The Inflation Attention Threshold and Inflation Surges

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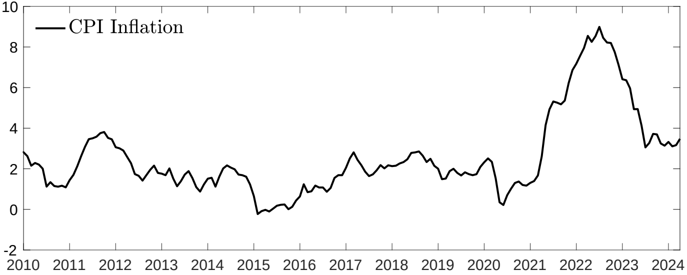
- Inflation surged in many countries during recovery phase of the pandemic
- Inflation higher and more persistent than many expected (e.g., Powell (2021))



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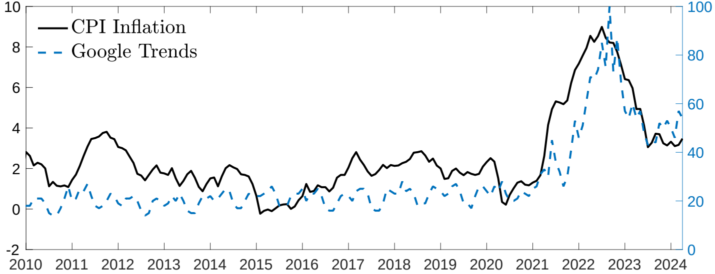

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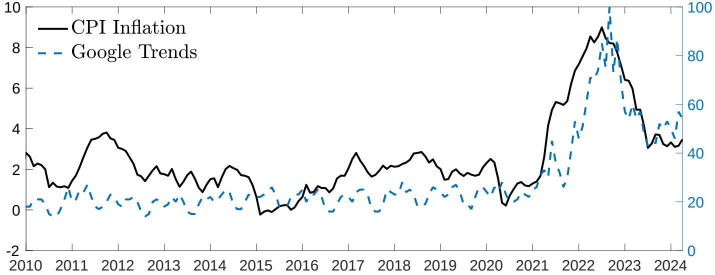

Q: Is higher attention just a side product or a driver of high and persistent inflation?

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- Estimate attention to inflation and threshold when attention changes:

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  - AS and AD curves steeper in high-attention regime
  - exceeding threshold changes inflation dynamics (resembling recent inflation surge)
  - threshold leads to inflation asymmetry, longer 'last mile', larger central bank losses, ...

Contribution to the literature

- Drivers of recent inflation surge: Shapiro (2023), Gagliardone/Gertler (2023), Bernanke/Blanchard (2023), Benigno/Eggertsson (2023), Amiti et al. (2023), Bianchi/Melosi (2022) & Bianchi et al. (2023), Reis (2022), Schmitt-Grohe/Uribe (2024), Erceg et al. (2024)...

  ⇒ Contribution: role of attention increase in inflation surge

- Measuring attention to inflation: Cavallo et al. (2017), Pfäuti (2021), Korenok et al. (2022), Bracha/Tang (2023), Weber et al. (2023), Kroner (2023)

  ⇒ Contribution: estimate attention threshold and attention in a way that directly maps into otherwise standard macro models

- State dependency of shocks: Auerbach/Gorodnichenko (2012a,b), Ramey/Zubairy (2018), Jo/Zubairy (2023), Tenreyro/Thwaites (2016), Ascari/Haber (2022), Joussier et al. (2023)

  ⇒ Contribution: role of attention regime for inflation response

- Theory: Mackowiak/Wiederholt (2009), Paciello/Wiederholt (2014), Reis (2006a,b) Pfäuti (2021), Carvalho et al. (2022), Afrouzi/Yang (2022), Gati (2022)

  ⇒ Contribution: GE model with attention threshold, role for inflation surges

Outline

1. **Quantify Attention and Attention Threshold**
2. Role of Attention for Inflation
3. Model + Model Results

Quantifying attention to inflation

- Perceived law of motion:

$$\pi_t = (1 - \rho_\pi)\underline{\pi} + \rho_\pi \pi_{t-1} + \nu_t, \text{ with } \nu_t \sim N(0, \sigma_\nu^2)$$

- current inflation is unobservable
- noisy signal: $s_t = \pi_t + \varepsilon_t$, with $\varepsilon_t \sim N(0, \sigma_\varepsilon^2)$, precision $\frac{1}{\sigma_\varepsilon^2}$ reflects attention

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$$\tilde{E}_t \pi_{t+1} = (1-\rho_\pi)\underline{\pi} + \rho_\pi \tilde{E}_{t-1}\pi_t + \rho_\pi \gamma_\pi \left(\pi_t - \tilde{E}_{t-1}\pi_t\right) + u_t$$

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(Vellekoop/Wiederholt 2019, Pfäuti 2021)

$$\tilde{E}_t \pi_{t+1} = \beta_0 + \beta_1 \tilde{E}_{t-1}\pi_t + \beta_2 \left(\pi_t - \tilde{E}_{t-1}\pi_t\right) + \epsilon_t,$$

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Rational inattention microfoundation: γ_π depends negatively on info cost ▸ Details

Attention threshold

- Test for different attention levels and attention threshold $\bar{\pi}$:

$$\tilde{E}_t \pi_{t+1} = \mathbb{1}_{\pi_{t-1} \leqslant \bar{\pi}} \left(\beta_{0,L} + \beta_{1,L} \tilde{E}_{t-1} \pi_t + \beta_{2,L} \left(\pi_t - \tilde{E}_{t-1} \pi_t \right) \right)$$
$$+ \left(1 - \mathbb{1}_{\pi_{t-1} \leqslant \bar{\pi}}\right) \left(\beta_{0,H} + \beta_{1,H} \tilde{E}_{t-1} \pi_t + \beta_{2,H} \left(\pi_t - \tilde{E}_{t-1} \pi_t \right) \right) + \tilde{\epsilon}_t$$

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- Estimate threshold $\bar{\pi}$ and regression coefficients jointly by minimizing SSR
- Baseline data:
  - monthly average expectations Michigan Survey of Consumers, 1978-2023
  - actual inflation: U.S. CPI inflation Time series

Empirical results: attention twice as high when inflation is above 4%

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s.e.		(0.013)	(0.037)	

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  - similar results when using regional data
  - median expectations, NY Fed SCE (HH panel), SPF
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- potential driver: news coverage of inflation higher in high-attention regime Details

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Attention regimes and the propagation of supply shocks

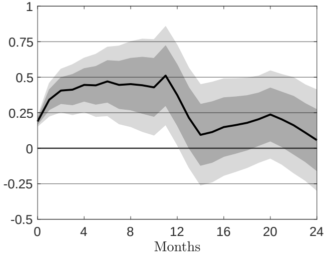
Estimate local projection:

$$y_{t+j} - y_{t-1} = \mathbb{1}_H \left(\alpha_j^H + \beta_j^H \varepsilon_t\right) + (1 - \mathbb{1}_H)\left(\alpha_j^L + \beta_j^L \varepsilon_t\right) + \Gamma' X_t + u_{t+j}$$

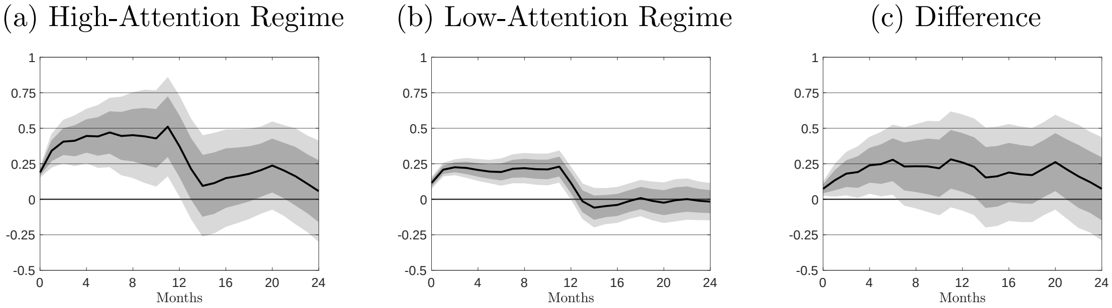
- y_{t+j} : y-o-y CPI inflation in period $t + j$
- $\mathbb{1}_H = 1$ if in high-attention regime (inflation $\geqslant 4\%$ or based on Google Trends)
- ε_t : oil supply news shock, 1975M1-2022M12 (Känzig, AER 2021)
- β_j^r : effect of supply shock on inflation at horizon j in regime $r \in \{L, H\}$
- X_t: controls

Supply shocks

(a) High-Attention Regime



Supply shocks are more inflationary in high-attention regime



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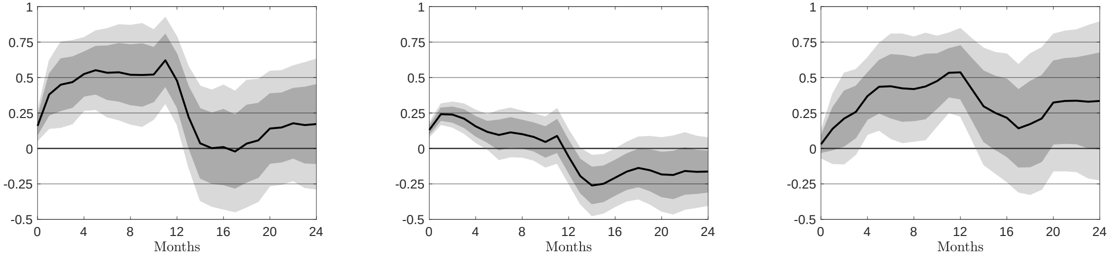
(a) High-Attention Regime (b) Low-Attention Regime (c) Difference



- inflation responds twice as much to supply shocks in high-attention regime
- Google Trends as regime-defining variable: effects larger and more persistent

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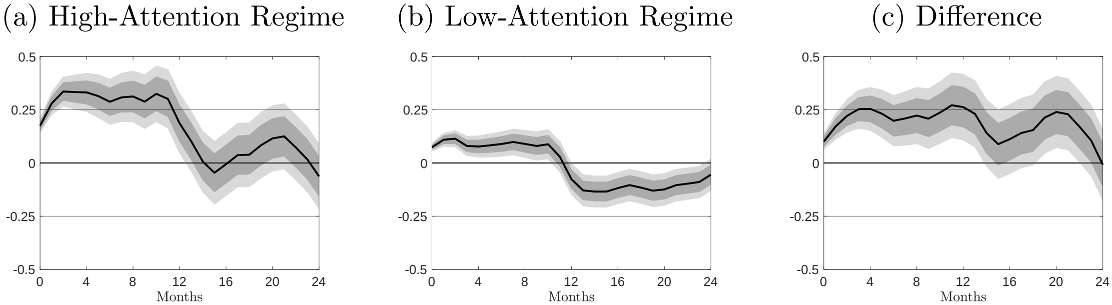

- inflation responds twice as much to supply shocks in high-attention regime
- Regional data yields similar conclusions ▸ Disentangle attention and inflation

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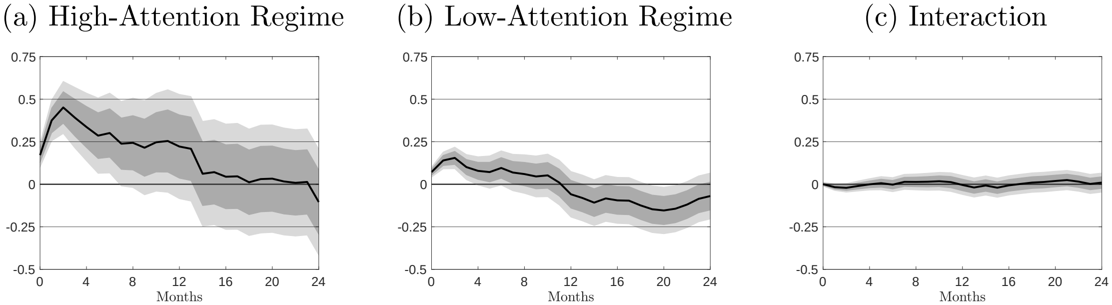

- inflation responds twice as much to supply shocks in high-attention regime
- interaction $\pi_{t-1} \times \varepsilon_t$ insignificant once we control for regimes ▸ Details ▸ Google

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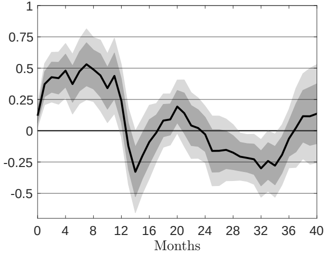
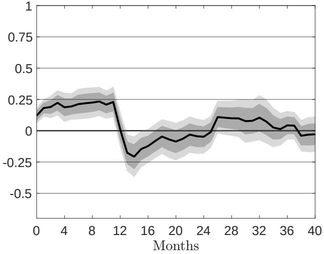


(b) Low-Attention Regime



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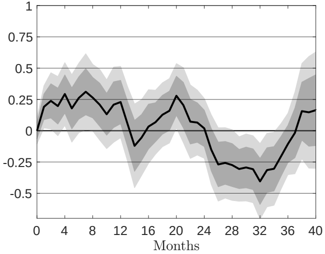

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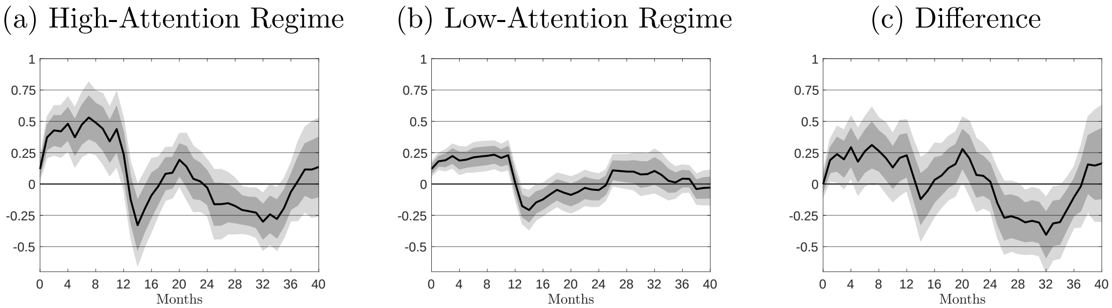

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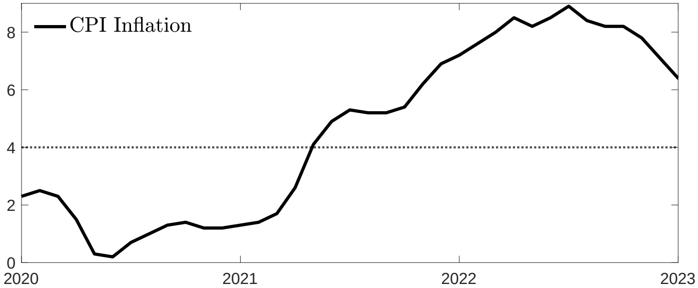
- forecast errors: overshooting more delayed in high-attention regime
- robustness: other shocks, controls, Covid, price level, shock size across regimes...

The recent inflation surge



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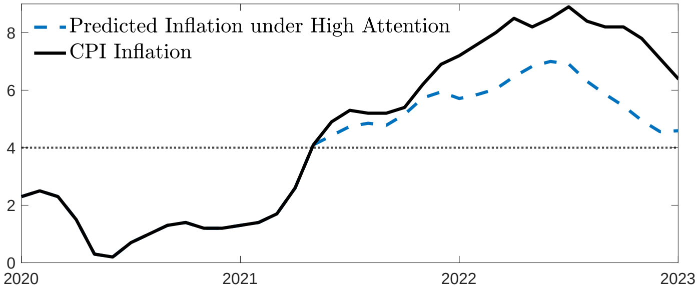

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⇒ oil supply shocks explain ≈ 60% of inflation from early 2021 - end of 2022

- ⇒ role of attention?

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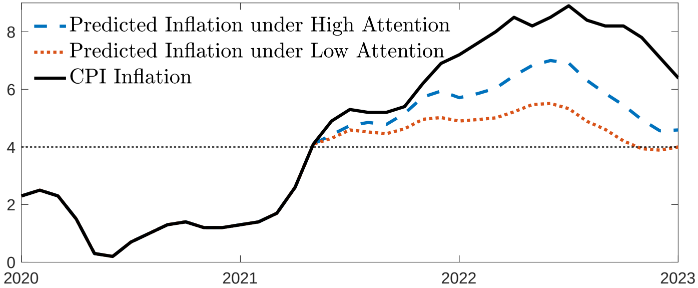

- U.S. entered high regime recently in April 2021
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  $\Rightarrow$ feed in oil supply shocks starting in April 2021 using IRF results

$\Rightarrow$ oil supply shocks explain $\approx$ 60% of inflation from early 2021 - end of 2022

  $\Rightarrow$ attention increase doubled inflationary effects of supply shocks

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Model overview

New Keynesian model with limited attention and attention threshold:

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- Government:
  - Fiscal authority: subsidy to firms, lump-sum taxes, issues bonds (zero supply) ‣ Details
  - Monetary authority: sets nominal interest rate, following Taylor rule (for now)

$$\tilde{i}_t = \rho_i \tilde{i}_{t-1} + (1 - \rho_i) \left(\phi_\pi \pi_t + \phi_x \widehat{x}_t \right)$$

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- get New Keynesian Phillips Curve with subjective expectations:

$$\pi_t = \beta \tilde{E}_t \pi_{t+1} + \kappa \widehat{x}_t + u_t$$

Subjective expectations of households

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- signals are public, but here abstract from noise shocks
- similar for consumption (and output gap) but constant attention:

▸ Different specification

$$\tilde{E}_t \widehat{c}_{t+1} = \tilde{E}_{t-1}\widehat{c}_t + \gamma_c\left(\widehat{c}_t - \tilde{E}_{t-1}\widehat{c}_t\right)$$

- in equilibrium: $\widehat{c}_t = \widehat{x}_t$ and $\tilde{E}_t\widehat{c}_{t+1} = \tilde{E}_t\widehat{x}_{t+1}$ if we assume $\tilde{E}_{-1}\widehat{c}_0 = \tilde{E}_{-1}\widehat{x}_0$

Cost-push shock: attention shift alters inflation dynamics

- Effects of cost-push shocks u_t on inflation? ▸ Eqbm ▸ Calibration ▸ Analytical Example
  1. large shock that pushes inflation above the threshold
  2. small one that does not push inflation above the threshold

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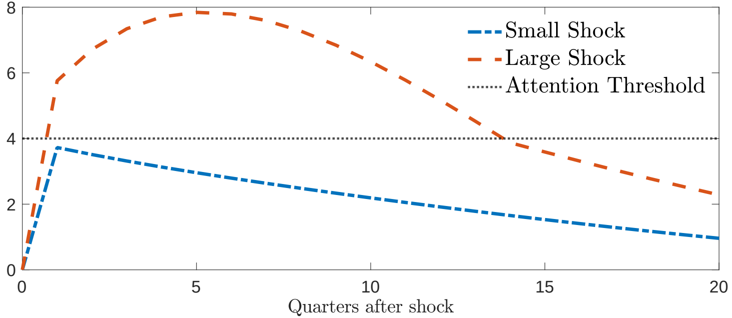

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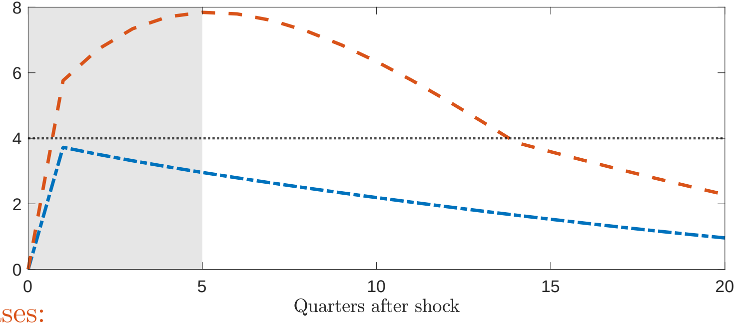

- Three phases:
  1. self-reinforcing inflation surge after shock due to attention increase

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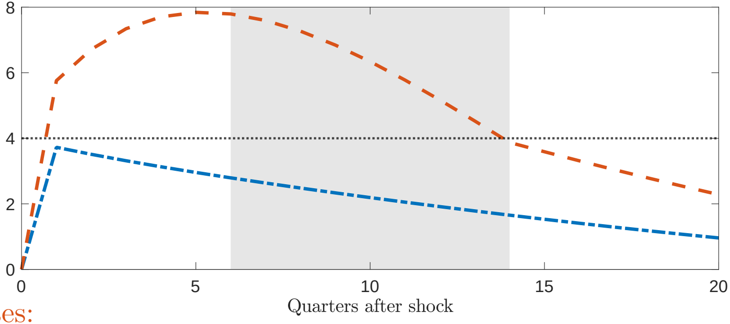

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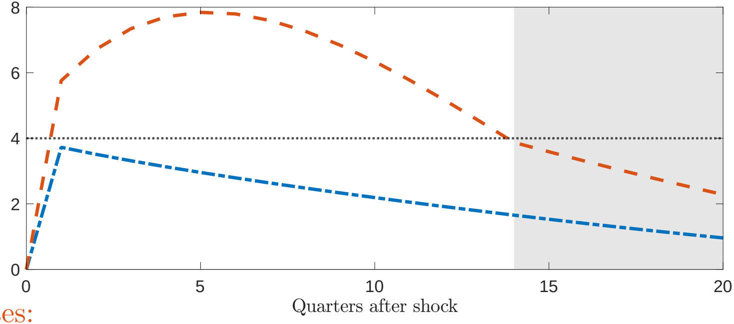

- Three phases:
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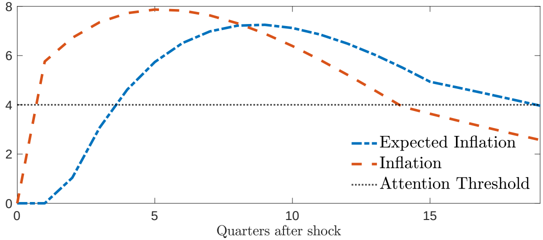
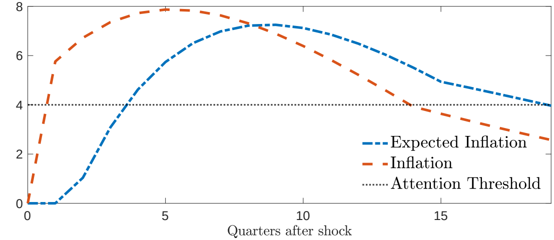
  2. relatively fast disinflation initially due to shock dying out and high attention
  3. disinflation slows down once inflation falls back below threshold

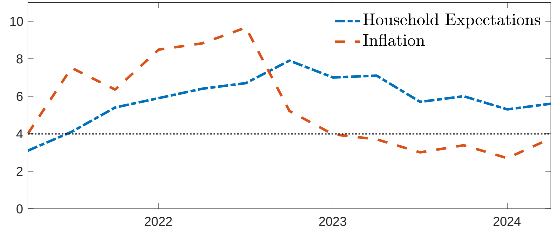
Inflation and inflation expectation dynamics: Model vs. Data



- **Model**: inflation hump-shaped and inflation expectations initially undershoot, followed by delayed overshooting

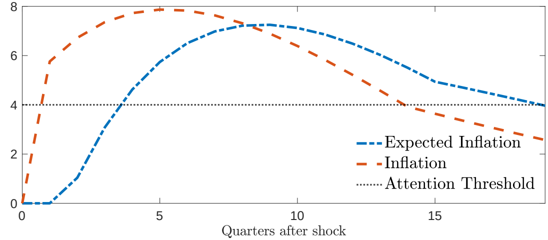
Inflation and inflation expectation dynamics: Model vs. Data

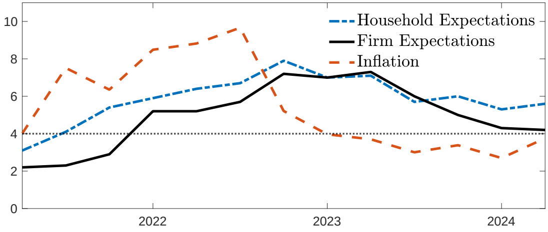




- **Model**: inflation hump-shaped and inflation expectations initially undershoot, followed by delayed overshooting
- **Data:** shows similar patterns

Inflation and inflation expectation dynamics: Model vs. Data





- **Model**: inflation hump-shaped and inflation expectations initially undershoot, followed by delayed overshooting
- **Data:** shows similar patterns **also for firms**

Timing of exogenous belief changes

Consider the following scenario:

- exogenous one-time "belief shock" to inflation expectations (e.g., if policy maker can affect expectations through communication)

$$\tilde{E}_t \pi_{t+1} = \tilde{E}_{t-1} \pi_t + \gamma_{\pi,r} \left(\pi_t - \tilde{E}_{t-1} \pi_t \right) + u_t$$

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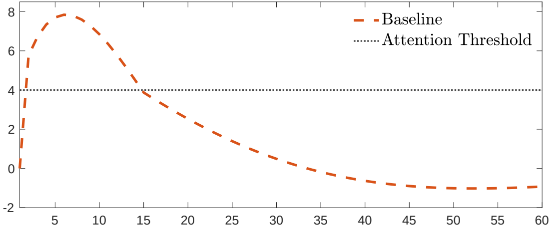
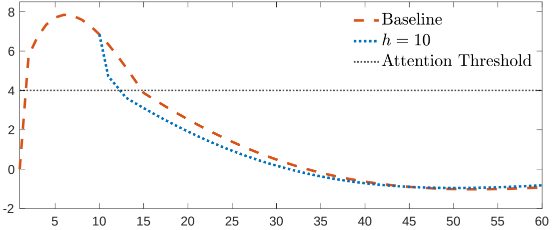
- **Q:** does it matter whether the economy is in the high- or low-attention regime when this "belief shock" occurs?

Timing of exogenous belief changes



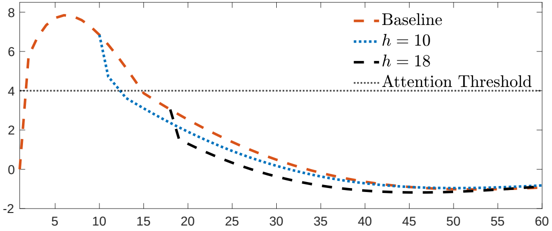
- Baseline case with no exogenous belief change

Exogenous belief changes in high-attention regime



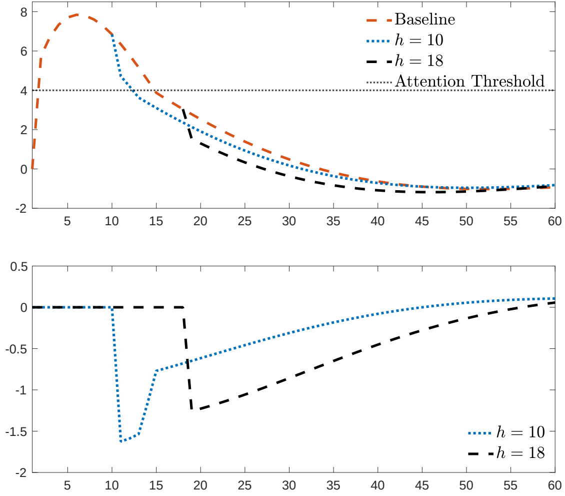
- 1p.p. exogenous decrease in inflation expectations in period $h = 10$ (i.e., in high-attention regime)

Exogenous belief changes in low-attention regime



- 1p.p. exogenous decrease in inflation expectations in period **h=18** (i.e., in **low-attention regime**)

Timing of belief shocks



- 1p.p. exogenous decrease in inflation expectations in period **h=18** (i.e., in **low-attention regime**)

- trade off: stronger initial effects vs. **persistence**

Additional Results

- Similar results for demand shocks ▸ IRFs
- Attention threshold induces asymmetry in inflation dynamics: thicker right tail ▸ Asymmetry
- Dovish monetary policy rules lead to larger central bank losses due to... ▸ Details

  ... higher inflation volatility

  ... positive average inflation due to asymmetry

Conclusion

- Recent inflation surge brought inflation back on people's minds
- I find that...

  ... attention doubles once inflation exceeds 4%

  ... attention amplifies supply shocks and played important role in recent inflation surge

  ... changes in attention affect inflation dynamics

  ... dovish monetary policy may lead to substantial central bank losses

Appendix

Limited-Attention Model

Model of optimal attention choice:

- Agent (household or firm) needs to form an expectation about future inflation
- Acquiring information is costly (cognitive abilities, time, etc.)
- Making mistakes leads to utility losses

  $\Rightarrow$ optimal level of attention depends on how costly information acquisition is, how high your stakes are and the properties of inflation itself

Setup

Agent believes that inflation follows an AR(1) process:

$$\pi' = \rho_\pi \pi + \nu,$$

with $\rho_\pi \in [0, 1]$ and $\nu \sim i.i.N(0, \sigma_\nu^2)$.
The full-information forecast is given by

$$\pi^{e*} = \rho_\pi \pi$$

Problem: current inflation is unobservable and acquiring information is costly.

Information Acquisition Problem

The agent's problem:

- Choose the form of the signal s
- to minimize the loss that arises from making mistakes, $U(s, \pi)$
- facing the cost of information $C(f) = \lambda I(\pi; s)$, with $I(\pi; s)$ being the expected reduction in entropy of π due to observing s

Information Acquisition Problem Continued

Quadratic loss function

$$U(\pi^e, \pi) = r(\underbrace{\rho_\pi \pi}_{\text{full-info}} - \pi^e)^2$$

r: stakes

Optimal signal has the form (Matejka/McKay (2015))

$$s = \pi + \varepsilon$$

where $\varepsilon \sim i.i.N(0, \sigma_\varepsilon^2)$ captures noise

σ_ε^2 is chosen optimally

Optimal Level of Attention

The optimal forecast is given by

$$\pi^e = \rho_\pi \hat{\pi} + \rho_\pi \gamma \left(s - \hat{\pi}\right),$$

where $\hat{\pi}$ is the prior belief of the agent and γ is the optimal level of attention:

$$\gamma = max\left(0, 1 - \frac{\lambda}{2r\rho_\pi \sigma_\pi^2}\right)$$

Attention is higher when:

- the cost of information λ is low
- the stakes r are high
- inflation is very volatile (high σ_π^2) or persistent (high ρ_π) Back

Attention changes within regime

Rolling-window approach to estimate time series of $\widehat{\gamma}_{\pi,t}$ and compute the window-specific average of the monthly q-o-q inflation rate, $\bar{\pi}_t$. Then:

$$\widehat{\gamma}_{\pi,t} = \delta_0 + \delta_1 1_{\bar{\pi}_t \geqslant 4} + \delta_2 \bar{\pi}_t + \delta_3 1_{\bar{\pi}_t \geqslant 4} \bar{\pi}_t + \varepsilon_t \tag{1}$$

Robustness:

$$\widehat{\gamma}_{\pi,t} = \delta_0 + \delta_1 1_{\bar{\pi}_t \geqslant 4} + \delta_2 \pi_{t-1} + \delta_3 1_{\pi_{t-1} \geqslant 4} \pi_{t-1} + \varepsilon_t, \tag{2}$$

	$\widehat{\delta}_1$	$\widehat{\delta}_2$	$\widehat{\delta}_3$
Regression (1)	0.393**	0.053	-0.079
s.e.	(0.192)	(0.047)	(0.051)
Regression (2)	0.119*	-0.010	0.010
s.e.	(0.0641)	(0.0141)	(0.0141)

back Additional results More

Attention changes within regimes: additional results

Estimate

$$\begin{aligned}\tilde{E}_t\pi_{t+1} = {} & \mathbb{1}_{\pi_{t-1}\leqslant\bar{\pi}}\left(\beta_{0,L} + \beta_{1,L}\tilde{E}_{t-1}\pi_t + \beta_{2,L}\left(\pi_t - \tilde{E}_{t-1}\pi_t\right)\right) \\ & + (1 - \mathbb{1}_{\pi_{t-1}\leqslant\bar{\pi}})\left(\beta_{0,H} + \beta_{1,H}\tilde{E}_{t-1}\pi_t + \beta_{2,H}\left(\pi_t - \tilde{E}_{t-1}\pi_t\right)\right) \\ & + \beta_3\left(\pi_t - \tilde{E}_{t-1}\pi_t\right)\cdot\pi_{t-1} + \beta_4\tilde{E}_{t-1}\left[\pi_t\right]\cdot\pi_{t-1} + \tilde{\epsilon}_t\end{aligned}$$

Results:

- $\beta_3 = 0.0032$ (s.e. 0.0027, p-val. 0.24)
- $\beta_4 = -0.0033$ (s.e. 0.0039, p-val. 0.41)
- $\frac{\widehat{\beta}_{2,L}}{\widehat{\beta}_{1,L}} = 0.19$ and $\frac{\widehat{\beta}_{2,H}}{\widehat{\beta}_{1,H}} = 0.33 \Rightarrow$ implied $\gamma_{\pi,L} = 0.2$ at $\pi_{t-1} = 2\%$ and $\gamma_{\pi,H} = 0.35$ at $\pi_{t-1} = 4\%$ back

Regional Data

Use FRED CPI data on four US regions and link to Michigan Survey.

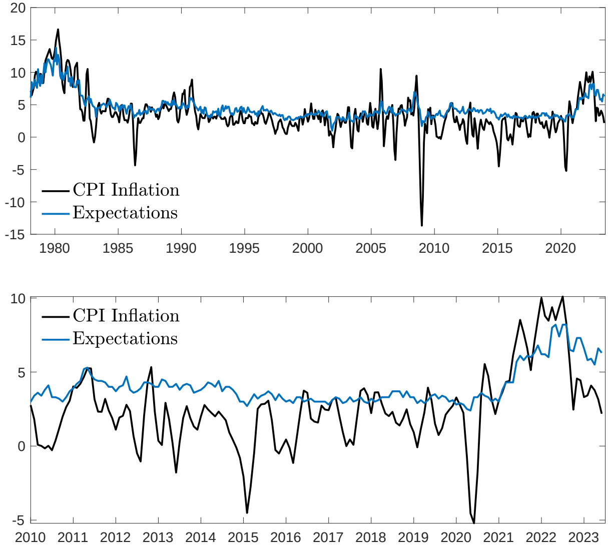
Use region-specific inflation as threshold-defining variable and on LHS of regression

Region	Threshold $\bar{\pi}$	Low Att. $\widehat{\gamma}_{\pi,L}$	High Att. $\widehat{\gamma}_{\pi,H}$
Northeast	5.30	0.17	0.27
Midwest	3.86	0.14	0.30
South	4.42	0.15	0.29
West	6.84	0.20	0.5

Enforcing threshold at 4% US CPI: $\widehat{\gamma}_{\pi,L} = 0.22$ and $\widehat{\gamma}_{\pi,H} = 0.42$ back

Inflation and Inflation Expectations

back



Robustness

	Threshold $\bar{\pi}$	$\widehat{\gamma}_{\pi,L}$	$\widehat{\gamma}_{\pi,H}$	p-val. $\gamma_{\pi,L} = \gamma_{\pi,H}$
Baseline	3.98%	0.18	0.36	0.000
s.e.		(0.013)	(0.037)	
Median exp.	4.41%	0.16	0.23	0.000
s.e.		(0.013)	(0.028)	
Quarterly freq.	3.21%	0.14	0.38	0.000
s.e.		(0.033)	(0.076)	

Current inflation rate rather than lagged inflation rate as the threshold-defining variable: $\widehat{\gamma}_{\pi,L} = 0.18$ and $\widehat{\gamma}_{\pi,H} = 0.36$ (p-val. 0.000)

Using individual consumer inflation expectations from the Survey of Consumer Expectations (NY Fed): $\widehat{\gamma}_{\pi,L} = 0.21$ and $\widehat{\gamma}_{\pi,H} = 0.40$ (p-val. 0.000)

SPF: threshold at 3.92%, $\widehat{\gamma}_{\pi,L} = 0.07$ and $\widehat{\gamma}_{\pi,H} = 0.17$ (p-val. 0.008)

Regional data with threshold at 4% US CPI: $\widehat{\gamma}_{\pi,L} = 0.22$ and $\widehat{\gamma}_{\pi,H} = 0.42$ back

Multivariate regression: controlling for unemployment expectations

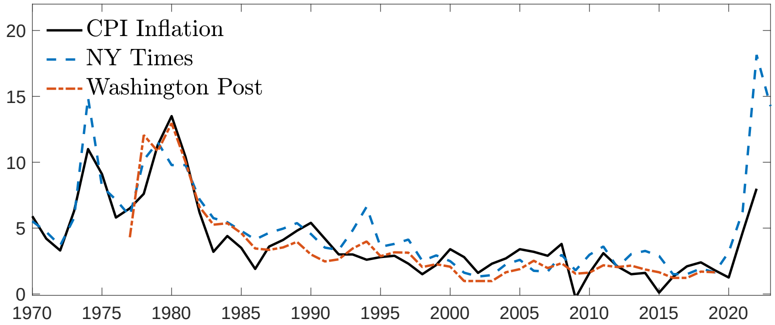
Transform qualitative unemployment expectations into quantitative ones, following Bhandari/Borovicka/Ho and then estimate

$$\begin{aligned}\tilde{E}_t\pi_{t+1} = \mathbb{1}_{\pi_{t-1}\leqslant\bar{\pi}} \Bigg[& \beta_{0,L} + \beta_{1,L}\tilde{E}_{t-1}\pi_t + \beta_{2,L}\left(\pi_t - \tilde{E}_{t-1}\pi_t\right) \\ & + \beta_{4,L}\tilde{E}_{t-1}U_t + \beta_{5,L}\left(U_t - \tilde{E}_{t-1}U_t\right)\Bigg] \\ & + \left(1 - \mathbb{1}_{\pi_{t-1}\leqslant\bar{\pi}}\right)\Bigg[\beta_{0,H} + \beta_{1,H}\tilde{E}_{t-1}\pi_t + \beta_{2,H}\left(\pi_t - \tilde{E}_{t-1}\pi_t\right) \\ & + \beta_{4,H}\tilde{E}_{t-1}U_t + \beta_{5,H}\left(U_t - \tilde{E}_{t-1}U_t\right)\Bigg] + \tilde{\epsilon}_t\end{aligned}$$

Results:

- $\widehat{\bar{\pi}} = 3.98$ (4.00 when ending the sample in 2019)
- $\widehat{\gamma}_{\pi,L} = 0.19$ (0.19) and $\widehat{\gamma}_{\pi,H} = 0.35$ (0.38) back

Potential driver: news coverage of inflation higher when inflation is high



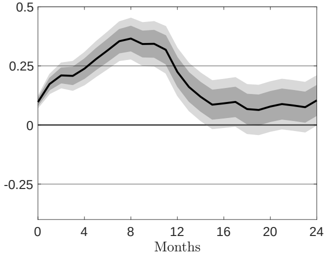
- frequency of word *inflation*: 2-3 times higher when inflation $> 4\%$
- monthly frequency (NYT, 1990-2023): news coverage slightly lags inflation

back

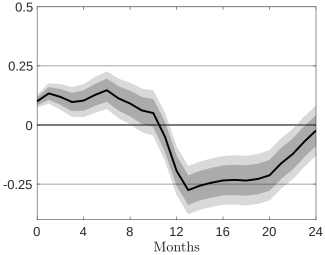
Disentangling attention and inflation ▸ back

Regional data, use Google as indicator variable but also include shocks interacted with dummy based on regional CPI $\lessgtr 4\%$

(a) High-attention regime



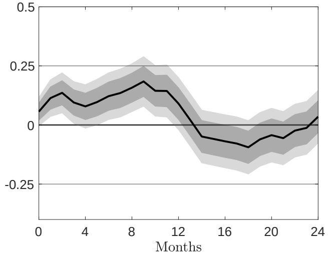
(b) Low-attention regime



Disentangling attention and inflation II ‣ back

Interact Google trends with shock and include regional CPI interaction, time and region FEs:

Interaction with Google



Interaction becomes insignificant when controlling for regimes

▸ back

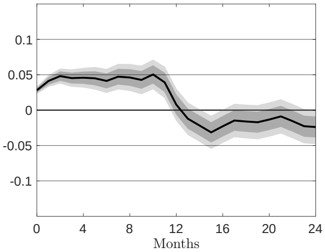
Local projection with interaction term but no 'regime controls':

$$\pi_{i,t+j} - \pi_{i,t-1} = \alpha_{i,j} + \beta_j \pi_{t-1} \varepsilon_t + \Gamma' X_{i,t} + u_{i,t+j}$$

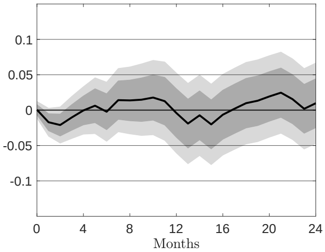
and with 'regime controls':

$$\pi_{i,t+j} - \pi_{i,t-1} = \beta_j \pi_{i,t-1} \varepsilon_t + \mathbb{1}_H \left(\alpha_{i,j}^H + \beta_j^H \varepsilon_t \right) + (1 - \mathbb{1}_H) \left(\alpha_{i,j}^L + \beta_j^L \varepsilon_t \right) + \Gamma' X_{i,t} + u_{i,t+j}$$

(a) Interaction without regime controls



(b) Interaction with regime controls

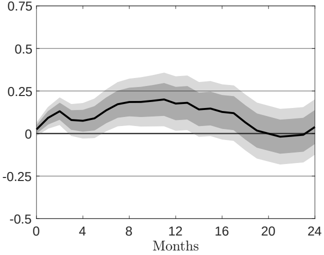


Interaction results when using Google Trends data

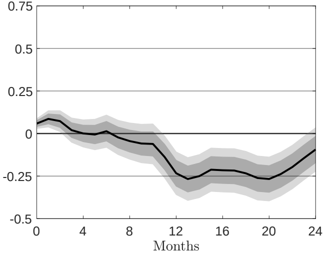
back

Use Google Trends as regime indicator and interaction term uses regional CPI.

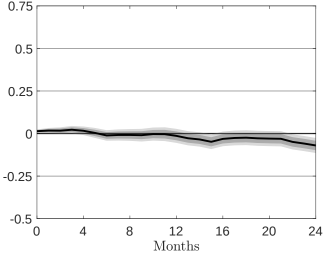
(a) High-Attention Regime



(b) Low-Attention Regime



(c) Interaction



Households

Representative household, lifetime utility:

$$\tilde{E}_0 \sum_{t=0}^{\infty} \beta^t Z_t \left[\frac{C_t^{1-\sigma}}{1-\sigma} - \Xi H_t \right]$$

Households maximize their lifetime utility subject to the flow budget constraints

$$C_t + B_t = w_t H_t + \frac{1+i_{t-1}}{1+\pi_t} B_{t-1} + \frac{T_t}{P_t}, \qquad \text{for all } t$$

Yields Euler equation

$$Z_t C_t^{-\sigma} = \beta(1+i_t)\tilde{E}_t \left[Z_{t+1} C_{t+1}^{-\sigma} \frac{1}{1+\pi_{t+1}} \right]$$

and the labor-leisure condition

$$w_t = \Xi C_t^{\sigma}$$

▸ back

Final goods producer

There is a representative final good producer that aggregates the intermediate goods $Y_t(j)$ to a final good Y_t, according to

$$Y_t = \left(\int_0^1 Y_t(j)^{\frac{\epsilon-1}{\epsilon}} dj \right)^{\frac{\epsilon}{\epsilon-1}}, \tag{3}$$

with $\epsilon > 1$. Nominal profits are given by $P_t \left(\int_0^1 Y_t(j)^{\frac{\epsilon-1}{\epsilon}} dj \right)^{\frac{\epsilon}{\epsilon-1}} - \int_0^1 P_t(j) Y_t(j) dj$, and profit maximization gives rise to the demand for each variety j:

$$Y_t(j) = \left(\frac{P_t(j)}{P_t} \right)^{-\epsilon} Y_t. \tag{4}$$

Thus, demand for variety j is a function of its relative price, the price elasticity of demand ϵ and aggregate output Y_t. The aggregate price level is given by

$$P_t = \left(\int_0^1 P_t(j)^{1-\epsilon} dj \right)^{\frac{1}{1-\epsilon}}. \tag{5}$$

back

Intermediate producers

Intermediate producer of variety j produces output $Y_t(j)$ using labor $H_t(j)$

$$Y_t(j) = H_t(j).$$

When adjusting the price, the firm is subject to a Rotemberg price-adjustment friction.

Per-period profits (in real terms) are given by

$$(1-\tau_t)P_t(j)\left(\frac{P_t(j)}{P_t}\right)^{-\epsilon}\frac{Y_t}{P_t} - w_t H_t(j) - \frac{\psi}{2}\left(\frac{P_t(j)}{P_{t-1}(j)} - 1\right)^2 Y_t + t_t^F(j)$$

Defining $T_t \equiv 1-\tau_t$, it follows that after a linearization of the FOC around the zero-inflation steady state, firm j sets its price according to

$$\widehat{p}_t(j) = \frac{1}{\psi+\epsilon}\left[\psi\widehat{p}_{t-1} + \epsilon\left(\widehat{mc}_t - \widehat{T}_t + \widehat{p}_t\right) + \beta\psi\tilde{E}_t^j\pi_{t+1}^j\right]$$

▸ back

Fiscal policy

The government imposes a sales tax τ_t on sales of intermediate goods, issues nominal bonds, and pays lump-sum taxes and transfers T_t to households and $t_t^F(j)$ to firms. The real government budget constraint is given by

$$B_t = B_{t-1}\frac{1+i_{t-1}}{\Pi_t} + \frac{T_t}{P_t} - \tau Y_t + t_t^f.$$

Lump-sum taxes and transfers are set such that they keep real government debt constant at the initial level B_{-1}/P_{-1}, which I set to zero. ▸ back

Equilibrium

- Aggregate supply:

$$\pi_t = \beta \tilde{E}_t \pi_{t+1} + \kappa \widehat{x}_t + u_t$$

- Aggregate demand:

$$\widehat{x}_t = \tilde{E}_t \widehat{x}_{t+1} - \varphi \left(\tilde{i}_t - \tilde{E}_t \pi_{t+1} - r_t^* \right)$$
$$\tilde{i}_t = \rho_i \tilde{i}_{t-1} + (1 - \rho_i) \left(\phi_\pi \pi_t + \phi_x \widehat{x}_t \right)$$

\+ shocks and expectation formation Analytical Example back

Numerical insights: calibration ‣ back

Parameter	Description	Value
β	Discount factor	$\frac{1}{1+1/400}$
φ	Interest rate elasticity	1
κ	Slope of NKPC	0.057
ρ_i	Interest rate smoothing	0.7
ϕ_π	Inflation response coefficient	2
ϕ_x	Output gap response coefficient	0.125
ρ_u	Shock persistence	0.8
σ_u	Shock volatility	0.3%
Attention parameters		
$\bar{\pi}$	Attention threshold	4% (annualized)
$\gamma_{\pi,L}$	Low inflation attention	0.18
$\gamma_{\pi,H}$	High inflation attention	0.36
γ_x	Output gap attention	0.25

An (hopefully) illustrative example

Consider a stylized version of the model: set $\widetilde{i}_t = \phi_\pi \pi_t$, $\gamma_x = 0$ and $\tilde{E}_{-1}\widehat{x}_0 = 0$

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Focus on first three periods:

0: Steady State

1: Cost-push shock hits: $u_1 > 0$

2: Shock persists: $u_2 = u_1 > 0$

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Focus on first three periods:

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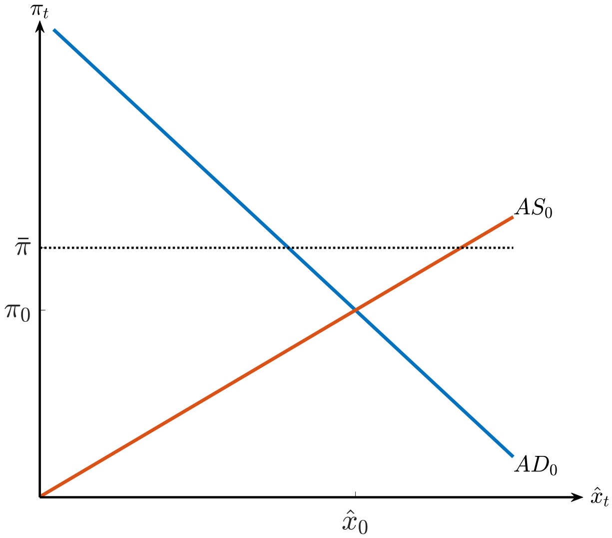
1: Cost-push shock hits: $u_1 > 0$

2: Shock persists: $u_2 = u_1 > 0$

Q: What happens to inflation?

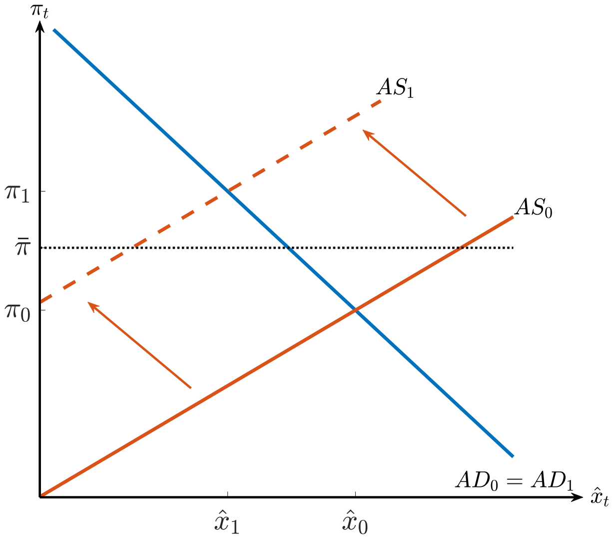
Period 0: economy in steady state



$$AS_0 : \quad \pi_0 = \frac{\kappa}{1 - \beta\gamma_{\pi,L}} \widehat{x}_0$$

$$AD_0 : \quad \pi_0 = -\frac{1}{\phi_\pi - \gamma_{\pi,L}} \widehat{x}_0$$

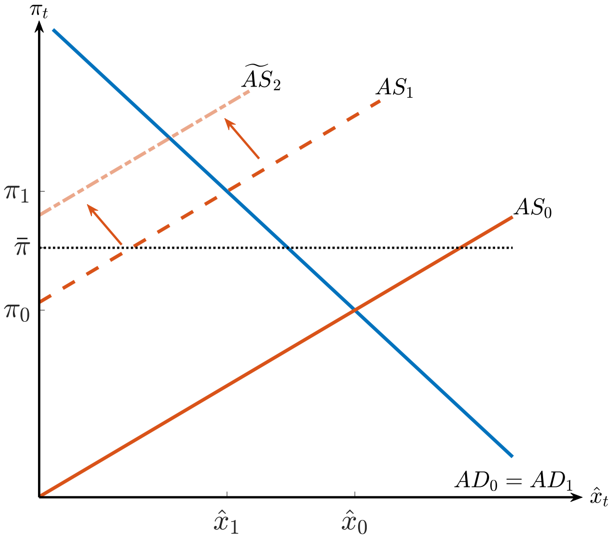
Period 1: Cost-push shock hits



$$AS_1: \quad \pi_1 = \frac{\kappa}{1-\beta\gamma_{\pi,L}}\widehat{x}_1 + \frac{1}{1-\beta\gamma_{\pi,L}}u_1$$

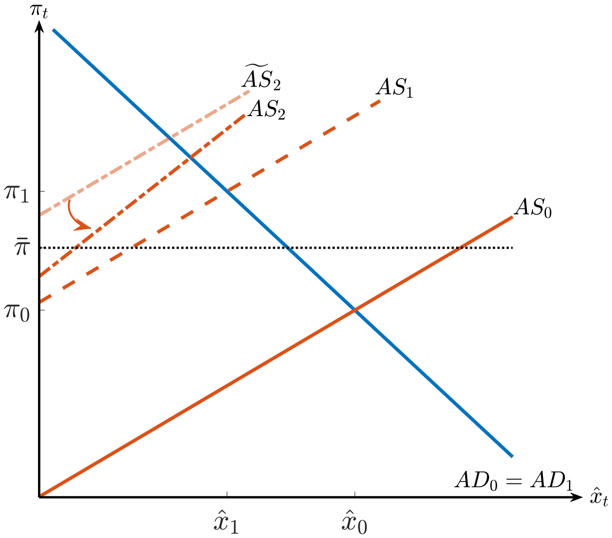
$$AD_1: \quad \pi_1 = -\frac{1}{\phi_\pi - \gamma_{\pi,L}}\widehat{x}_1$$

Period 2: AS further up due to ongoing shock & prior expectations



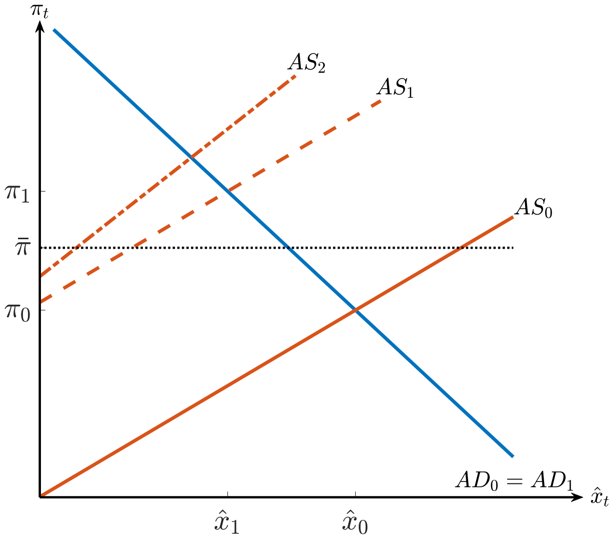
$$\widetilde{AS}_2 : \quad \pi_2 = \frac{\kappa}{1-\beta\gamma_{\pi,L}}\widehat{x}_2 + \frac{1}{1-\beta\gamma_{\pi,H}}u_2 + \frac{\beta(1-\gamma_{\pi,H})\gamma_{\pi,L}}{1-\beta\gamma_{\pi,H}}\pi_1$$

Period 2: AS becomes steeper due to higher attention

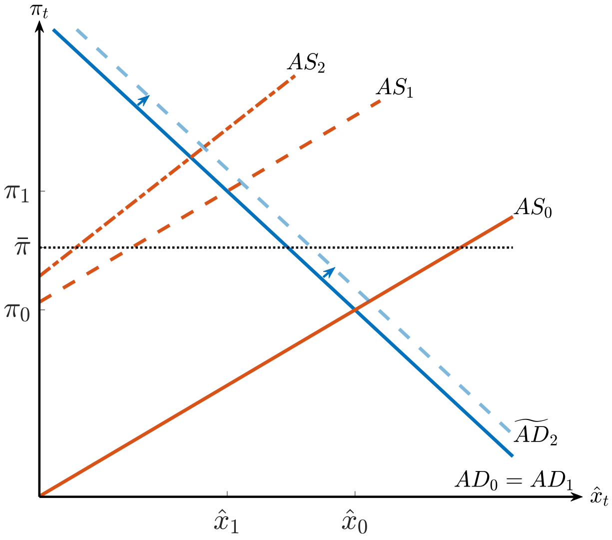


$$AS_2: \quad \pi_2 = \frac{\kappa}{1-\beta\gamma_{\pi,H}}\hat{x}_2 + \frac{1}{1-\beta\gamma_{\pi,H}}u_2 + \frac{\beta(1-\gamma_{\pi,H})\gamma_{\pi,L}}{1-\beta\gamma_{\pi,H}}\pi_1$$

Period 2: What about aggregate demand?

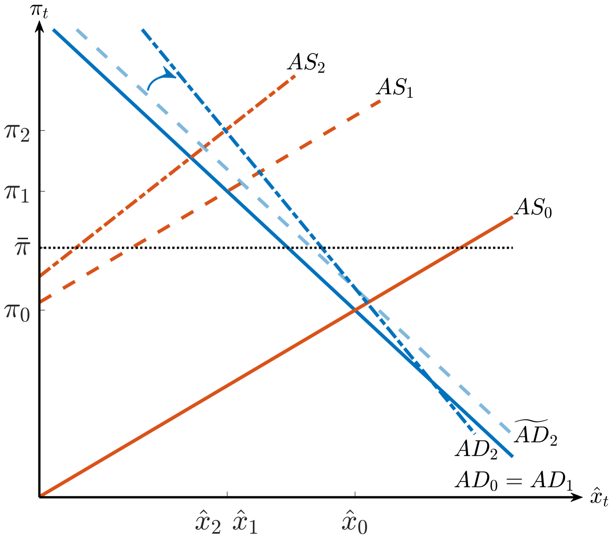


Period 2: AD shifts out due to positive prior expectations



$$\widetilde{AD}_2: \quad \pi_2 = -\frac{1}{\phi_\pi - \gamma_{\pi,L}}\widehat{x}_2 + \frac{(1-\gamma_{\pi,H})\gamma_{\pi,L}}{\phi_\pi - \gamma_{\pi,H}}\pi_1$$

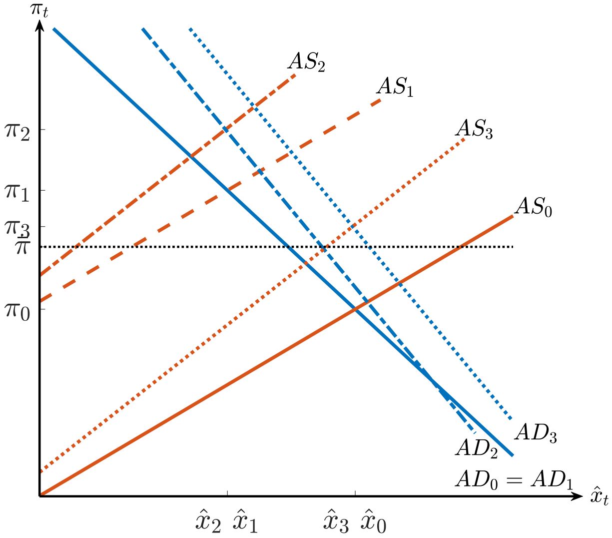
Period 2: AD becomes steeper due to higher attention



$$AD_2: \quad \pi_2 = -\frac{1}{\phi_\pi - \gamma_{\pi,H}}\widehat{x}_2 + \frac{(1-\gamma_{\pi,H})\gamma_{\pi,L}}{\phi_\pi - \gamma_{\pi,H}}\pi_1$$

▸ Period 3 ▸ back

Illustrative example: Period 3



$$AS_3: \quad \pi_3 = \frac{\kappa}{1-\beta\gamma_{\pi,H}}\widehat{x}_3 + \frac{\beta(1-\gamma_{\pi,H})}{1-\beta\gamma_{\pi,H}}\tilde{E}_2\pi_3$$

$$AD_3: \quad \pi_3 = -\frac{1}{\phi_\pi - \gamma_{\pi,H}}\widehat{x}_3 + \frac{1-\gamma_{\pi,H}}{\phi_\pi - \gamma_{\pi,H}}\tilde{E}_2\pi_3$$

▸ back

Role of $\tilde{E}_t \hat{c}_{t+1}$

back to model

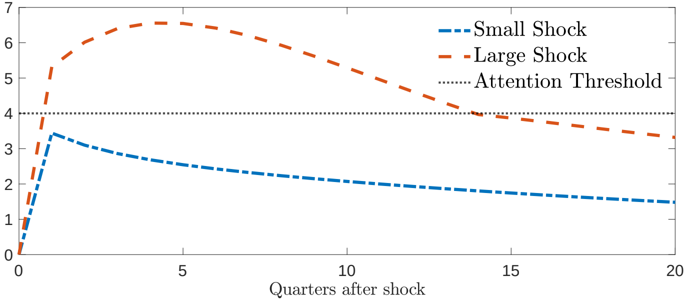
In model under FIRE and with Taylor rule $i_t = \phi_\pi \pi_t$, we have

$$\hat{c}_t = \rho_u \hat{c}_{t-1}.$$

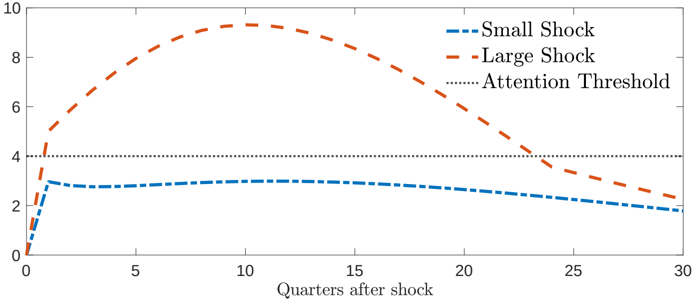
With that perceived law of motion (i.e., ignoring that limited attention to inflation affects the equilibrium), and full attention to consumption, it follows:

$$\tilde{E}_t \hat{c}_{t+1} = \rho_u \hat{c}_t.$$

Inflation dynamics are similar:



Demand shocks



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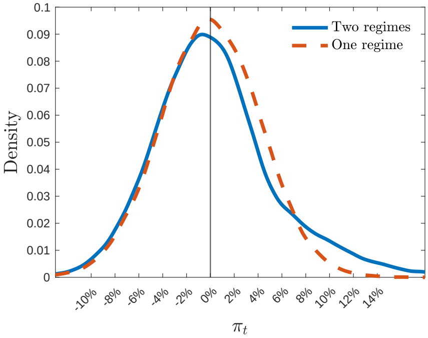
Asymmetry in Inflation Dynamics

- The attention threshold leads to an asymmetry in inflation dynamics

  ⇒ heightened risk of high-inflation periods



- Frequency of inflation above 8%: **11% in the data**
  9% with 2 regimes vs. 3% with 1 regime
- Both models yield similar predictions for median inflation and deflation probabilities
- average inflation > 0 with 2 regimes
  $= 0$ with one regime
- absolute forecast errors in model similar to data: mean 2.1 vs. **1.84** and standard dev. 1.60 vs. **1.86**

back

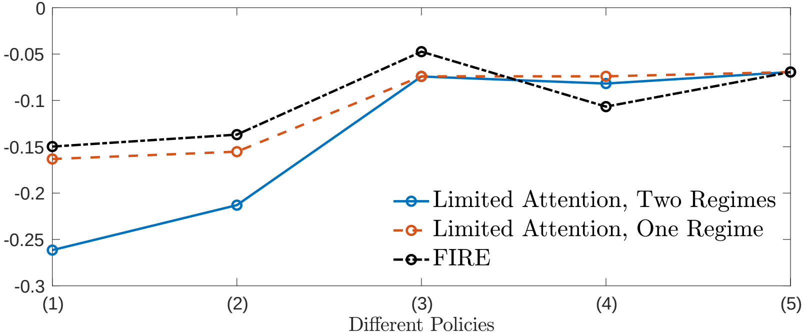
Implications of different monetary policy rules for central bank losses

Central bank loss $\equiv -\frac{1}{2} E_0 \sum_{t=0}^{\infty} \beta^t \left[\pi_t^2 + \Lambda \widehat{x}_t^2\right]$, with $\Lambda = 0.007$

Compare welfare implications of different policy rules:

Nr.	Name	Equation
(1)	Taylor rule with smoothing	$\tilde{i}_t = \rho_i \tilde{i}_{t-1} + (1-\rho_i)(\phi_\pi \pi_t + \phi_x \widehat{x}_t)$
(2)	Taylor rule without smoothing	$\tilde{i}_t = \phi_\pi \pi_t$
(3)	Optimal RE commitment policy	$\pi_t + \frac{\Lambda}{\kappa}(\widehat{x}_t - \widehat{x}_{t-1}) = 0$
(4)	Optimal RE discretionary policy	$\pi_t + \frac{\Lambda}{\kappa}\widehat{x}_t = 0$
(5)	Strict inflation targeting	$\pi_t = 0$

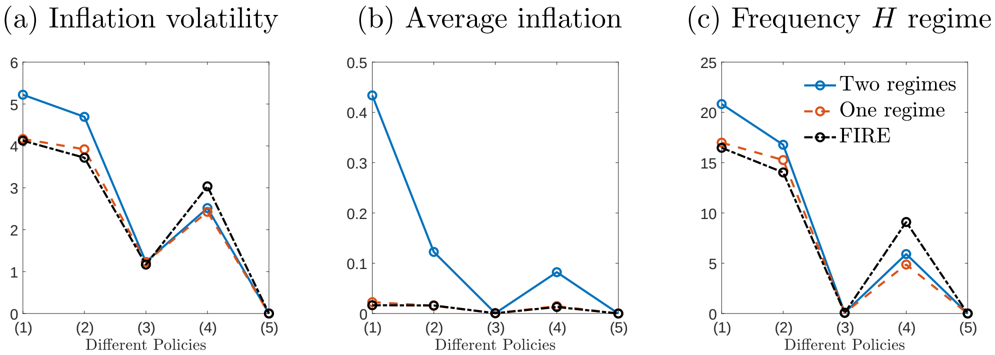
Central bank loss



- Taylor rules lead to larger central bank losses than in other models
  - especially with interest-rate smoothing

back

Asymmetry of attention threshold increases average level of inflation



- Asymmetry $\Rightarrow$ average level > 0 $\Rightarrow$ losses

▸ back