Monetary Communication Rules*

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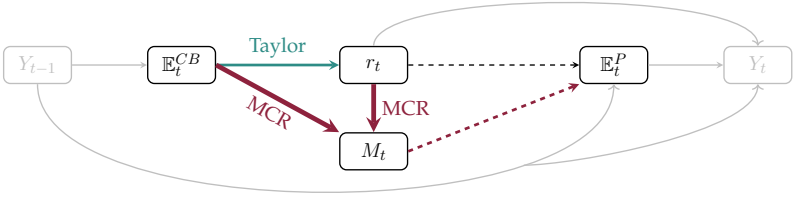
*The views expressed herein are our own and do not necessarily reflect those of the ECB or the Eurosystem.

Motivation

- Monetary economics: interest rate determined by policy rule
  - Systematic mapping between macroeconomic variables and interest rate
  - "'Policy rule' was replaced by 'systematic policy,'... 'methodical, according to a plan, and not casually or at random."' (Taylor, 1993)
- We propose thinking about *communication* with a systematic rule
  - Is there evidence of systematic communication from the Fed?
  - What internal information is systematically communicated?
  - How does this affect investor reactions to announcements?



This Paper

1. Estimate monetary communication rule (MCR) as a correspondence
   - FOMC post-meeting announcements, decided by FOMC vote
   - Target rate, assets, Fed forecasts (inflation, output, unemployment)

2. Find strong evidence of systematic communication, with a break in 2008
   - Pre: communicate policy rate / Post: also communicate forecasts
   - System of equations is jointly significant (F-stat), and R^2 of 30-40%

3. Find magnitude of *investor surprises* depends on systematic MCR
   - Post-break: larger investor reactions to systematic language and MCR *deviations*
   - More systematic $\rightarrow$ better signal $\rightarrow$ increase investor attention

     $\hookrightarrow$ When communication is a stronger tool, greater consequences to miscommunication

Related Literature

- **Text Analysis of Communication**
  - Baker, Bloom and Davis (2016); Baker, Bloom, Davis and Renault (2021); Calomiris, Harris, Mamaysky and Tessari (2022); Campbell, Evans, Fisher and Justiniano (2012); Cieslak, Hansen, McMahon and Xiao (2021); Doh, Song and Yang (2022b); Ehrmann and Fratzscher (2005, 2007); Ericsson (2017, 2016); Gardner, Scotti and Vega (2021); Gentzkow, Kelly and Taddy (2019); Handlan (2020); Hansen, McMahon and Prat (2018); Hassan, Hollander, van Lent and Tahoun (2019); Husted, Rogers and Sun (2020); Liang, Meursault, Routledge and Scanlon (2022); Shapiro and Wilson (2021); and others...
  - **This paper:** focuses on systematic aspects of central bank communication
- **Theory of Public Communication**
  - Angeletos and La'O (2013); Angeletos and Lian (2018); Angeletos and Pavan (2007); Bassetto (2019); Caballero and Simsek (2022); Crawford and Sobel (1982); Doh, Gruber and Song (2022a); Farmer, Nakamura and Steinsson (2023); Gáti (2023); Herbert (2022); Kydland and Prescott (1977); Morris and Shin (2002); Moscarini (2007); Ou, Zhang and Zhang (2022); and others...
  - **This paper**: framework for systematic communication rule for data

Presentation Outline

1. Intro
2. Monetary Communication Rules
3. The Big Shift
4. Reactions to Communication
5. Conclusion

Monetary Communication Rule Definition

Definition (*Monetary Communication Rule*)

The Fed's communication rule is the mapping $\mathcal{F} : \mathbb{R}^n \to \mathbb{R}^J$, such that in each period t, the Fed communicates the following information

$$M_t = \mathcal{F}(Y_t),$$

where M_t is the vector encoding the announcement language at meeting t that is in $\mathbb{R}^J$, and Y_t is the vector of n variables in the information set at time t, including macro forecast variables and policy instruments variables.

Data

- **Communication Text** (ΔM_t):
  - FOMC statements (FRB, 1999-2019) Example
  - Encoded with distilRoBERTa + PCA (more next slide)
- **Policy and Forecast variables** (ΔY_t)
  - **Realized policy variables** (FRB, 1999-2019)
    - Change in FFR target (Δffr)
    - Change in Fed total assets ($\Delta total\ assets$)
  - **Internal Forecasts:** Greenbook/Tealbook (FRB, 1999-2019)
    - Real GDP growth, unemployment, and core inflation ($\Delta y^q, \Delta u^q, \Delta \pi^q$)
    - Change in next quarter and next year forecasts
    - Change in FRB Financial Conditions Index (adjusted) ($\Delta ANFCI$)

Text Representation

Text Dimensions

Statements	t	m_1	m_2	$\cdots$	m_J
	1	#	#	$\cdots$	#
	2	#	#	$\cdots$	#
	$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$

- **Large-language model (BERT)** Representation
  - Minimal text cleaning: remove numbers and dates
  - Encode statement string with BERT model (distilRoBERTa)
  - Dense space that encodes word order and "context" of statement as vector
  - 768 dimension vector $\rightarrow$ 10 components $\approx$ 75% variation
- First-differences: $\Delta m_{j,t} = m_{j,t} - m_{j,t-1}$

PCA Graph

Regression Specification (1/2)

- Assumptions:
  - A1. Message is approximated well by the text representation $M_t = \{m_j\}_1^{10}$
    $\hookrightarrow$ We apply PCA $\rightarrow$ orthogonal m_j
  - A2. Linearity of the communication rule, F
- We can represent the communication rule by each text dimension, j

$$\Delta m_{1,t} = f_1(\Delta Y_t) + \varepsilon_1$$
$$\vdots$$
$$\Delta m_{J,t} = f_J(\Delta Y_t) + \varepsilon_J,$$

Where $\Delta Y_t = [\Delta ffr_t, \Delta total\ assets_t, \Delta ANFCI_t, \{\Delta g_t^1, \Delta g_t^4\}_{g \in \{\pi, y, u\}}]$

Accounting for Time Series

- Variables are non-stationary and cointegrated

1. Estimate an error correction model
2. Standardize and orthogonalize first-differenced regressors

Accounting for Time Series

- Variables are non-stationary and cointegrated

1. Estimate an error correction model
   - Estimate error correction term:

$$\begin{aligned} m_{j,t} =& \alpha_j + \beta_{j,1} ffr_t + \beta_{j,2} total\ assets_t + \beta_{j,3} ANFCI_t \\ &+ \sum_{g \in GB} \gamma_{g,j,1} g_t^1 + \gamma_{g,j,2} g_t^4 + \varepsilon_{j,t} \\ ECT_{j,t} \equiv& m_{j,t} - \hat{m}_{j,t} \end{aligned}$$

   - Estimate regression that uses first-differences and the ECT (next slide)
2. Standardize and orthogonalize first-differenced regressors

Accounting for Time Series

- Variables are non-stationary and cointegrated

1. Estimate an error correction model
2. Standardize and orthogonalize first-differenced regressors
   - Δg^4_ϵ: residual change in g^4 not corr. with g^1 revision for $g \in GB \equiv \{\pi, y, u\}$
   - Δffr_ϵ: residual change in ffr not corr. with forecasts

$$\Delta ffr_t = \beta_1 \Delta ANFCI_t + \sum_{g \in GB} \gamma_{g,1} \Delta g^1_t + \gamma_{g,2} \Delta g^4_{\epsilon,t} + \varepsilon_t$$

   - Δ total assets$_\epsilon$: residual change in assets not correlated with forecasts or ffr

$$\Delta total\ assets_t = \beta_1 \Delta ANFCI_t + \beta_2 \Delta ffr_{\epsilon,t} + \sum_{g \in GB} \gamma_{g,1} \Delta g^1_t + \gamma_{g,2} \Delta g^4_{\epsilon,t} + \varepsilon_t$$

Regression Specification (2/2)

- We estimate the following ECM specification for each j:

$$\Delta m_{j,t} = +\beta_{j,1}\Delta ffr_{\epsilon,t} + \beta_{j,2}\Delta total\ assets_{\epsilon,t} + \beta_{j,3}\Delta ANFCI_t + \sum_{g \in GB} \gamma_{g,j,1}\Delta g^1_t + \gamma_{g,j,2}\Delta g^4_{\epsilon,t} + \phi_j ECT_{j,t-1} + \varepsilon_{j,t}$$

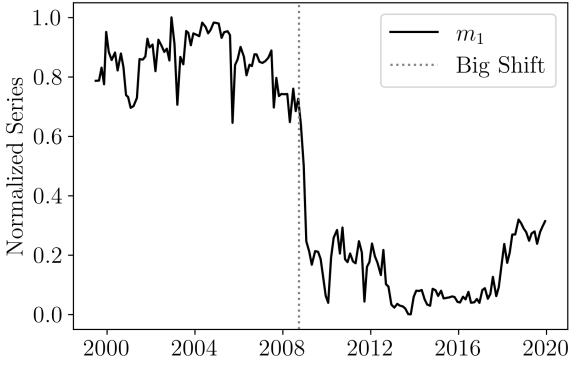
  where $GB = \{\pi, y, u\}$

- Baseline: HAC standard errors with small sample correction
- Evaluate system of ECM regressions: overall and partial F tests and R^2
- But first, graph the series and check for breaks

The Big Shift in Communication

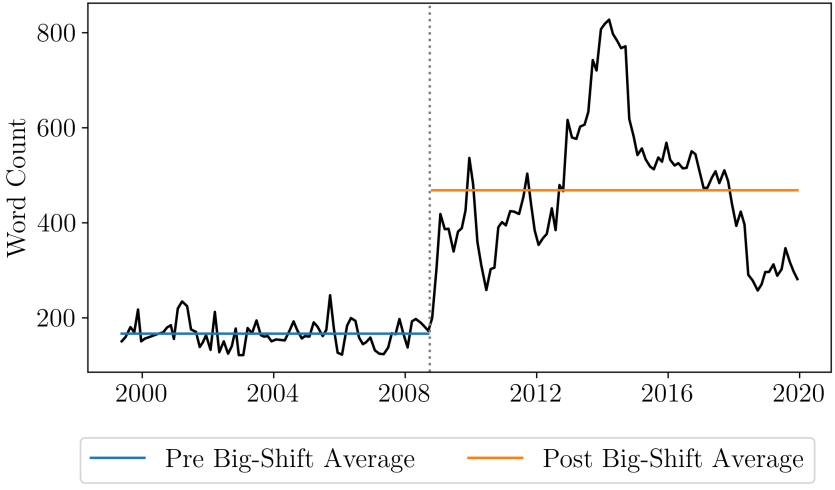
The First Text Component and the Big Shift

- The first PC, m_1, is dimension that captures the largest variation in FOMC statements over the sample



Others 1 Others 2

FOMC Statement Length



Structural Break Test

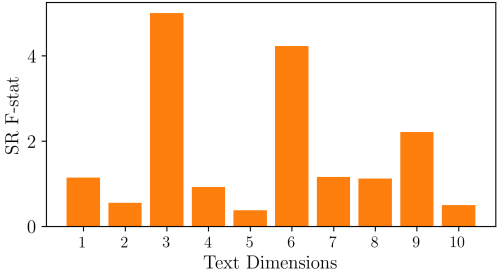
	Big Shift
# of Δm_j breaks	8 of 10
Chow Test p-value (PC weights)	0.006
N Pre/Post	75/90
Break Date	Oct-2008
Likely Break?	Yes

Notes: Break significance p<0.1. P-values aggregated with weighted Z-test method with PCA weights.

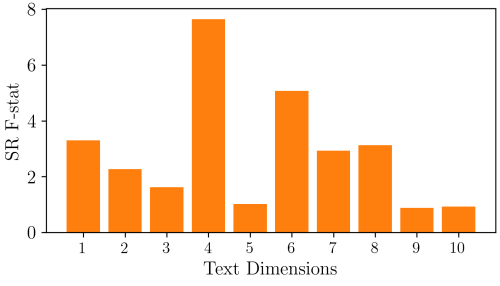
Statistical Significance of Short-Run Fluctuations

- Post-2008 more systematic response to fluctuations ΔY_t
- More j-components sig. models for short-run changes (non-ECT)

(a) **Pre**-2008 F-stat



(b) **Post**-2008 F-stat



- With the ECT term, all Δm_j models are stat. significant

w/ECT

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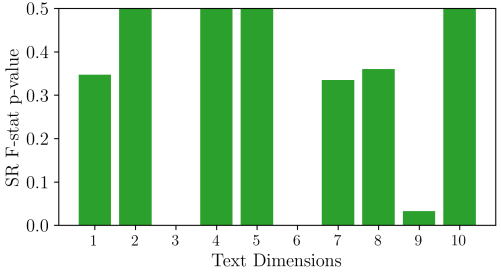
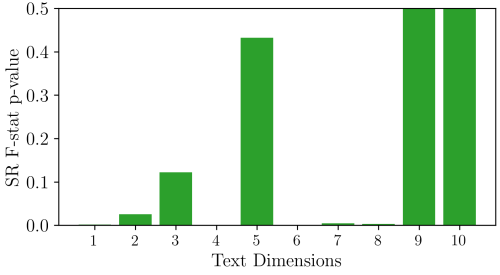


(b) **Post**-2008 F-stat pvalue



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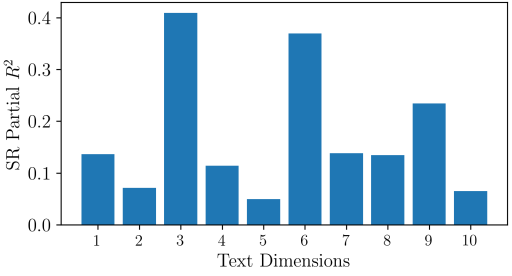
w/ECT

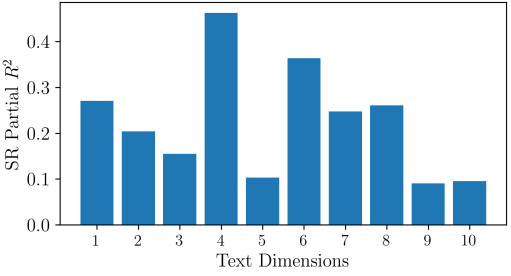
R^2 Pre/Post models

- Consider Partial R^2 for ΔY_t (non-ECT) w/ECT

(a) **Pre**-2008 R^2



(b) **Post**-2008 R^2

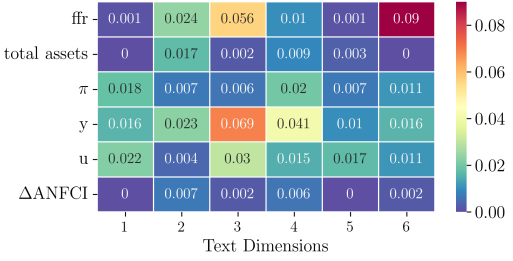


- Overall, Post-2008 overall more systematic with ΔY_t

Pre/Post Drivers

- We can see different shifts in the drivers of the first size components
  - **Pre**: target rate and unemployment forecast
  - **Post**: real forecasts and financial condition index

(a) **Pre**-2008 Partial R^2



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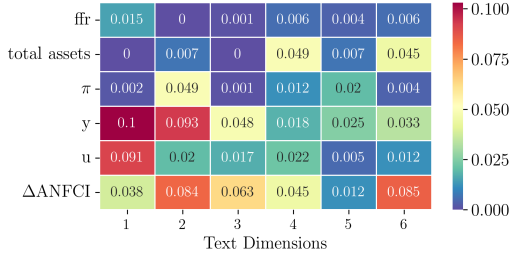


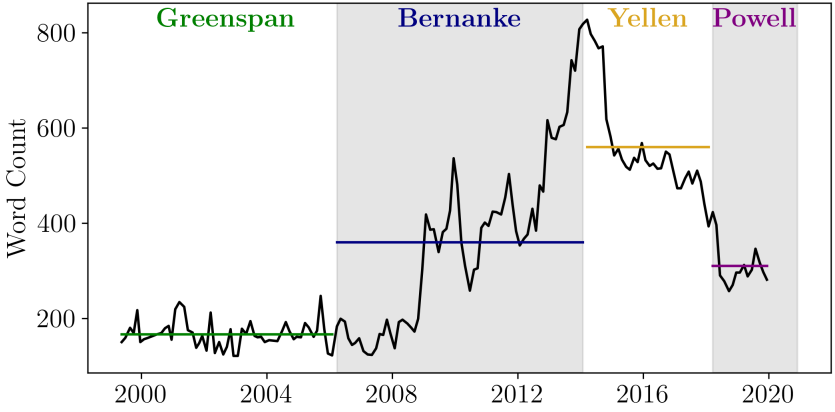
Other Breaks?

- Consider breaks with introduction of new chairs and the dot plot

	Big Shift	Gsp/Bern	Bern/Y+P	Dot Plot
# of Δm_j breaks	8/10	7/10	2/10	1/10
Chow Test p-value	0.006	0.074	0.767	0.656
N Pre/Post	75/90	53/65	43/47	101/64
Break Date	Oct-2008	Jan-2006	Feb-2014	Jan-2012
Likely Break?	Yes	Maybe	No	No

Notes: Break significance $p < 0.1$. P-values aggregated with weighted Z-test method with PCA weights. "Gsp/Bern" = Greenspan/Bernanke. "Bern/Y+P" = Bernanke/Yellen and Powell.

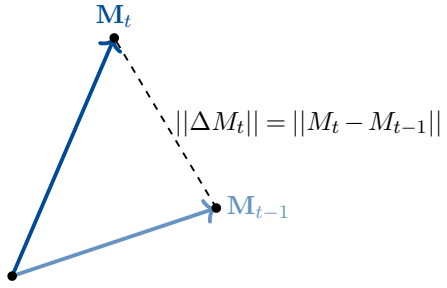
FOMC Statement Length by Chair



Private Sector Reactions to Communication

Summarize Difference between Sequential Statements

- Each statement M_t is a vector, distance between two $\rightarrow$ Euclidean distance
- Conceptually matches well with first differences
- Tradeoff: tractable 1-dimension vs. only a magnitude measure



Note: Cosine similarity is an alternative metric.

Simplified Communication Rule

- We estimate a simplified version of the MCR

More

$$||\Delta M_t|| = f_t(|\Delta Y_t|) + \varepsilon_t$$

- Simplified MCR more stable
- Use simplified MCR for today:
  - Systematic change in communication = fitted value

$$\widehat{||\Delta M_t||}$$

  - Deviations from communication rule = residuals

$$\varepsilon_t^M \equiv ||\Delta M_t|| - \widehat{||\Delta M_t||}$$

$\hookrightarrow \varepsilon_t^M > 0 \implies M_t$ changed more than implied by Y_t

Private Sector Reactions

- How do investors react to systematic vs non-systematic communication?
- Monetary surprises: a measure of market reaction to Fed announcements
  - Based on high-freq. price changes in futures markets
  - Monetary Surprise series: Nakamura and Steinsson (NS), Gürkaynak Sack and Swanson (GSS), Bauer and Swanson (SB), and Jarociński and Karadi (JK)
- Across the regimes, are surprises larger or smaller with
  - systematic changes?
  - non-systematic deviations?

$$|MPS_t| = \alpha + \beta_1 ||\widehat{\Delta M_t}|| + \beta_2 \varepsilon_t^M + \eta_t$$

Surprises with Simplified MCR

Pre-2008	NS MPS	GSS Target	GSS Path	SB MPS	SB Ortho'zd	JK MP	JK Info
systematic	0.082	0.262***	-0.164	0.043	-0.022	0.140	0.037
	(0.092)	(0.065)	(0.107)	(0.085)	(0.096)	(0.085)	(0.089)
deviation	0.188*	0.185	0.242**	0.173*	0.122	0.021	0.101
	(0.108)	(0.128)	(0.101)	(0.101)	(0.086)	(0.120)	(0.106)
R^2	0.049	0.125	0.068	0.035	0.014	0.021	0.013
N	75	75	75	75	75	75	75

Post-2008	NS MPS	GSS Target	GSS Path	SB MPS	SB Ortho'zd	JK MP	JK Info
systematic	0.482**	0.491**	0.373***	0.466**	0.406***	0.352**	0.122
	(0.193)	(0.232)	(0.107)	(0.188)	(0.133)	(0.175)	(0.127)
deviations	0.241***	0.083	0.327***	0.220***	0.170*	0.155	0.124
	(0.069)	(0.075)	(0.089)	(0.057)	(0.090)	(0.103)	(0.174)
R^2	0.235	0.229	0.188	0.217	0.161	0.149	0.024
N	90	90	90	90	90	66	66

Notes: NS = Nakamura and Steinsson, GSS = Gurkaynak, Sack, and Swanson, SB = Bauer and Swanson. HAC-robust standard errors with small sample correction in parentheses. * $p < .1$, ** $p < .05$, *** $p < .01$. Variables are standardized.

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Interpretation: MCR as strength of signal

- Stronger reaction to informative signals, those that follow a stronger MCR
  - **Pre-2008:** primarily under Greenspan, known for ambiguous FedSpeak

"Since I've become a central banker, I've learned to mumble with great incoherence. If I seem unduly clear to you, you must have misunderstood what I said."

- Greenspan, Dec 1987, US Congress

  - **Post-2008:** Bernanke led shift to forward guidance and strong signals

"I began my time as Chairman with the goal of increasing the transparency of the Federal Reserve, and of monetary policy in particular. In response to a financial crisis and a deep recession, the Fed's monetary policy communications have proved far more important...than I would have envisioned eight years ago."

- Bernanke, Nov 2013, BIS

Conclusion

- Evidence of systematic Fed communication, *monetary communication rules*
  - Fed uses communication as a *policy tool*
  - First step in measuring systematic communication policy
  - Important for quantifying policy effects
- Strong evidence of a break in MCR at the end of 2008
- Impacts: more systematic monetary communication (stronger MCR)

  $\hookrightarrow$ announcements perceived as a more valuable signals

  $\hookrightarrow$ tighter relationship with investor surprises:
  - Move expectations more (role for guidance)
  - But bigger consequences of miscommunication

Thank You!

Appendix

Taylor (1993)

- ”A policy rule can be implemented and operated more informally by policymakers who recognize the general instrument responses that underlie the policy rule, but who also recognize that operating the rule requires judgment”

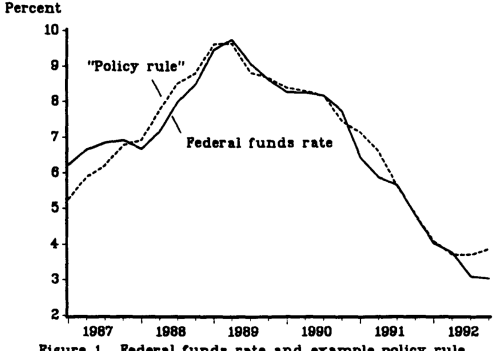


Figure 1. Federal funds rate and example policy rule.

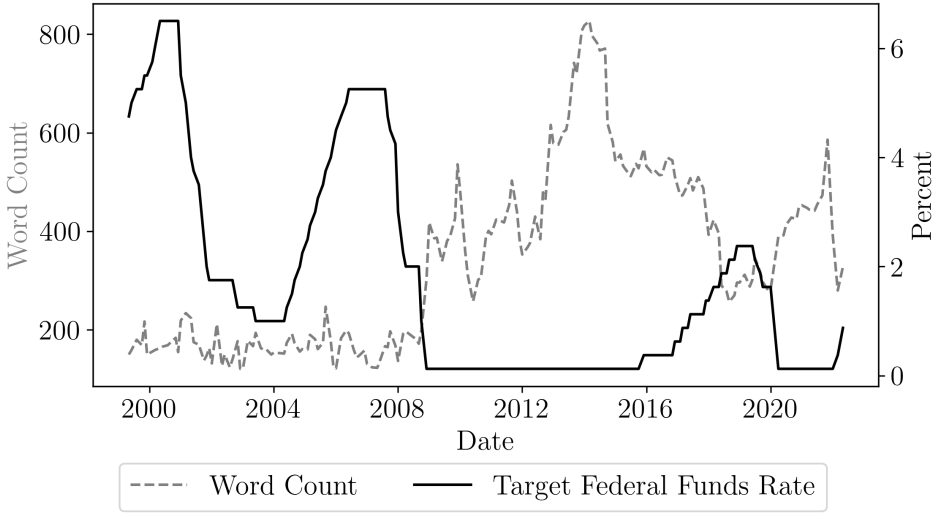
Back-Intro

Example FOMC Statement (Sept 2006) by Sentence

1. The Federal Open Market Committee decided today to keep its target for the federal funds rate at 5-1/4 percent.
2. The moderation in economic growth appears to be continuing, partly reflecting a cooling of the housing market.
3. Readings on core inflation have been elevated, and the high levels of resource utilization and of the prices of energy and other commodities have the potential to sustain inflation pressures.
4. However, inflation pressures seem likely to moderate over time, reflecting reduced impetus from energy prices, contained inflation expectations, and the cumulative effects of monetary policy actions and other factors restraining aggregate demand.
5. Nonetheless, the Committee judges that some inflation risks remain.
6. The extent and timing of any additional firming that may be needed to address these risks will depend on the evolution of the outlook for both inflation and economic growth, as implied by incoming information.

Back-Intro Back-Data

Text and Rates have Different Variation



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Monetary Communication in News

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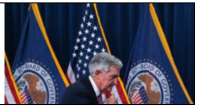
What to Watch at the Fed's First Meeting of 2023

The central bank is expected to lift interest rates and offer signals about what might come next.



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Fed's words in focus as markets bet rate hikes will soon end

By Ann Saphir

What Will the Fed Say?

There is more suspense than usual surrounding the central bank's latest policy meeting.

REVIEW & OUTLOOK

Opinion: Hawkish Fed Talk, Dovish Action

The central bank signals negative real interest rates throughout 2022.

Markets

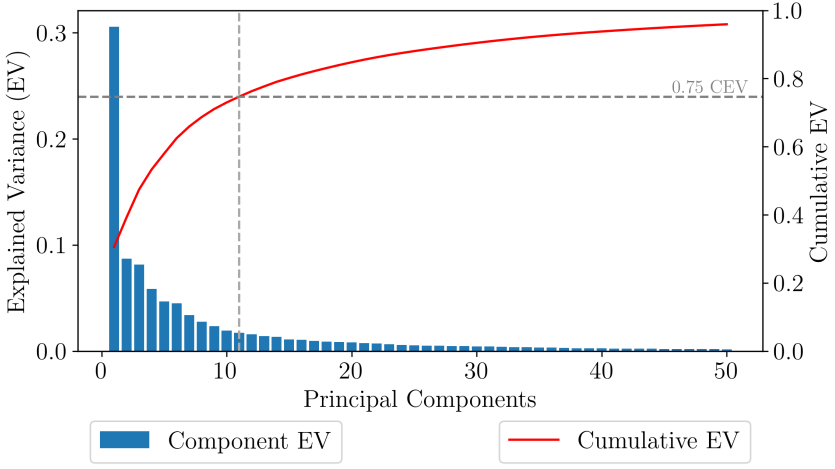
What to Expect From the Fed This Week

Bloomberg reporter, K

The Fed Chair's Challenge: Be Clear, but Not Too Certain

Talking to the former chair Ben Bernanke and others about the task ahead

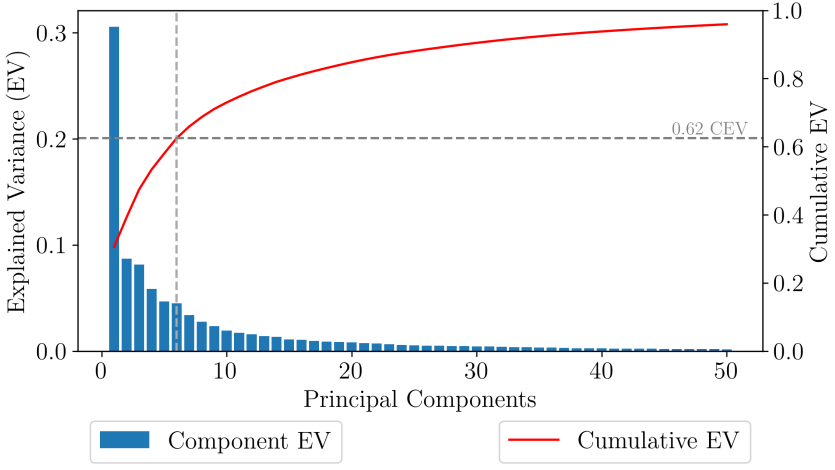
PCA Text Dimensions



- Each component's explained variance → weights for system average stats

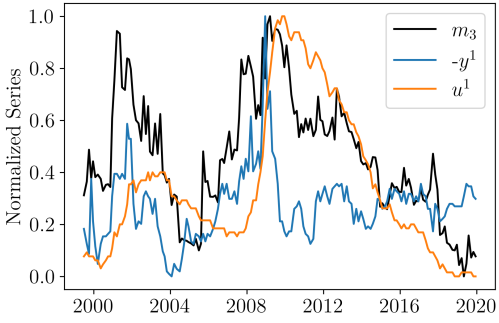
PCA

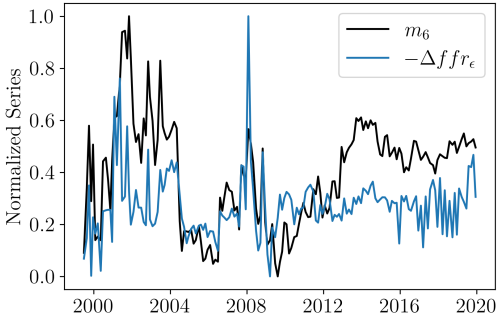
PCA Text Dimensions



PCA

Other Text Components (3 and 6)





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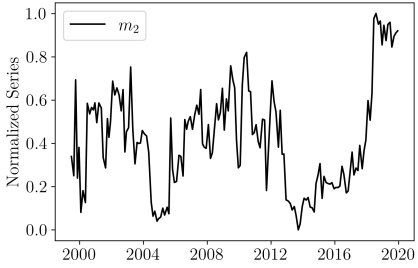
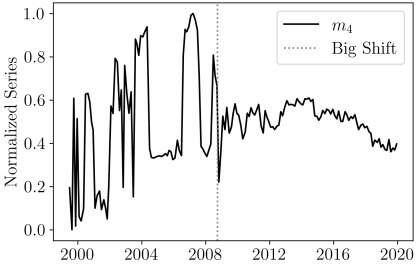
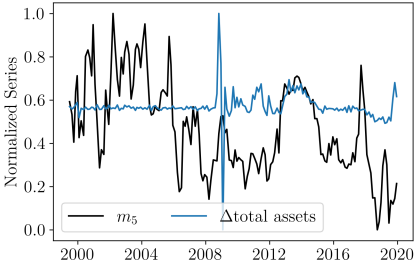
Other Text Components (2, 4, 5)







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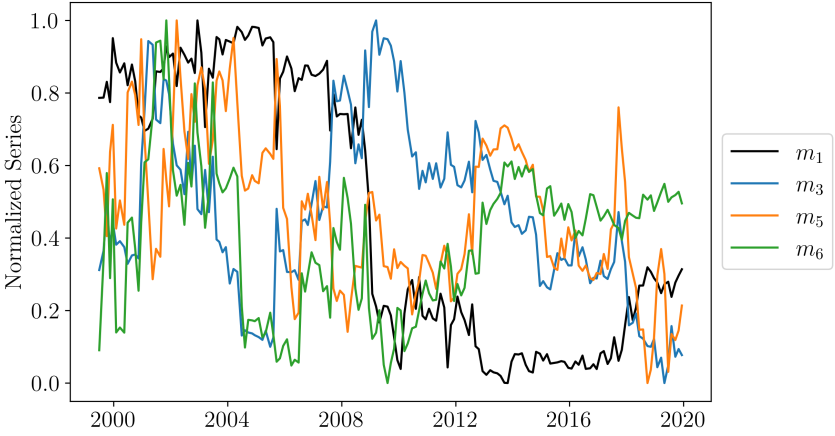
Select Components Over Time (PC1,3,5,6)



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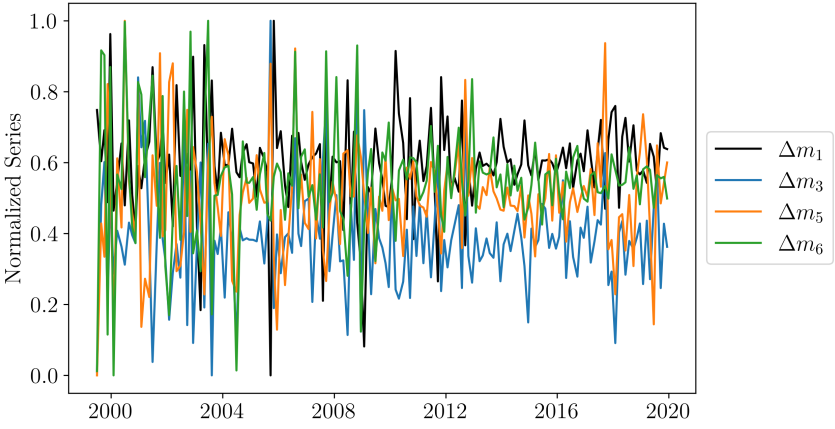
First Difference Select Components Over Time (PC1,3,5,6)



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Additional Equations

$$\text{Generalized } R^2 = \frac{1 - |\sum_{residual}|}{|\sum_{total}|} = \frac{\text{multivariate variation explained by model}}{\text{total multivariate variation}}$$

$$\text{PC weight } w_j = \frac{PC_j \text{ explained variance}}{\sum_j^{40} PC_j \text{ explained variance}}$$

$$\text{PC-weighted } R^2 = \sum_j w_j R_j^2$$

$$Partial\ R_j^2 = \frac{(R^2 - R_{-j}^2)}{(1 - R_{-j}^2)}$$

Z-test Method to Aggregate P-values

- Convert p-values to z statistics
- Weighted average of z statistics across regressions
- Use PC weights

$$w_j = \frac{PC_j \text{ explained variance}}{\sum_j^{40} PC_j \text{ explained variance}}$$

- Evaluate p-value for combined z-statistic

Joint significance Pre/Post models with ECT

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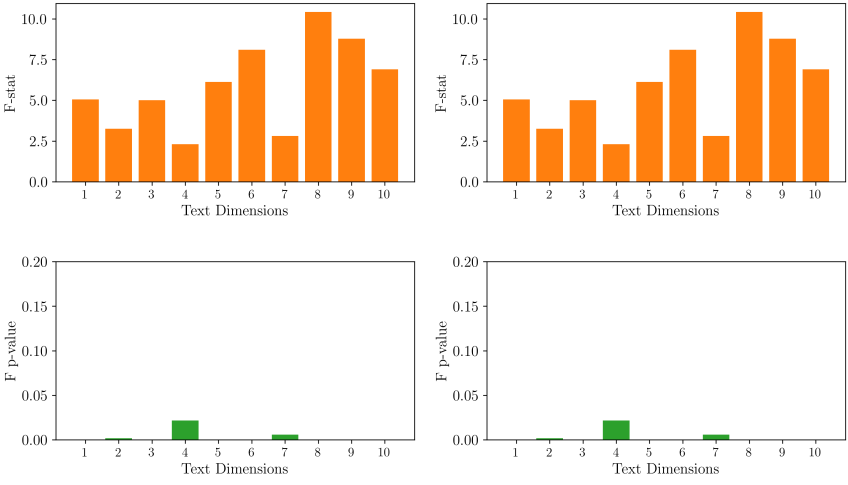
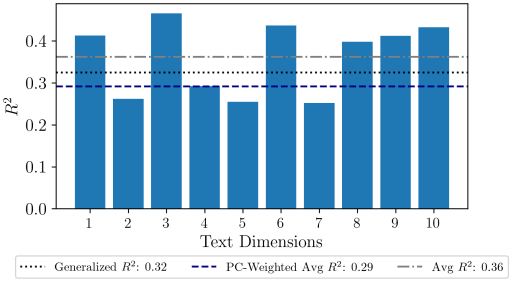
(a) **Pre**-2008 F-stat

(b) **Post**-2008 F-stat

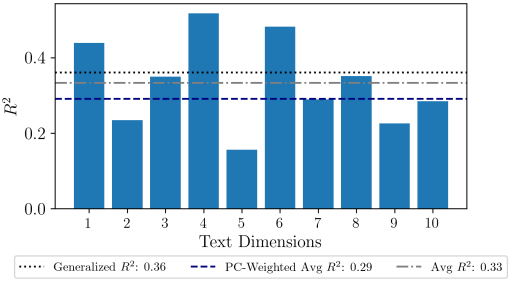


R^2 Pre/Post models with ECT

(a) **Pre**-2008 R^2



(b) **Post**-2008 R^2



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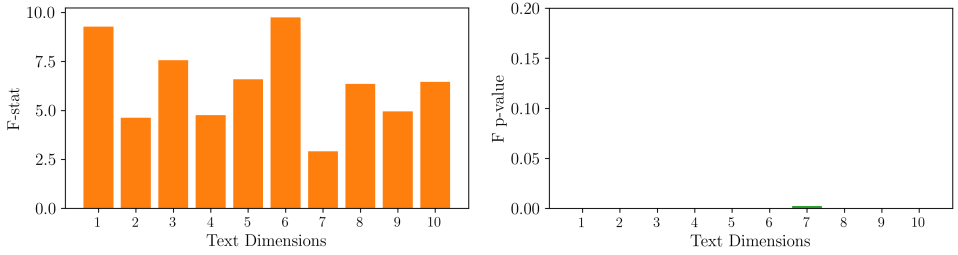
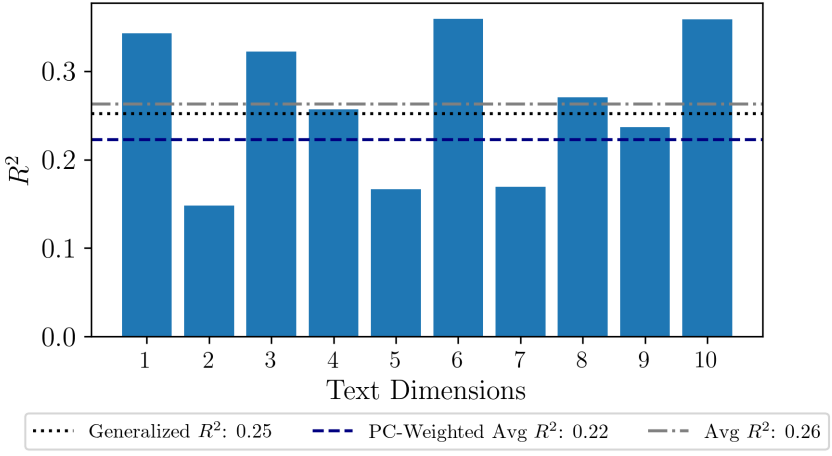
Statistically Significant Monetary Communication Rule

- Component-wise and system-wide evidence of systematic communication



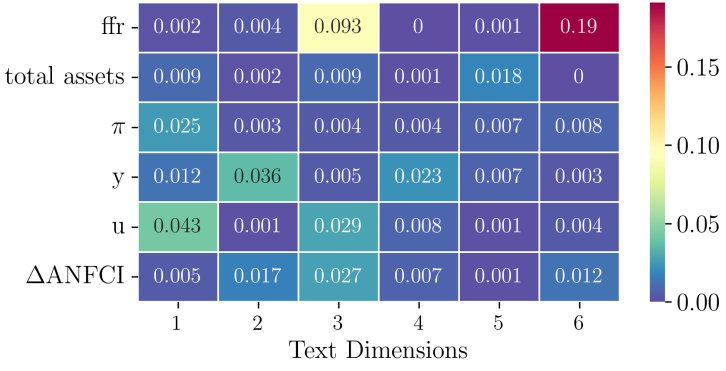
Fit Summary of Estimated Monetary Communication Rule

- Component-wise and system-wide evidence of systematic communication



Drivers of MCR and Partial R^2

- Different components capture different dimensions of Fed information set
  - Δm_3 and Δm_6 are primarily driven by the target policy rate
- Partial R^2 of variable groups:



Simplified MCR Regression

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	$\|\|\Delta M\|\|$	Pre $\|\|\Delta M\|\|$	Post $\|\|\Delta M\|\|$
Δffr$_\epsilon$	0.133*	0.095	0.055
	(0.077)	(0.125)	(0.088)
Δtotal assets$_\epsilon$	-0.222***	0.022	-0.140
	(0.080)	(0.091)	(0.113)
$\Delta\pi^1$	0.206**	0.218*	0.216
	(0.080)	(0.116)	(0.131)
$\Delta\pi^4_\epsilon$	0.053	0.056	-0.047
	(0.085)	(0.164)	(0.111)
Δy^1	0.390***	0.360***	0.229
	(0.111)	(0.110)	(0.190)
Δy$^4_\epsilon$	-0.001	-0.011	-0.010
	(0.087)	(0.148)	(0.109)
Δu^1	-0.132*	-0.073	0.040
	(0.077)	(0.119)	(0.177)
Δu$^4_\epsilon$	0.035	-0.057	0.179
	(0.081)	(0.106)	(0.163)
ΔANFCI	0.074	-0.108	0.163
	(0.072)	(0.120)	(0.138)
R^2 / Adj. R^2	0.228 / 0.183	0.178 / 0.066	0.327 / 0.252
N	164	75	90

Notes: HAC-robust standard errors with small sample correction in parentheses. Data is standardized (z-scored). * p<.1, ** p<.05, *** p<.01.

References I

Angeletos, G.M., La'O, J., 2013. Sentiments. Econometrica 81, 739–779.

Angeletos, G.M., Lian, C., 2018. Forward Guidance without Common Knowledge. American Economic Review 108, 2477–2512. URL: https://pubs.aeaweb.org/doi/10.1257/aer.20161996, doi:10.1257/aer.20161996.

Angeletos, G.M., Pavan, A., 2007. Efficient use of information and social value of information. Econometrica 75, 1103–1142.

Baker, S., Bloom, N., Davis, S., 2016. Measuring economic policy uncertainty. Quarterly Journal of Economics 131, 1593–1636.

Baker, S.R., Bloom, N., Davis, S., Renault, T., 2021. Twitter-derived measures of economic uncertainty. Technical Report. Stanford University.

Bassetto, M., 2019. Forward guidance: Communication, commitment, or both? Journal of Monetary Economics 108, 69–86. doi:10.1016/j.jmoneco.2019.08.015.

Caballero, R.J., Simsek, A., 2022. Monetary policy with opinionated markets. American Economic Review 112, 2353–92. URL: https://www.aeaweb.org/articles?id=10.1257/aer.20210271, doi:10.1257/aer.20210271.

Calomiris, C., Harris, J., Mamaysky, H., Tessari, C., 2022. Fed implied market prices and risk premia. NBER Working Paper .

Campbell, J., Evans, C., Fisher, J., Justiniano, A., 2012. Macroeconomic Effects of Federal Reserve Forward Guidance. Brookings Papers on Economic Activity 43, 1–80.

Cieslak, A., Hansen, S., McMahon, M., Xiao, S., 2021. Policymakers' uncertainty. Working Paper .

Crawford, V.P., Sobel, J., 1982. Strategic Information Transmission. Econometrica 50, 1431–1451. URL: http://www.jstor.org.ezp2.lib.umn.edu/stable/1913390, doi:10.2307/1913390.

Doh, T., Gruber, J., Song, D., 2022a. Does the state-based forward guidance change the way policymakers talk about the outlook? Technical Report. Federal Reserve Bank of Kansas City.

Doh, T., Song, D., Yang, S.K., 2022b. Deciphering Federal Reserve Communication via Text Analysis of Alternative FOMC Statements. FRB Kansas City Working Paper .

Ehrmann, M., Fratzscher, M., 2005. How should central banks communicate? ECB Working Paper .

Ehrmann, M., Fratzscher, M., 2007. Communication by central bank committee members: Different strategies, same effectiveness? Journal of Money, Credit and Banking 39, 509–541.

References II

Ericsson, N., 2017. Predicting Fed forecasts. Journal of Reviews on Global Economics .

Ericsson, N.R., 2016. Eliciting GDP forecasts from the FOMC's minutes around the financial crisis. International Journal of Forecasting 32, 571–583.

Farmer, L., Nakamura, E., Steinsson, J., 2023. Learning about the long run. Working Paper .

Gardner, B., Scotti, C., Vega, C., 2021. Words speak as loudly as actions: Central bank communication and the response of equity prices to macroeconomic announcements. Journal of Econometrics 231, 387–409.

Gáti, L., 2023. Talking over time – dynamic central bank communication. Journal of Money, Credit and Banking 55, 1147–1176.

Gentzkow, M., Kelly, B., Taddy, M., 2019. Text as data. Journal of Economic Literature 57, 535–74.

Handlan, A., 2020. Text shock and monetary suprises: Text analysis of fomc statements with machine learning. Working Paper .

Hansen, S., McMahon, M., Prat, A., 2018. Transparency and deliberation within the fomc: a computational linguistics approach. The Quarterly Journal of Economics 133, 801–870.

Hassan, T., Hollander, S., van Lent, L., Tahoun, A., 2019. Firm-level political risk: Measurement and effects. The Quarterly Journal of Economics 134, 2135–2202.

Herbert, S., 2022. State-dependent Central Bank Communication with Heterogeneous Beliefs. Technical Report. Banque de France.

Husted, L., Rogers, J., Sun, B., 2020. Monetary Policy Uncertainty. Journal of Monetary Economics 115, 20–36.

Kydland, F.E., Prescott, E.C., 1977. Rules Rather than Discretion: The Inconsistency of Optimal Plans. Journal of Political Economy 85, 473–491. URL: https://www.jstor.org/stable/1830193.

Liang, P., Meursault, V., Routledge, B., Scanlon, M., 2022. Pead.txt: Post-earnings announcement drift using text. Working Paper .

Morris, S., Shin, H.S., 2002. Social value of public information. American Economic Review 92, 1521–1534.

Moscarini, G., 2007. Competence Implies Credibility. American Economic Review 97, 37–63. URL: https://www.aeaweb.org/articles?id=10.1257/aer.97.1.37, doi:10.1257/aer.97.1.37.

Ou, S., Zhang, D., Zhang, R., 2022. The return of Greenspan: Mumbling with great incoherence. Working Paper .

Shapiro, A., Wilson, D., 2021. Taking the Fed at its Word: A New Approach to Estimating Central Bank Objectives Using Text Analysis. Review of Economic Studies 89, 2768–2805.

Taylor, J., 1993. Discretion versus policy rules in practice. Carnegie-Rochester Conference Series on Public Policy 39, 195–214.