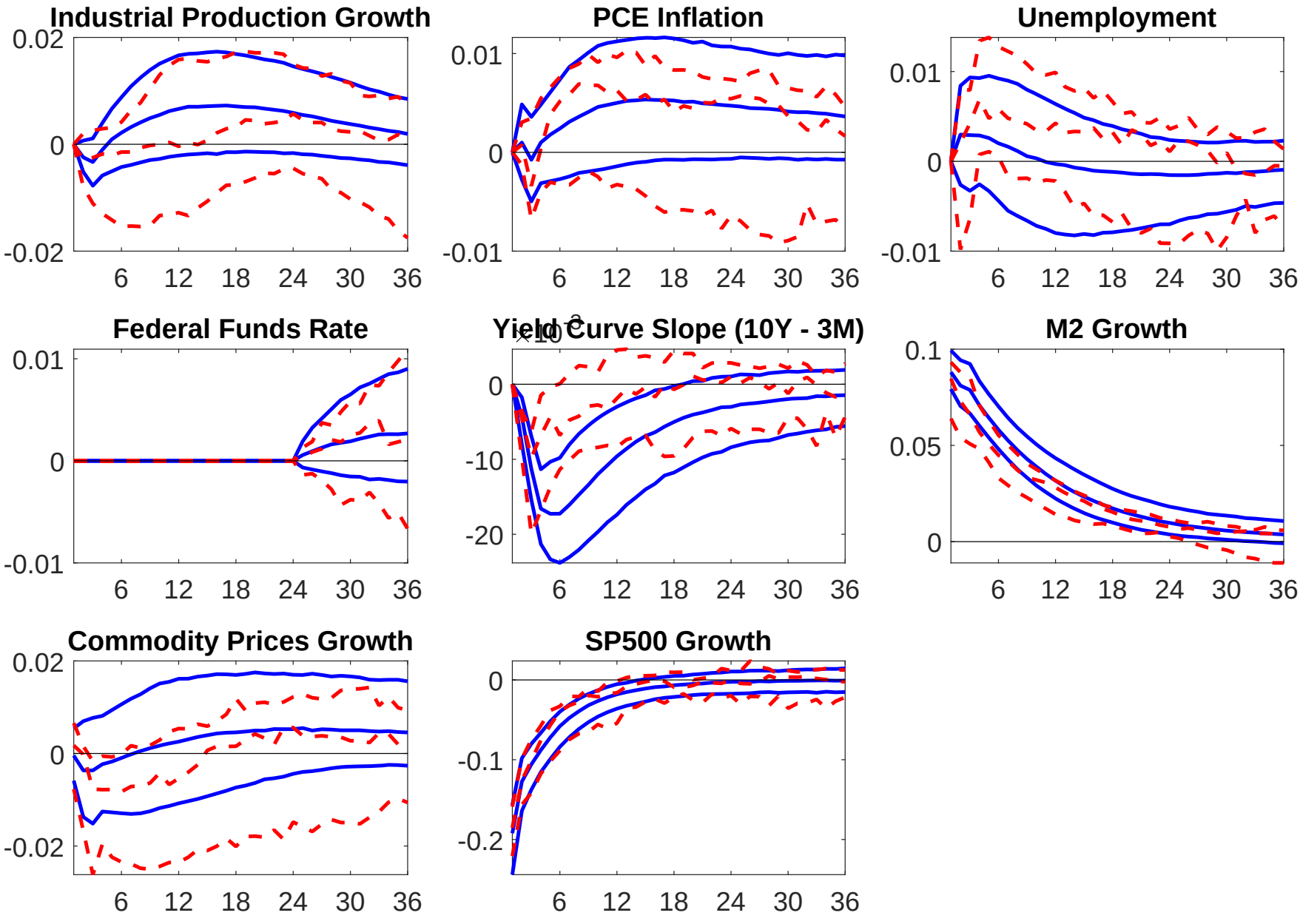
Dynamics in response to liquidity shocks



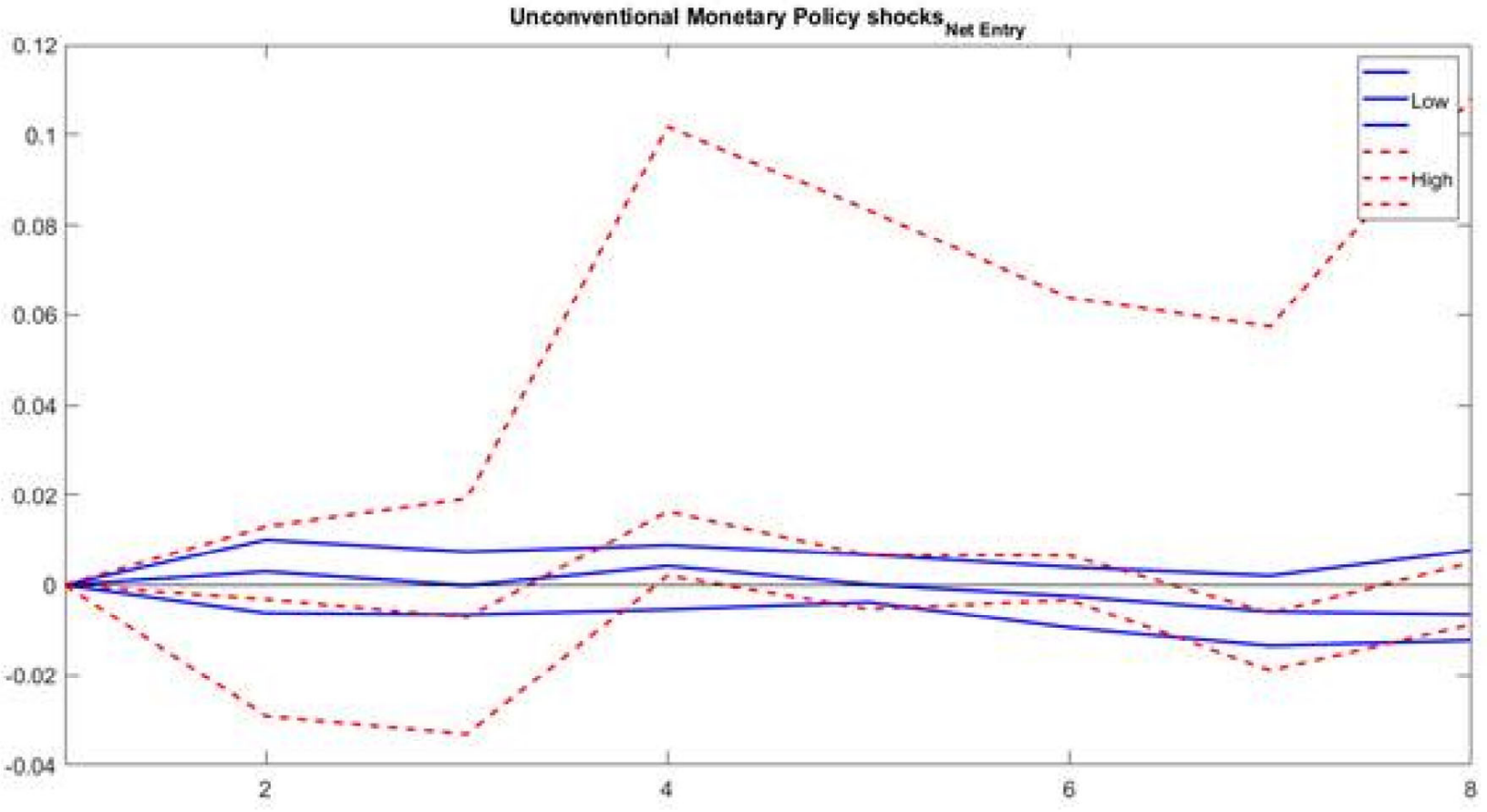
Interpretation

- SP500 growth response inversion in **high** state: signaling effect?
- Run a counterfactual: fix the response of SP500 in the high regime. Check the responses of production growth, unemployment and inflation. Are they similar?
- Does firm net entry (proxy for profitability) react more to liquidity shocks in the **high** regime?

Counterfactual dynamics in response to liquidity shocks



Dynamics of new entries (quarterly): liquidity shocks



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Evaluating theories

- Menu costs: PC slope steeper in high inflation regime.
- Slanted-L: PC slope steeper if vu ratio is high (high inflation regime)

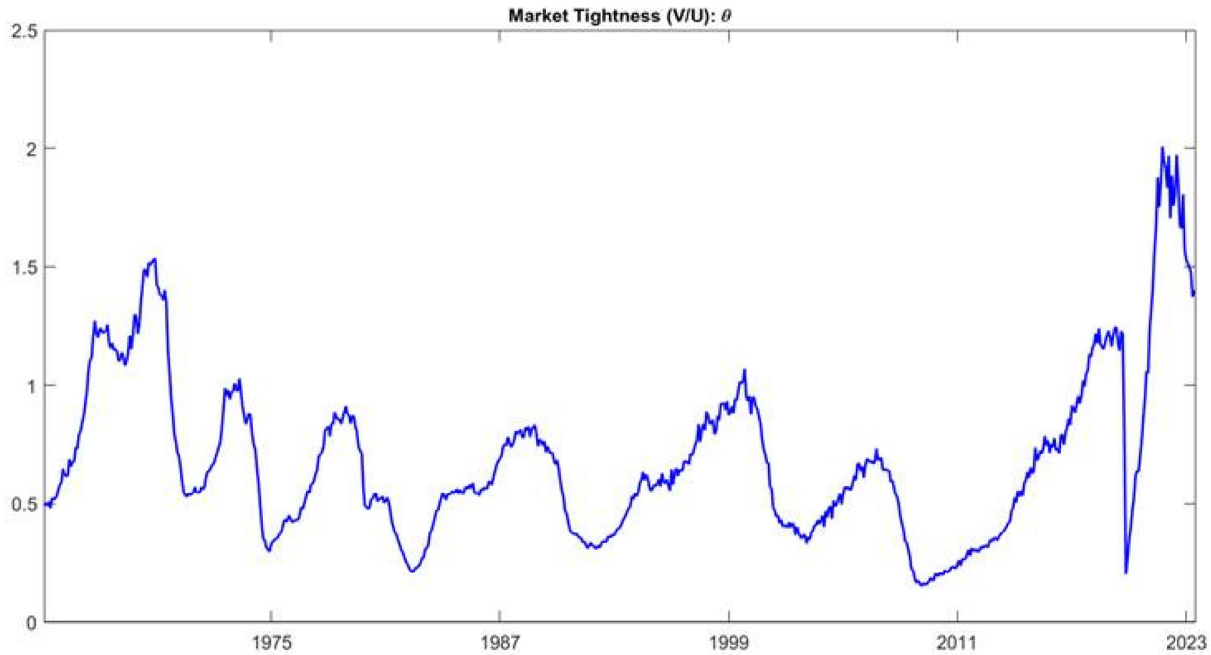
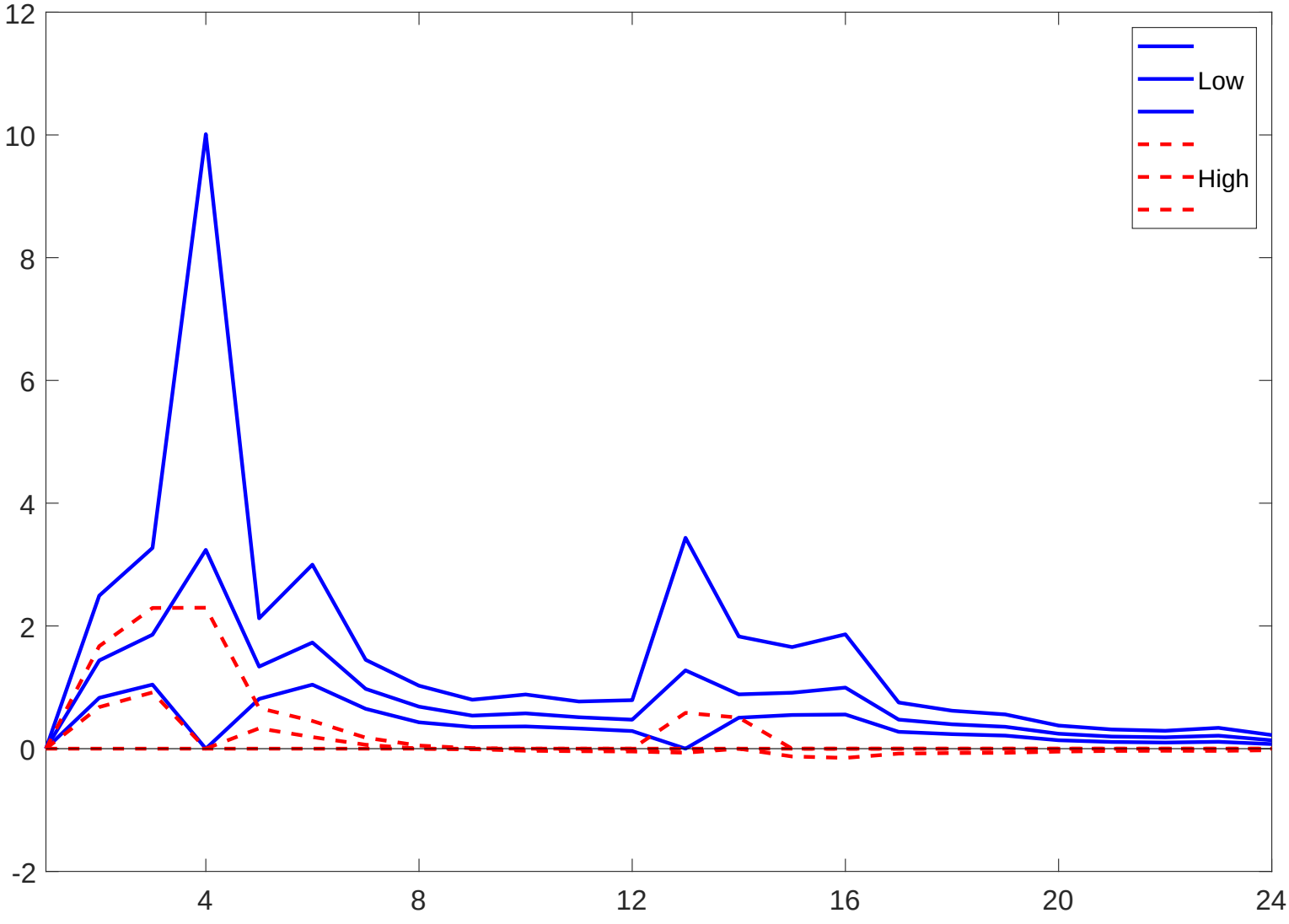


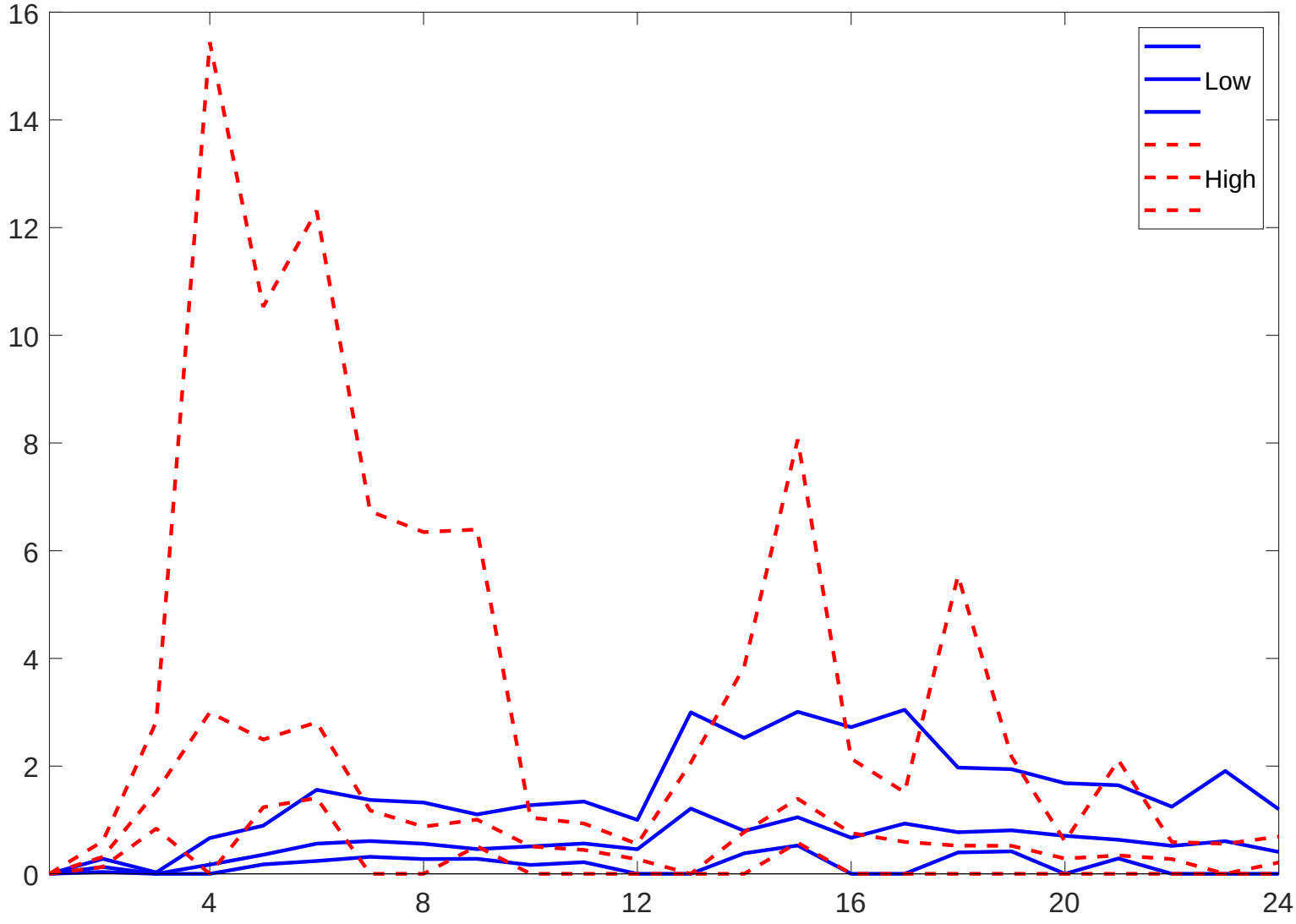
Figure: US Vacancies to unemployment ratio

- Rational inattention: inflation expectations more reactive to shocks in high inflation regime.

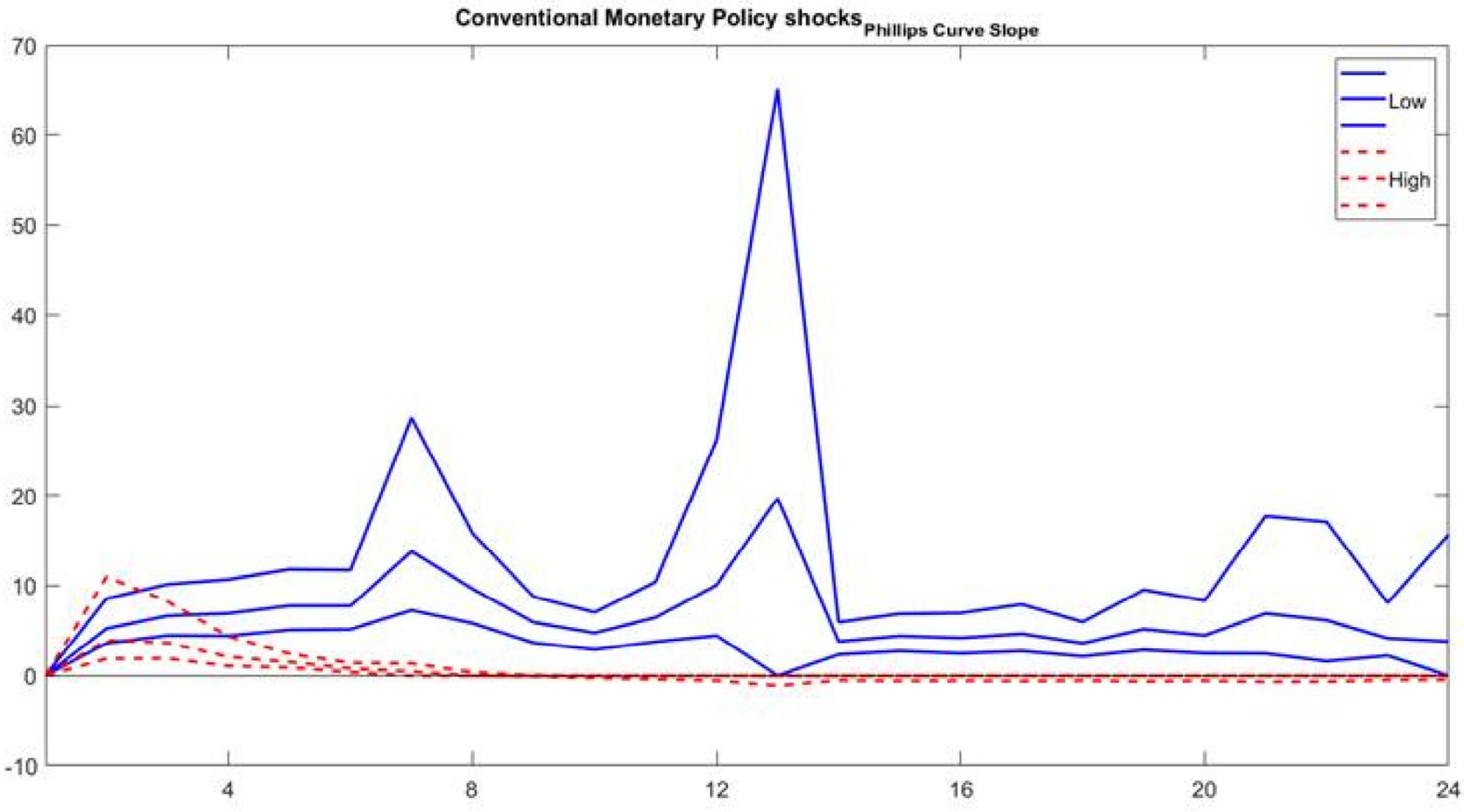
PC slope (labor share) in response to CMP shocks



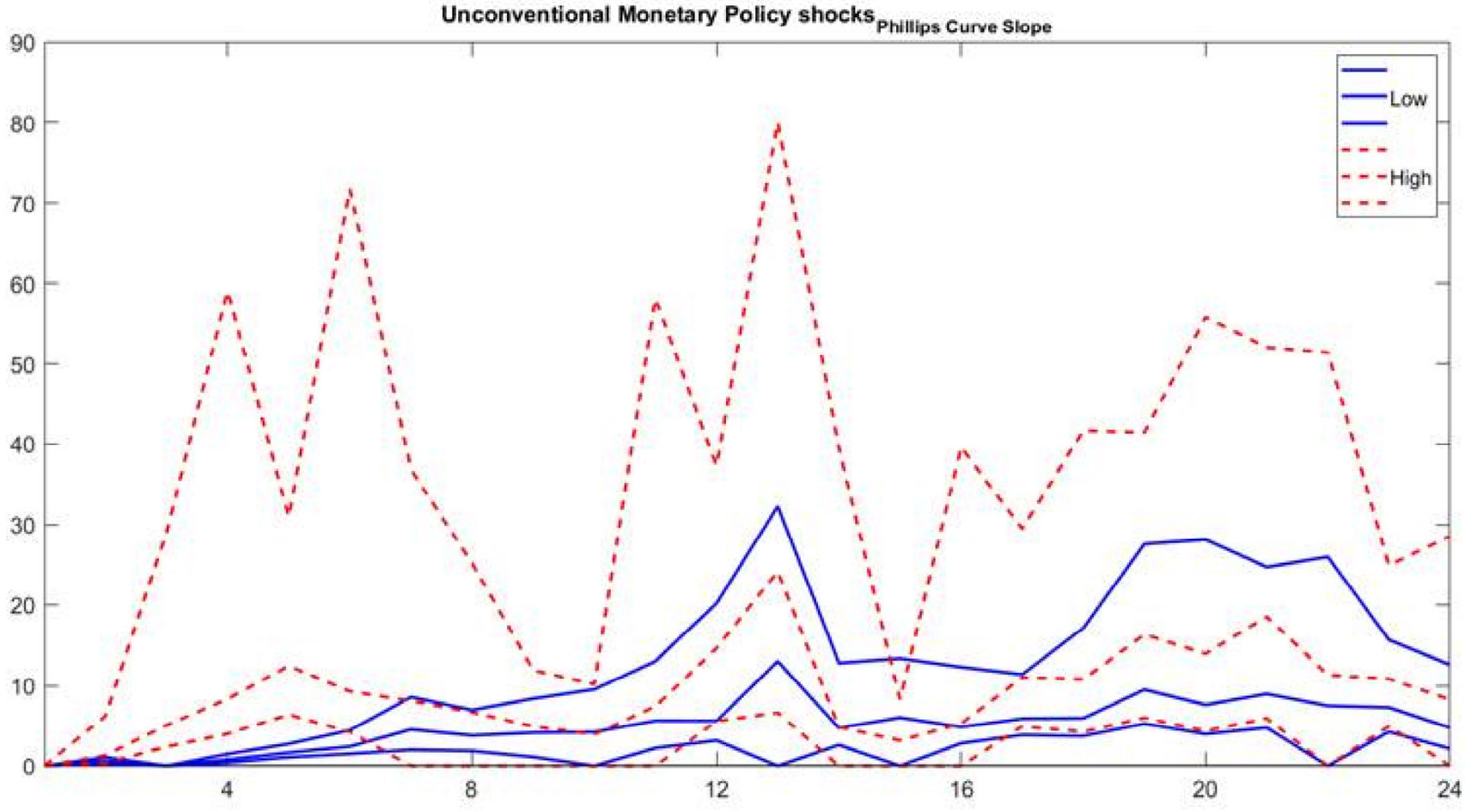
PC slope (labor share) in response to liquidity shocks



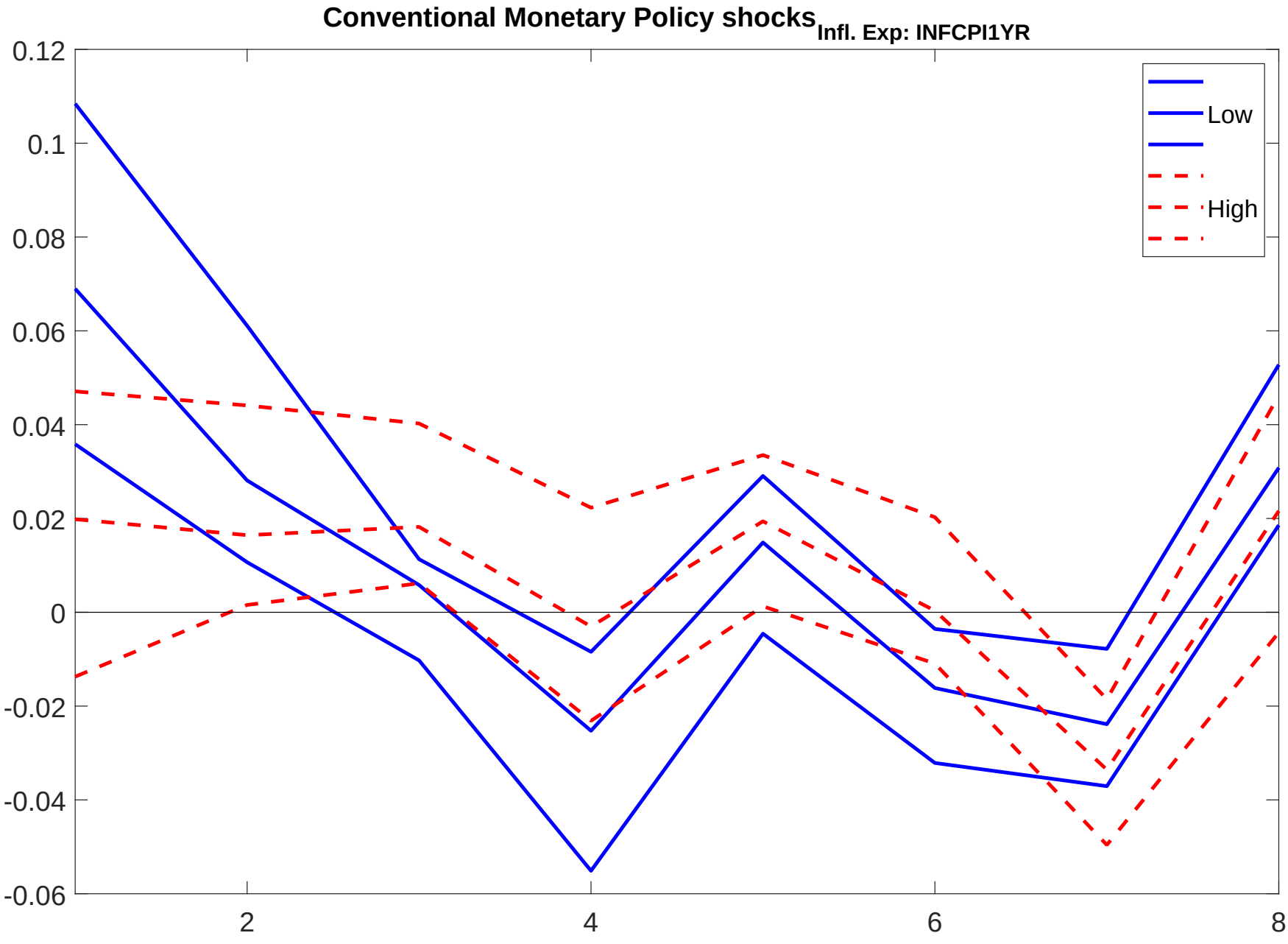
PC slope (v/u ratio) in response to CMP shocks



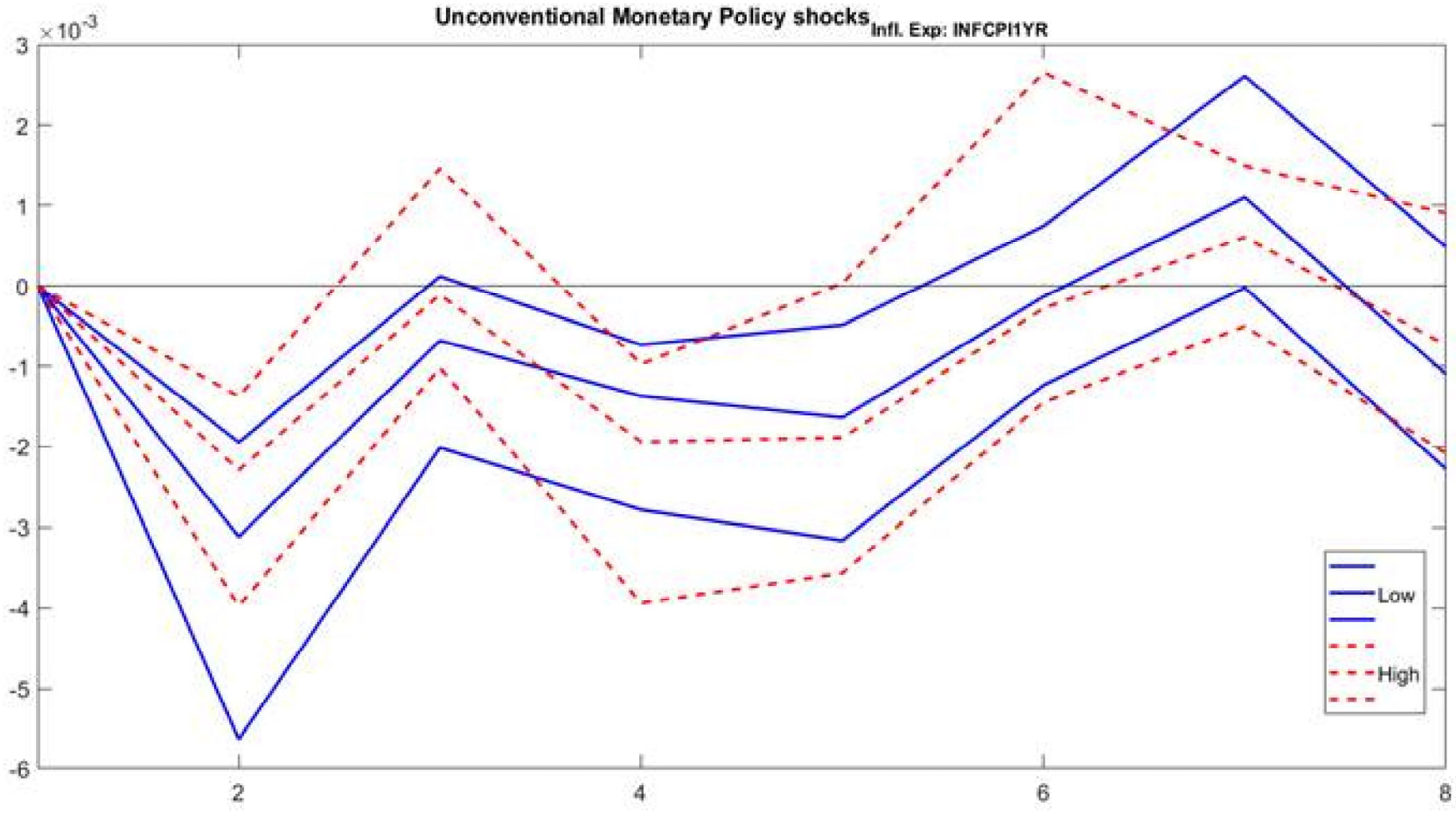
PC slope (v/u ratio) in response to liquidity shocks



Inflation expectations in response to CMP shocks



Inflation expectations in response to liquidity shocks



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Robustness

- Eliminate λ_t from the T-VAR specification.
- Sample 1989-2019: threshold 3.3.
- 3 states model (thresholds 1.5, 3.3, 5.3).
- PCE less food and energy.
- WTI Oil price in place of commodity prices
- No constraints on short term rate after liquidity shocks.
- Size and sign non-linear responses.

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Conclusions

- Conventional monetary policy less powerful but longer lasting effects in the high inflation regime.
- Bond market perceives the shock differently.
- Liquidity shocks are more expansionary in the short term when inflation is high.
- Stock market perceives the shock differently.
- Evidence at odds with standard models of MP transmission. Consistent with asymetric informational effects.

The data

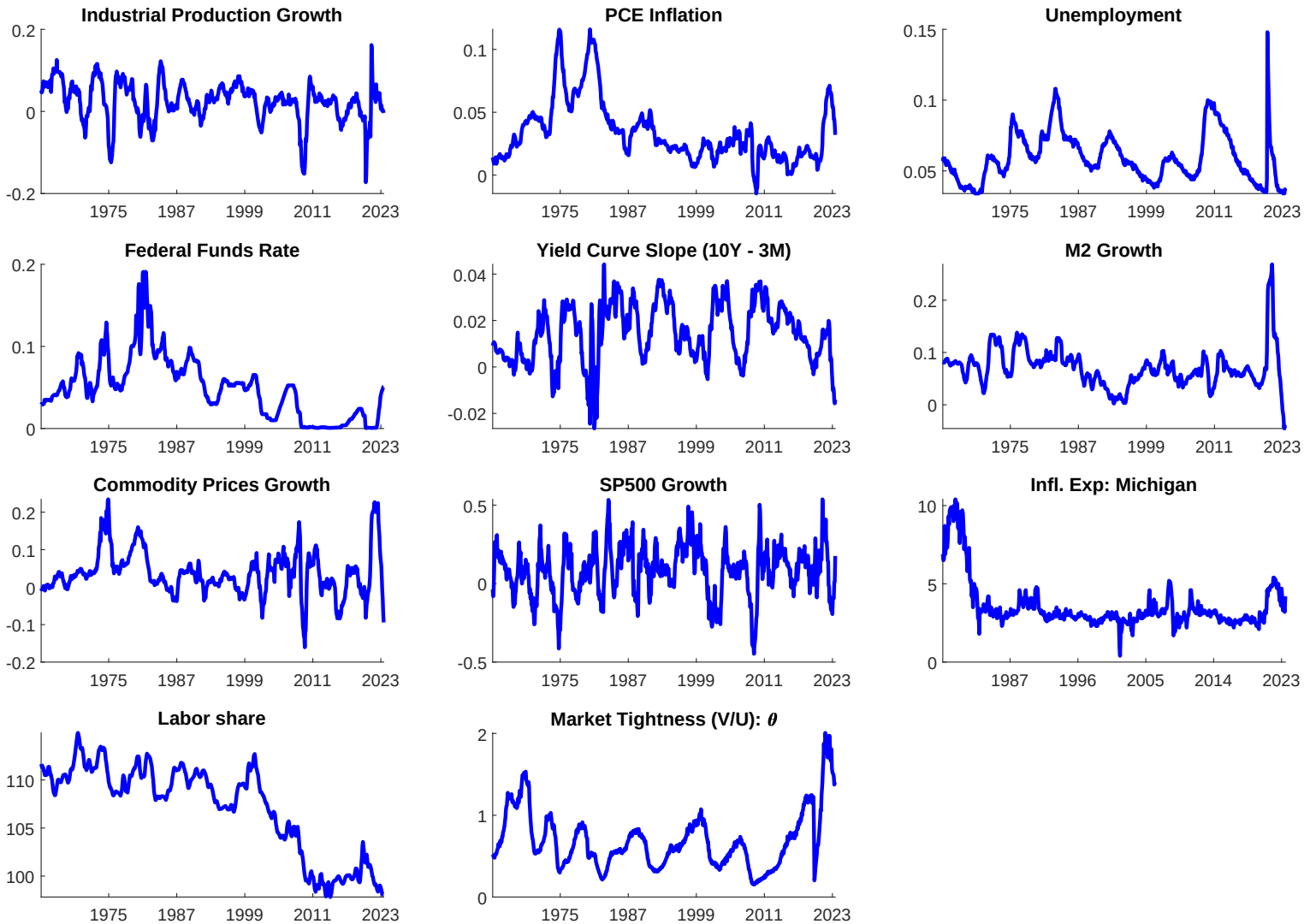

Figure: The US Data (FRED Database): 1960-2023

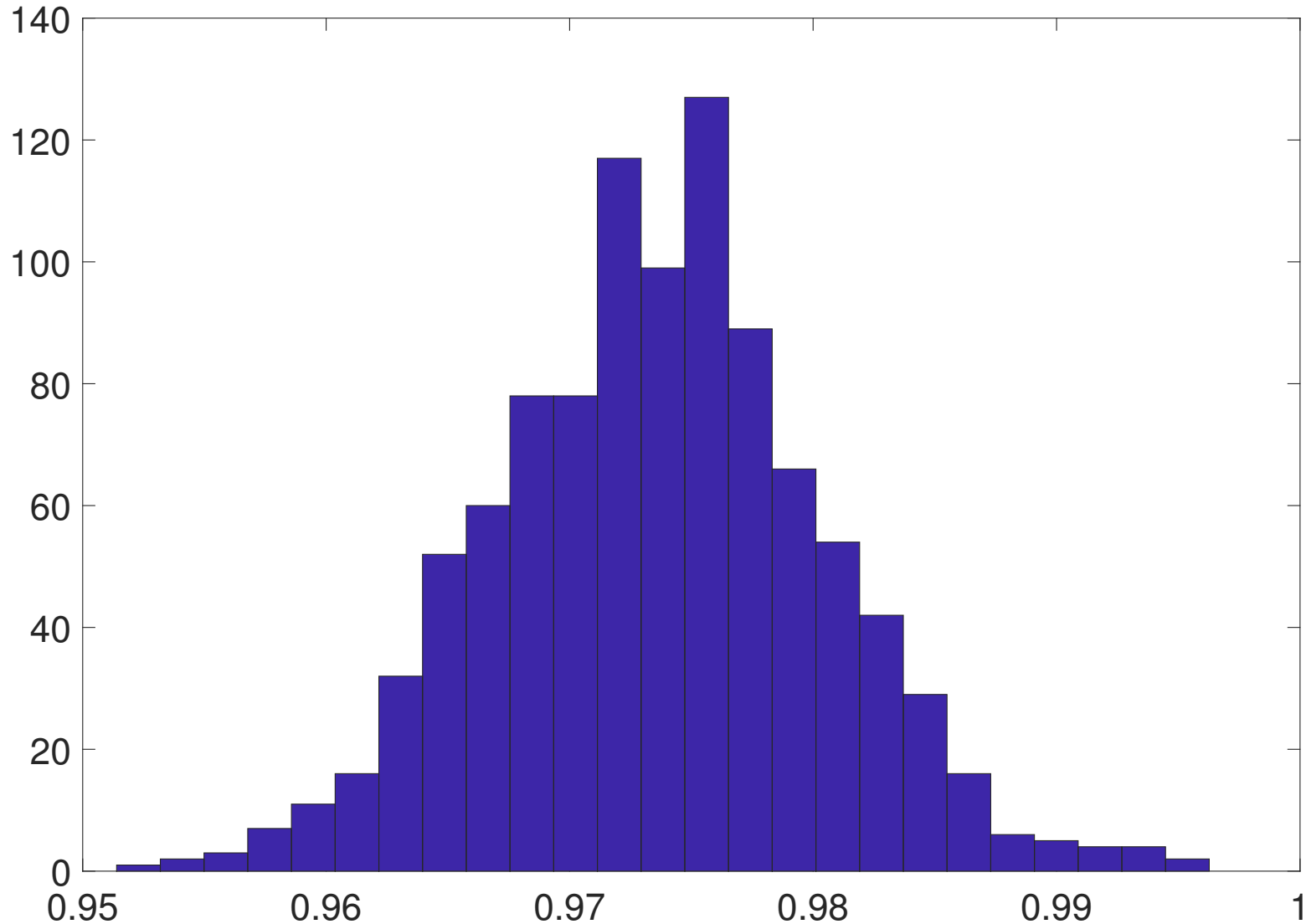

Figure: Posterior distribution persistence parameter F

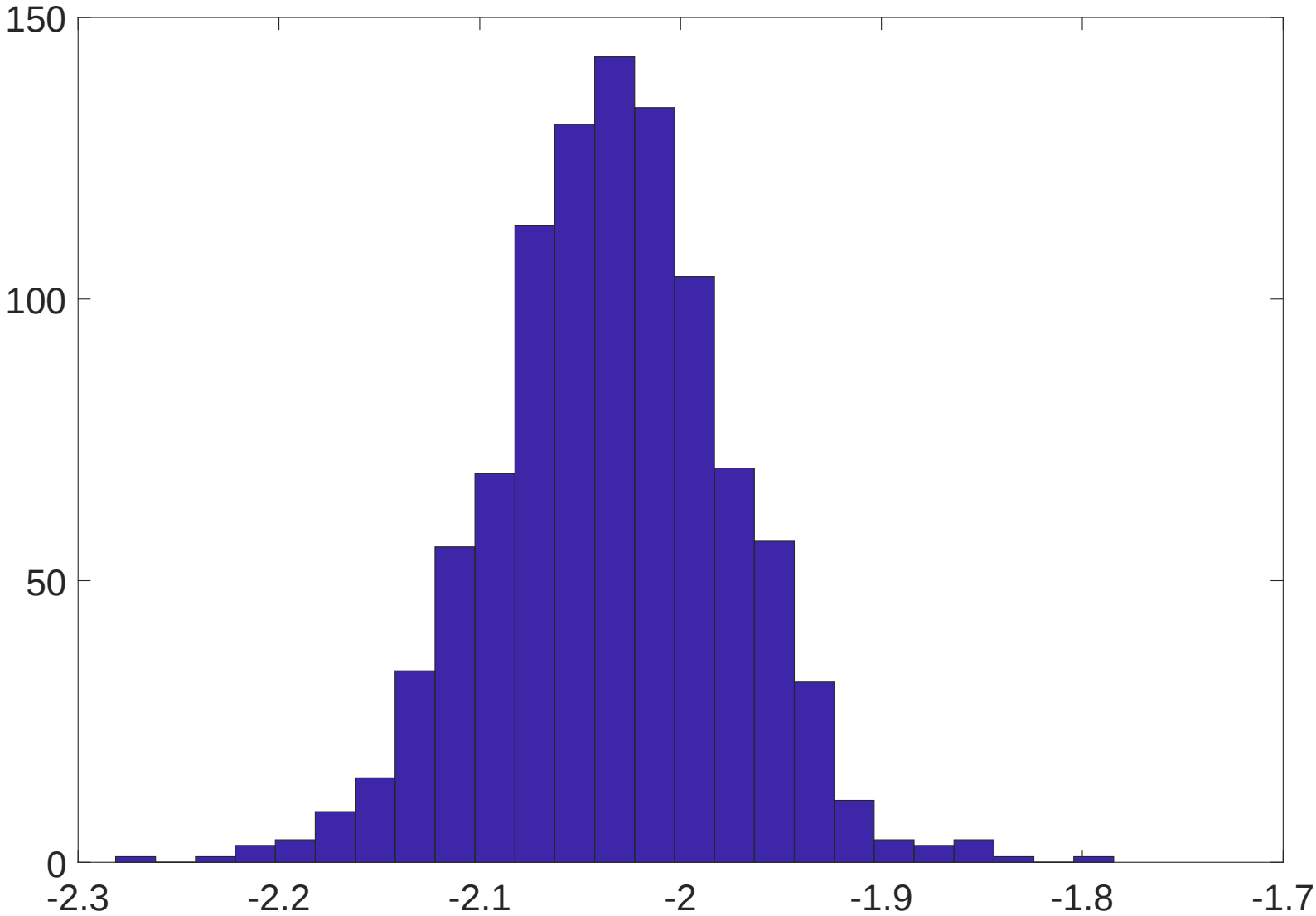

Figure: Posterior distribution mean parameter μ

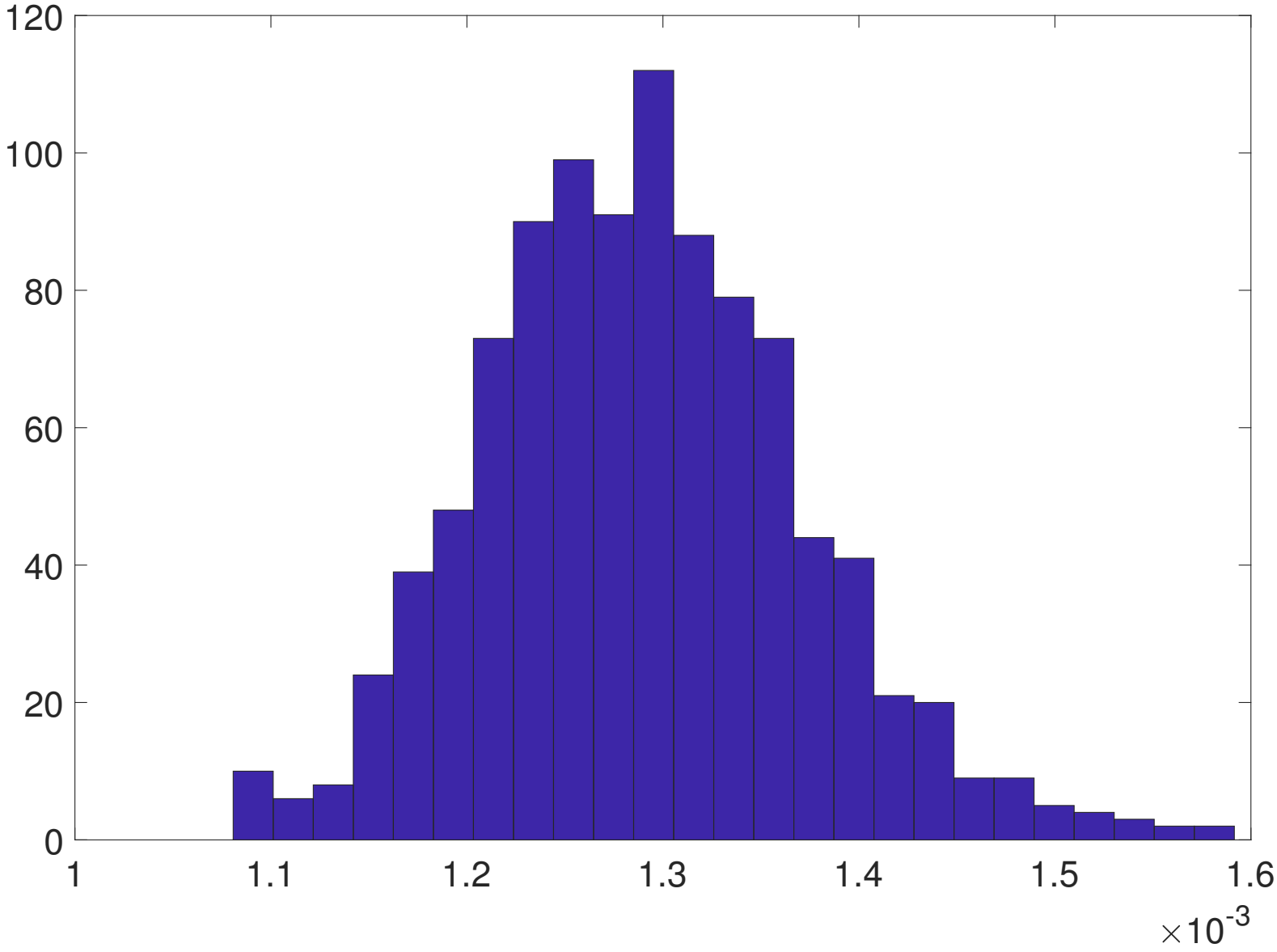

Figure: Posterior distribution variance parameter Q

Other nonlinear effects

- Any other evidence of sign and size non linearities?
- Menu costs: the larger is the shock the smaller should be the slope of the PC within regime

Size nonlinearities: CMP

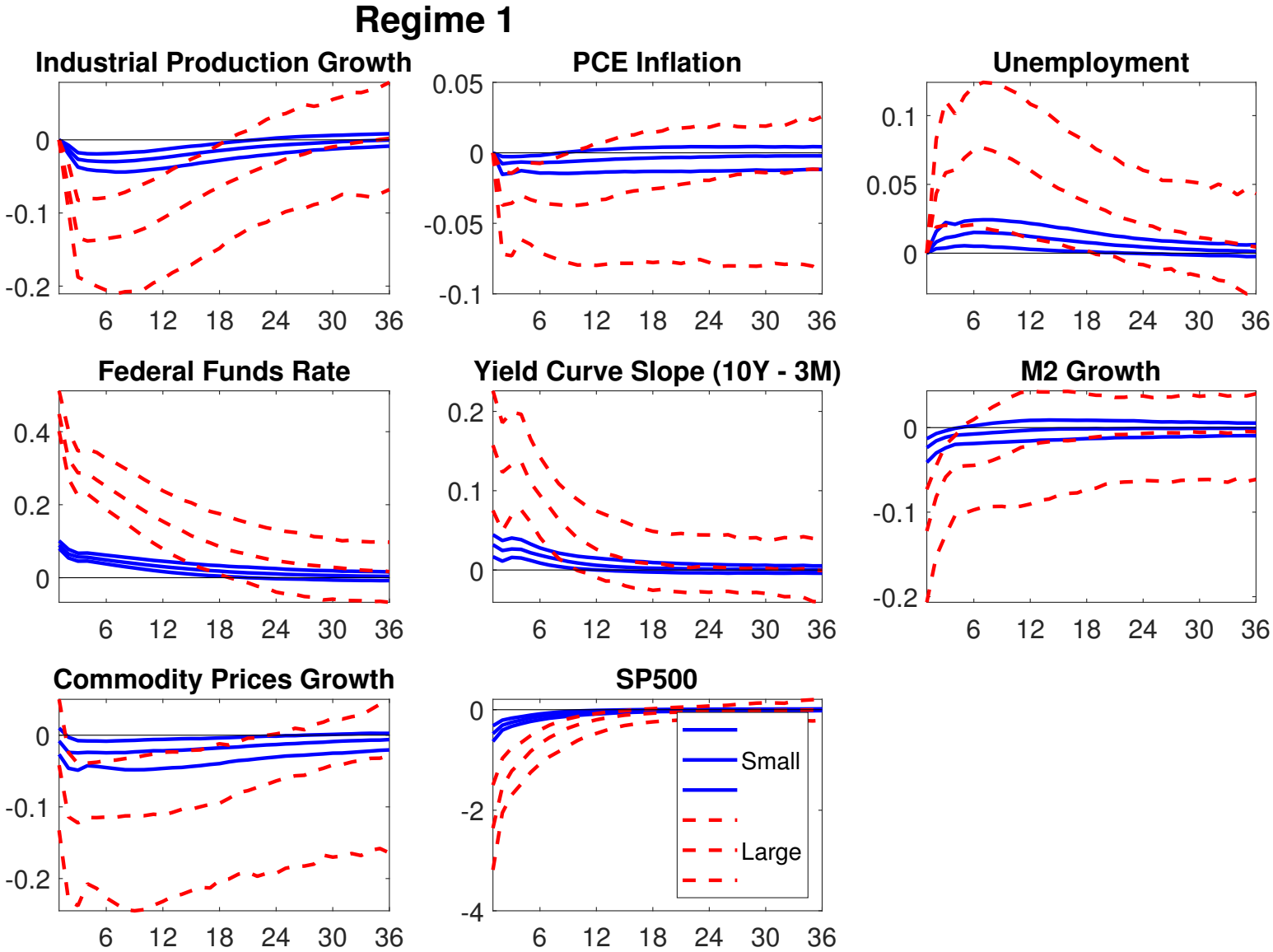

Figure: Conventional MP Shocks of different size (low inflation regime)

Size nonlinearities: CMP

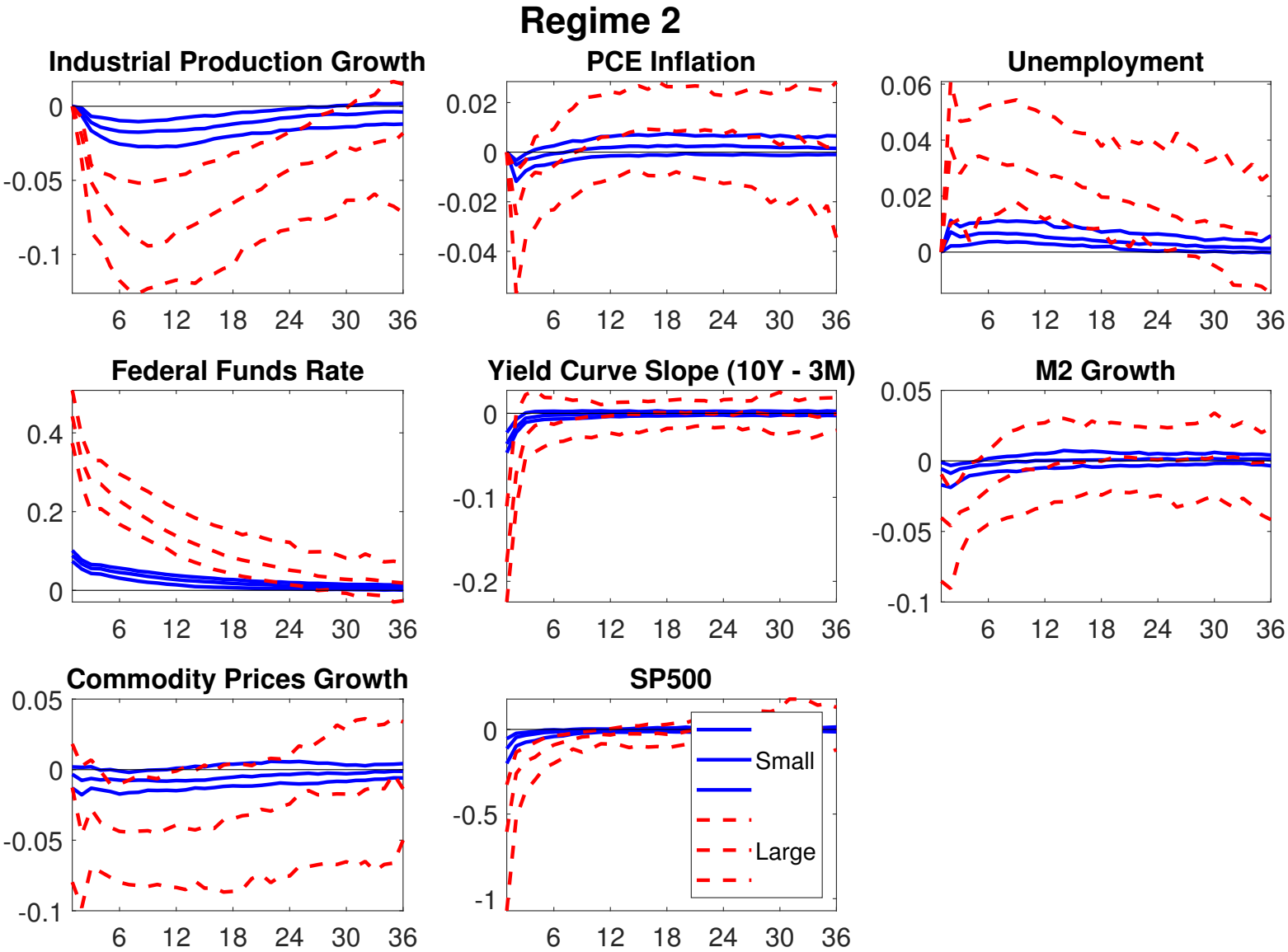

Figure: Conventional MP Shocks for different size (high inflation regime)

Sign nonlinearities: CMP

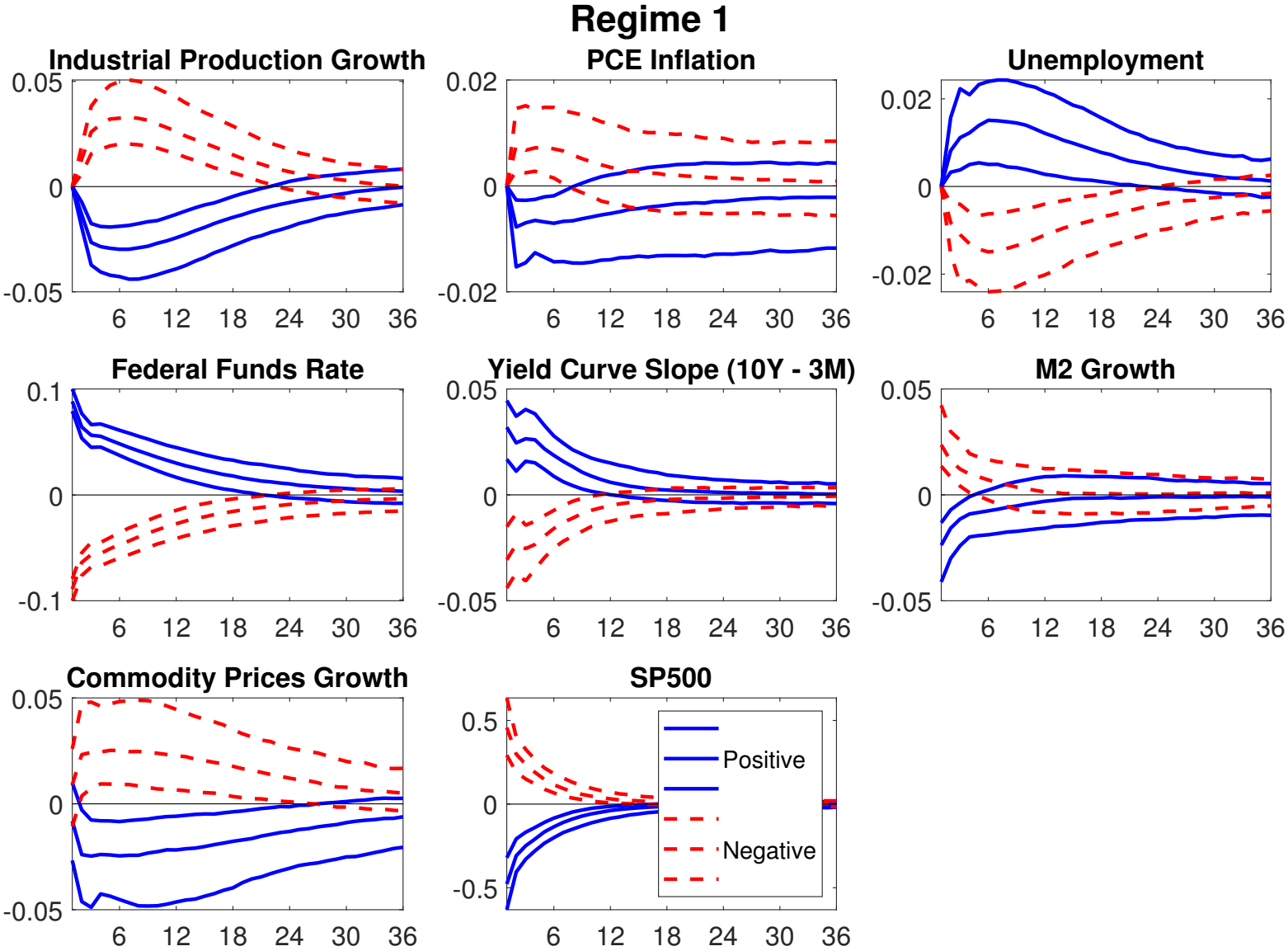

Figure: Conventional MP Shocks for different sign (low inflation regime)

Sign nonlinearities: CMP

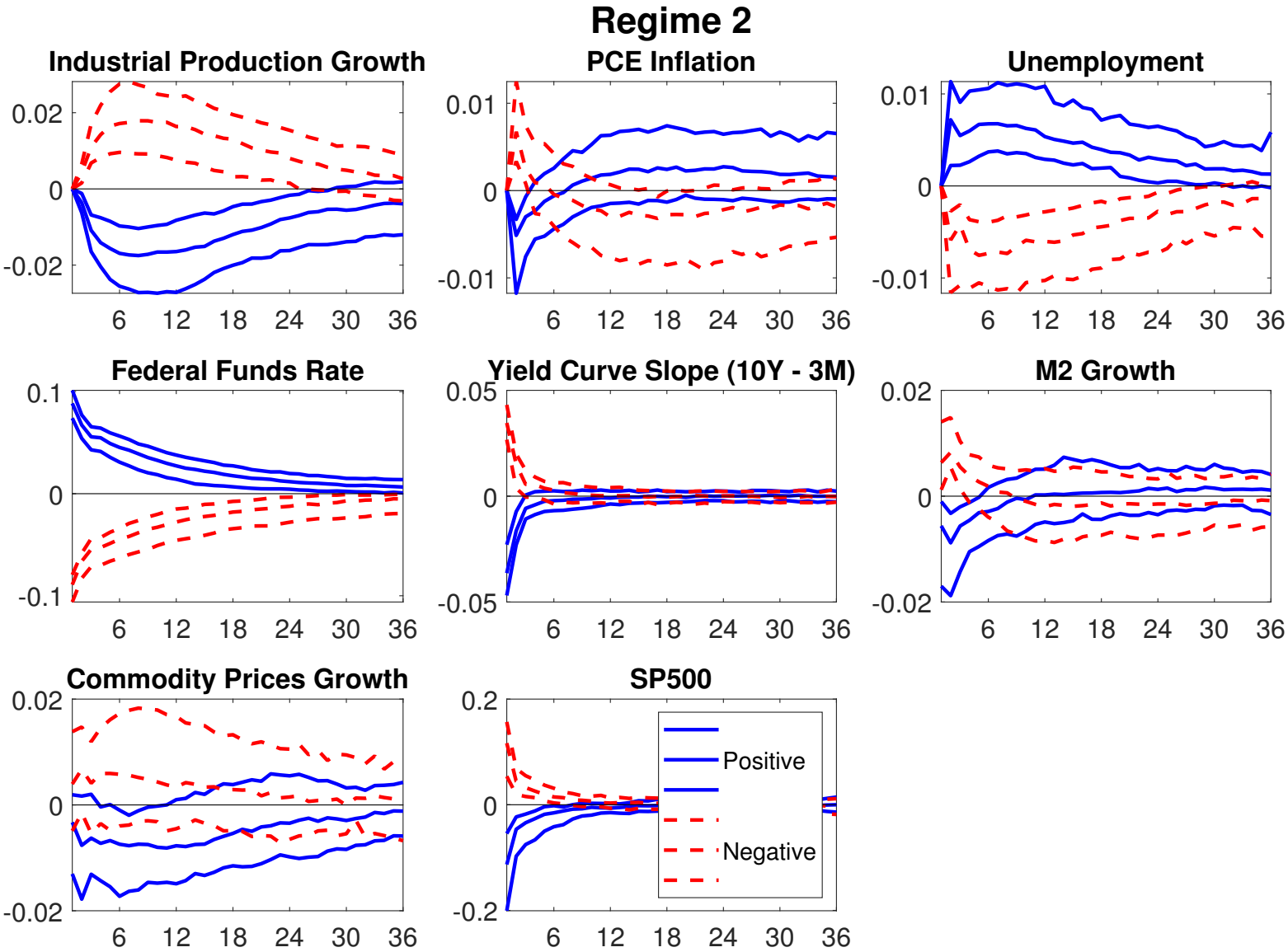

Figure: Conventional MP Shocks for different sign (high inflation regime)

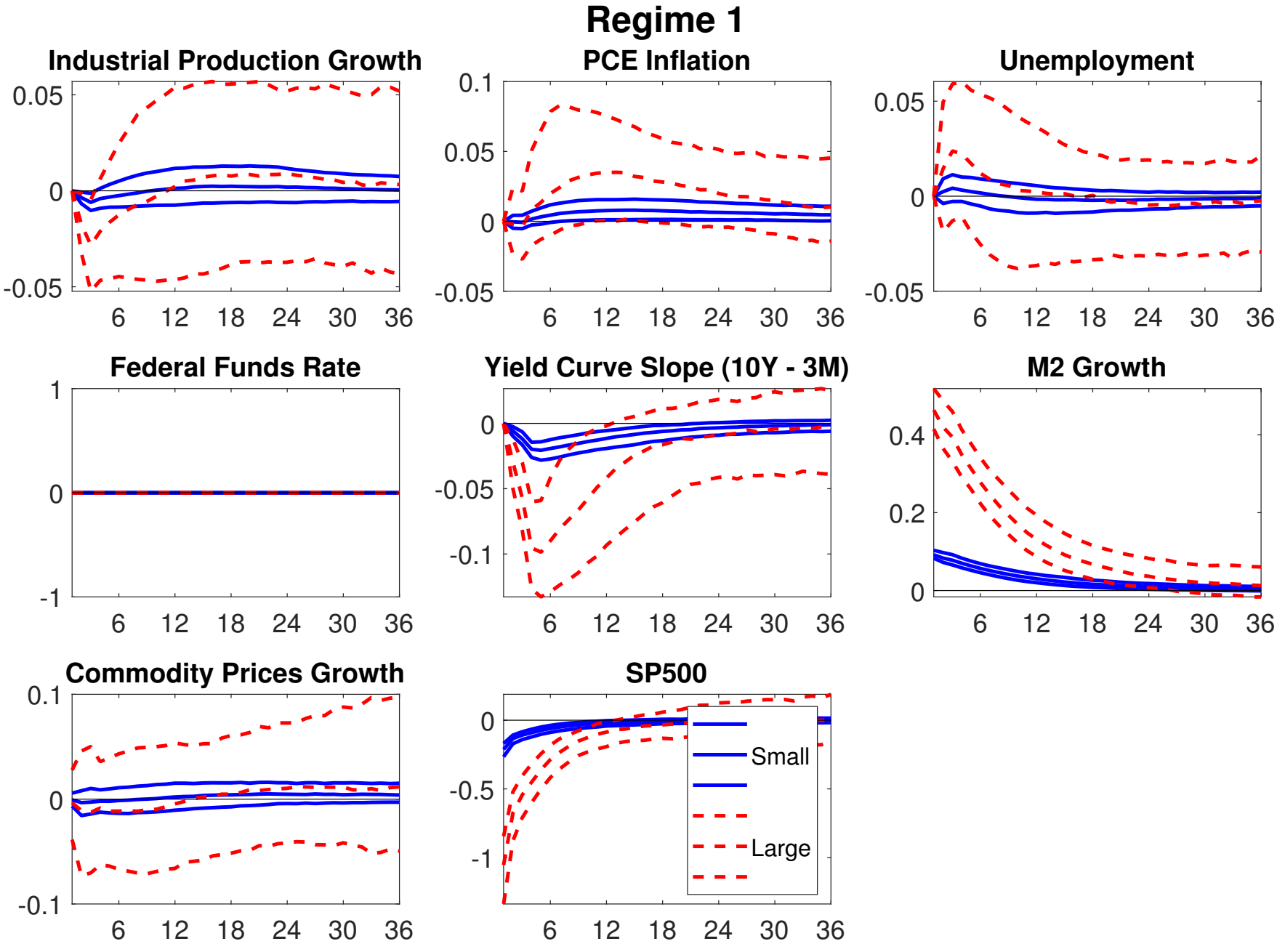

Figure: Liquidity shocks of different size (low inflation regime)

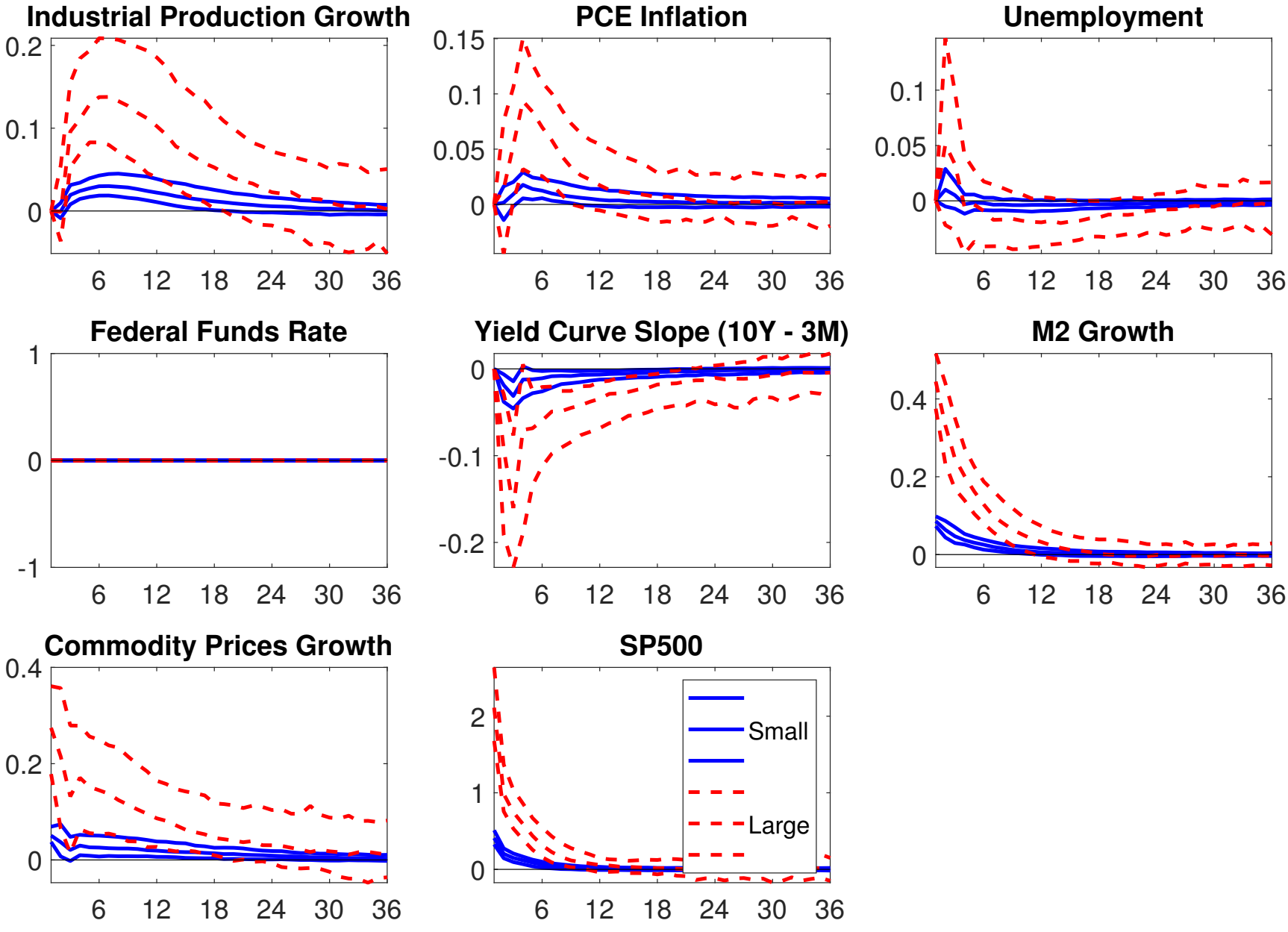

Figure: Liquidity shocks of different size (high inflation regime)

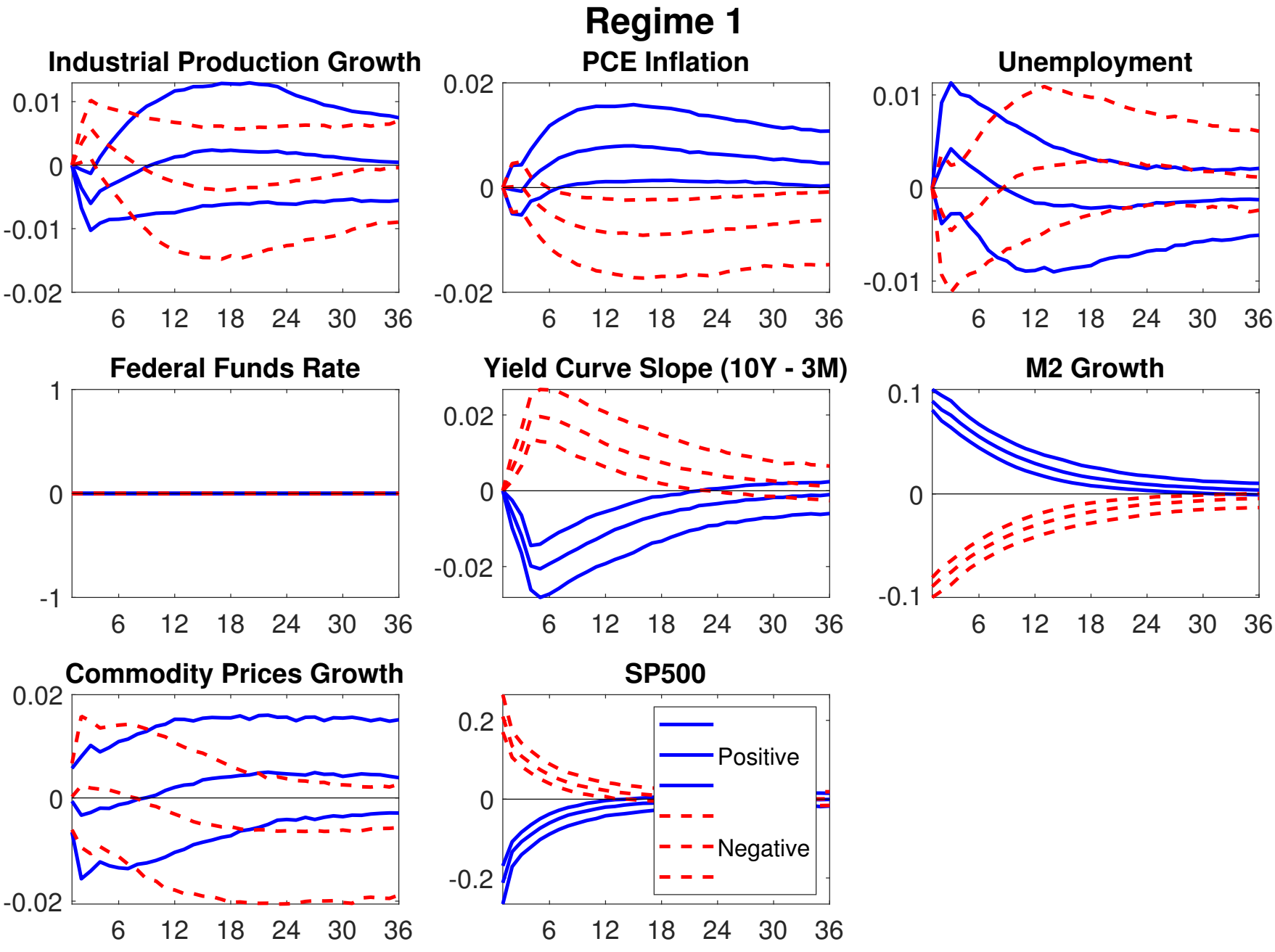

Figure: Liquidity shocks of different sign (low inflation regime)

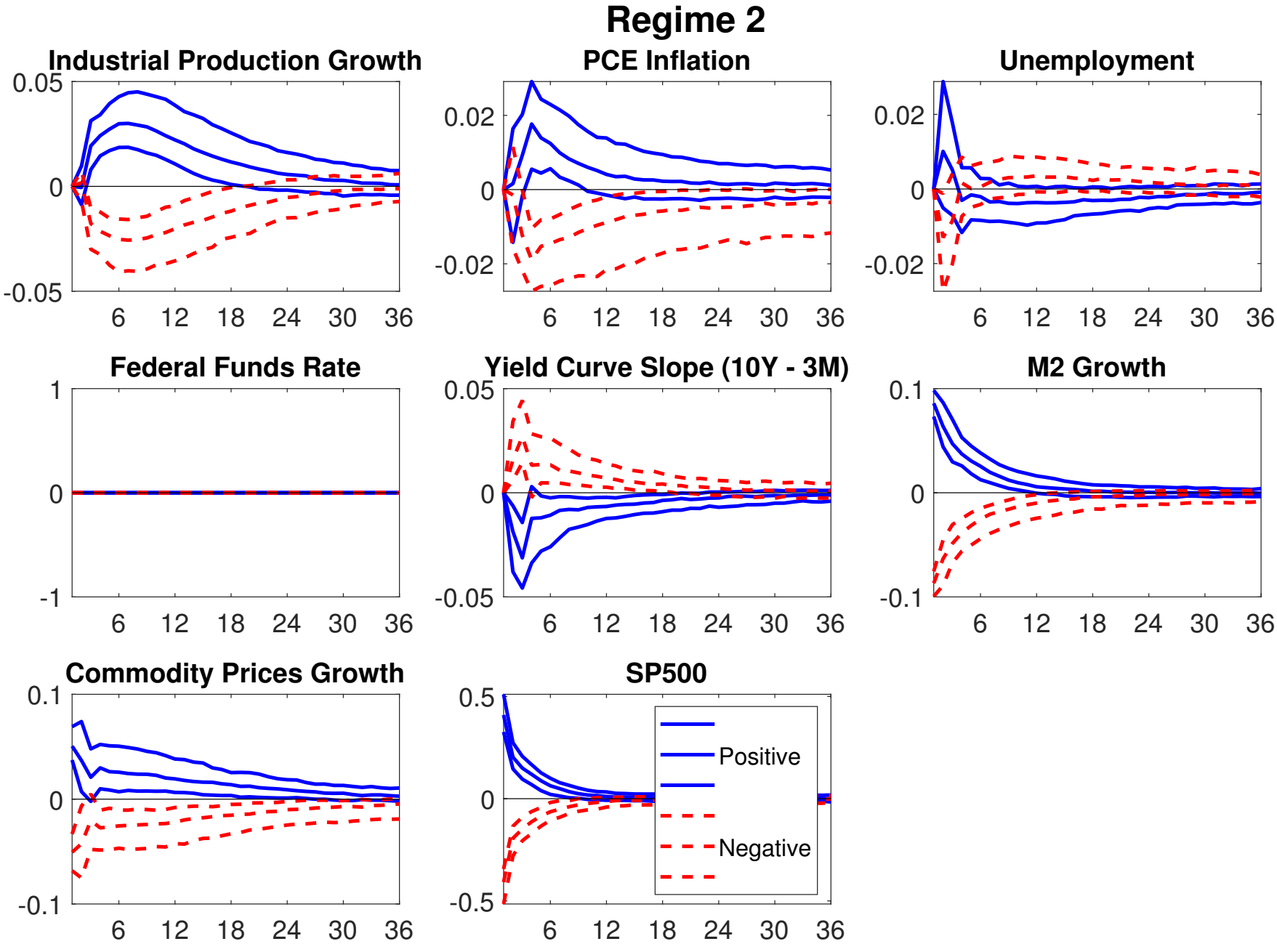

Figure: Liquidity shocks of different sign (high inflation regime)