Deciphering Federal Reserve Communication via Text Analysis of Alternative FOMC Statements

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Contribution

- Provide a framework to quantify the monetary policy stance based on texts.
- Identify tones in different texts based on the similarity of a given text with benchmark texts intended to signal alternative monetary policy stances (alternative FOMC statements).
- Quantify contexts in texts using a novel natural language processing algorithm (Universal Sentence Encoding).
- **Existing Approach**: Back out unexpected information in the statement from the response of interest rates. (bond market response $\rightarrow$ text shock)
- Evaluate asset market responses under **alternative** statements with **market expectation** of the statement fixed.

Main Findings

- Monetary policy surprises identified by text analysis of alternative FOMC statements are highly correlated with forward guidance shocks in the literature.
- Changes in the description of economic factors regarding outlook can be as powerful as cutting the rate further.
- Providing context behind the outlook and the risk assessment can make forward guidance more effective.

Natural Language Processing Tools

- Two different word representations
    1. Context-independent: One-hot encoding, GloVe, word2vec.
    2. Context-aware: Transformer-based Models (BERT, USE etc.)
- Transfer learning more effective in the context-aware representation
- "You shall know a word by the company it keeps "(J. R. Firth 1957).

Universal Sentence Encoding (USE)

- Given a text $D_i = (w_{i,1}, \cdots, w_{i,n_i})$ for $i = 1, \cdots, D$, generate an embedding vector U_i for D_i.

$$U_i = (U_{i,1}, \cdots, U_{i,512}),$$
$$Sim(Text_1, Text_2) = \frac{U_1' U_2}{\|U_1\| \times \|U_2\|} \tag{1}$$

- Representation of features above and beyond word frequency (TF-IDF).
- Pre-trained with a large number of texts in STS benchmarks.
- Available through **Google Tensorflow Hub**.
- Sentiment analysis: to mimic human understanding of text.

Motivation: December 2010 FOMC

Component	Alternative A	Alternative D
Inflation Development	Longer-term inflation expectations have remained stable, but measures of underlying inflation have continued to trend downward.	Although measures of underlying inflation have trended lower in recent quarters, longer-term inflation expectations have remained stable.

Source: Federal Reserve Board.

Back to December 2010 FOMC Example

- In spite of many overlapping words, inflation outlook of Alt A and that of Alt D are substantially different.
- Why? Word order and conjuction.
- Post-meeting statement basically follows inflation outlook description in Alt A.
- Dovish tone is much stronger under USE representations than TF-IDF.

FOMC STATEMENT—OCTOBER 2013 ALTERNATIVE A

1. **The effects of the temporary shutdown of the federal government [, including delays in releases of some key data,] have made the evolution of economic conditions during the intermeeting period somewhat more difficult to assess. However,** information received since the Federal Open Market Committee met in ~~July~~ **September generally** suggests that economic activity has been expanding at a ~~moderate~~ **modest** pace. ~~Some~~ Indicators of labor market conditions have shown **some** further improvement ~~in recent months~~, but the unemployment rate remains elevated. **Available data suggest that** household spending and business fixed investment advanced, ~~and~~ **but that the recovery in** the housing sector ~~has been strengthening, but mortgage rates have risen further~~ **has slowed in response to higher mortgage rates.** ~~and~~ Fiscal policy is restraining economic growth. Apart from fluctuations due to changes in energy prices, inflation has been running below the Committee's longer-run objective, ~~but~~ **even though** longer-term inflation expectations have remained stable.

Similarity Score for Oct. 2013 FOMC Statements

	TF-IDF	USE
$\text{Sim}(FOMC_{A,t}, FOMC_t)$	0.975	0.895
$\text{Sim}(FOMC_{C,t}, FOMC_t)$	0.972	0.990

- Alt A mentions challenges in interpreting improvements in incoming data due to government shutdown while Alt C and the released statement do not.
- The phrase provides information on the FOMC's interpretation of the recent data.

Deciphering Federal Reserve Communication via Text Analysis of Alternative FOMC Statements

Assumptions

1. Alternative FOMC statements prepared by the Board staff roughly capture tail parts of market expectations of monetary policy stance tilt (hawkish or dovish).

2. Dissimilarity between the previous FOMC statement and the current FOMC statement captures the magnitude of monetary policy tilt.

3. The sign of change is identified by using alternative FOMC statements, making the labeled datasets!

4. High-frequency financial market data responds to **surprises** in monetary policy stance tilt.

Text-based Identification of Monetary Policy Stance Tilt (mp_t)

- Text-based shock: novelty $\times$ tone (KKX 2019).
- Novelty: 1-similarity between statements released after two consecutive meetings.
- Tone: sign of $|mp_t - mp_{t-1}|$

$$Sign(|mp_{A,t} - mp_{t-1}|) = -1,$$
$$Sign(|mp_{C,t} - mp_{t-1}|) = 1,$$

$$mp_t = \underbrace{(1 - Sim(FOMC_t, FOMC_{t-1}))}_{\text{Novelty}} \underbrace{\left(\frac{Sim(FOMC_t, FOMC_{C,t}) - Sim(FOMC_t, FOMC_{A,t})}{1 - Sim(FOMC_{A,t}, FOMC_{C,t})} \right)}_{\text{Tone}} \quad (2)$$

- Tone always belongs to the interval $[-1, 1]$.
- Monotonicity:
  $Sign(|mp_{A,t} - mp_{t-1}|) \leqslant Sign(|mp_t - mp_{t-1}|) \leqslant Sign(|mp_{C,t} - mp_{t-1}|)$.

Surprises in Monetary Policy Stance Tilt

- $E_{t-\delta}(mp_t - mp_{t-1})$: Market expectations of the change in the intended policy stance (mp_t) prior to the meeting.

$$E_{t-\delta}(mp_t - mp_{t-1}) = -p_t|mp_t - mp_{t-1}| + (1 - p_t)|mp_t - mp_{t-1}|. \quad (3)$$

- Financial market (i-th asset) response to surprises in the announced policy stance.

$$\ln(\frac{P_{i,t+\Delta_h}}{P_{i,t-\Delta_l}}) = \alpha_i + \beta_i(mp_t - mp_{t-1} - E_{t-\delta}(mp_t - mp_{t-1})) + \epsilon_{i,t}. \quad (4)$$

- Δ_h and Δ_l capture the event window for high-frequency variations in financial market variables.

Calibration p_t

- Monetary policy surprise:
 $MPS(p_t; t - \Delta) = mp_t - mp_{t-1} - E_{t-\Delta}(mp_t - mp_{t-1})$.

- Maximize the negative rank correlation between $MPS(p_t; t - \Delta)$ and high-frequency bond returns.

$$(p_{\tau_i})_{i=1}^T = \operatorname*{argmax} \sum_{t \neq t'} 1(r^b_{\tau_t - \Delta_l, \tau_t - \Delta_h} > r^b_{\tau_{t'} - \Delta_l, \tau_{t'} - \Delta_h}) 1(MPS(p_{\tau_t}) < MPS(p_{\tau_{t'}})). \quad (5)$$

- Grid search w.r.t. p_{τ_t} to achieve the largest negative correlation.

Data

- 87 Statements (March 2004 to December 2014) excluding two intermeeting announcements (Aug 2007, Jan 2008).
- Normalize MP level to make the sample standard deviation equal to one.
- Alternative statements help us to identify changes in the tone by construction.

Estimates of MP
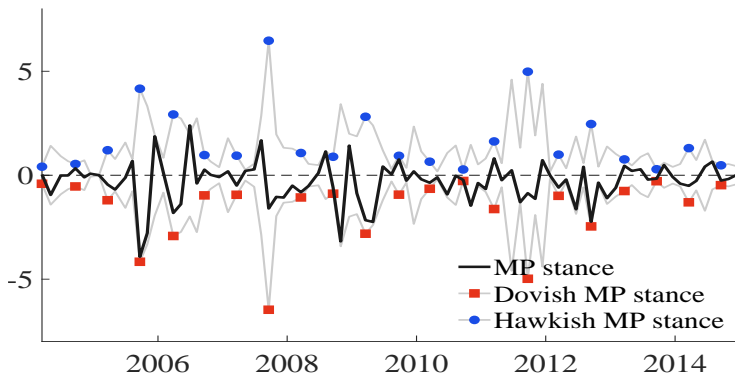
- Estimates also robust to different event window intervals/bond maturity.

Estimates of Monetary Policy Surprise

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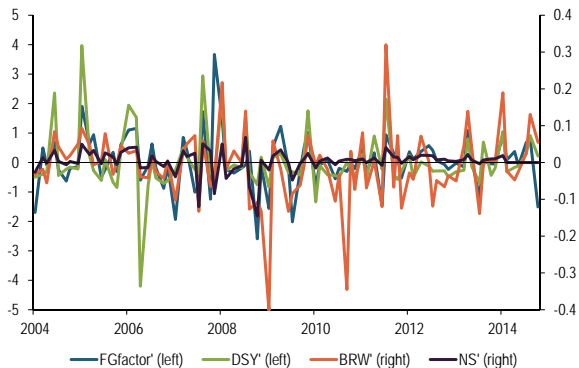
Comparison with Existing MPS Estimates

	MPS
Bu et al. (2020)	0.50
NS (2018)	0.50
Swanson (2017) (FFR+FG+LSAP)	0.50
FFR	0.20
FG	0.52
LSAP	-0.12

Summary

- Analysis of FOMC public communications using a novel natural language processing tool.
- Alternative policy statements provide a way to identify the tone in statements naturally.
- Our text-based monetary policy surprises are highly correlated with forward guidance shock estimates in literature.
- Context matter: changing wording in risk assessment and/or providing a color to the interpretation of incoming data.

Future Works

- Train deep learning models to construct the montery policy shock based on publicly available texts only.
    1. Use the labeled dataset whose tone is identifed by alternative statements.
    2. Speeches by FOMC participants during the intermeeting period can be used to mimic market expectations ($\approx$ monetary policy stance if Alt B were adopted).
    3. Train/Dev/Test split to evaluate different deep learning models.