Monetary Policy & Anchored Expectations
An Endogenous Gain Learning Model

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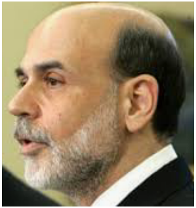
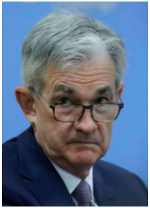
[1]The views expressed are solely the views of the author and do not necessarily reflect the views of the European Central Bank or the Eurosystem.

Anchoring

"Essential to anchor inflation expectations at some low level."

"We don't see a de-anchoring."



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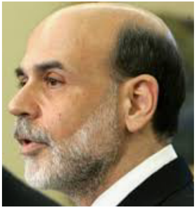  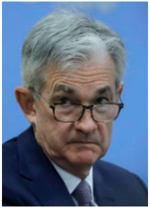 

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   - anchors expectations to inflation target
   - responds aggressively to movements in long-run expectations

Related literature

- **Optimal monetary policy in the New Keynesian model**
  Clarida, Gali & Gertler (1999), Woodford (2003)

- **Adaptive learning**
  Evans & Honkapohja (2001, 2006), Sargent (1999), Adam (2005), Primiceri (2006), Lubik & Matthes (2018), Bullard & Mitra (2002), Preston (2005, 2008), Evans & McGough (2015), Ferrero (2007), Molnár & Santoro (2014), Mele et al (2019), Eusepi & Preston (2011), Milani (2007, 2014), Marcet & Nicolini (2003), Eusepi, Giannoni & Preston (2020), Slobodyan & Wouters (2011)

- **Anchoring and the Phillips curve**
  Goodfriend (1993), Svensson (2015), Afrouzi & Yang (2020), Reis (2020), Hebden et al 2020, Hazell et al (2021), Gobbi et al (2019), Carvalho et al (2022)

Model of anchoring expectations

Quantification of anchoring

Optimal monetary policy

Households: standard up to $\hat{\mathbb{E}}$

Maximize lifetime expected utility

$$\hat{\mathbb{E}}_t^i \sum_{T=t}^{\infty} \beta^{T-t} \left[U(C_T^i) - \int_0^1 v(h_T^i(j))dj \right]$$

Budget constraint

$$B_t^i \leq (1 + i_{t-1})B_{t-1}^i + \int_0^1 w_t(j)h_t^i(j)dj + \Pi_t^i(j)dj - T_t - P_t C_t^i$$

Firms: standard up to $\hat{\mathbb{E}}$

Maximize present value of profits

$$\hat{\mathbb{E}}_t^j \sum_{T=t}^{\infty} \alpha^{T-t} Q_{t,T} \left[\Pi_t^j(p_t(j)) \right]$$

subject to demand

$$y_t(j) = Y_t \left(\frac{p_t(j)}{P_t} \right)^{-\theta}$$

Aggregate relationships

- New Keynesian core: standard IS and Phillips curves

$$x_t = \hat{\mathbb{E}}_t \sum_{T=t}^{\infty} \beta^{T-t}((1-\beta)x_{T+1} - \sigma(\beta i_T - \pi_{T+1}) + \sigma r_T^n)$$

$$\pi_t = \kappa x_t + \hat{\mathbb{E}}_t \sum_{T=t}^{\infty} (\alpha\beta)^{T-t}(\kappa\alpha\beta x_{T+1} + (1-\alpha)\beta\pi_{T+1} + u_T)$$

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Observables: (π, x, i) inflation, output gap, interest rate
Exogenous states: (r^n, u) natural rate and cost-push shock

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→ short-run surprises informative about long-run inflation expectations $\bar{\pi}_t$

Learning mean inflation from data

Yesterday's one-period ahead inflation forecast:

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$k_t \in (0,1)$ learning gain as sensitivity to surprises

Alternatives for the gain

1. Decreasing gain:

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Carvalho et al (2022): endogenous gain as a metric for unanchoring

- Low gain: anchored regime
- High gain: unanchored regime

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Model of anchoring expectations

Quantification of anchoring

Optimal monetary policy

Estimating form of gain function

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- Moments: autocovariances of inflation, output gap, federal funds rate and 1-year ahead Survey of Professional Forecasters (SPF) inflation expectations at lags $0, \dots, 4$

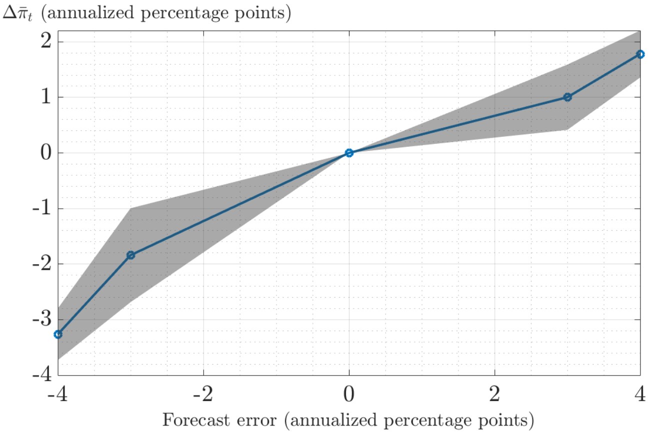
Calibration - parameters from the literature

β	0.98	stochastic discount factor
σ	1	intertemporal elasticity of substitution
α	0.5	Calvo probability of not adjusting prices
κ	0.0842	slope of the Phillips curve
ψ_π	1.5	coefficient of inflation in Taylor rule
ψ_x	0.3	coefficient of the output gap in Taylor rule
σ_r	0.01	standard deviation, natural rate shock
σ_i	0.01	standard deviation, monetary policy shock
σ_u	0.5	standard deviation, cost-push shock
$\bar{g}$	0.145	initial value of the gain

Chari et al (2000), Woodford (2003), Nakamura & Steinsson (2008)
Carvalho et al (2022)

Estimated expectations process

$$\bar{\pi}_t - \bar{\pi}_{t-1} = \hat{\mathbf{g}}(f_{t|t-1})\, f_{t|t-1}$$



Estimated change in long-run inflation expectations for various forecast errors

MODEL OF ANCHORING EXPECTATIONS

QUANTIFICATION OF ANCHORING

OPTIMAL MONETARY POLICY

Ramsey problem

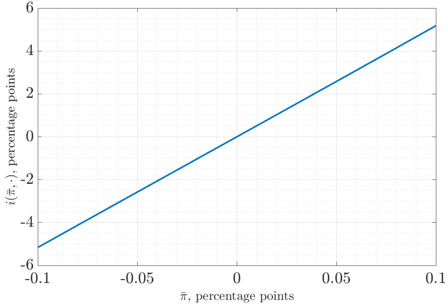
$$\min_{\{y_t, \bar{\pi}_{t-1}, k_t\}_{t=t_0}^{\infty}} \mathbb{E}_{t_0} \sum_{t=t_0}^{\infty} \beta^{t-t_0} (\pi_t^2 + \lambda_x x_t^2)$$

s.t. model equations

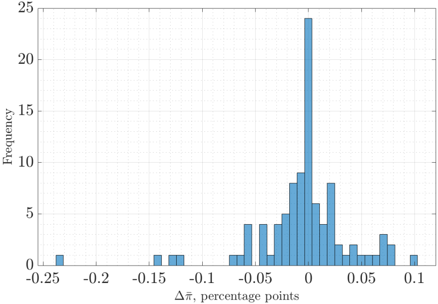
s.t. evolution of expectations

- $\mathbb{E}$ is the central bank's (CB) expectation
- Assumption: CB observes private expectations and knows the model

Optimal policy - responding to unanchoring



$i(\bar{\pi}$, all other states at their means)



Stabilizing $\bar{\pi}$

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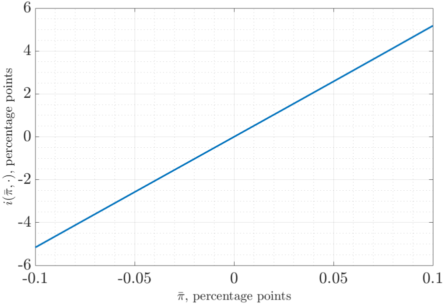

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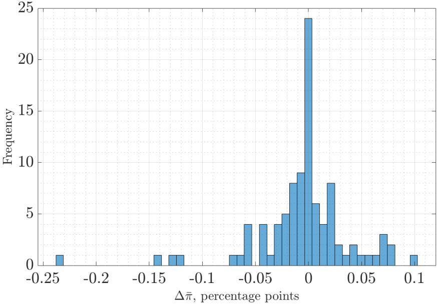

Stabilizing $\bar{\pi}$

$\uparrow \bar{\pi}$ by 5 bp $\quad \Rightarrow \quad \uparrow i$ by 250 bp

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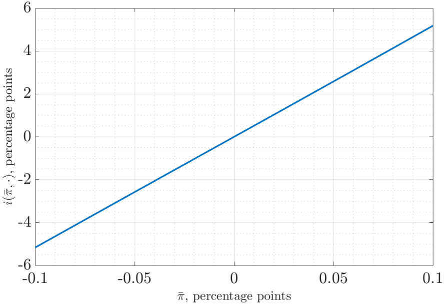

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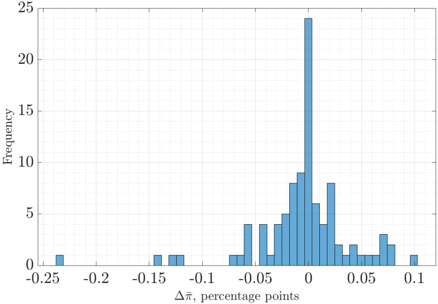

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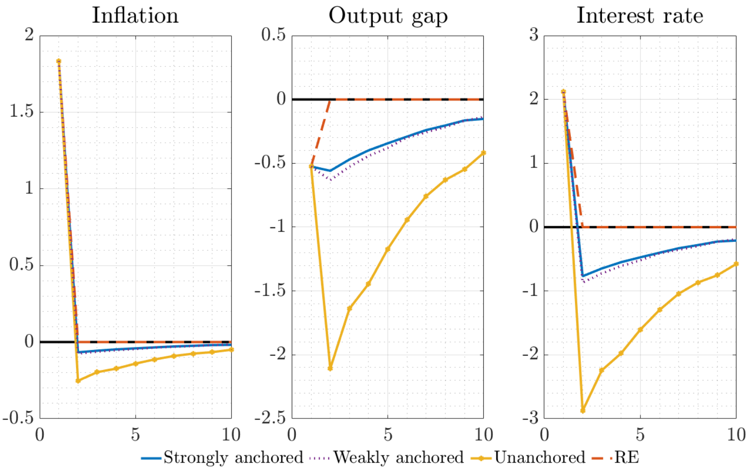
Mode: 0.3 bp movement in $\bar{\pi}$

Unanchoring amplifies shocks



Impulse responses after a cost-push shock when policy follows a Taylor rule

Conclusion

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Model-based notion of unanchoring

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Optimal monetary policy

- Anchors expectations by responding aggressively to long-run expectations