Navigating Uncertainty in New Keynesian Models:
Stochastic Volatility, Learning, and Optimal Policy Responses

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June 2025

Motivation: Uncertainty on the Rise

- Uncertainty has increased due to geopolitical, technological, and environmental risks
- Uncertainty affects economic decision-making: consumption, investment, expectation formation
- Few macroeconomic models incorporate uncertainty
- If they do, they assume full information about the stochastic volatility process

This paper

Contributes to the understanding of how information frictions shape monetary policy under uncertainty

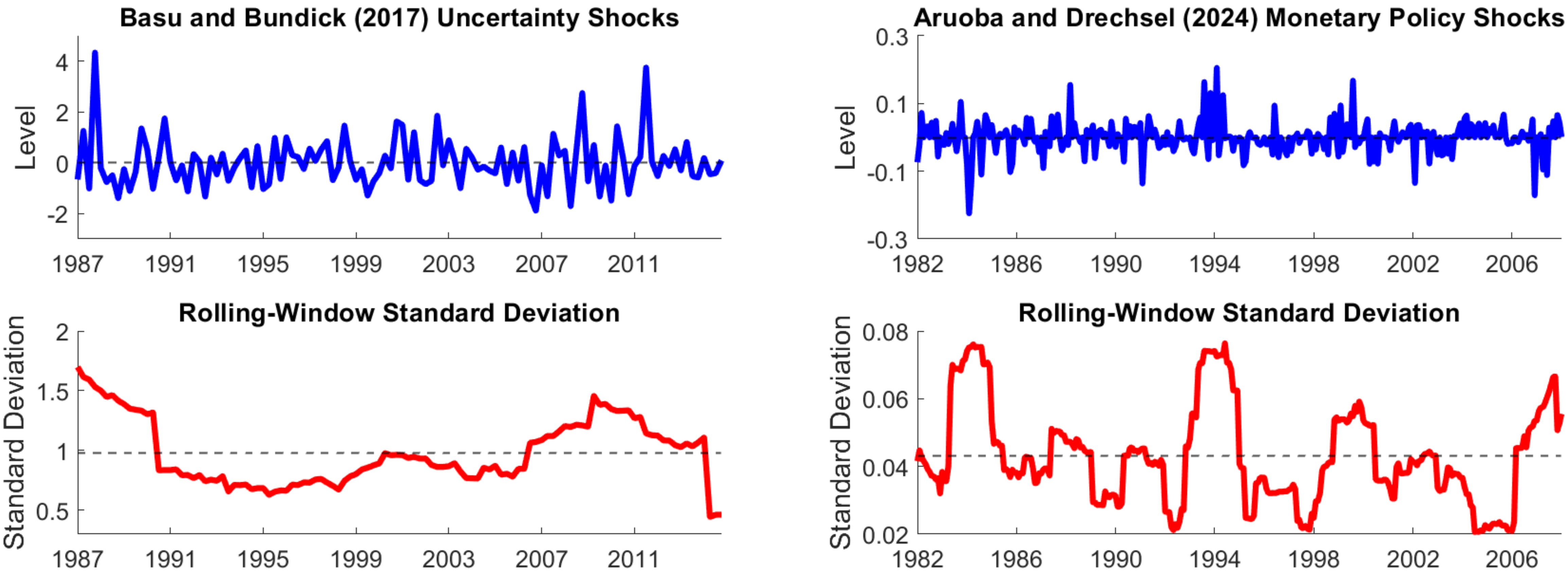
  - Motivated by inattention, publication lags, data revisions
- Builds on a standard NK model with stochastic volatility
  - Introduces a gap between perceived and actual uncertainty
  - Agents learn about volatility
- Derives optimal monetary policy under full (actual volatility) and partial information (perceived volatility)

<u>Main findings</u>:

1. Perceived uncertainty lags actual uncertainty in the data.
2. Partial information leads to overreactive monetary policy.
3. Average Inflation Targeting (AIT) helps stabilize policy even under information frictions.

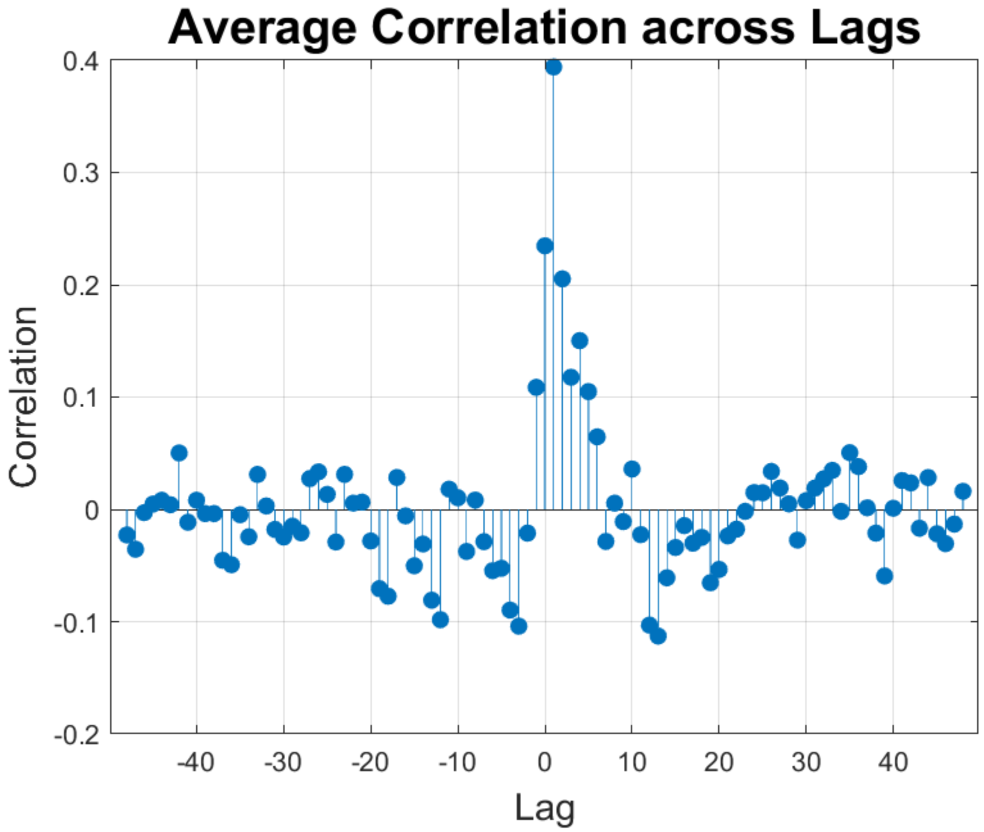
UNCERTAINTY FROM AN EMPIRICAL PERSPECTIVE

Uncertainty matters!



Gap between Actual and Perceived Uncertainty

- Actual uncertainty: Macro, real, and financial uncertainty by Jurado et al. (2015, *AER*)
- Perceived uncertainty: Uncertain future, Michigan Survey
- Largest correlation at positive lags
- PLM lags behind ALM



A NEW KEYNESIAN MODEL WITH A GAP BETWEEN ACTUAL AND PERCEIVED UNCERTAINTY

Model framework

- Off-the-shelf model with stochastic volatility: Basu and Bundick (2017, *Econometrica*)
  - Representative household with Epstein-Zin preferences
  - Firm sector faces Rotemberg (1982) price adjustment cost
  - Monetary policy follows a Taylor rule
- Stochastic volatility in household's discount factor shock

$$M_{t+1} = \left(\beta \, \frac{a_{t+1}}{a_t}\right) \left(\frac{C_{t+1}^{\eta}(1 - N_{t+1})^{1-\eta}}{C_t^{\eta}(1 - N_t)^{1-\eta}}\right)^{(1-\sigma)/\theta_V} \left(\frac{C_t}{C_{t+1}}\right) \left(\frac{V_{t+1}^{1-\sigma}}{E_t[V_{t+1}^{1-\sigma}]}\right)^{1-1/\theta_V}$$

$$a_t = (1 - \rho_a)a + \rho_a a_{t-1} + \sigma_{t-1}^a \epsilon_t^a$$

$$\sigma_t^a = (1 - \rho_{\sigma^a})\sigma^a + \rho_{\sigma^a}\sigma_{t-1}^a + \sigma^{\sigma^a}\epsilon_t^{\sigma^a}$$

Gap between Actual and Perceived Uncertainty

- Stochastic discount factor under PLM

$$M_{t+1} = \left(\beta\, \frac{\hat{a}_{t+1}}{\hat{a}_t}\right) \left(\frac{C_{t+1}^{\eta}(1 - N_{t+1})^{1-\eta}}{C_t^{\eta}(1 - N_t)^{1-\eta}}\right)^{(1-\sigma)/\theta_V} \left(\frac{C_t}{C_{t+1}}\right) \left(\frac{V_{t+1}^{1-\sigma}}{E_t[V_{t+1}^{1-\sigma}]}\right)^{1-1/\theta_V}$$

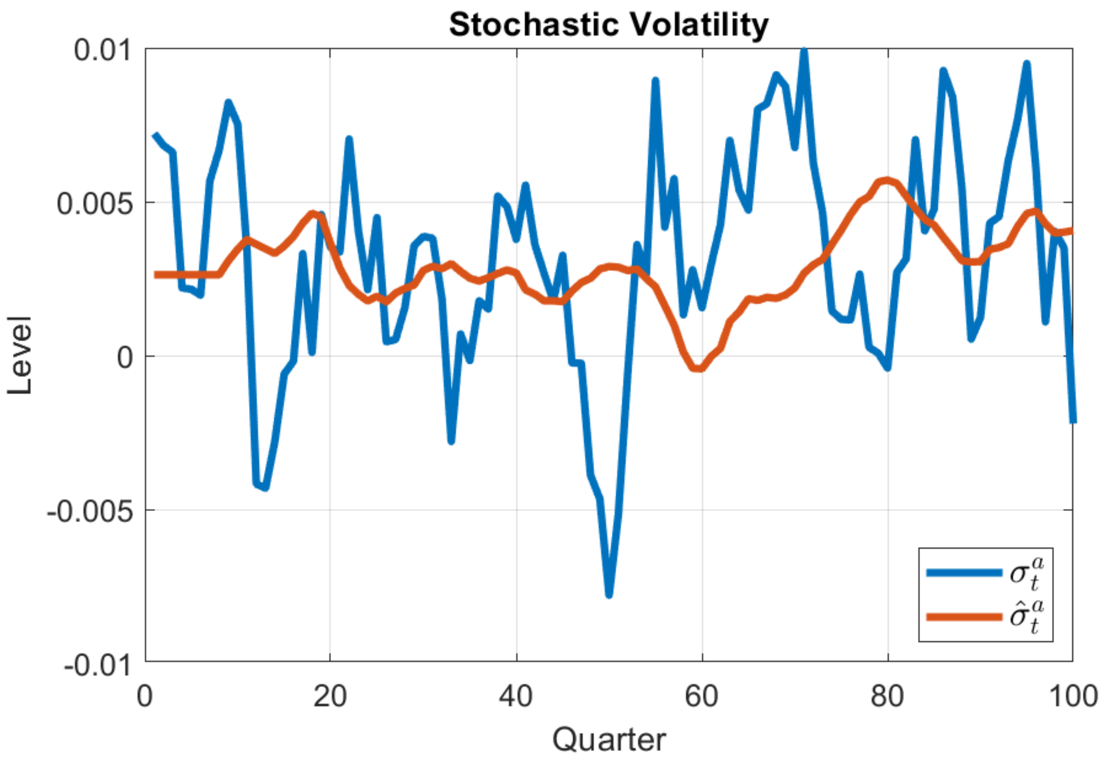
- Shock process under PLM

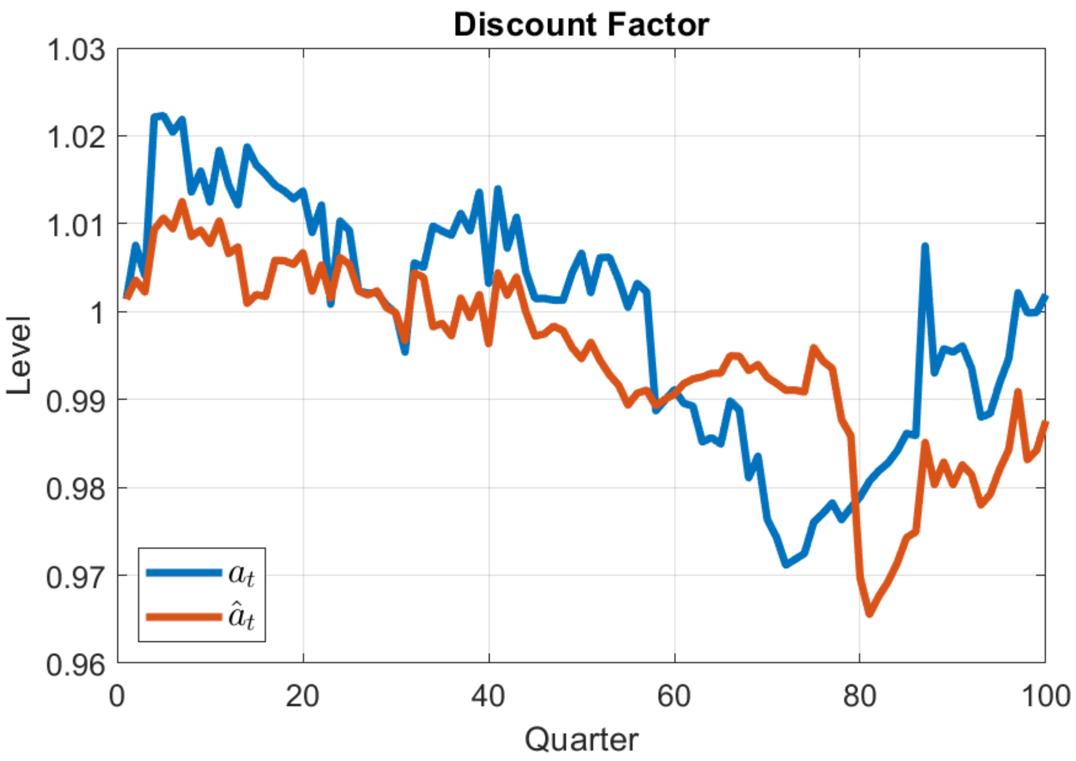
$$\hat{a}_t = (1 - \rho_a)a + \rho_a \hat{a}_{t-1} + \hat{\sigma}_{t-1}^{a} \epsilon_t^{a}$$

- Constant-gain learning under PLM

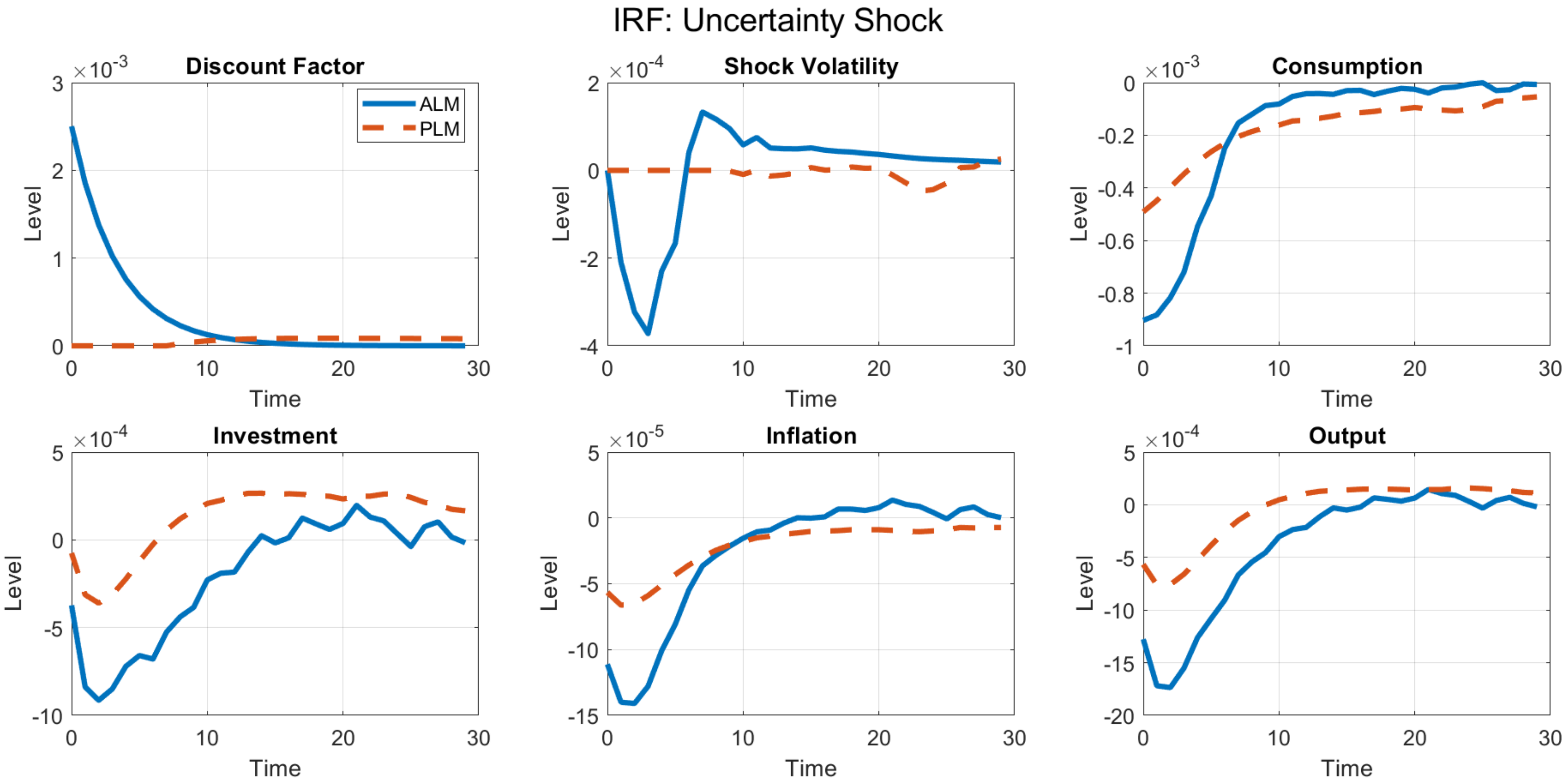
$$\hat{\sigma}_t^{a} = \hat{\sigma}_{t-1}^{a} + \delta\,(\sigma_{t-h}^{a} - \hat{\sigma}_{t-1}^{a})$$

Model dynamics





Relevance for Monetary Policy?



MONETARY POLICY DESIGN

Monetary policy

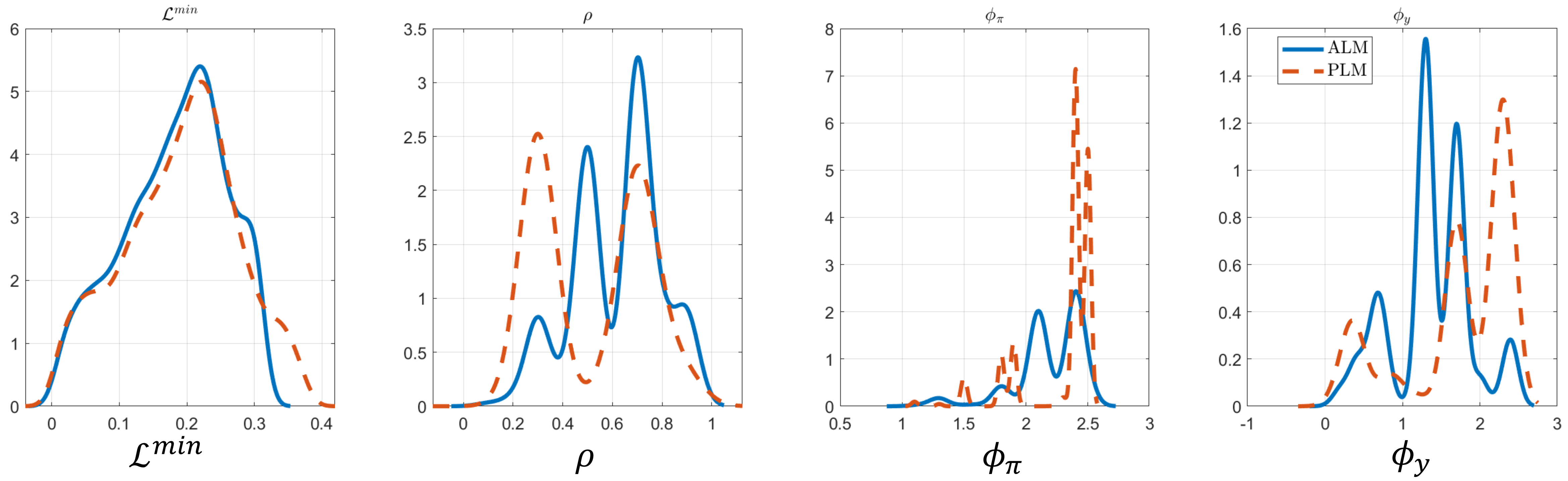
- Optimal policy design in view of uncertainty about uncertainty?
- Loss function:

$$\min_{\{\rho,\phi_\pi,\phi_y\}} \mathcal{L}_t = \sum_{j=0}^{\infty} \left(\lambda_0 \pi_{t+1}^2 + \lambda_1 y_{t+i}^2 + \lambda_2 i_{t+i}^2\right)$$

Approach:

- Agnostic standpoint towards $\lambda_{0:2}$
- Normalize variances of π, y, and i
- $\sum_{i=0}^{2} \lambda_i = 1$ for relative preferences
- Numerical solution

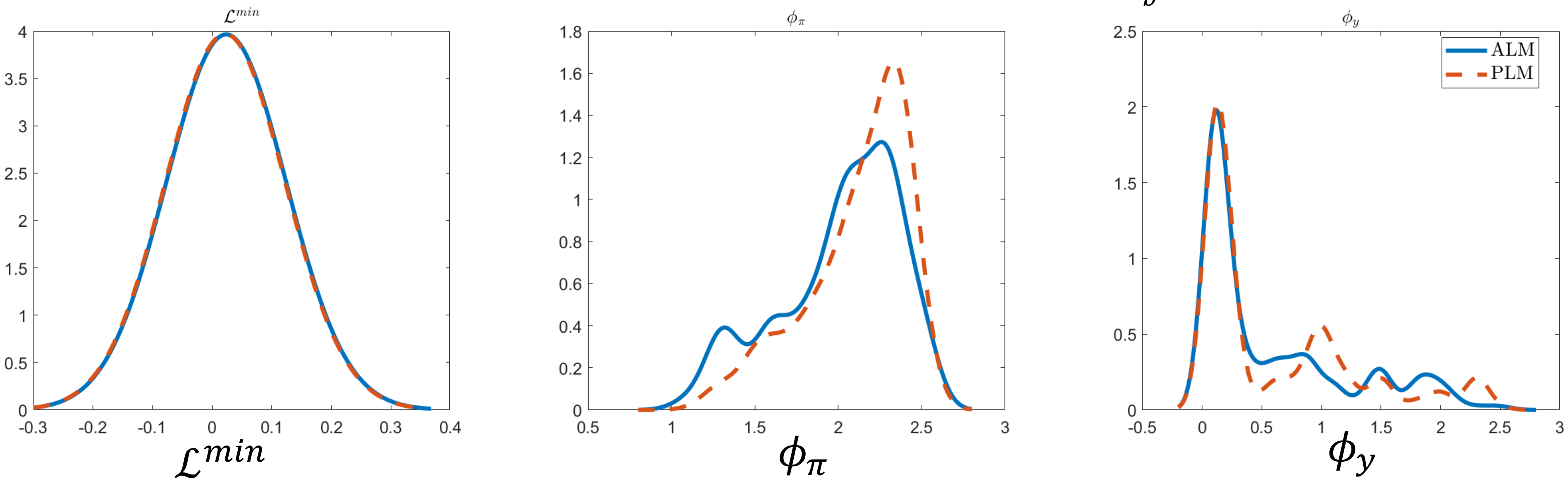
Optimal policy design



Alternative monetary policy?

- Can Average Inflation Targeting (AIT) cope with uncertainty about uncertainty better than Inflation Targeting?

$$i_t = \phi_\pi MA_{\pi_t} + \phi_y y_t \qquad MA_{\pi_t} = \frac{1}{\omega_b + 1} \sum_{t=-\omega_b}^{0} \pi_t$$



IT vs AIT

Policy	$\mathcal{L}^{min}$	ρ	ϕ_π	ϕ_y
IT (rational)	0.006	0.7	2.4	1.3
IT (learning)	0.004	0.3	2.4	2.3
AIT (rational)	0.001		2.3	0.1
AIT (learning)	0.001		2.3	0.1

CONCLUDING REMARKS

First attempt to

- … understand uncertainty about uncertainty in the New Keynesian framework
- … quantify the resulting implications for monetary policy

Findings

1. Perceived uncertainty lags actual volatility empirically.
2. Partial information leads to policy overreaction.
3. AIT performs robustly under learning.

Implications

1. Learning is essential for modeling expectations realistically.
2. Information frictions can destabilize policy outcomes.
3. AIT effectively dampens biases induced by misperceived uncertainty.

Thank you for attending the session.

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