Perceptions about Monetary Policy

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Monetary policy: the importance of perceptions

"Improving the public's understanding of the central bank's policy strategy reduces economic and financial uncertainty and helps households and firms make more-informed decisions." (Bernanke, 2010)

"Fundamentally, a central bank defines the monetary regime through the way in which it conditions markets to anticipate how its instrument will change in response to incoming information about the economy." (www.federalreservehistory.org)

- Effectiveness depends on public perceptions about monetary policy
- Important for anchoring, trade-offs, sacrifice ratio, sunspots, welfare, …
  (e.g., Blinder et al., 2008; Eusepi and Preston, 2010)

What is the perceived monetary policy rule?

- Monetary policy rules summarize policy framework and are used extensively in positive and normative analysis
- Estimates based on observed macro data show *historical* systematic conduct of monetary policy
- Open questions:
    - *What policy rule does the public think the Fed follows?*
    - Does it align with the Fed's actual rule?
    - How does it change? How are beliefs updated?
    - Can rule beliefs explain systematic forecast errors, bond risk premia, conundrum episodes, taper tantrum, ...?

This paper

Estimate perceived monetary policy rule from monthly panel of survey forecasts

- Blue Chip Financial Forecasts, monthly, horizon up to five quarters
  - Federal funds rate, inflation, real GDP growth
- Estimate simple policy rule with *time-varying parameters*
- Two different estimation approaches yield similar results:
  - Separate panel regressions for each survey
  - State-space model for policy rule and macro forecasts
- Validate and analyze estimated rules—with NK theory and data

Our findings

Time-varying perceived rule matters for monetary policy and financial markets

- Pronounced cyclical variation in perceived responsiveness to real activity, $\hat{\gamma}_t$
  - Low during easing cycle (policy changes quick and surprising)
  - High during tightening (policy changes gradual and expected)
- Perceived rule explains time-varying sensitivity of interest rates to macroeconomic news (Swanson and Williams, 2014)
- Forecasters learn gradually about rule from actual policy decisions (monetary policy surprises), update in rational direction
- Perceived rule explains systematic fed funds forecast errors (Cieslak, 2018)
- Bond risk premia: perceived rule, $\hat{\gamma}_t$, predicts excess bond returns, consistent with asset pricing logic
  - Possible explanation for lower term premium during conundrum period

Literature

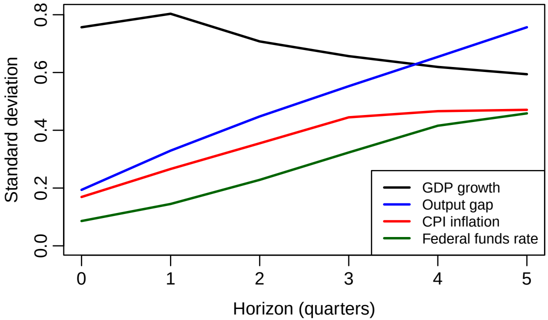
- **Monetary policy rules from time series and financial data:** Taylor (1993), Clarida, Gali, and Gertler (2000), Orphanides (2003), Hamilton, Pruitt and Borger (2011)
- **Constant monetary policy rule from macro surveys**: Carvalho and Nechio (2014), Andrade, Crump, Eusepi and Moench (2016), Kim and Pruitt (2017)
- **Macro sunspots and policy rules:** Clarida, Gali, and Gertler (1999), Clarida, Gali, and Gertler (2000), Eusepi and Preston (2010)
- **Monetary policy surprises and fed funds forecast errors:** Gürkaynak, Sack, Swanson (2005), Stein and Sunderam (2018), Cieslak (2018), Bauer and Swanson (2021, 2022)
- **Monetary policy and the term structure:** Ang and Piazzesi (2003), Ang et al. (2011), Campbell, Sunderam, Viceira (2017), Campbell, Pflueger, Viceira (2020), Bianchi, Lettau, Ludvigson (2022)

Data and estimation

Blue Chip Financial Forecasts (BCFF)

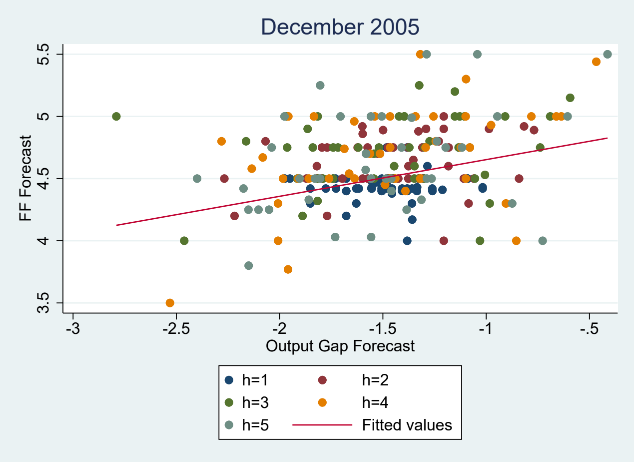
- Monthly survey of 30-50 professional forecasters
- Quarterly forecasts from current-quarter to five-quarter *horizons*
- Sample: we use 1992-2021 (starts in 1982, but no GDP forecasts)
- Forecasts of various interest rates: fed funds, Treasury yields, ...
- Forecasters also asked to provide *assumptions* used for interest rate forecasts, incl. CPI inflation and real GDP growth
- We impute *output gap* forecasts, using
  - Real-time GDP and implied GDP level forecasts
  - Real-time CBO potential output projections
- Robustness: very similar results using SPF and unemployment forecasts

Term structure of disagreement



- Substantial disagreement
- Term structure of disagreement supports classic output gap rule

Snapshot: forecasts in December 2005 BCFF survey



$$\hat{\gamma}^{FE}_{Dec2005} = 0.48$$

Policy rule for interest rate forecasts

- Simple monetary policy rule with time-varying coefficients:

$$i_t = r_t^* + \pi_t^* + \beta_t(\pi_t - \pi_t^*) + \gamma_t x_t + u_t$$

  - Adding (constant degree of) policy inertia is just a level shift for β_t and γ_t

- Rule for forecasts:

$$E_t^{(j)} i_{t+h} = \alpha_t^{(j)} + \hat{\beta}_t E_t^{(j)} \pi_{t+h} + \hat{\gamma}_t E_t^{(j)} x_{t+h} + e_{th}^{(j)}$$

  - Forecaster-specific intercept: $\alpha_t^{(j)} = E_t^{(j)} r_t^* + (1 - \beta_t) E_t^{(j)} \pi_t^*$
  - Error term: $e_{th}^{(j)} = E_t^{(j)} u_{t+h} +$ meas. error

- Forecasters disagree over output, inflation, trends and policy shocks

- Assume forecasters agree on coefficients $\hat{\beta}_t$ and $\hat{\gamma}_t$
  - If they disagree, we estimate the cross-sectional average coefficient (under certain conditions)

Policy rule coefficients: the Fed, the public, and estimation bias

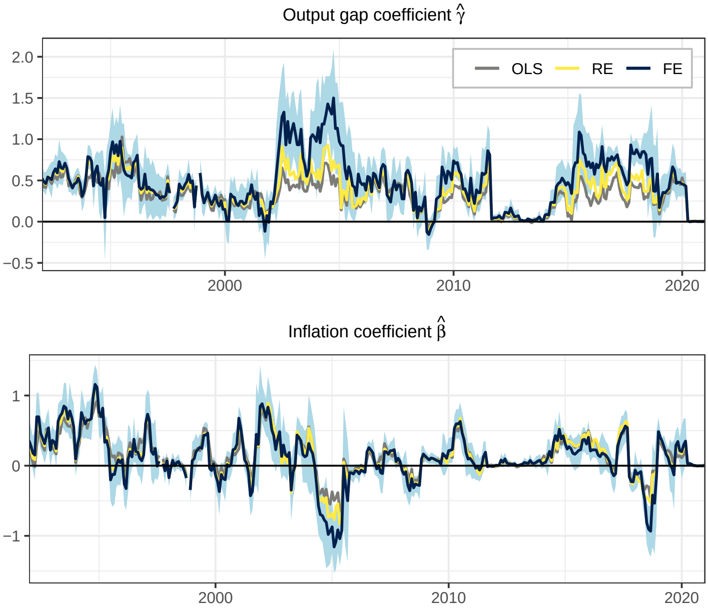
1. True monetary policy rule followed by the Fed: β and γ
2. Perceived monetary policy rule: $\hat{\beta}$ and $\hat{\gamma}$
   - This is what we are primarily interested in
3. Estimated monetary policy rule: $\tilde{\beta}$ and $\tilde{\gamma}$
   - May differ from $\hat{\beta}$ and $\hat{\gamma}$ due to estimation bias (CGG 1999) or even lack of identification (Cochrane, 2011)
   - Sims (2008): identification problem arises only in special case of NK model
   - Carvalho, Nechio, Tristao (2021) and our own calculations suggest that endogeneity bias likely small

Estimation via panel regressions

$$E_t^{(j)} i_{t+h} = \alpha_t^{(j)} + \hat{\beta}_t E_t^{(j)} \pi_{t+h} + \hat{\gamma}_t E_t^{(j)} x_{t+h} + e_{th}^{(j)}$$

- Each month t estimate panel regression
- Error term is $\alpha_t^{(j)} + e_{th}^{(j)}$
  - Includes disagreement about long-run inflation and real rate
- Three different sets of estimates
  - Pooled OLS
  - Forecaster FE
  - Forecaster RE

Results for panel regressions

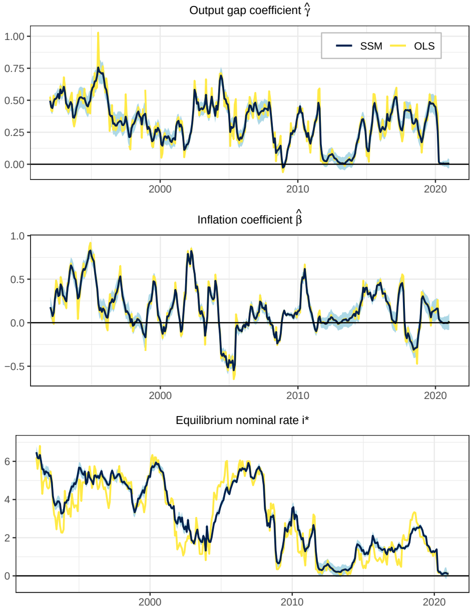


Estimation via state-space model

$$E_t^{(j)} i_{t+h} = i_t^* + \hat{\beta}_t \left(E_t^{(j)} \pi_{t+h} - \pi^* \right) + \hat{\gamma}_t E_t^{(j)} x_{t+h} + e_{th}^{(j)}$$

- Improve precision by linking surveys from month t and $t+1$
- Additional structure:
  - No disagreement and constant π^* (otherwise non-linear SSM)
  - Independent random walks for i_t^*, $\hat{\beta}_t$, and $\hat{\gamma}_t$
  - Measurement errors $e_{th}^{(j)}$ assumed *iid*, uncorrelated across h and j (corresponds to Pooled OLS assumptions)
  - Future work: relax assumptions about $e_{th}^{(j)}$, censoring at ZLB
- Bayesian estimation with MCMC and diffuse prior

Results for state-space model



Cyclical shifts in perceived policy rule

$$\hat{\gamma}_t = b_0 + b_1 Slope_t + b_2 y_t^{(1y)} + b_3 Unemp_t + \varepsilon_t$$

	Panel FE $\hat{\gamma}$			State-Space Model $\hat{\gamma}$		
	(1)	(2)	(3)	(4)	(5)	(6)
Slope	0.08***	0.10***	0.16***	0.02	0.06***	0.08***
	(2.60)	(2.93)	(3.91)	(1.18)	(3.49)	(4.20)
1-Year Yield		0.07	-0.02		0.15***	0.12***
		(1.36)	(-0.39)		(5.16)	(3.95)
Unemployment			-0.17***			-0.05***
			(-4.47)			(-3.04)
Constant	0.47***	0.51***	0.45***	0.32***	0.41***	0.39***
	(14.44)	(14.03)	(11.91)	(16.43)	(17.32)	(14.66)
Observations	349	349	347	349	349	347
R^2	0.09	0.09	0.22	0.03	0.20	0.27

Perceived responsiveness to output gap is lower when (i) short-term yield low, (ii) slope of the yield curve low, and (iii) unemployment high

Timing matters

Quick, surprising rate cuts but gradual, predictable tightening

- Fed cuts quickly at beginning of easing cycles
  - No further action anticipated for a while and $\hat{\gamma}$ falls
  - "*Front-loaded easing policy*" (FOMC minutes, January 29-30, 2001)
  - "*Investors and analysts do not expect the Fed to be as fast in cutting rates in the months ahead.*" (NYTimes, January 31, 2001)
- As economy starts to recover, Fed aims to gradually, predictably tighten according to incoming data
  - "Data-dependent" (Bernanke, FOMC press conference, December 2013)
  - "policy will depend on [. . .] incoming data" (Yellen, speech December 2, 2015)
  - "Data-dependent" (Powell, speech October 8, 2019)

Sensitivity of interest rates to macroeconomic news

Shifts in the sensitivity of interest rates to macro news

- Large macro-finance literature estimates impact of macroeconomic news on financial markets using high-frequency event studies:

$$\Delta y_t = b_0 + b_1 s_t + \varepsilon$$

  - Δy_t high-frequency change around macro data release
  - s_t surprise component, e.g., non-farm payroll employment relative to consensus expectation prior to announcement

- Swanson and Williams (2014) estimate shifts in sensitivity b_1
  - Zero lower bound makes short-term yields unresponsive
  - Use linear combination of *all macro news*, Z_t, and rolling regressions

- Interest rate sensitivity should be determined by perceived responsiveness of monetary policy to macroeconomy!

High-frequency event study regressions for macroeconomic news

$$\Delta y_t = b_0 + b_1 \hat{\gamma}_t + b_2 Z_t + b_3 \hat{\gamma}_t Z_t + \varepsilon_t$$

	3m FF fut.	6m FF fut.	2y yield	10y yield
$\hat{\gamma}^{SSM}$	0.7*	0.6	-0.04	-0.5
	(1.83)	(1.26)	(-0.07)	(-0.76)
Z	0.1	0.3**	0.4***	0.6***
	(0.72)	(2.04)	(2.73)	(3.75)
$\hat{\gamma}^{SSM} \times Z$	1.9***	2.1***	1.6***	1.0**
	(3.83)	(5.33)	(4.62)	(2.36)
Constant	-0.2	-0.2	0.04	0.2
	(-1.54)	(-1.13)	(0.18)	(0.75)
Observations	3155	3155	3155	3155
R^2	0.08	0.13	0.13	0.08

Interpreting event study regressions

$$\left(E_t - E_{t-}\right) i_{t+1} = b_0 + b_1 \tilde{\gamma}_t + b_2 Z_t + b_3 \tilde{\gamma}_t Z_t + \varepsilon_t.$$

- Assumptions:
  - Macro news provides information about $E_t x_{t+1}$
  - But not about policy rule or shock (following Swanson and Williams, 2014)

$$Z_t \propto (E_t - E_{t-}) x_{t+1}$$

- Interest rate response, based on perceived policy rule and simple NK model:

$$(E_t - E_{t-}) i_{t+1} = \frac{\hat{\gamma}_t}{\bar{\gamma}} Z_t$$

  - $\bar{\gamma}$ is time-series average of perceived coefficient $\hat{\gamma}_t$

Interpreting event study regressions

$$(E_t - E_{t-})\, i_{t+1} = b_0 + b_1\tilde{\gamma}_t + b_2 Z_t + b_3\tilde{\gamma}_t Z_t + \varepsilon_t \quad \text{and} \quad (E_t - E_{t-}) i_{t+1} = \frac{\hat{\gamma}_t}{\bar{\gamma}} Z_t$$

- We don't know perceived $\hat{\gamma}_t$, estimate may have bias and error:

$$\tilde{\gamma}_t = \hat{\gamma}_t + \mu + e_t$$

  - μ is constant bias, e_t is (uncorrelated) estimation noise

- Predictions for estimated coefficients:

$$b_2 = -\frac{\mu}{\bar{\gamma}}\rho^2 + 1 - \rho^2 \quad \text{and} \quad b_3 = \frac{\rho^2}{\bar{\gamma}}, \quad \rho = Corr(\hat{\gamma}_t, \tilde{\gamma}_t)$$

- For classic Taylor rule $\bar{\gamma} = 0.5$ and no bias/noise:

$$b_2 = 0 \quad \text{and} \quad b_3 = 2$$

Take-aways: macro news event studies and estimation bias

- Changes in perceived rule capture shifts in interest rate sensitivity
- Validation of our $\hat{\gamma}_t$ estimates as perceived policy coefficient
- Model-based interpretation of suggests limited estimation bias and error
  - SSM estimate γ_t tracks time-variation in perceived $\hat{\gamma}_t$ well, small downward bias (leaves time-variation unaffected)
  - Panel regression estimate of $\hat{\gamma}_t$ somewhat noisier
- Additional analysis with NK model also suggests that bias in regression estimates of policy rule is likely to be small
  - Carvalho, Nechio and Tristao (2021) argue OLS estimation of policy rules is fine
  - Relative importance of monetary policy shocks, and thus endogeneity bias, likely small (Ramey, 2016)

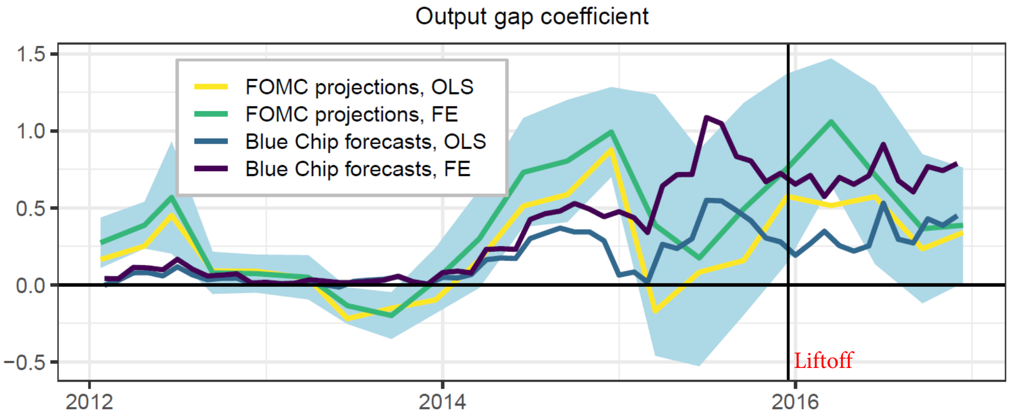
$\Rightarrow$ Can use new estimates to study how $\hat{\gamma}_t$ varies over time

Updating of policy rule beliefs

Comparison to the Fed's own policy rule

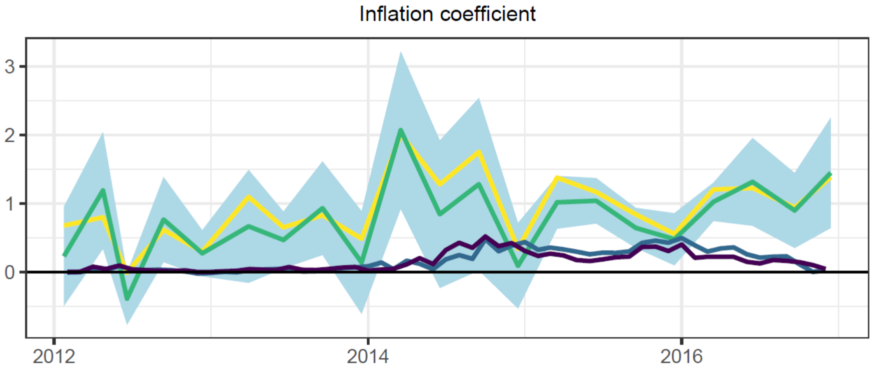
- How do beliefs about policy rule respond to shifts in the *actual* policy rule?
- Some tentative evidence from comparison to rule estimated from Summary of Economic Projections (SEP)
  - Individual SEP projections for FOMC participants available for 2012–2016
  - Use projections for fed funds rate, real GDP growth (impure output gap), and core PCE
  - Use year-end projections for current and next year
- Use exact same panel regression methodology to estimate Fed's rule coefficients β_t and γ_t
- Case study around first liftoff (Dec 2015): 2012-2016

BCFF vs. SEP policy rule: output gap coefficient



- Around liftoff from ZLB, BCFF perceived output gap coefficient tracks Fed's own coefficient *with a lag*

BCFF vs. SEP policy rule: inflation coefficient



- More action in SEP forecasts for inflation forecasts
- Possible explanations:
  - Blue Chip uses CPI (including noncore) while FOMC forecasts use core PCE
  - In our sample, inflation fluctuations were almost entirely transitory

Do forecasters rationally update their beliefs about the policy rule?

- When monetary policy is *more responsive* to economic conditions than anticipated, rational forecasters should update $\hat{\gamma}$ upwards (and vice versa)
- Measure *monetary policy surprises* using high-frequency changes in market rates around FOMC announcements
- Predictions of rational updating:
  - Surprise tightening in strong economy $\Rightarrow \hat{\gamma}$ increases
    - Fed is proactive in preventing economy from overheating
  - Surprise tightening in weak economy $\Rightarrow \hat{\gamma}$ decreases.
    - Fed does not sufficiently support a struggling economy
- See simple learning models in Bauer and Swanson (2021, 2022)

Local projections to estimate updating of policy rule beliefs

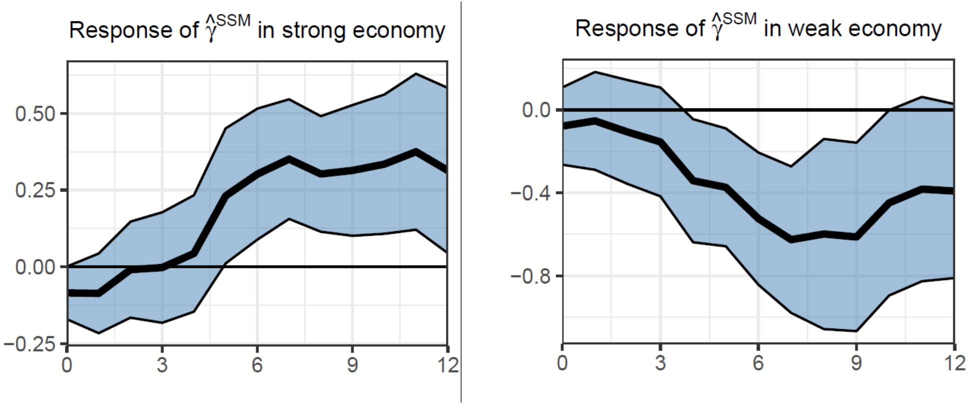
State-dependent local projections with identified shocks (Ramey and Zubairy, 2018)

$$\hat{\gamma}_{t+h} = a^{(h)} + b_1^{(h)} mps_t \times (1 - weak_t) + b_2^{(h)} mps_t \times weak_t + c^{(h)} weak_t + d^{(h)} \hat{\gamma}_{t-1} + \varepsilon_{t+h}$$

- mps_t monthly series of high-frequency monetary policy surprise (Nakamura and Steinsson, 2018)
- $weak_t$ indicator for weak economy: when output gap is below median
- Prediction for state-dependent impulse responses:

  $\Rightarrow \quad b_1^{(h)}$ positive and $b_2^{(h)}$ negative

Local projection estimates of state-dependent impulse responses



- Sizeable response to monetary policy surprises
- Gradual and in the direction predicted by rational learning

Fed funds rate forecast errors

Fed funds rate forecast errors are predictable

- Consider $i_{t+h} - E_t i_{t+h}$ based on survey forecasts for fed funds rate
- Under Full Information Rational Expectations (FIRE), these forecast errors should be unpredictable based on information at t (e.g., Coibion and Gorodnichenko, 2015)
  - FIRE also implies $\gamma_t = \hat{\gamma}_t$
- Cieslak (2018) and others document strong predictability of fed funds forecast errors using cyclical variables
- Potential explanation: misperceptions about monetary policy (see also Bauer and Swanson, 2021, 2022; Schmeling et al., 2021)
- Does predictability vary with perceived responsiveness of monetary policy?

Decomposition of fed funds forecast errors

- Use simple version of policy rule:

$$i_t = \gamma_t x_t + u_t$$

- Policy rate expectations are based on perceived rule:

$$E_t i_{t+h} = \hat{\gamma}_t E_t x_{t+h} + E_t \varepsilon_{t+h}$$

- Forecast error has three components:

$$i_{t+h} - E_t i_{t+h} = (\gamma_{t+h} - \hat{\gamma}_t) x_{t+h} + \hat{\gamma}_t (x_{t+h} - E_t x_{t+h}) + u_{t+h} - E_t \varepsilon_{t+h}$$

1. Actual rule may deviate from perceived rule
2. Macroeconomic forecast errors
3. (Unexpected) Monetary policy shocks

Predictive regressions for fed funds forecast errors

			Panel FE $\hat{\gamma}$		SSM $\hat{\gamma}$	
	$q = 2$	$q = 4$	$q = 2$	$q = 4$	$q = 2$	$q = 4$
$CFNAI_t$	0.32***	0.66**	0.57***	1.12***	0.70***	1.26***
	(2.90)	(2.31)	(5.45)	(5.15)	(6.39)	(5.87)
i_t	-0.10***	-0.17**	-0.10***	-0.17**	-0.11***	-0.18**
	(-3.08)	(-2.20)	(-3.49)	(-2.39)	(-3.49)	(-2.37)
$\hat{\gamma}_t$			-0.05	-0.11	-0.06	-0.08
			(-1.28)	(-1.55)	(-1.14)	(-0.67)
$\hat{\gamma}_t \times CFNAI_t$			0.25***	0.48***	0.33***	0.60***
			(4.46)	(5.33)	(5.88)	(5.20)
N	114	112	114	112	114	112
R^2	0.26	0.24	0.37	0.35	0.46	0.39

Predictability of fed funds forecast errors

$$i_{t+h} - E_t i_{t+h} = (\gamma_{t+h} - \hat{\gamma}_t)x_{t+h} + \hat{\gamma}_t(x_{t+h} - E_t x_{t+h}) + u_{t+h} - E_t \varepsilon_{t+h}$$

- Predictability of policy rate forecasts errors varies over time
- Predictability most pronounced when perceived responsiveness of monetary policy is high
- Some additional evidence that first component – misperceptions of policy – drive predictability
  - *CFNAI* predicts output gap but not output gap forecast error
  - $\hat{\gamma} \times$ *CFNAI* predicts realized fe dfunds rate more strongly than forecasts
- Forecast errors arise mainly because policy rule is not fully known by the public

Risk premia in long-term bonds

Comovement and bond risk premia

- Asset pricing 101: investors require additional return for high-beta assets
  - More risky if asset payoffs more strongly correlated with consumption growth/market return/economic conditions
  - Better hedge if more negatively correlated
- (Perceived) Treasury bond beta negatively related to γ

  Higher γ, Fed more responsive

  $\Rightarrow$ Rates fall/bond prices rise (more) in bad times

  $\Rightarrow$ Bonds less risky (or even hedge), lower bond risk premium
- Implies that $\hat{\gamma}_t$ predicts excess returns on Treasury bonds with *negative sign*

Perceived monetary policy rule and bond risk premia

	$xr^{(5y)}_{t\to t+12}$			$xr^{(5y)}_{t\to t+24}$		
$\hat{\gamma}$	-0.84*	-0.66	-0.84*	-1.69***	-1.35**	-1.51***
	(-1.84)	(-1.38)	(-1.94)	(-3.17)	(-2.58)	(-3.19)
CFNAI		-0.99	-2.58***		-1.65*	-3.26***
		(-1.16)	(-2.82)		(-1.93)	(-3.43)
$\hat{\gamma} \times$ *CFNAI*			-1.61***			-1.59***
			(-2.94)			(-2.73)
Const.	3.17***	3.15***	3.55***	4.48***	4.43***	4.81***
	(4.22)	(4.45)	(5.42)	(5.01)	(5.97)	(6.57)
N	337	337	337	325	325	325
R^2	0.15	0.17	0.21	0.18	0.23	0.28

- Dependent variable: excess return on five-year Treasury bond
- Controls always include three principal components of yields

$\Rightarrow$ $\hat{\gamma}_t$ strongly predicts bond returns (SSM estimate here, similar for FE)

A new explanation for conundrum episodes?

- Monetary policy surprise $\Rightarrow$ Perceived policy rule
  - Conditional on strong economy, *10bp monetary policy surprise* leads to 0.15 SD increase in $\hat{\gamma}$ (SSM) after 6-12 months
- Perceived policy rule $\Rightarrow$ Term premium
  - 0.15 SD increase in $\hat{\gamma}$ (SSM) predicts 23bp lower excess returns over 24 months
  - Assume conservatively that expected excess returns 3-5 years are unaffected
  - Implies *5bp lower term premium* in five-year yield
- In a strong economy, a *positive* monetary policy surprise could lead to a *decline* in long-term term rates
- Potential explanation for lower term premium and lower yields during conundrum period (Backus and Wright, 2007)

Conclusion

- New methodology to estimate time-varying *perceived* monetary policy rule
- Document substantial cyclical variation in rule's output gap coefficient, consistent with theoretical predictions
- Learning about the rule can decouple long rates from short rate via risk premia
- Shifts in rule capture monetary policy surprises and forward guidance
- *What's next*: generalize SSM specification; time-varying policy inertia; tighter connection to Cieslak's evidence on predictable forecast errors

Appendix Slides

Simple New Keynesian Framework

- **Euler Equation:** $x_t = E_t x_{t+1} - (i_t - E_t \pi_{t+1}) + v_t$
- **Phillips Curve:** $\pi_t = E_t \pi_{t+1} + \kappa x_t$
- **Monetary Policy Rule:** $i_t = \beta \pi_t + \gamma x_t + u_t$
- Simplify to perfectly sticky prices, i.e. $\kappa = 0$ (Cabellero and Simsek (2021))
- If shocks uncorrelated and *iid*, time series regression coefficient is

$$\tilde{\gamma}^{TS} = \frac{Cov\left(i_t, x_t\right)}{Var\left(x_t\right)} = \gamma - \frac{1}{1+\gamma} \frac{Var\left(u_t\right)}{Var\left(x_t\right)}$$

  - Suggests small bias if $Var(u_t) << Var(x_t)$ (Ramey, 2016)

Estimation bias in panel regressions

- Panel regression coefficient:

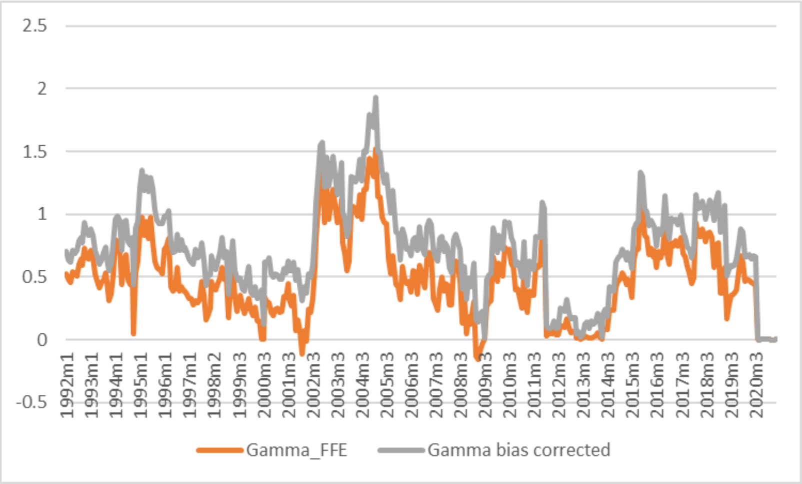
$$\tilde{\gamma}^{Panel} \equiv \frac{Cov_t\left(E_t^{(j)} i_{t+h}, E_t^{(j)} x_{t+h}\right)}{Var_t\left(E_t^{(j)} x_{t+h}\right)}$$

- Assume expected shocks uncorrelated across forecasters and horizons
- To first-order estimation bias equals

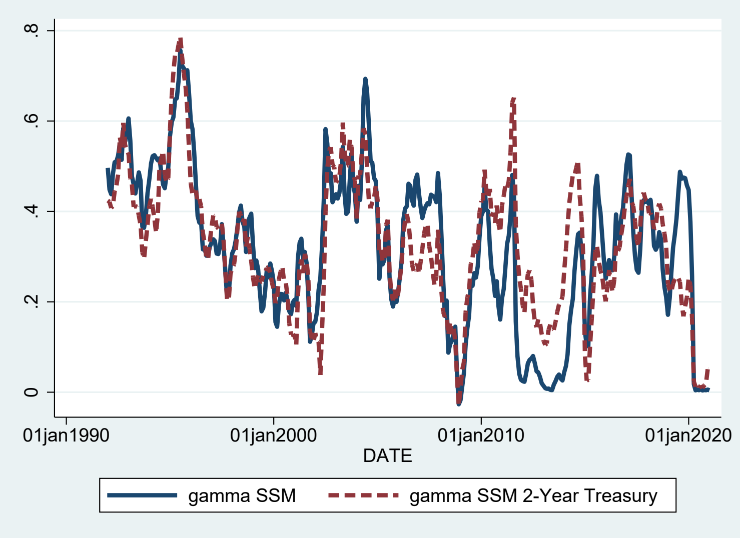
$$\tilde{\gamma}^{Panel} - \hat{\gamma} = -\frac{1}{1+\tilde{\gamma}_t^{Panel}} \frac{Var_t\left(E_t^{(j)} \bar{u}_{t+h}\right)}{Var_t\left(E_t^{(j)} x_{t+h}\right)}$$

- Bias depends on ratio of monetary policy shock variance to output gap variance

Baseline and Bias-Corrected Estimates Track Each Other



Monetary policy rule for two-year yield



Predicting fed funds forecast errors: alternative specification

	Dependent Variable: 4-Quarter Fed Funds Forecast Error		
		Panel FE $\hat{\gamma}^{FE}$	State-Space Model $\hat{\gamma}^{SSM}$
$\hat{E}_t x_{t+4}$	-0.03	-0.12	-0.20
	(-0.41)	(-1.25)	(-1.54)
$\hat{\gamma}_t$		0.27*	0.67*
		(1.80)	(2.19)
$\hat{\gamma}_t \times \hat{E}_t x_{t+4}$		0.27*	0.67**
		(1.80)	(2.19)
Const.	-0.61**	-1.05**	-1.21*
	(-2.26)	(-2.07)	(-1.81)
N	112	112	112
R-sq	0.00	0.05	0.05