Inflation Persistence, Noisy Information and the Phillips Curve

José-Elías Gallegos
IIES, Stockholm University

IIES

An Important Problem: theory does not explain data!

- A vast literature has documented that (i) US inflation persistence has fallen in recent decades, and (ii) that the Phillips curve has flattened in recent decades
- However, these empirical findings are difficult to explain in monetary models
- A change in firms' belief formation in the 1980s can help understand these challenges!
- Sluggishness in expectation responses to information until the 1980s, but not afterwards
  - Break coincides with a change in the US Federal Reserve's communication policy

(i) Explain fall in inflation persistence through a decrease in information frictions
- Change in firms' forecasting behavior explains 90% of the fall in inflation persistence: $\downarrow \rho$ in

$$\pi_t = \rho \pi_{t-1} + \varepsilon_t$$

(ii) Explain changes in Phillips curve through a decrease in information frictions
- Flattening implies that central bank actions are less effective in affecting inflation: $\downarrow \kappa$ in

$$\pi_t = \kappa \tilde{y}_t + \beta \mathbb{E}_t \pi_{t+1} \tag{1}$$

- Under noisy information, Phillips curve enlarged with anchoring and myopia

$$\pi_t = \omega_1 \pi_{t-1} + \omega_2 \kappa \tilde{y}_t + \omega_3 \beta \mathbb{E}_t \pi_{t+1} \tag{2}$$

- Explain changes in the Phillips curve dynamics through changes in beliefs: $\{\downarrow \omega_1, \uparrow \omega_3\}$
- Under *general* information structure, no evidence of a change in κ

Inflation Persistence: the first puzzle

- Literature documents changes in inflation dynamics over time: level, volatility, persistence,...
- Persistence: high persistence up until the mid-1980s, falling significantly since then (Cogley and Sbordone 2008; Cogley, Primiceri and Sargent 2010; Goldstein and Gorodnichenko 2020)
- Fall in inflation persistence not easily understood through the lens of monetary models: "inflation persistence puzzle" (Fuhrer 2010)
  - Structural shock persistence: stable (monetary, TFP, cost-push)
  - Optimal monetary policy: insufficient and unlikely
  - Change in trend inflation: insufficient
- Contribution: explain this fall through changes in expectations

Flattening in Phillips Curve: the second puzzle

- Literature arguing flattening of Phillips Curve, mixed results
- Flattening: inflation less affected by demand side (including interest rate)
- Benchmark NK: inflation path given by (1). Explain flattening: only $\downarrow \kappa$
- Contribution: show that κ has not changed, and explain the change in dynamics via expectations

Empirical Evidence on Sluggishness in Expectations

- Data: Survey of Professional Forecasters. Robust to Livingston Survey
- Firms' forecasts used to underreact to information before mid-1980s, not afterwards
- Forecast underreaction: positive co-movement between forecast errors and revisions

$$\text{forecast error}_t = \pi_{t+4,t} - \mathbb{F}_t \pi_{t+4,t}, \qquad \text{forecast revision}_t = \mathbb{F}_t \pi_{t+4,t} - \mathbb{F}_{t-1} \pi_{t+4,t}$$

- Consistent with noisy information models (forecast errors react to monetary shocks and disagreement does not)

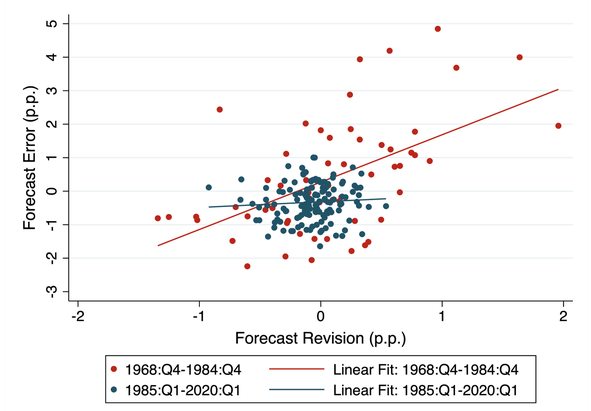

Table: forecast error$_t = \alpha + (\beta_{rev} + \beta_{rev,*} \times \mathbb{1}_{\{t \geq t^*\}})$ revision$_t + \epsilon_t^{rev}$

	Full Sample	1968:Q4-1984:Q4	1985:Q1-2020:Q1	Structural Break	
Revision	1.230***	1.414***	0.169	1.501***	1.414***
	(0.250)	(0.283)	(0.193)	(0.317)	(0.281)
Revision $\times \mathbb{1}_{\{t \geq t^*\}}$				-1.111***	-1.245***
				(0.379)	(0.341)
Constant	-0.0875	0.271	-0.317***	-0.135*	0.271
	(0.0696)	(0.185)	(0.0478)	(0.0690)	(0.184)
Constant $\times \mathbb{1}_{\{t \geq t^*\}}$					-0.587***
					(0.190)
Observations	197	58	139	197	197

Robust standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Theory

- New Keynesian model + noisy information
- Households and central bank are NK-standard
- Firms are subject to information frictions
  - Signal extraction problem: each firm j observes an imprecise signal x_{jt} on monetary shock

$$x_{jt} = shock_t + \sigma_u u_{jt}, \qquad \text{with } u_{jt} \sim \mathcal{N}(0,1)$$

  - Generates endogenous forecast underreaction: firms shrink forecasts towards prior beliefs
- Result: Forecast sluggishness $\beta_{\text{rev}} = \frac{\mathbb{C}(\text{forecast error}_t, \text{revision}_t)}{\mathbb{V}(\text{revision}_t)}$ increases in information frictions

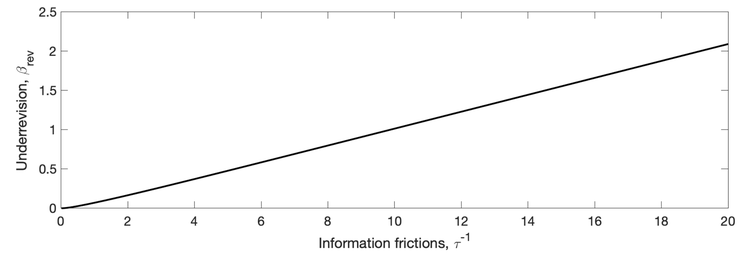

Fig. 3: Forecast sluggishnessβ_{rev} and information frictions $\tau^{-1} = \sigma_u^2$

Fall in Persistence Explained

- Inflation first order autocorrelation $\rho_1 = \frac{\mathbb{C}(\pi_t, \pi_{t-1})}{\mathbb{V}(\pi_t)}$ increases in forecast sluggishness β_{rev}

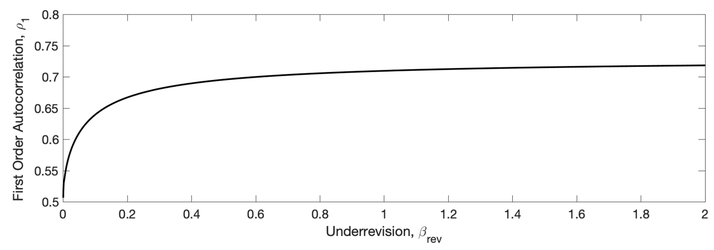

Fig. 4: Autocorrelation ρ_1 and forecast sluggishness β_{rev}

- Inflation depends on expectations $\implies$ persistent expectations increase inflation persistence

Table: First Order Autocorrelation ρ_1, Data vs. Model

	1968:Q4-1984:Q4	1985:Q1-2020:Q1
Data	0.757	0.497
Model	0.716	0.500

Flattening Phillips Curve Explained

- Empirical evidence: information frictions before mid-1980s, not afterwards
- Model implication:
  - Pre-1985, Phillips curve under information frictions (extended with anchoring and myopia: $(\omega_1, \omega_3) \in (0,1)^2$)

$$\pi_t = \omega_1 \pi_{t-1} + \omega_2 \kappa \tilde{y}_t + \omega_3 \beta \mathbb{E}_t \pi_{t+1}$$

  - Post-1985, Phillips curve under no information frictions post-1985: $\omega_1 = 0$, $\omega_2 = \omega_3 = 1$

$$\pi_t = \kappa \tilde{y}_t + \beta \mathbb{E}_t \pi_{t+1}$$

- Consistent with empirical evidence on the Phillips curve!

Table: Regression table

	Wedge Phillips Curve
π_{t-1}	0.720***
	(0.131)
$\pi_{t-1} \times \mathbb{1}_{\{t \geq t^*\}}$	-0.597**
	(0.232)
$\tilde{y}_t$	0.0566
	(0.0488)
$\tilde{y}_t \times \mathbb{1}_{\{t \geq t^*\}}$	-0.0143
	(0.0781)
π_{t+1}	0.273**
	(0.129)
$\pi_{t+1} \times \mathbb{1}_{\{t \geq t^*\}}$	0.643***
	(0.244)
Observations	202

HAC robust standard errors in parentheses
Instrument set: four lags of effective federal funds rate, CBO Output gap, GDP Deflator growth rate, Commodity inflation, M2 growth rate, spread between long and short-run interest rate and labor share.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Conclusion and Policy Implications

- A change in US firms' belief formation in the mid-1980s can explain two empirical challenges: (i) the fall in inflation persistence, and (ii) the "flattening" of the Phillips curve
- Document forecast underreaction before mid-1980s, not afterwards: positive co-movement between forecast errors and revisions
- Explain around 90% of fall in inflation persistence through changes in expectations: given that inflation is forward-looking (depends on expectations), forecast underreaction generates persistence in inflation
- Explain changing dynamics in Phillips curve through changes in expectations: reshuffle between backward and forward-lookingness
- Lessons for monetary policy:
  - Communication policy affects macro dynamics
  - Fed's actions have less memory - ideal for addressing temporary spikes in inflation!