Monetary Policy & Anchored Expectations

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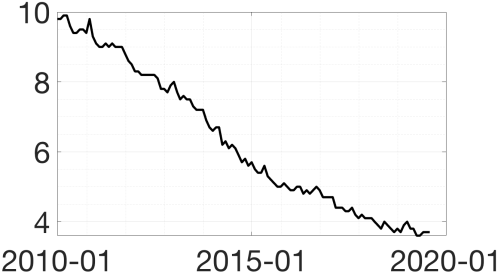
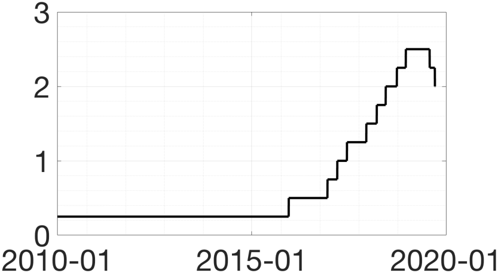


(a) Unemployment rate



(b) Fed funds rate target range, upper limit

This project

1. Combines a formal definition of an anchoring mechanism (AM) from econometric learning

2. with a standard macro model of monetary policy

$\Rightarrow$ Explains current monetary policy as a concern to keep expectations anchored

- Reinterprets Great Inflation as a period of unanchored expectations
- Reevaluates optimal monetary policy

Structure of talk

1. Related literature
2. Intuition: what is anchoring and why should it matter?
3. A formal notion of anchoring
4. Model with anchoring mechanism
5. Simulations

Related literature

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

- **Econometric learning**
  Evans & Honkapohja (2001), Preston (2005), Graham (2011)

- **Anchoring**
  Carvalho et al (2019), Svensson (2015), Hooper et al (2019)

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Phillips Curve

$$\pi_t = \beta \hat{\mathbb{E}}_t \pi_{t+1} + \kappa x_t$$

- $\pi_t =$ inflation
- $x_t =$ output gap
- $\hat{\mathbb{E}}_t =$ expectation-operator (not necessarily rational)

Suppose a negative demand shock:

$$\pi_t = \beta \hat{\mathbb{E}}_t \pi_{t+1} + \kappa \underset{\downarrow}{x_t}$$

If expectations do not move:

$$\underset{\downarrow}{\pi_t} = \beta \hat{\mathbb{E}}_t \pi_{t+1} + \kappa \underset{\downarrow}{x_t}$$

If seeing $\underset{\downarrow}{\pi_t}$, expectations adjust:

$$\underset{\downarrow\downarrow}{\pi_t} = \beta \hat{\mathbb{E}}_t \underset{\downarrow}{\pi_{t+1}} + \kappa \underset{\downarrow}{x_t}$$

Keeping expectations stable may be desirable

$\rightarrow$ “Anchored”: notion of stable expectations

(Flattening PC due to anchored expectations, Hooper et al (2019))

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A learning model of expectation formation

Suppose firms and households

- observe everything up to time t
- do not observe future variables
- KEY: are unsure about the long-run mean of inflation, $\bar{\pi}$

Agents construct one-period-ahead inflation forecasts as

$$\hat{\mathbb{E}}_t \pi_{t+1} = \bar{\pi}_{t-1} + b s_t \tag{1}$$

$\bar{\pi}$ = estimate of inflation drift (= long-run mean, "target")

$\hat{\mathbb{E}}$ = subjective expectation operator (not rational expectations, $\mathbb{E}$)

b = matrix of constants

s = shocks

Definition: Anchoring mechanism

$$\bar{\pi}_t = \bar{\pi}_{t-1} + k_t \overbrace{\left(\pi_t - (\bar{\pi}_{t-1} + bs_{t-1})\right)}^{\text{short-run forecast error}} \tag{2}$$

$$k_t = \begin{cases} \frac{1}{k_{t-1}+1} & \text{if} \quad \overbrace{|\hat{\mathbb{E}}_{t-1}\pi_t - \mathbb{E}_{t-1}\,\pi_t|/\sigma_s}^{\equiv\theta_t} \leq \bar{\theta} \\ \bar{g} & \text{otherwise} \end{cases} \tag{3}$$

Equation (3): endogenous gain

- Carvalho et al (2019)
- Difference to standard econometric learning

- Expectations anchored $=$ when agents choose **decreasing** gains

- Expectations unanchored $=$ when agents choose **constant** gains

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The model

Households maximize

$$\hat{\mathbb{E}}_t^i \sum_{s=0}^{\infty} \beta^s \left(U(C_s^i) - v(H_s^i) \right) \tag{4}$$

Household budget constraint:

$$B_t^i \leq (1 + i_{t-1}) B_{t-1}^i + W_t H_t^i + \Pi_t^i - T_t - P_t C_t^i \tag{5}$$

Firms: monopolistic competition in varieties C^j, Calvo price setting

Expectations: $\hat{\mathbb{E}}$ as in (1)

3-Equation New Keynesian Model

$$x_t = -\sigma i_t + \hat{\mathbb{E}}_t \sum_{T=t}^{\infty} \beta^{T-t}\left((1-\beta)x_{T+1} - \sigma(\beta i_{T+1} - \pi_{T+1}) + \sigma r_T^n\right) \tag{6}$$

$$\pi_t = \kappa x_t + \hat{\mathbb{E}}_t \sum_{T=t}^{\infty} (\alpha\beta)^{T-t}\left(\kappa\alpha\beta x_{T+1} + (1-\alpha)\beta\pi_{T+1} + u_T\right) \tag{7}$$

$$i_t = \psi_\pi \pi_t + \psi_x x_t + \bar{i}_t \tag{8}$$

"Long-horizon forecasts" $\rightarrow$ agents do not know the model
Preston (2005)

▸ Derivations

▸ Compact notation

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Calibration

β	0.98
σ	0.5
α	0.5
ψ_π	1.5
ψ_x	1.5
$\bar{g}$	$1/0.145^*$
$\bar{\theta}$	5*
ρ_r	0
ρ_i	0.877*
ρ_u	0
σ_i	0.359*
σ_r	0.1
σ_u	0.277*

* Carvalho et al (2019)'s estimates. Exception: $\bar{\theta} = 0.029$.

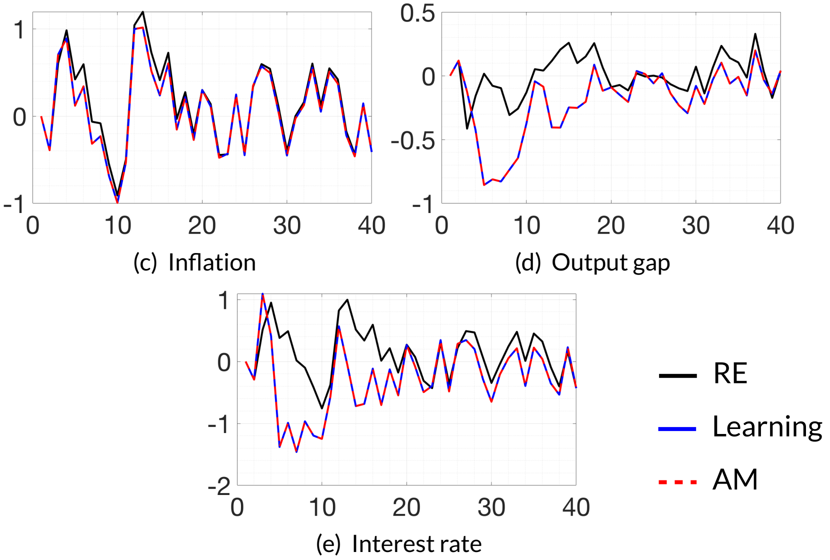
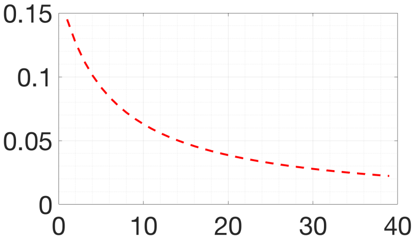
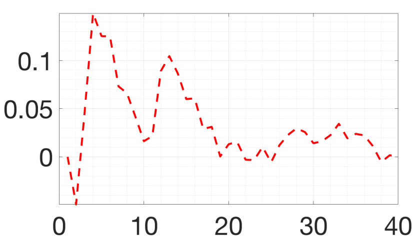


FIGURE: Rational expectations (RE), learning and anchoring mechanism (AM)



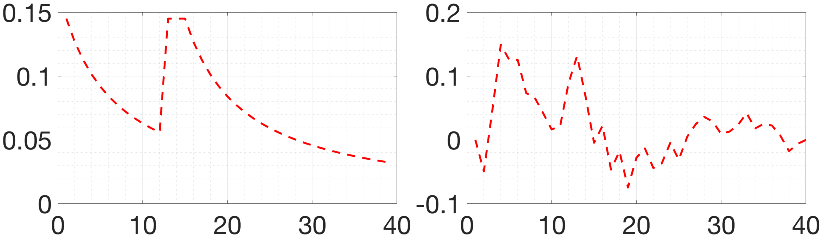
(a) Gain



(b) Inflation drift

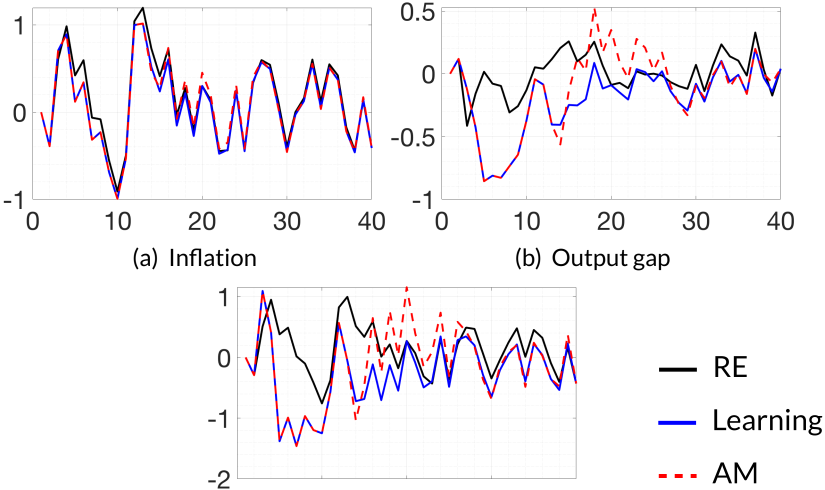
FIGURE: Well anchored expectations: decreasing gain

DECREASING $\bar{\theta}$: AN UNANCHORED CASE



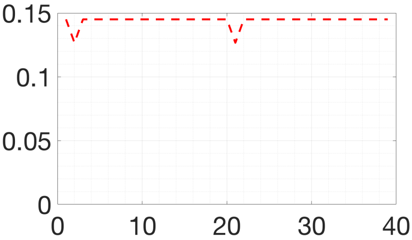
(a) Gain (b) Inflation drift

FIGURE: $\bar{\theta} = 1$. Unanchored expectations: constant gain



(a) Inflation (b) Output gap (c) Interest rate

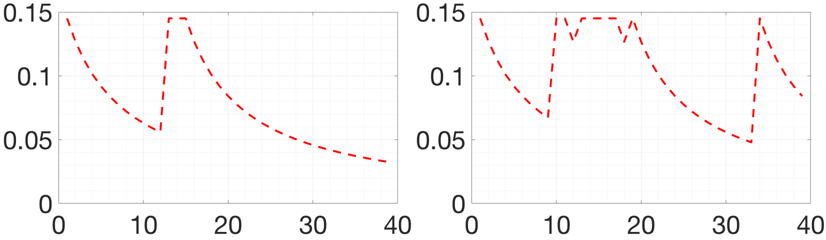
FIGURE: $\bar{\theta} = 1$



(a) Gain

FIGURE: $\bar{\theta} = 0.029$. Carvalho et al's estimate extremely unanchored!

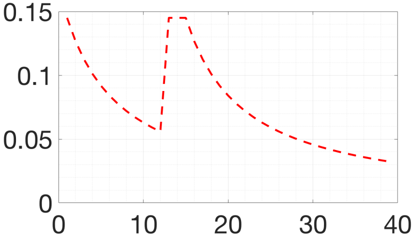
Gain when Varying Taylor-rule coefficients



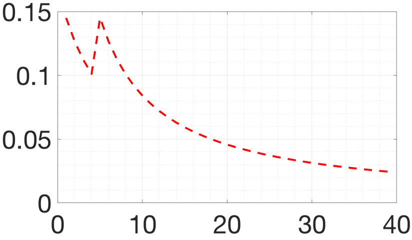
(a) $(\psi_\pi, \psi_x) = (1.5, 1.5)$ (b) $(\psi_\pi, \psi_x) = (1.1, 1.5)$

Figure: Less aggressive on inflation

$\bar{\theta} = 1$

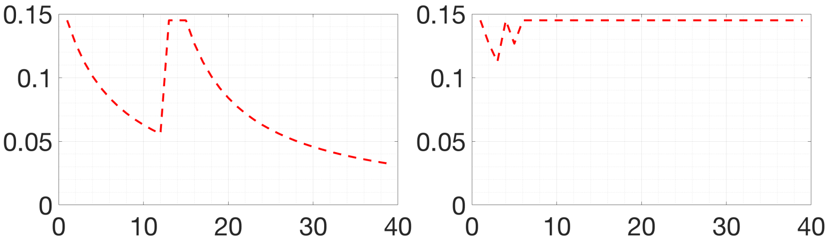


(a) $(\psi_\pi, \psi_x) = (1.5, 1.5)$



(b) $(\psi_\pi, \psi_x) = (3, 1.5)$

FIGURE: More aggressive on inflation



(a) $(\psi_\pi, \psi_x) = (1.5, 1.5)$ (b) $(\psi_\pi, \psi_x) = (5 , 1.5)$

FIGURE: Too aggressive on inflation?

Today's conclusion and work ahead

- Formal definition of anchoring $+$ macro model with monetary policy

  $\rightarrow$ investigation of new constraint on monetary policy

- Next steps
  - Write and solve monetary policy problem
  - Estimate model

Thank you!

Derivations

Household FOCs

$$\hat{C}_t^i = \hat{\mathbb{E}}_t^i \hat{C}_{t+1}^i - \sigma(\hat{i}_t - \hat{\mathbb{E}}_t^i \hat{\pi}_{t+1}) \tag{9}$$

$$\hat{\mathbb{E}}_t^i \sum_{s=0}^{\infty} \beta^s \hat{C}_t^i = \omega_t^i + \hat{\mathbb{E}}_t^i \sum_{s=0}^{\infty} \beta^s \hat{Y}_t^i \tag{10}$$

where a hat denotes log-linear approximation and $\omega_t^i \equiv \frac{(1+i_{t-1})B_{t-1}^i}{P_t Y^*}$.

1. Solve (9) backward to some date t, take expectations at t
2. Sub in (10)
3. Aggregate over households i

$\rightarrow$ Obtain (6)

◂ Return

Compact notation

$$z_t = A_1 f_{a,t} + A_2 f_{b,t} + A_3 s_t \tag{11}$$

$$s_t = P s_{t-1} + \epsilon_t \tag{12}$$

where

$$z_t \equiv \begin{pmatrix} \pi_t \\ x_t \\ i_t \end{pmatrix} \qquad s_t \equiv \begin{pmatrix} r_t^n \\ \bar{i}_t \\ u_t \end{pmatrix} \tag{13}$$

and

$$f_{a,t} \equiv \hat{\mathbb{E}}_t \sum_{T=t}^{\infty} (\alpha\beta)^{T-t} z_{T+1} \qquad f_{b,t} \equiv \hat{\mathbb{E}}_t \sum_{T=t}^{\infty} (\beta)^{T-t} z_{T+1} \tag{14}$$

◂ Return