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
  - FOMC post-meeting announcements, decided by FOMC vote

    $\hookrightarrow$ Text covers Fed's policy decisions and expectations of economy
  - Systematic language corresponding to other policy and macro forecasts
- Can we measure systematic monetary policy communication in the data?

Taylor (1993) Statement Ex. FedSpeak in News Text vs. Rates

This Paper

1. We find that the Fed systematically chooses announcement language
   - Estimate time-varying regression (ridge) on text and Fed policy/forecasts
   - Different text regressions for each forecast/policy variable

     $\hookrightarrow$ Example: *Target fed funds rate rule* relates target FFR to text measures
   - The estimated mappings are called *monetary communication rules*

2. We measure when the rules shift and private expectation responses
   - Change in communication rules correlated with increased uncertainty
     - Larger high-frequency monetary surprises

3. Framework to model, estimate, and track systematic communication

Related Literature

- **Text Analysis of Communication**
  - 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); 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

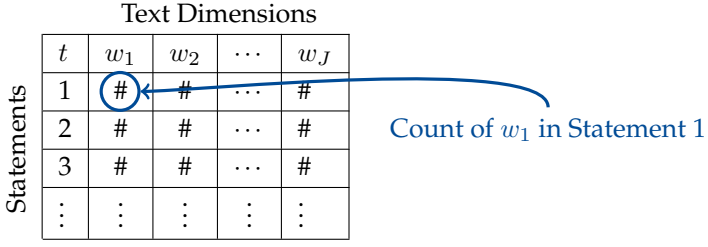
Presentation Outline

Data

- **Communication Text**: FOMC statements (FRB, 1999-2022) Example
- **Realized policy variables** (FRB, 1999-2022)
  - Target fed funds rate, change in FFR, target FFR next year
  - Total assets, shadow rate, 10Y Treasury - FFR
- **Internal Forecasts:** Greenbook/Tealbook (FRB, 1999-2017)
  - Real GDP growth, unemployment, headline and core inflation
  - Next quarter and next year
- **Private sector expectations** (2007-2022)
  - |Monetary surprises| from Acosta (2023); Bauer and Swanson (2023); Gürkaynak, Sack and Swanson (2005); Jarociński and Karadi (2020); Nakamura and Steinsson (2018)

Text Representation: Intuition

- Need to numerically represent FOMC post-meeting statement text
- First, consider a simplified representation:
  - Text dimensions = set of all words used in FOMC Statements, $\{w_1, ..., w_J\}$
  - Each statement = a vector of counts of words



Text Representation: Two Versions

Text Dimensions

Statements

t	w_1	w_2	$\cdots$	w_J
1	#	#	$\cdots$	#
2	#	#	$\cdots$	#
$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$

1. Count occurrences of common phrases → **Clustered 4-grams Approach**
   - Phrases→ clusters of similar sequences of 4 words (4-grams)
   + Interpretable dimensions & captures exact word changes
   - No ordering or interaction between phrases & *huge dimensionality*
2. Latent numerical vector from LLM → **Large-Language Model Approach**
   - BERT model → encodes entire FOMC statement as a vector
   + Quantifies "context", interactions between words and their order
   - Smooths over exact words & non-interpretable dimensions & *large dimensionality*

Clustered 4-gram Approach

- Constructing the 4-gram representation

4-grams

  - Standard text processing/cleaning
  - Collect all sequences of 4 words in a row (4-grams)
  - Drop 4-grams that occur in $< 5\%$ statements

The Federal Open Market Committee decided today to keep its target for the federal funds rate at 5-1/4 percent...	`["fomc decide today keep", "decide today keep target", "today keep target fundsrate",...]`

- Clustering common phrases

Clusters

  - Encode each 4-gram with large-language model (BERT)
  - Euclidean distance to group similar 4-grams (agglomerative clustering)

  $\rightarrow$ 100 clusters

Large Language Model Approach

- Encode each FOMC statement with large-language model More Details
  - Minimal text processing → remove numbers and months
  - Off-the-shelf BERT model (distill-roberta) commonly used for text encoding
  - Encodes entire statement into a 768 dimension vector
- Reduce dimensionality of statement representation
  - BERT dimensionality is more than we need to compare fairly similar texts
  - PCA to reduce dimensionality PCA Graph
  - 94% of variation across FOMC-vectors captured with lower representation

  → 40 principal components
- Robustness: text processing and dimension reduction

Regression Specifications

Assumptions

1. FOMC statement is union of messages m^y about variables $y \in Y$ Sub-messages
2. y-message (m^y) $\approx$ linear combo of text dimensions (w_j) Linear Combo
3. Fed chooses text aligned with expectations, on average Mean Truth
4. Stable mapping between y-variable and text over time window h Fixed Coef.

$\rightarrow$ *Communication rule on variable y*:

$$m_t^y = \mathcal{F}_t^y(y_t)$$

5. $\mathcal{F}^y$ invertible, so can write *inverse communication rule*:

$$y_t = (\mathcal{F}_t^y)^{-1}(m_t^y)$$

Set Y

$\hookrightarrow$ Focus today: inverse target FFR communication rule

Communication Rule Specification

- Estimate inverse communication rule for each policy/forecast (y):

$$y_t = \sum_j \beta_j^{h,y} w_{j,t} + \varepsilon_t^{h,y}$$

$$\hat{\beta}_{ridge}^{h,y} = \underset{\beta}{\text{argmin}} \sum_t \left(y_t - \sum_j \beta_j^{h,y} w_{j,t} \right)^2 + \alpha^{h,y} \sum_j \left(\beta_j^{h,y} \right)^2$$

  - $\alpha^{h,y}$ = optimal ridge penalty parameter estimated CV

- Consider two different timing assumptions:
  1. *Fixed Rules:* only one h, estimate same parameters for whole sample
  2. *Time-varying Rules:* estimate parameters for different h windows

Fixed Communication Rules

Fixed Communication Rules

- Suppose that the communication rule is stable over whole sample or "fixed"

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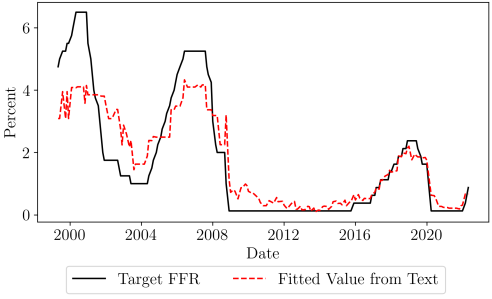
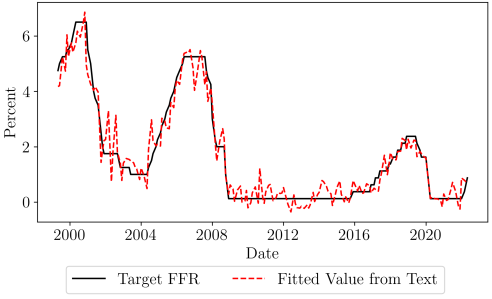
Clustered 4-grams



Large-Language Model (BERT)



- Evidence of systematic communication: R^2 More: Real More: Inflation Taylor (1993)
  - Fitted-values from estimated communication rules ($\hat{y}$) close to actual values (y)
  - True for all variables, except next-quarter headline inflation forecast

Robustness: Shuffled Communication Rules

- Exercise: Shuffle timing of FOMC statements, so no longer match with y_t
  - Estimate ridge regressions with mismatched observations

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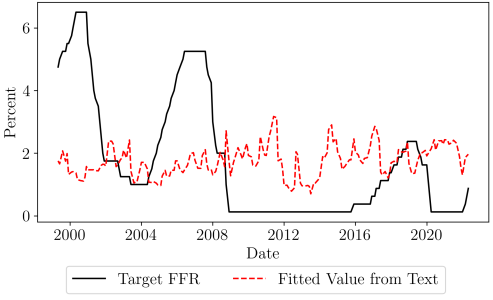
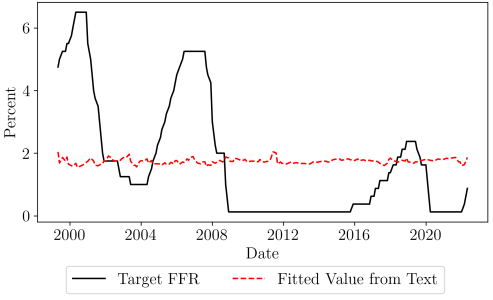
Clustered 4-grams



Large-Language Model (BERT)



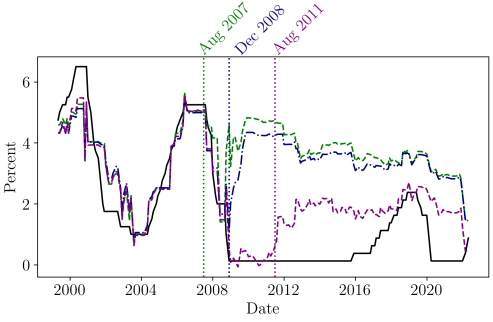
↪ Fitted-values from "shuffled" communication rules do **not** match y

Other Text Methods

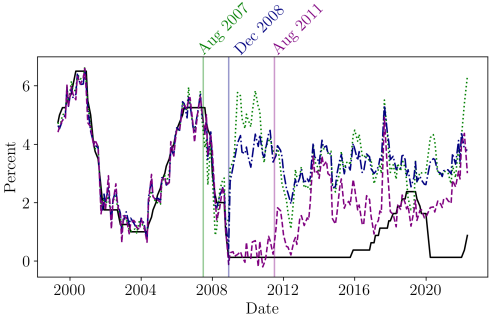
Communication Rules Over Time

Forecasting with Communication Rules Out-of-Sample

Clustered 4-grams



Large-Language Model (BERT)



- Out-of-sample fit deteriorates

  ↪ Anecdotally, communication style and policy changed in this period

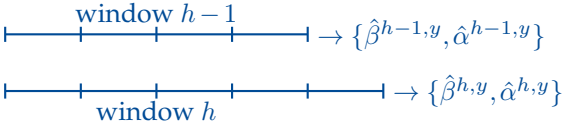
  ↪ How to measure shifts in systematic communication over time?

Statement Lengths Chair Rules

Shifts in Communication Rules Over Time

- Estimate communication rules with an expanding window h
  - Different $\{\beta^{h,y}, \alpha^{h,y}\}$ for each variable y and each window h
  - First, smallest window = 8 years (64 FOMC meetings)

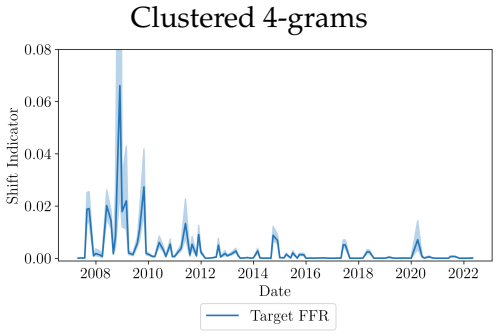
- Shift in communication rule from window $h-1$ to h
  - Estimate rules for different windows:

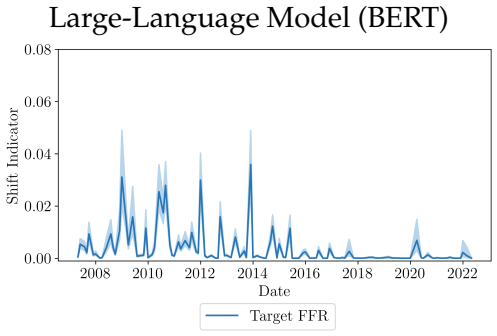


  - Produce fitted-values with each rule for same sample $\rightarrow \hat{y}^{h-1}$, $\hat{y}^{h}$

$$\text{Shift Indicator}_h = 1 - \text{Corr}(\hat{y}^{h-1}, \hat{y}^{h})$$

Shift Indicator for Target FFR Communication Rule





- Spike in indicator → shift in parameters of rule

Pairwise Correlations

Most Predictive Phrases Pre/Post 2008

- Compare the most predictive phrase clusters:

TFFR	Aug 2007 Rule	Aug 2011 Rule
High	labor outlook improves inflation assessment, food and energy prices resource utilization medium-run inflation and risk	anchoring inflation expectations conditions warrant gradualism end asset purchase program judge consistent with dual mandate
Low	labor conditions and inflation low level and gradual return to normal level weak labor conditions improving inflation near symmetric objective	low compensation measure of inflation low survey-based measure (*inflation*) remain for some time below level (*FFR*) low level and gradual return to normal level (*FFR*)

- After 2008: more forward guidance and asset purchases

Private Sector Beliefs

Private Sector Beliefs and Communication Rule Changes

- How do shifts in communication rule relate to private sector beliefs?
  - Use high-frequency changes in asset prices around FOMC meetings

    $\hookrightarrow$ Absolute value of "monetary surprises"
  - Surprise Series, 2007-2022: Bauer and Swanson (2023); Gürkaynak et al. (2005); Jarociński and Karadi (2020); Nakamura and Steinsson (2018); Acosta (2023)
- Shifts in communication rule associated with larger monetary surprises
  - Especially measures associated with forward guidance

    $\hookrightarrow$ Communication policy affects investor interest rate expectations

Monetary Surprises and Communication Rule Shifts

- Specification:

$$|\text{Surprise}|_t = \gamma_0 + \gamma_1(\text{BERT Shift})_t + \gamma_2|\text{Change Target FFR}|_t + \tau_t + \varepsilon_t$$

	NS	GSS		BS		JK	
	MPS	Target	Path	MPS	ORTHO	PM_Mon	PM_Info
Shift	0.205**	0.105	0.256**	0.353***	0.076	0.386***	-0.331**
	(0.085)	(0.076)	(0.099)	(0.083)	(0.095)	(0.095)	(0.127)
$\lvert\Delta\text{TFFR}\rvert$	0.275***	0.47***	0.087	0.289***	0.291***	0.325***	0.502***
	(0.096)	(0.087)	(0.113)	(0.096)	(0.11)	(0.122)	(0.163)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	120	120	120	102	102	78	78
R^2	0.507	0.6	0.327	0.552	0.417	0.579	0.247

- Log transformation + standardized, drop 12-2008/1-2009/3-2020

Clustered 4-grams

Conclusion

- Evidence of systematic Fed communication, *monetary communication rules*
- First step in measuring systematic communication policy
- Private sector beliefs move more with changes in the communication rule
- Flexible method to study systematic communication

Other Text Methods

Thank You!

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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"

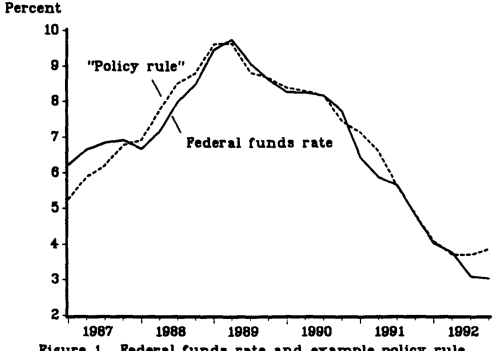


Figure 1. Federal funds rate and example policy rule.

Back-Intro Back-Fixed Rules

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

FOMC Statement (June 2022) - Part 1

- Overall economic activity appears to have picked up after edging down in the first quarter. Job gains have been robust in recent months, and the unemployment rate has remained low. Inflation remains elevated, reflecting supply and demand imbalances related to the pandemic, higher energy prices, and broader price pressures.

- The invasion of Ukraine by Russia is causing tremendous human and economic hardship. The invasion and related events are creating additional upward pressure on inflation and are weighing on global economic activity. In addition, COVID-related lockdowns in China are likely to exacerbate supply chain disruptions. The Committee is highly attentive to inflation risks.

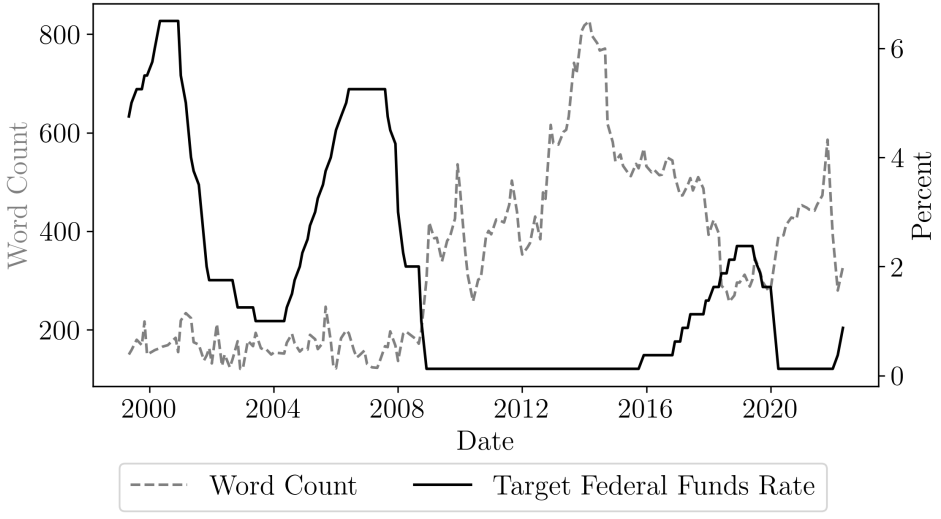
FOMC Statement (June 2022) - Part 2

- The Committee seeks to achieve maximum employment and inflation at the rate of 2 percent over the longer run. In support of these goals, the Committee decided to raise the target range for the federal funds rate to 1-1/2 to 1-3/4 percent and anticipates that ongoing increases in the target range will be appropriate. In addition, the Committee will continue reducing its holdings of Treasury securities and agency debt and agency mortgage-backed securities, as described in the Plans for Reducing the Size of the Federal Reserve's Balance Sheet that were issued in May. The Committee is strongly committed to returning inflation to its 2 percent objective.

- In assessing the appropriate stance of monetary policy, the Committee will continue to monitor the implications of incoming information for the economic outlook. The Committee would be prepared to adjust the stance of monetary policy as appropriate if risks emerge that could impede the attainment of the Committee's goals. The Committee's assessments will take into account a wide range of information, including readings on public health, labor market conditions, inflation pressures and inflation expectations, and financial and international developments.

Back-Intro Back-Data

Text and Rates have Different Variation



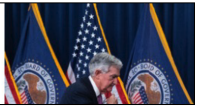
Back

Monetary Communication in News

Back

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 for Jerome Powell, the central bank's current chief

Text Processing and 4-gram Construction

- Build vocabulary from all 4-grams used in FOMC Statements
  - Pre-processing: Drop numbers/stopwords (*the/a/of/to/...*)

    Lemmatization (*decided/deciding* → **`decide`**)

    Entity-encoding (*Federal Open Market Committee* → `fomc`)

The Federal Open Market Committee decided today to keep its target for the federal funds rate at 5-1/4 percent...	`["fomc decide today keep", "decide today keep target", "today keep target fundsrate",...]`

  - Drop 4-grams in $< 5\%$ statements → 4-grams vocabulary $= 685$

- Weighting adjusts for text length and common 4-grams (TFIDF) Weighting
  - TFIDF weighting adjusts for text length and common/uninformative words
- Robustness: sequence length, occurrence threshold, weighting, cleaning

Back

TFIDF Weighting

- Each statement = vector of weighted counts of 4-grams (sequences of 4 words)
- TFIDF = Term-frequency inverse-document-frequency

$$\text{TFIDF} = \frac{TF}{DF}$$

where

$$TF = \frac{\text{\# token t occurs in document d}}{\text{total \# of tokens in document d}}$$

and

$$DF = \frac{\text{\# of documents in which token t occurs}}{\text{total \# of documents}}$$

- TFIDF weighting adjusts for text length and common/uninformative words

Back

Clustering 4-grams

4-gram	Cluster ID
medium_run near_term risk economic_outlook	76
near_term risk economic_outlook appear	76
risk economic_outlook appear roughly	76
risk outlook economic activity	76
see risk outlook economic	76
significant downside risk economic_outlook	76
begin remove policy accommodation	81
believe policy accommodation remove	81
decide begin remove policy	81
policy accommodation remove pace	81
remove policy accommodation take	81

Back

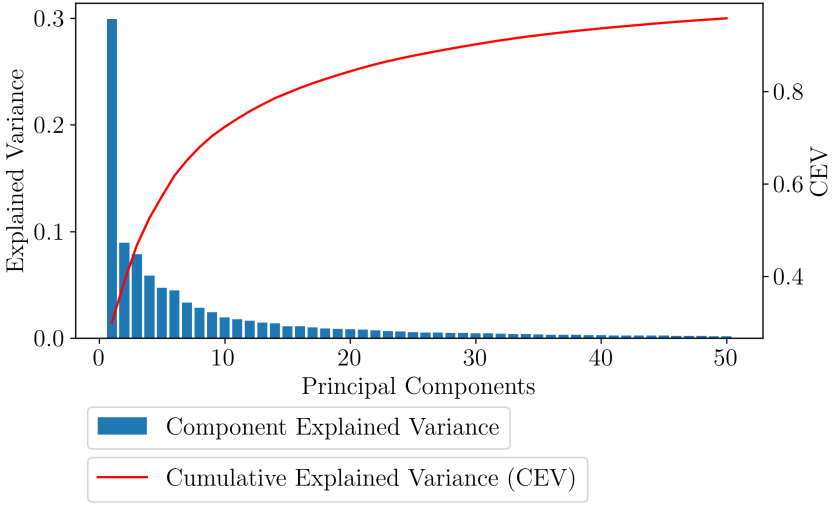
BERT Application

- BERT is a general, LLM to encode English text numerically
  - Encoded vectors capture ”context” with 768 dimensions
- BERT model has a limit on length of text input $\sim$ 400 words
  - Some FOMC statements are longer than this

    $\hookrightarrow$ Divide in two $\rightarrow$ encode each segment $\rightarrow$ length-weighted average vector
- BERT has some unnecessary dimensions for analysis within a specific domain
  - General model differentiates extremely varied texts
  - Comparing only FOMC statements, need fewer dimensions
- Apply PCA to the embeddings $\rightarrow$ 40 components $\approx$ 94% variation

PCA GRAPH Back

BERT Embeddings and PCA



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Assumption 1. Sub-messages

Messages are made of sub-messages for each variable $y \in Y$.

$$m_t = \bigcup_{y \in Y} m_t^y$$

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Assumption 2. Linear Combo

Sub-message on y is a linear combination of text dimensions (w_j).

$$m_t^y = \sum_j \beta_j^y w_{j,t}.$$

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Assumption 3. Mean truthtelling

We assume that the Fed chooses m_t^y such that on average

$$m_t^y = y.$$

for each variable $y \in Y$.

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Assumption 4. Fixed coefficients

$$\hat{\beta}^{h,y}_{ridge} = \underset{\beta}{\text{argmin}} \sum_t (y_t - \sum_j \beta^{h,y}_j w_{j,t})^2 + \alpha^{h,y} \sum_j (\beta^{h,y}_j)^2$$

For each window, h, assume communication rule coefficients $\hat{\beta}^{h,y}_{ridge}$ are stable.

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The Set of Macro Variables

A macro variable $y \in Y$ denotes y_{t+k}, where

- $k = 0 \rightarrow$ realized contemporaneous variable:
  - Target Fed funds rate, change in FFR, target FFR next year
  - Total assets, shadow rate, 10Y Treasury - FFR
- $k > 0 \rightarrow k$-quarter-ahead forecasts:
  - Fed expectation of real GDP growth, unemployment, headline and core inflation k quarters ahead
  - Next quarter ($k = 1$) and next year ($k = 4$)

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Stratified K-Fold Cross-Validation

1. 5 subsamples (folds)
   - Stratified $\rightarrow$ Fed chair and rate change
   - Five iterations where use 4 folds training (in-sample), 1 for validation (out-of-sample)
2. Create a grid for α, and for each α_i on the grid, estimate β and choose the α that minimizes some measure of out-of-sample error (MSE).
3. Do this for each configuration of training and validation samples.
4. Take average across the configurations.
5. "One-standard-error" rule: α that generates MSE one-SE above min. $\rightarrow \alpha^*$
6. Estimate β^{ridge} for that α^*.

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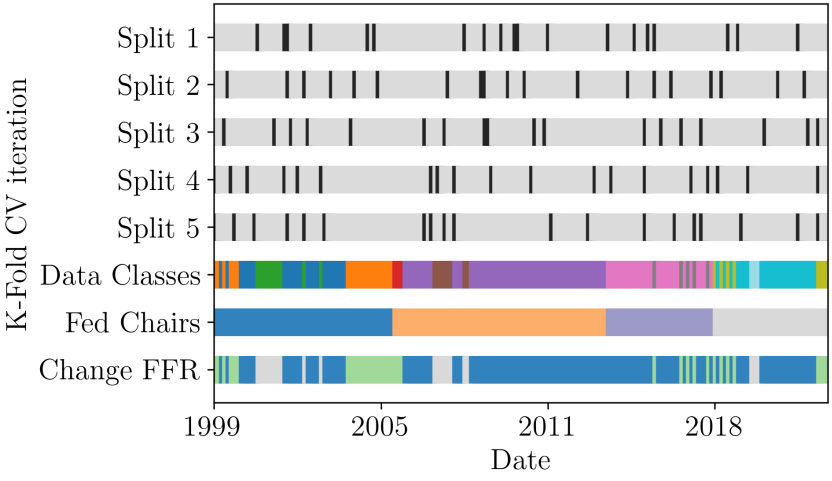
Stratified K-Folds



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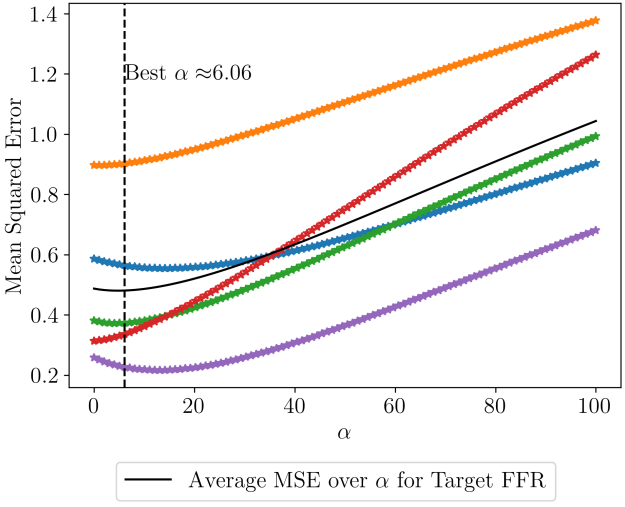
Select Optimal Penalty Parameter α



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Out-of-sample Accuracy

- Split data into 5 subsamples $\rightarrow$ Stratified splits by Fed chair and rate change
- Produces 5 opportunities for evaluation:
  - Estimate regression on 4 subsamples as the "in-sample"
  - Remaining subsample not used in estimation, used as "out-of-sample"
  - Rotate the fold used as out-of-sample
- Below is average accuracy for target FFR communication rule

Average R^2	In	Out
Clustered 4-grams	77%	71.7%
Large-Language Model	95.5%	85.6%

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Real Forecasts (Next Quarter)

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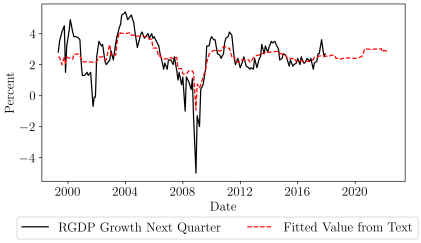
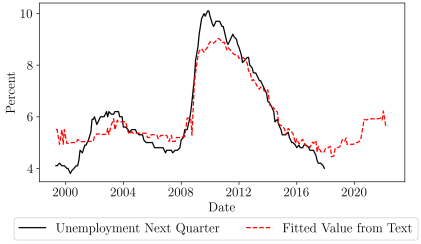
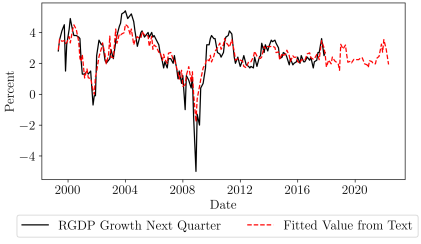
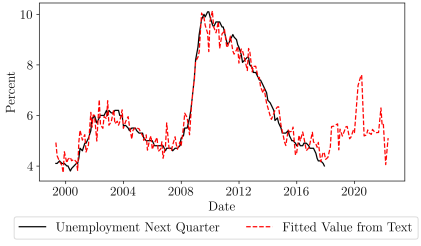
	RGDP Growth	Unemployment
4-grams		
LLM		

Inflation Forecasts (Next Quarter)

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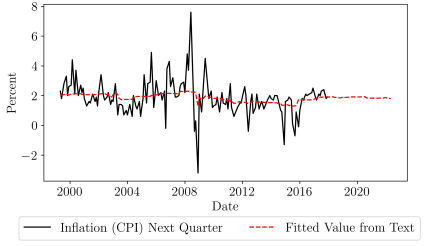
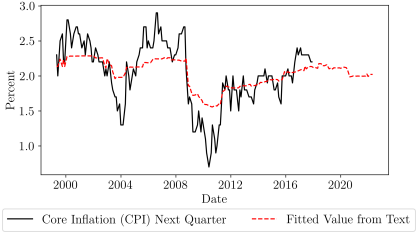
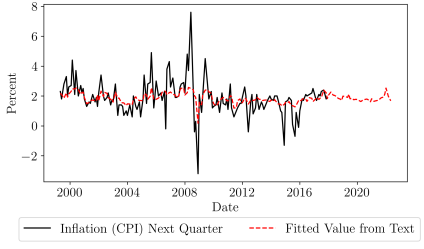
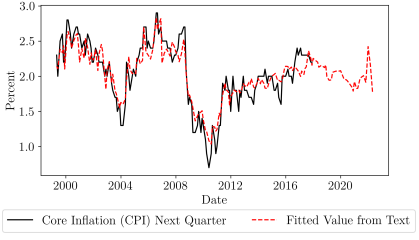
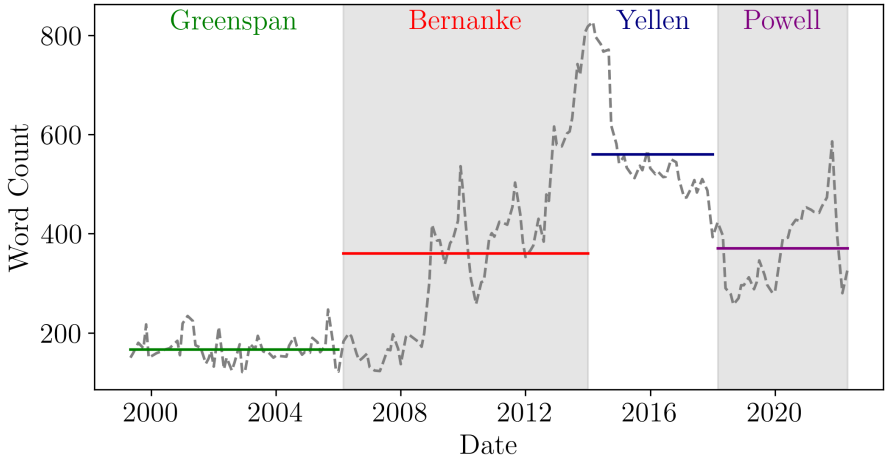
	Headline Inflation (CPI)	Core Inflation (CPI)
4-grams		
LLM		

FOMC Statement Length by Chair



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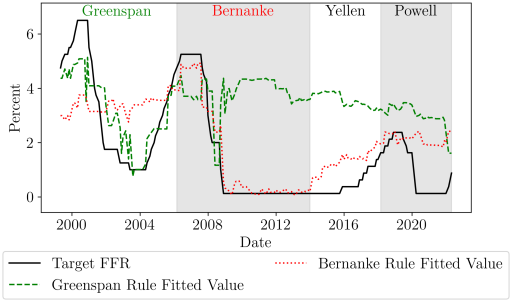
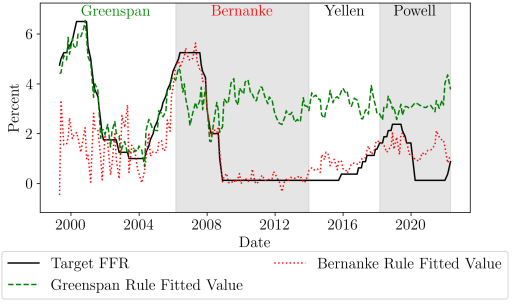
Fed Chair Communication Rules

Clustered 4-grams



Large-Language Model



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Pairwise Correlation of Shift Indicators (BERT)

	Target FFR	Δ Target FFR	RGDP q+1	CPI q+1	Core CPI q+1	Unemp. q+1	RGDP q+4	CPI q+4	Core CPI q+4	Unemp. q+4	TFFR Next Year	Fed Total Assets	Shadow Rate	10Y Treas - FFR	Average
Target FFR	1.00	0.34	0.77	0.57	0.63	0.80	0.60	0.62	0.80	0.83	0.49	0.43	0.83	0.50	0.66
Δ Target FFR	0.34	1.00	0.44	0.31	0.16	0.19	0.23	0.18	0.28	0.30	0.14	0.23	0.26	0.12	0.30
RGDP q+1	0.77	0.44	1.00	0.82	0.58	0.66	0.75	0.64	0.86	0.88	0.44	0.69	0.49	0.47	0.68
CPI q+1	0.57	0.31	0.82	1.00	0.59	0.49	0.55	0.61	0.76	0.70	0.51	0.60	0.29	0.40	0.59
Core CPI q+1	0.63	0.16	0.58	0.59	1.00	0.63	0.46	0.59	0.77	0.64	0.74	0.44	0.51	0.49	0.59
Unemp q+1	0.80	0.19	0.66	0.49	0.63	1.00	0.68	0.61	0.86	0.91	0.46	0.46	0.61	0.38	0.63
RGDP q+4	0.60	0.23	0.75	0.55	0.46	0.68	1.00	0.48	0.73	0.75	0.46	0.72	0.39	0.53	0.59
CPI q+4	0.62	0.18	0.64	0.61	0.59	0.61	0.48	1.00	0.77	0.70	0.37	0.42	0.45	0.42	0.56
Core CPI q+4	0.80	0.28	0.86	0.76	0.77	0.86	0.73	0.77	1.00	0.95	0.52	0.65	0.54	0.52	0.71
Unemp q+4	0.83	0.30	0.88	0.70	0.64	0.91	0.75	0.70	0.95	1.00	0.45	0.66	0.59	0.47	0.70
TFFR Next Year	0.49	0.14	0.44	0.51	0.74	0.46	0.46	0.37	0.52	0.45	1.00	0.31	0.46	0.40	0.48
Fed Total Assets	0.43	0.23	0.69	0.60	0.44	0.46	0.72	0.42	0.65	0.66	0.31	1.00	0.29	0.60	0.54
Shadow Rate	0.83	0.26	0.49	0.29	0.51	0.61	0.39	0.45	0.54	0.59	0.46	0.29	1.00	0.40	0.51
10YTreas-FFR	0.50	0.12	0.47	0.40	0.49	0.38	0.53	0.42	0.52	0.47	0.40	0.60	0.40	1.00	0.48

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Pairwise Correlation of Shift Indicators (Cluster)

	Target FFR	Δ Target FFR	RGDP q+1	CPI q+1	Core CPI q+1	Unemp. q+1	RGDP q+4	CPI q+4	Core CPI q+4	Unemp. q+4	TFFR Next Year	Fed Total Assets	Shadow Rate	10Y Treas - FFR	Average
Target FFR	1.00	0.77	0.84	0.78	0.85	0.86	0.51	0.73	0.88	0.84	0.89	0.70	0.89	0.47	0.79
Δ Target FFR	0.77	1.00	0.91	0.81	0.75	0.80	0.49	0.69	0.86	0.86	0.80	0.73	0.62	0.22	0.74
RGDP q+1	0.84	0.91	1.00	0.88	0.78	0.85	0.42	0.65	0.91	0.92	0.84	0.76	0.68	0.24	0.76
CPI q+1	0.78	0.81	0.88	1.00	0.71	0.77	0.33	0.58	0.81	0.82	0.75	0.71	0.60	0.11	0.69
Core CPI q+1	0.85	0.75	0.78	0.71	1.00	0.89	0.46	0.79	0.89	0.87	0.83	0.64	0.74	0.41	0.76
Unemp q+1	0.86	0.80	0.85	0.77	0.89	1.00	0.48	0.76	0.96	0.98	0.89	0.71	0.68	0.33	0.78
RGDP q+4	0.51	0.49	0.42	0.33	0.46	0.48	1.00	0.44	0.50	0.45	0.45	0.34	0.45	0.43	0.48
CPI q+4	0.73	0.69	0.65	0.58	0.79	0.76	0.44	1.00	0.81	0.74	0.74	0.57	0.60	0.38	0.68
Core CPI q+4	0.88	0.86	0.91	0.81	0.89	0.96	0.50	0.81	1.00	0.98	0.88	0.75	0.69	0.31	0.80
Unemp q+4	0.84	0.86	0.92	0.82	0.87	0.98	0.45	0.74	0.98	1.00	0.89	0.75	0.65	0.26	0.79
TFFR Next Year	0.89	0.80	0.84	0.75	0.83	0.89	0.45	0.74	0.88	0.89	1.00	0.64	0.80	0.36	0.77
Fed Total Assets	0.70	0.73	0.76	0.71	0.64	0.71	0.34	0.57	0.75	0.75	0.64	1.00	0.51	0.31	0.65
Shadow Rate	0.89	0.62	0.68	0.60	0.74	0.68	0.45	0.60	0.69	0.65	0.80	0.51	1.00	0.67	0.68
10yTreas-FFR	0.47	0.22	0.24	0.11	0.41	0.33	0.43	0.38	0.31	0.26	0.36	0.31	0.67	1.00	0.39

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Monetary Surprises and Communication Rule Shifts

- Specification:

$$|\text{Surprise}|_t = \gamma_0 + \gamma_1(\text{Cluster Shift})_t + \gamma_2|\text{Change Target FFR}|_t + \tau_t + \varepsilon_t$$

	NS	GSS		BS		JK	
	MPS	Target	Path	MPS	ORTHO	PM_Mon	PM_Info
Shift	0.218**	0.031	0.226**	0.404***	0.127	0.239***	-0.308***
	(0.087)	(0.079)	(0.102)	(0.08)	(0.094)	(0.088)	(0.11)
$\lvert\Delta$TFFR$\rvert$	0.282***	0.499***	0.111	0.293***	0.278**	0.468***	0.429***
	(0.095)	(0.086)	(0.112)	(0.091)	(0.107)	(0.118)	(0.148)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	120	120	120	102	102	78	78
R2	0.509	0.593	0.316	0.58	0.424	0.527	0.257

- Log transformation + standardized, drop 12-2008/1-2009/3-2020

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Benchmarking to Other Text Approaches

- To benchmark our 4-gram/BERT ridge regression approaches, we implement:
  - Dictionary approach — Dictionary
  - ChatGPT approach — ChatGPT
- This comparison is for the fixed communication rules

Back-Shuffle Back-Conclusion

Dictionary Approach

- Create a dictionary of
  - Topic words (macro forecasts and policy terms)
  - Direction words (increasing/high vs decreasing/low)
- Identify (topic $\times$ direction) at the sentence level
  - Negation handling, subsentence phrases, and scaling
  - Sentences may have multiple topics
  - Then aggregate up to FOMC statement level
- Implicitly, dictionary method is a "fixed" communication rule

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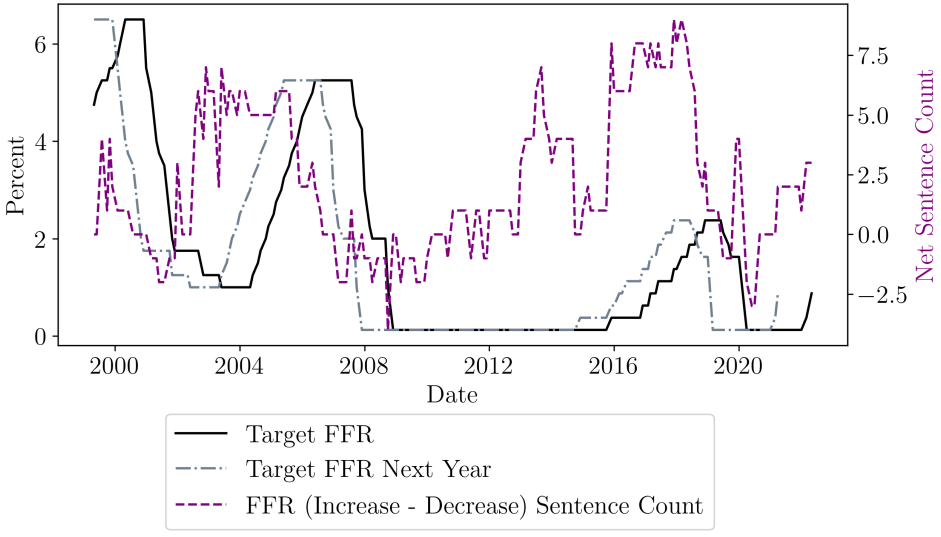
Dictionary Rule



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ChatGPT Prompt

- GPT-3.5 Turbo frontier LLM that captures context in text
- Ask it to predict Tealbook forecast and policy variables
  - Few-shot learning with three examples
- Prompt:

  "Based on the following FOMC statement, what is your best guess of the `<measure>` *the Federal Reserve thinks the* `<variable>` *will be* `<horizon>`*? FOMC statement:* `<statement>`*"*

- Overall, it is a powerful tool.
  - Able to extract numbers well, but not specialized concepts
  - Training data unknown, fine-tuning data too small

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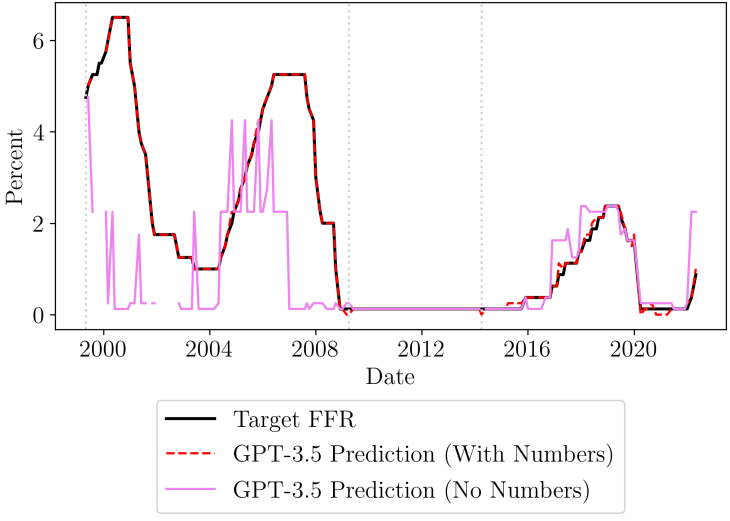
ChatGPT Rule: Target FFR



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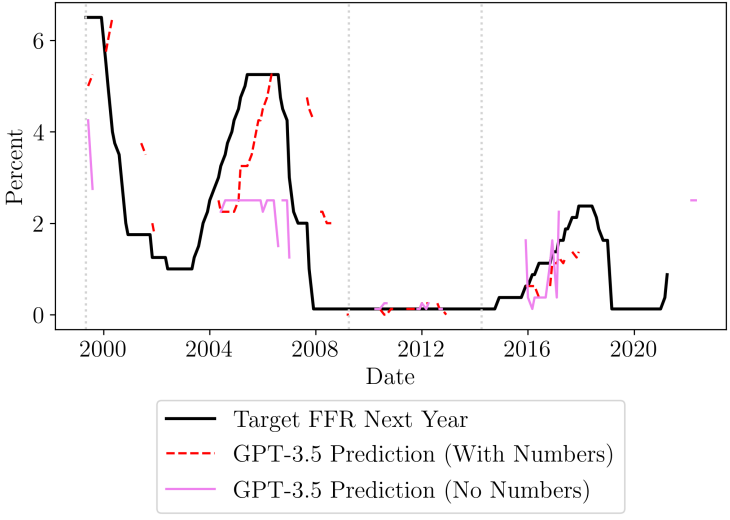
ChatGPT Rule: Target FFR Next Year



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