

More Than Words: Fed Chairs' Communication During Congressional Testimonies

Michelle Alexopoulos¹ Oleksiy Kryvtsov²
Xinfen Han² Xu Zhang²

¹University of Toronto

²Bank of Canada

Disclaimer: The views expressed in this paper are those of the authors and do not necessarily represent those of the Bank of Canada.

Research question

- ▶ Central bank communication plays a central role
Current research focuses on policy rate decisions and/or text data
- ▶ However, it is not only what they say, how they say it also matters
*“A big takeaway from today is how much Janet Yellen owned the words of the policy that were used by Bernanke in the FOMC and how much she was involved in creating them. **Either that or she deserves an Oscar for the acting she did.**”*
– *CNBC Street Signs (February 11, 2014)*

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- ▶ Whether the information contained in the Fed Chair’s emotional cues (text, voice, face) influences financial markets?

In this paper

- ▶ We use videos for congressional testimonies by Fed Chairs
 - ▶ 32 testimonies from 2010-2017
 - ▶ 84 hours video covering Bernanke + Yellen
- ▶ We construct the three emotions (text, voice, face) jointly
- ▶ We align emotions with the tick-by-tick financial market data
- ▶ We study how emotions move financial markets

Results preview

- ▶ Fed Chair's emotions have significant effects on the financial market.
 - ▶ Higher voice pitch, less negative facial emotions \Rightarrow
 \uparrow S&P 500, \downarrow VIX
- ▶ These effects add up and propagate after the testimony.
- ▶ Markets respond most to the Chair's emotions expressed about monetary policy-related issues.

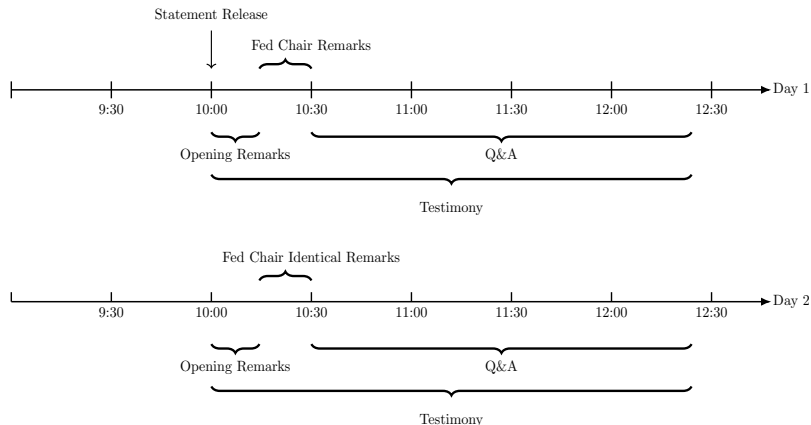
Related literature

- ▶ Monetary policy and high-frequency financial data
Kuttner 2001; Gurkaynak et al. 2005; Nakamura & Steinsson 2018;
Swanson 2021 and many papers
- ▶ Central bank and testimonies
Fraccaroli et al. 2020
- ▶ Emotions studies in political science
Dietrich et al. 2018; Dietrich et al. 2019
- ▶ Emotions and press conference
Gorodnichenko et al. 2021; Curti & Kazinnik 2021
- ▶ Psychology Emotions literature
Ekman & Friesen 1969; Ekman et al. 2002; Lausen & Schcht 2018;
Kamilogoglu et al. 2020
- ▶ Applied Computer science
Devlin et al. 2018; Malo et al. 2014; Aarachi 2019

Testimony Structure

Two congressional testimonies, within a day or two days, alternate

- ▶ the House Financial Services committee
- ▶ the Senate Banking, Housing, and Urban Affairs committee

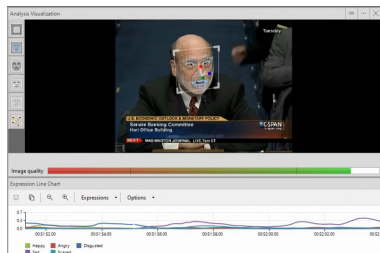
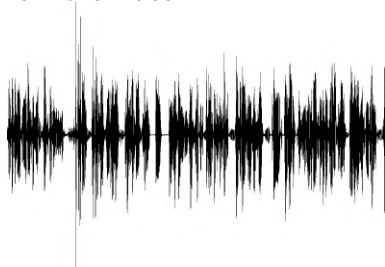


Testimony data: an example from March 1st, 2011

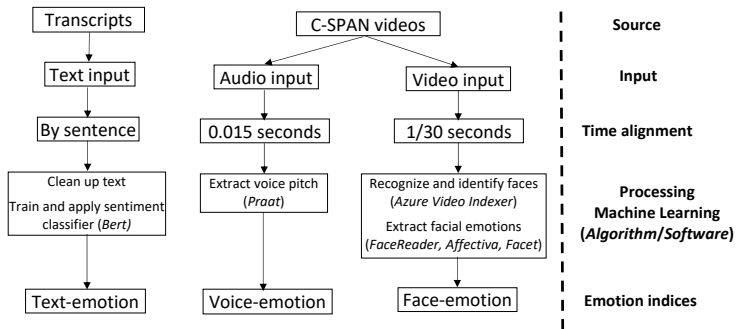
From the transcript:

Speaker	Sentence
MENENDEZ:	And so would you give me your view of how the first and second rounds of quantitative easing are working?
BERNANKE:	I think they're working – I think they're working well. The first round in March 2009 was almost – almost the same day as the trough of the stock market. Since then, the market has virtually doubled. The economy was going from total collapse at the end of the first quarter of '09 to pretty strong growth in the second half of '09. And as I said, it's now in the seventh quarter of expansion.

From the video:



Overview of procedures used for extraction



Testimony emotion construction: Text

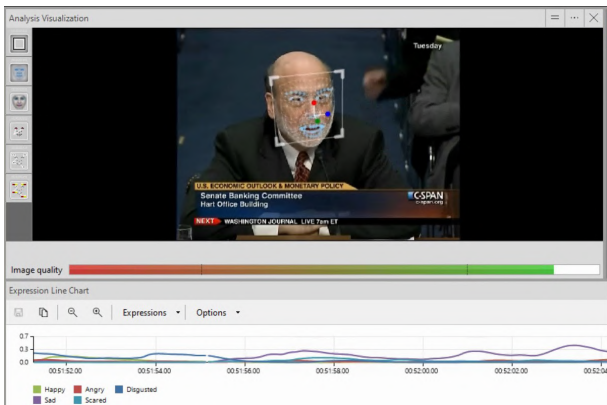
- ▶ Text sentence as the unit
- ▶ State-of-art NLP model: BERT
- ▶ Fine-tuned BERT model with labels from 2 testimonies
- ▶ The model outperformed standard BERT and Fin-Bert (based on F1 Scores)
- ▶ Classify sentiment T_0 to positive(1), negative(-1) or neutral(0)

Testimony emotion construction: Voice

- ▶ Sentences timestamps: forced alignment algorithm
- ▶ Parse audio to sentences level
- ▶ Audio analysis: Praat
- ▶ Produce pitch data F_0 at 15ms interval
 - ▶ 60 - 180Hz for man, 160 - 300Hz for woman
- ▶ Calculate pitch deviation from individual pitch baseline
- ▶ High pitch associate with active and intensified emotions

Testimony emotion construction: Face

- ▶ We use MS Video indexer to identify 166 participants
- ▶ Ekman(1978): facial muscular movements→facial expressions
- ▶ Frequency: 30 frames per second to capture micro expressions
- ▶ 8 million frames
- ▶ Off-the-shell models to extract facial emotion from Microsoft, Facereader etc. are not trained on people talking



Testimony emotion construction: Face

- ▶ We map facial action units to emotions from psychology lit
- ▶ Remove AUs related to the mouth



- ▶ Facial emotions are the linear combination of action units

Emotion	Action Units
Sad	1+4
Fear	1+2+4+5
Angry	4+5+7
Disgust	9

$$FaceScore_f = -(Sad_f + Fear_f + Anger_f + Disgust_f)/4.$$

Data alignment and aggregation

We aggregate granular emotion data into “blocks”

- ▶ Q&A: one round of Q-A btw Fed Chair and Congress member
- ▶ Remarks: 10 sentences

We normalize the emotion to have unit standard deviation

For testimony date t block b , $i \in \{Chair, Member\}$

$$\begin{aligned}\text{TEXT}_{\tau,b}^i &= \text{mean}(T0) / \text{sd}_{\text{TEXT}}^i \\ \text{VOICE}_{\tau,b}^i &= \text{mean}(F0 - \overline{F0}_i) / \text{sd}_{\text{VOICE}}^i \\ \text{FACE}_{\tau,b}^i &= \text{mean}(\text{FaceScore}) / \text{sd}_{\text{FACE}}^i\end{aligned}$$

We align emotion data with tick-by-tick financial data.

Breaking news from CNBC during time of testimonies

We use the breaking news to eliminate the influence of other major events on financial markets during testimonies.



Regression specification I for Remarks

Local projections

$$\begin{aligned} Outcome_{t,b+h} - Outcome_{t,b} = & \beta_{\text{TEXT}}^{(h)} \text{TEXT}_{tb} + \beta_{\text{VOICE}}^{(h)} \text{VOICE}_{tb} + \beta_{\text{FACE}}^{(h)} \text{FACE}_{tb} \\ & + \text{controls} + \text{constant} + \varepsilon_{tb}^{(h)} \end{aligned}$$

Outcome: the outcome variable (e.g., the log price of S&P 500)

t: testimony date; b: end of block b; b+h: h minutes after the block b

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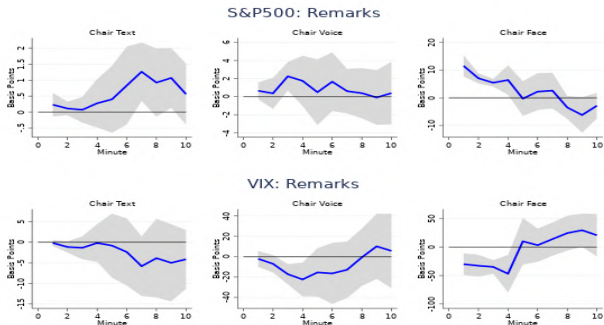
t: testimony date; b: end of block b; b+h: h minutes after the block b

Controls:

- ▶ testimony fixed effects
- ▶ dovish/ hawkish sentiment based on Gorodnichenko et al 2021
- ▶ two lags of the one-minute change in the outcome variable, one lag for each emotion index

Parameters of interests: $\beta_{\text{TEXT}}^{(h)}$, $\beta_{\text{VOICE}}^{(h)}$, $\beta_{\text{FACE}}^{(h)}$, $h = 1, 2, 3, \dots$

Remarks: Chair emotions $\uparrow \Rightarrow$ S&P500 \uparrow , VIX \downarrow



Driscoll-Kraay standard errors, 90% confidence interval

Regression specification II for Remarks

Causal context: Fed Chair delivers virtually identical remarks \implies

- ▶ Text-emotion is identical between two days
- ▶ Respond to Chair's voice- and face-emotions differences

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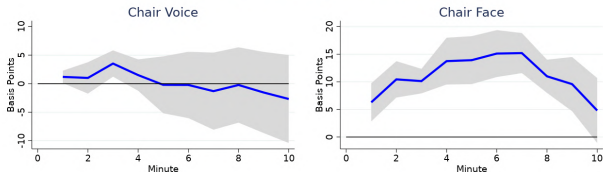
- ▶ Text-emotion is identical between two days
- ▶ Respond to Chair's voice- and face-emotions differences

$$\begin{aligned} Outcome_{t,b+h} - Outcome_{t,b} = & \beta_{VOICE}^{(h)} \Delta VOICE_{tb} + \beta_{FACE}^{(h)} \Delta FACE_{tb} \\ & + \text{controls} + \text{constant} + \varepsilon_{t,b}^{(h)} \end{aligned}$$

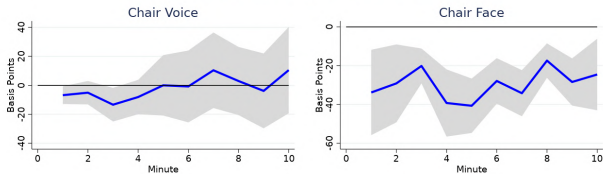
$\Delta VOICE_{tb}$, $\Delta FACE_{tb}$: differences on day 2 from the same block on day 1

Day 1 vs. day 2: Chair emotions $\uparrow \Rightarrow$ S&P500 \uparrow , VIX \downarrow

S&P500: Day 1 vs. Day 2 Identification



VIX: Day 1 vs. Day 2 Identification



Driscoll-Kraay standard errors, 90% confidence interval

Regression specification for Q&A session

Local projections

$$\begin{aligned} Outcome_{t,b+h} - Outcome_{t,b} = & \beta_{\text{TEXT}}^{(h)} \text{TEXT}_{tb} + \beta_{\text{VOICE}}^{(h)} \text{VOICE}_{tb} + \beta_{\text{FACE}}^{(h)} \text{FACE}_{tb} \\ & + \text{controls} + \text{constant} + \varepsilon_{tb}^{(h)} \end{aligned}$$

Outcome: the outcome variable (e.g., the log price of S&P 500)

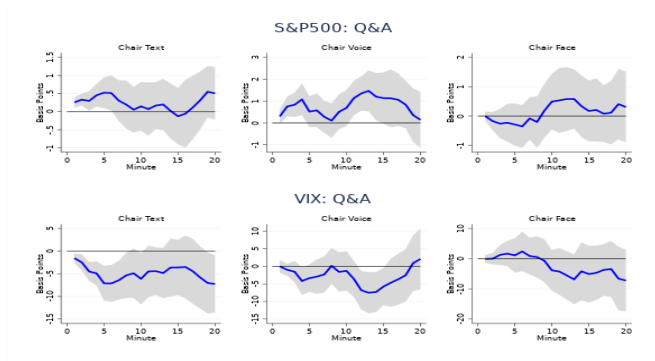
t: testimony date; b: end of block b; b+h: h minutes after the block b

Controls:

- ▶ testimony fixed effects
- ▶ dovish/ hawkish sentiment based on Gorodnichenko et al 2021
- ▶ Congress members text-, voice- and face-emotions
- ▶ fractions of Chair sentences, time length of speaking and face on screen
- ▶ two lags of the one-minute change in the outcome variable, one lag for each emotion index

Parameters of interests: $\beta_{\text{TEXT}}^{(h)}$, $\beta_{\text{VOICE}}^{(h)}$, $\beta_{\text{FACE}}^{(h)}$, $h = 1, 2, 3, \dots$

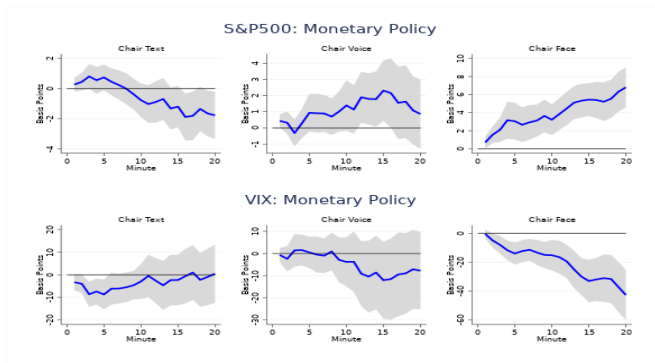
Q&A: Remarks: Chair emotions $\uparrow \Rightarrow$ S&P500 \uparrow , VIX \downarrow



Driscoll-Kraay standard errors, 90% confidence interval

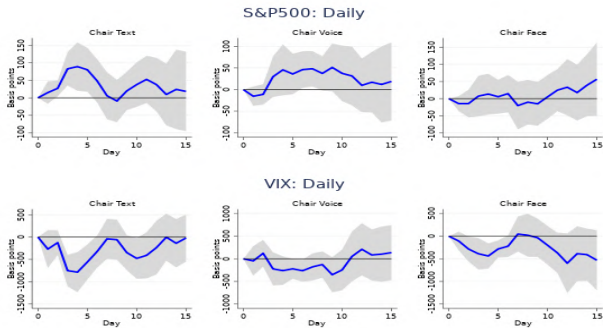
Q&A monetary policy related topics: Chair emotions $\uparrow \Rightarrow$ S&P500 \uparrow , VIX \downarrow

- ▶ Monetary policy topic (balance sheet operations, inflation & Policy) appears 7% of the time
- ▶ Responses are all large and significant



Driscoll-Kraay standard errors, 90% confidence interval

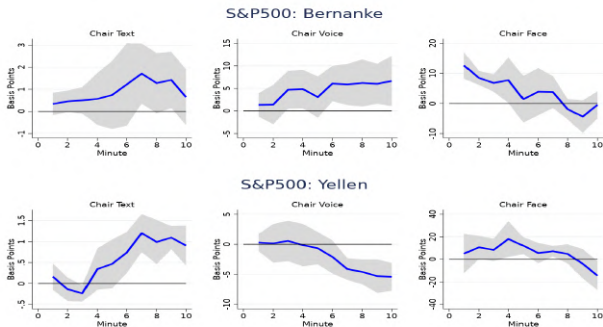
Results: Daily



Driscoll-Kraay standard errors, 90% confidence interval

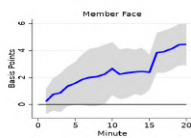
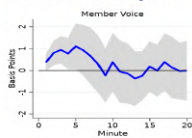
Remarks by Fed Chair

- ▶ More responsive to Bernanke in Remarks section
- ▶ Different response to Yellen tone change

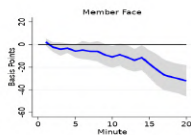
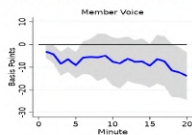
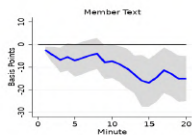


Members can also move the market

S&P500: Monetary Policy



VIX: Monetary Policy



Findings

- ▶ Text, voice and facial emotions in testimonies move financial markets (indexes not significantly correlated)
- ▶ Magnitude of impacts are different between Remarks and Q&A
- ▶ Magnitudes of responses grow in the days following the testimony
- ▶ Responses to sentiment in text, face and voice can differ significantly across topics
- ▶ Responses may also differ by Fed Chair
- ▶ Congressional members' emotions can also affect markets
- ▶ Using “off the shelf” tools can give unintuitive results