

# More Than Words: Fed Chairs' Communication During Congressional Testimonies

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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

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## Research question

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*“...So we all heard what Yellen was saying, but what about her body language...in one of the clips you watched, **her arms cross, the eyebrows go up and that’s a sign of insecurity...she was much more secure when talking about monetary policy than financial regulatory policy ... every time she tried talked, she got cut off, you saw the frustration and anxiety... If we did this with Bernanke, there were times Bernanke’s voice got so shaky...there were.**”*  
– *CNBC Streets Signs (February 11, 2014).*
- ▶ 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
- ▶ 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.
  - ▶ Positive text, higher voice pitch, less negative facial emotions  
⇒  $\uparrow$  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
- ▶ Central bank and testimonies  
Fraccaroli et al. 2020
- ▶ Emotions and press conference  
Gorodnichenko et al. 2021; Curti & Kazinnik 2021

## Related literature

- ▶ Emotions studies in political science  
Dietrich et al. 2018; Dietrich et al. 2019
- ▶ Emotions studies in psychology  
Ekman & Friesen 1969; Ekman, Friesen & Hager 2002; Gelder, Teunissen & Benson 1997; Cowie & Cornelius 2003; Laukka, Juslin & Bresin 2005; Lausen & Schacht 2018; Kamiloglu, Fischer & Sauter 2020
- ▶ Applied computer science  
Devlin, Chang, Lee & Toutanova 2018; Campello, Moulavi & Sander 2013; Malo, Sinha, Takala, Pekka & Wallenius 2014; Aarachi 2019



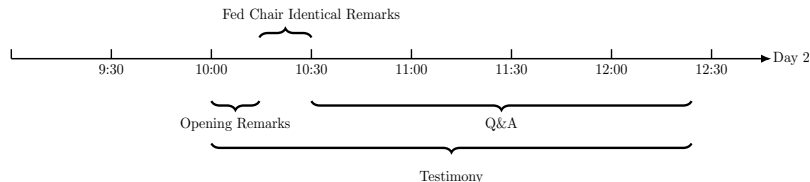
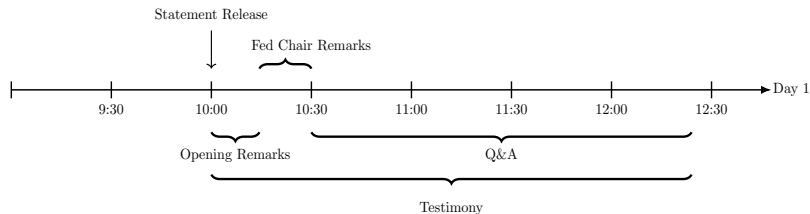
# Why semiannual monetary policy report to the congress?

- ▶ Long history: 1983 – current
- ▶ Scheduled two times a year, each time repeated twice
- ▶ Each testimony is 2-3 hours long, including 1 hour long Q&A
- ▶ Chair's remarks are prepared; Q&A session is unscripted
- ▶ Robustly covered by the media; broadcast through TV
- ▶ Do not accompany monetary policy announcements
- ▶ Repeated Chair's remarks provide alternative identification

# 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

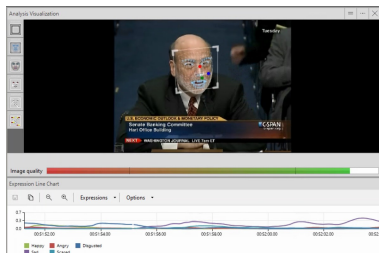
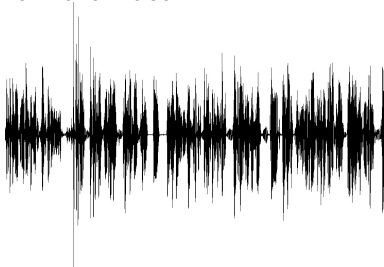


# Testimony data: an example from March 1<sup>st</sup>, 2011

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:



## Testimony emotion construction: Text

- ▶ Text sentence as the unit
- ▶ State-of-art NLP model: BERT
- ▶ Finetune BERT with authors annotated testimony data
- ▶ Classify sentence to positive(1), negative(-1) or neutral(0)
- ▶ Sentences timestamps?

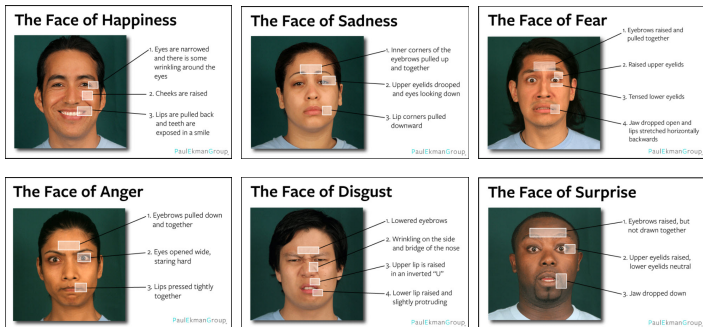
## Testimony emotion construction: Voice

- ▶ Sentences timestamps: forced alignment algorithm
- ▶ Parse audio to sentences level
- ▶ Audio analysis: Praat
- ▶ Produce pitch data at 15ms interval
  - ▶ 60 - 180Hz for man, 160 - 300Hz for woman
- ▶ Average pitch to sentence level
- ▶ Weight sentence pitch by timespan
- ▶ Demean pitch from group pitch baseline
  - ▶ Yellen, Bernanke, and Congress members groups
- ▶ High pitch associate with active and intensified emotions

# Testimony emotion construction: Face

Emotion data construction:

- ▶ Ekman(1978): facial muscular movements → facial expressions



# Testimony emotion construction: Face

Emotion data construction:

- ▶ Action Units (AU) examples (McDuff et al. 2016)



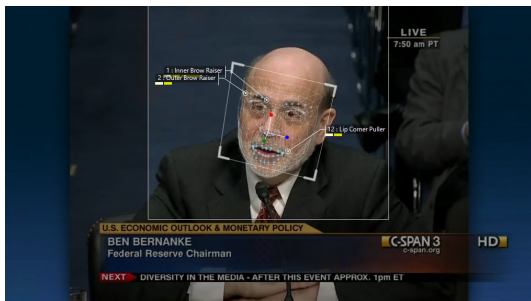
- ▶ Facial Actions Coding System (FACS)
- ▶ Facial emotions are the combination of action units, e.g.

Emotion	Action Units
Happy	12
Sad	1+4
Fear	1+2+4+5
Angry	4+5+7
Disgust	9

# Testimony emotion construction: Face

Four steps approach:

- ▶ Step1 - AUs creation: FaceReader





# Testimony emotion construction: Face

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Testimony video frames normally include multiple faces

# Testimony emotion construction: Face

Four steps approach:

- ▶ Step 2 - Faces recognition & names identification: MS video indexer
- ▶ Step 3 - Match face and AU data
- ▶ Step 4 - Construct facial emotions by combining AU data

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

# Testimony emotion construction: Face

Emotion data construction:

- ▶ Frequency: 30 frames per second
- ▶ Average negative emotions from -1 (present) to 0 (absent)
  - ▶ sad, fear, angry, disgust

# Data alignment

- ▶ Emotion data alignment by sentence
- ▶ Emotion data alignment with real time
  - ▶ CNBC live coverage with S&P500 real time data on screen
  - ▶ CSPAN live coverage timestamps on screen
  - ▶ Testimony official start time and end time published
- ▶ Emotion data alignment with financial data
  - ▶ Aggregate emotion data to “blocks”
  - ▶ Align financial data by block



# Emotion data aggregation

Emotion data aggregated to “blocks”:

- ▶ Fed Chair remarks: 10 sentences (about 1 min) per block
- ▶ Q&A: a complete Q-A round btw Fed Chair and Congress member (about 5 min)

## Emotion data aggregation

For testimony date  $t$  block  $b$ :

$$\text{TEXT}_{tb} = \frac{\text{num pos sentences} - \text{num neg sentences}}{\text{total num sentences in block } b} / \text{sd}_{\text{TEXT}}$$

$$\text{VOICE}_{tb} = \frac{\sum_{i \in b} (\text{sentence voice pitch} * \text{sentence time span})}{\text{total time span in block } b} / \text{sd}_{\text{VOICE}}$$

$$\text{FACE}_{tb} = \frac{\sum_{f \in b} (\text{FaceScore}_f)}{\text{total num video frames in block } b} / \text{sd}_{\text{FACE}}$$

$$\text{FaceScore}_f = - \frac{(\text{sad}_f + \text{fear}_f + \text{anger}_f + \text{disgust}_f)}{4}$$

# Regression - Baseline: Fed Chair 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)

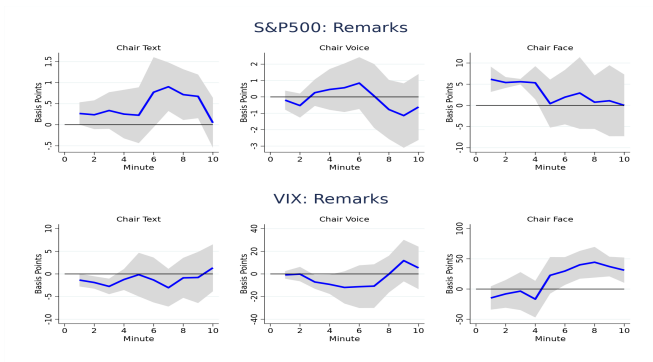
t: testimony date; b: end of block b; b+h: h minutes after the block b

### Controls:

- ▶ testimony fixed effects
- ▶ dovish/hawkish sentiment based on Gorodnichenko et al 2021

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

# Results - Baseline: Fed Chair Remarks



Driscoll-Kraay standard errors, 90% confidence interval



## Regression - Alternative: Fed Chair Remarks

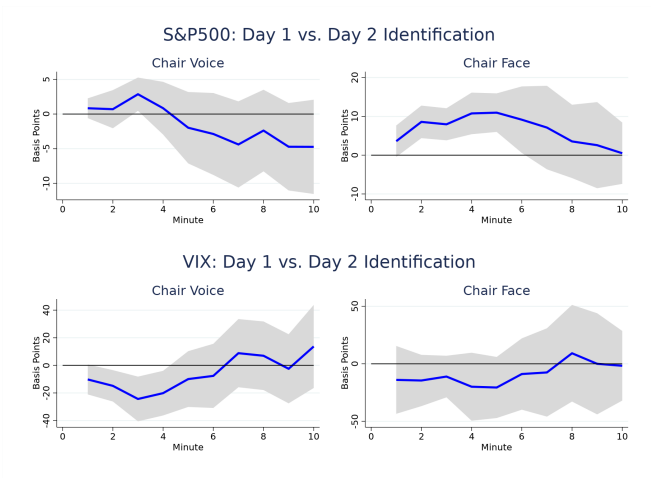
At two days testimonies, Fed Chair delivers the same remarks  $\implies$

- ▶ Identical text-emotion for the two days
- ▶ Market response to the 2-day voice-emotion difference
- ▶ Market response to the 2-day face-emotion difference

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

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

# Results - Alternative: Fed Chair Remarks



Driscoll-Kraay standard errors, 90% confidence interval

# Regression: Q&A section

## Local projections

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

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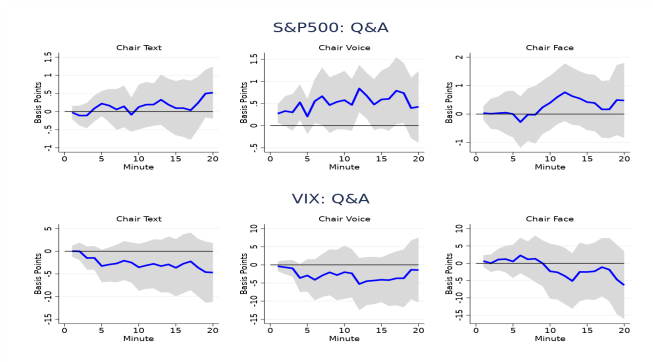
t: testimony date; b: end of block b; b+h: h minutes after the block b

### Controls:

- ▶ testimony fixed effects
- ▶ dovish/hawkish sentiment based on Gorodnichenko et al 2021
- ▶ Congress members text-, voice- and face-emotions
- ▶ fractions of Chair sentences, time length of speaking and face on screen

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

# Results: Q&A section



Driscoll-Kraay standard errors, 90% confidence interval

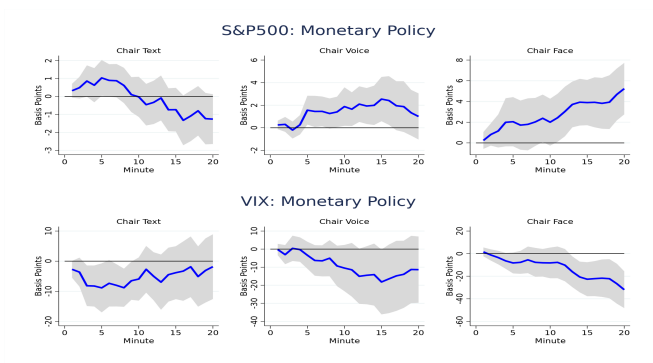
# Q&A section topics

Topics are derived by BERTopics algorithm (Grootendorst 2022)



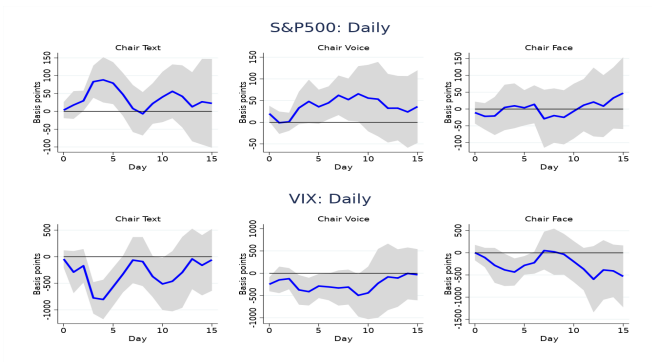
# Results: Q&A section - monetary policy related topics

- ▶ Monetary policy topics appear about 7% of time
  - ▶ Balance sheet operations, inflation and policy rate
- ▶ Responses are all large and significant



Driscoll-Kraay standard errors, 90% confidence interval

# Results: Daily



Driscoll-Kraay standard errors, 90% confidence interval

# Conclusion

- ▶ Fed Chair's emotions have significant effects on the financial market.
- ▶ These effects add up and propagate after the testimony.
- ▶ Markets respond most to the Chair's emotions expressed about monetary policy-related issues.