MIXED SIGNALS? HOW MEDIA DISTILLS CENTRAL BANK MESSAGES

BANK OF CANADA
BANQUE DU CANADA

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Disclaimer: The views expressed are solely those of the researchers and do not necessarily reflect the views of the Bank of Canada.

Overview

- Motivation
- Proposed method to explore how reporting of CB messaging is influenced by:
  - *Words chosen (Topics, sentiment, stance)*
  - *Non-textual information (Facial expressions, Voice pitch, Body movement)*
  - *Audience (media type, foreign v domestic, political leaning, etc.)*

Questions:

1. ***What parts of Central Bank communications make it through to the public?***
2. ***How are these portions transformed?***

Preview of Results

Textual and non-textual emotional cues significantly impact Policy messages reported in the media

▶️ Higher voice pitch, facial expressions and sentiment of the text impact what is selected for reporting

▶️ Emotional cues can impact the tone (sentiment) seen in the coverage.

▶️ Emotional cues can impact how the media changes the wording of the messages

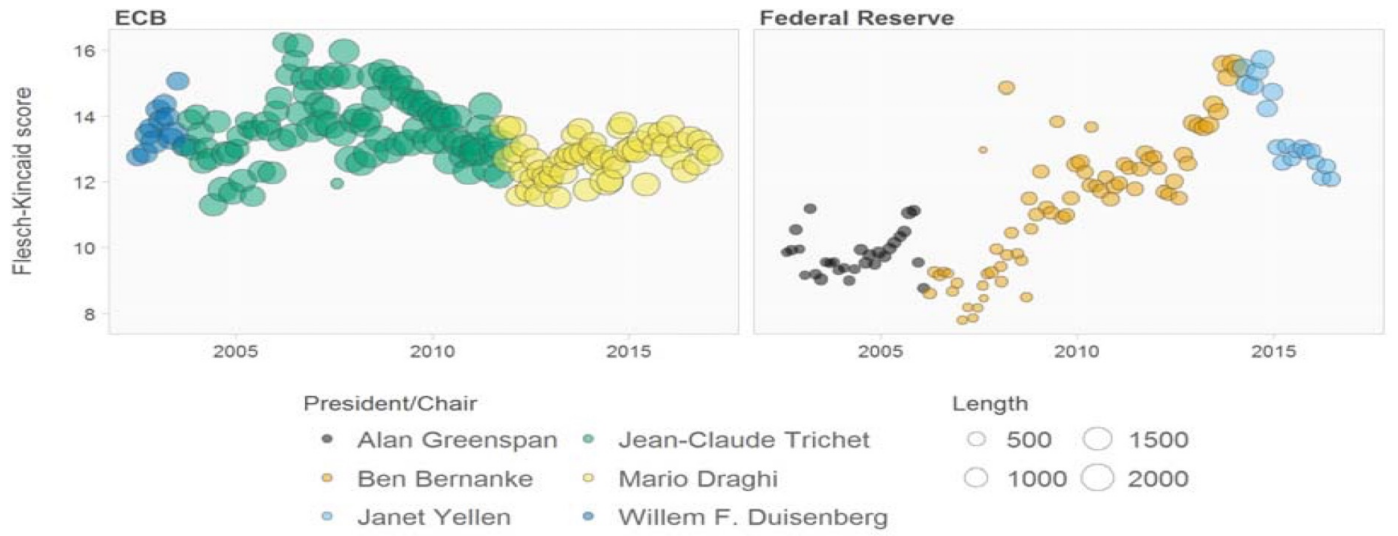
Motivation: Importance Of Policy Communication

Monetary policies enacted by central banks…

- Have large impacts on the welfare of businesses & individuals
- Are often complex

Achieving desired results requires policy communication being *RECEIVED ACCURATELY*

Figure 2: Length of ECB/FOMC monetary policy statements and difficulty of language employed



Note: The figure depicts the length of the ECB's introductory statements and the FOMC monetary policy statements, measured by the number of words, through the size of the circles. The difficulty of the language employed is measured by the Flesch-Kincaid reading grade level statistic (which indicates how many years of formal training are required to understand the text, based on the length of its sentences and words). Last observation: March 2017.

Source: Coenen, Ehrmann, Gaballo, Hoffmann, Nakov, Nardelli, Persson & Strasser (2017)

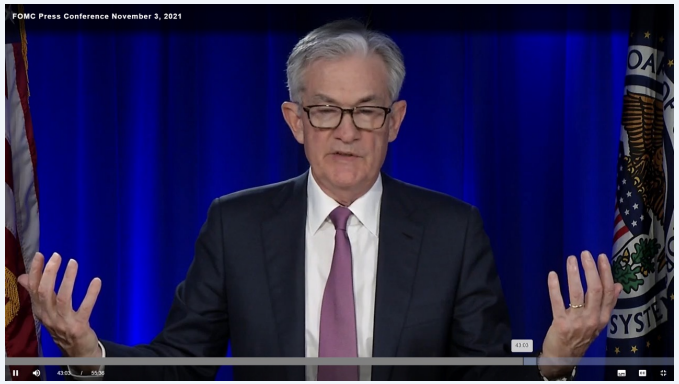
Mixed Signals: Perceived & Received

Mixed Signals can come from:

1. Perception of different parts of the communication *(words)* tell conflicting stories
2. Words perceived to be *misaligned with non-textual signals* sent during delivery

Received Signals Also Depend on Form of Central Bank Communications

Examples of Direct Communication



Press Release

March 22, 2023

Federal Reserve issues FOMC statement

For release at 2:00 p.m. EDT

Examples of Indirect Communication

Tiffany Thomas @wealthytiffany · 2h

Fed Holds the Course at September **2021** Meeting

Fed **Chair Powell** issued an upbeat report after the Sept. **2021** FOMC meeting, signaling no immediate policy changes.

investopedia.com

Fed Holds the Course at September 2021 Meeting

Fed Chair Powell issued an upbeat report after the Sept. 2021 FOMC meeting, signaling no immediate...

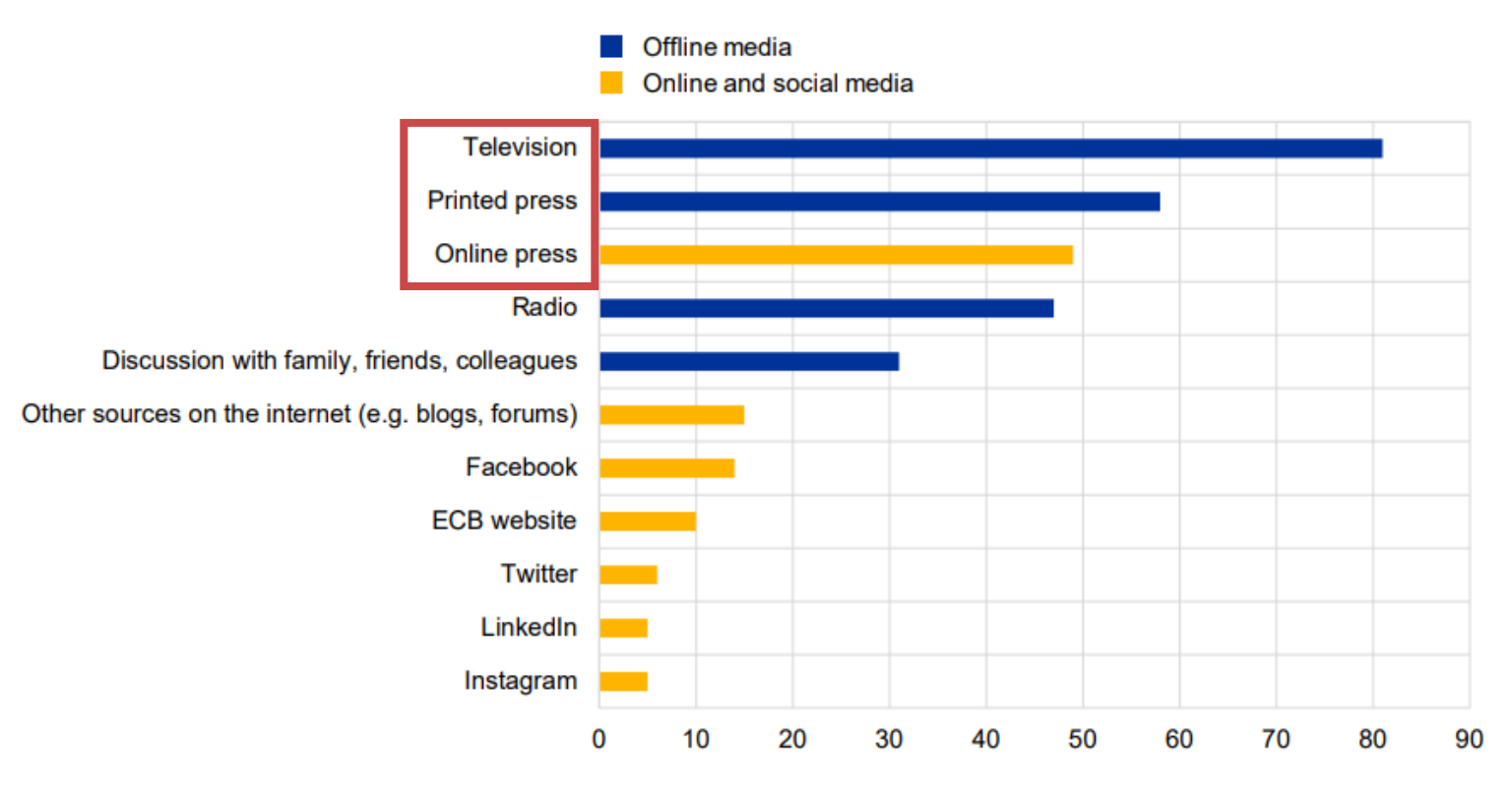
The New York Times

Powell Pledges to Maintain Economic Support

For now, "the economy is a long way from our employment and inflation goals, and it is likely to take some time for substa...

Jul 1, 2021

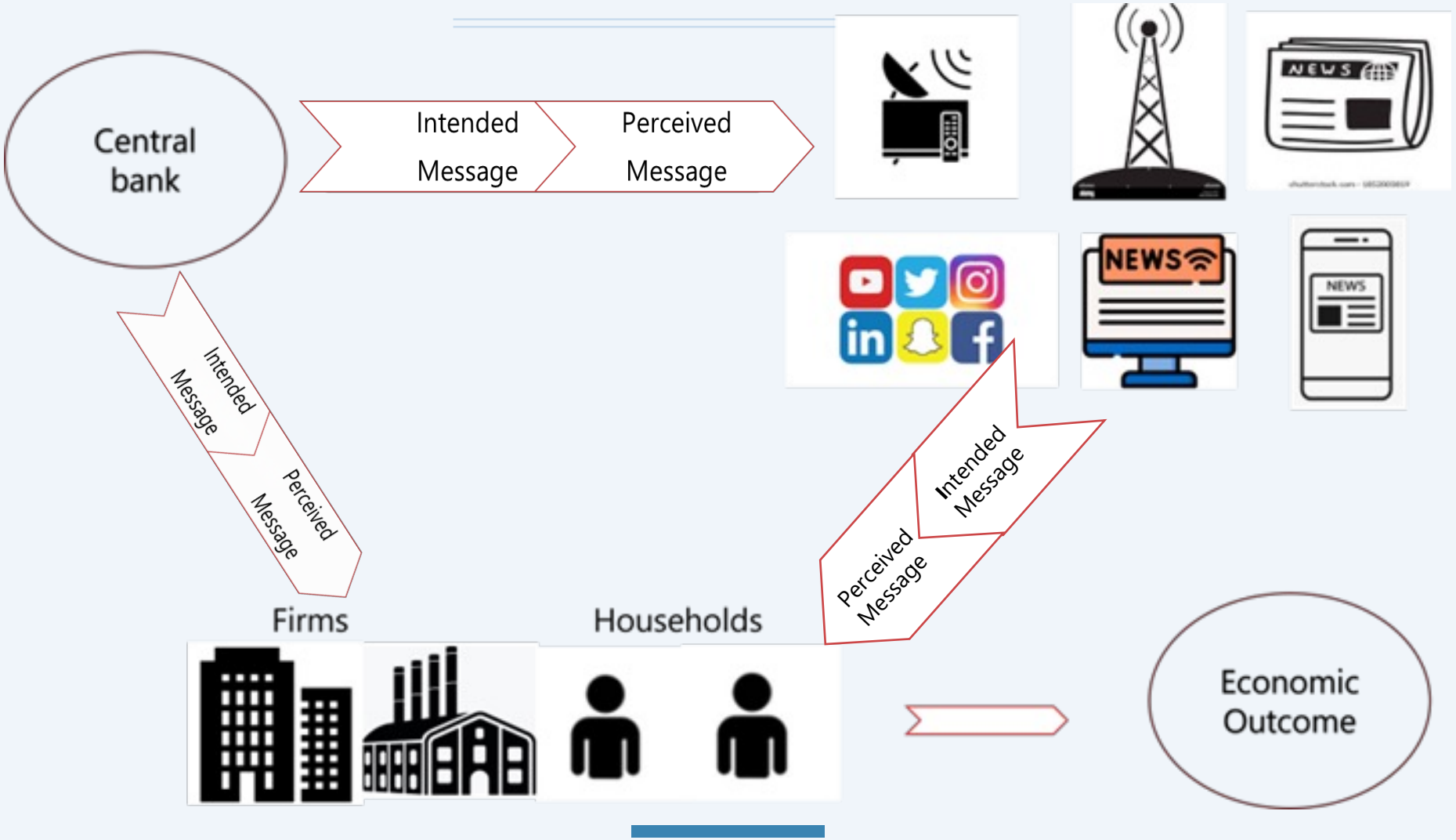
Indirect Communications reaches the largest audience but often with a lag…



Source: Blinder et al. (2024)

See also Gardt, et al (2022) , Blinder and Krueger (2004), Coibion, et al (2020), Alexopoulos, et al. (2024)

Mixed Signal Problem is Worse for Indirect Communications



What do we study?

How does the content & delivery of central bank messages impact:

1) Selection of what is reported by media, and
2) How reported messages are transformed?
    a. Complexity
    b. Sentiment
    c. Semantic meaning

Related Literature

Monetary Policy Communications & Impacts

- Blinder et al (2024); Gurkaynak et al. (2005); Swanson (2021); Hansen and McMahon (2016); Bholat et al. (2019); Ehrmann and Talmi (2020); Ehrmann and Wabitsch (2022); Kryvtsov and Petersen (2021)

Emotions Studies in Political Science

- Dietrich et al. (2018); Dietrich et al. (2019)

Emotions in Press Conferences & Testimonies

- Gorodnichenko et al. (2023); Curti & Kazinnik (2024); Alexopoulos et al (2024); Kanelis & Siklos (2022); Fraccaroli et al. (2023)

Determinants of Media Reporting

- Gentzhow and Shaipro (2010); Berger et al (2013); Mullainathan and Shleifer (2015)

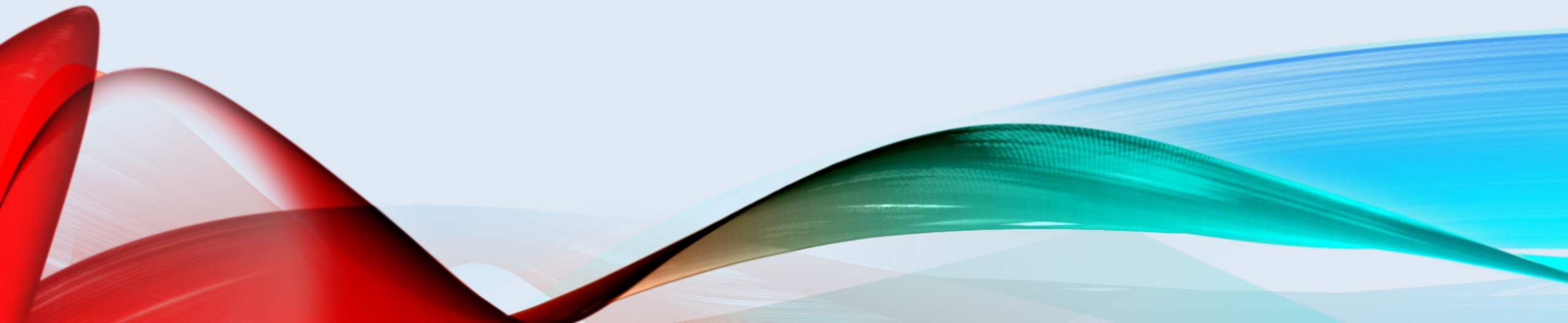
Psychology Emotions literature

- Ekman & Friesen (1969); Ekman, Frieen & Hager (2002); Gelder, Teuniess & Benson (1997); Cowie & Cornelius (2003); Laukka, Juslin & Bresin (2005); Lausen & Schcht (2018); Kamilogoglu, Fischer & Sauter (2020)

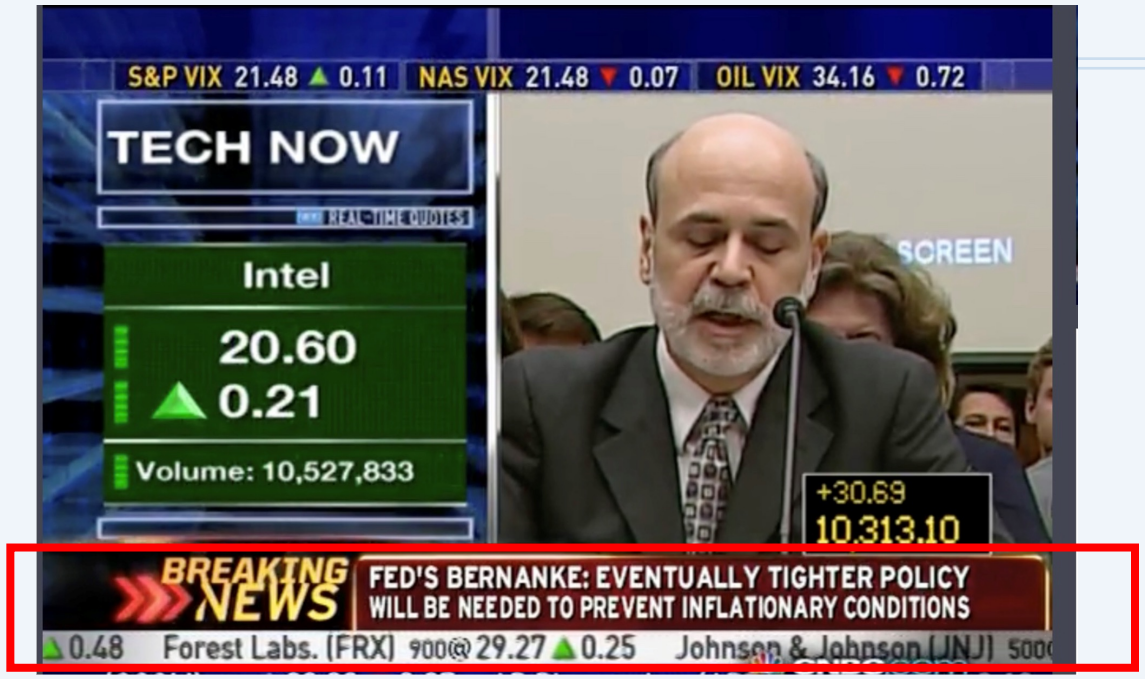
Applied Computer Science

- Devlin, Chang, Lee & Toutanova (2018); Campello, Moulavi & Sander (2013); Malo, Sinha, Takala, Pekka & Wallenius (2014); Aarachi (2019)

Our research adds to the literature along a number of dimensions…



We include TV data in the analysis



[001:21:45;667] LET'S GO TO THE HOUSE FINANCIAL
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[001:21:47;869] WE BELIEVE JANET YELLEN IS ABOUT
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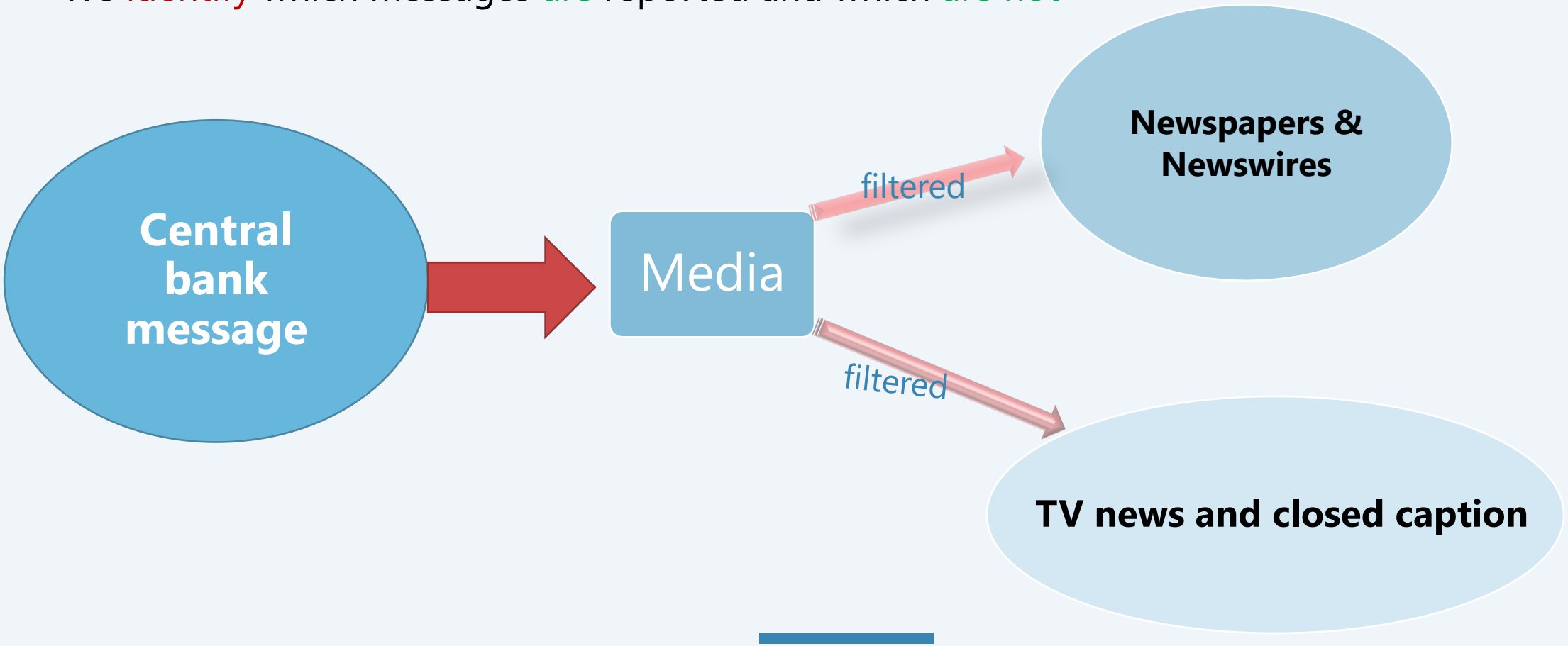
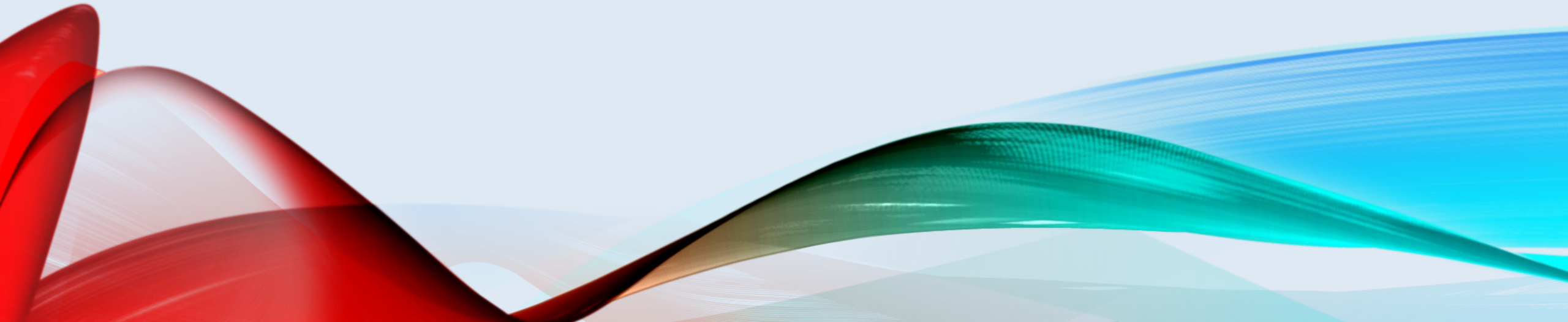
TV rolling news and closed captions

We study pass-through of messaging

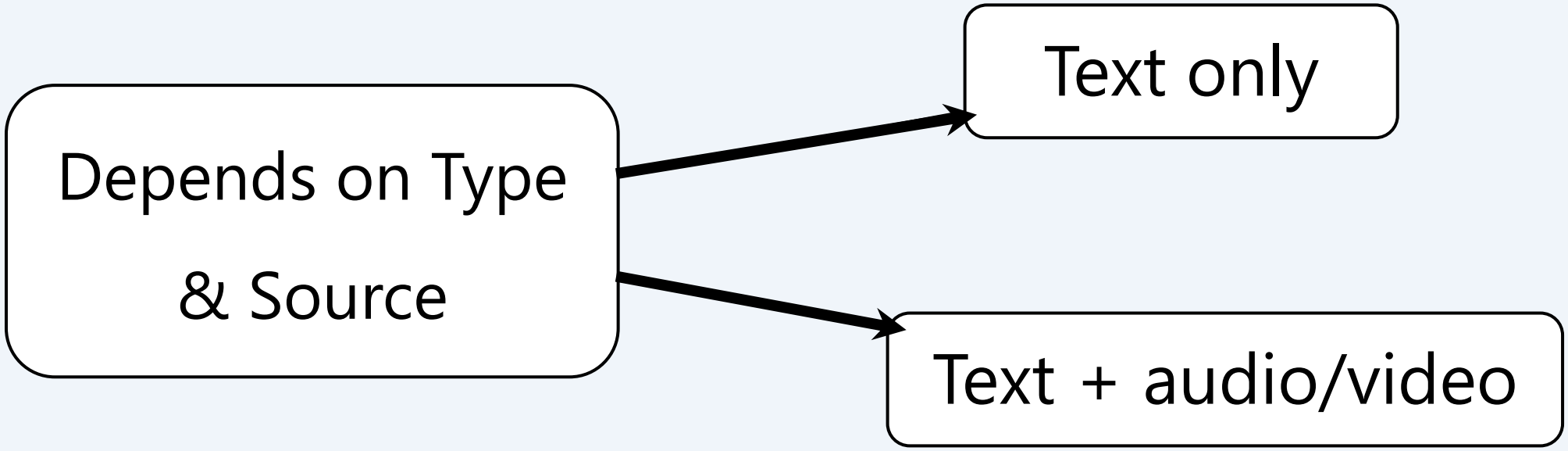
- We match news sentences to the central bank messages
- We identify which messages are reported and which are not



What Forms the Central Bank's Message?



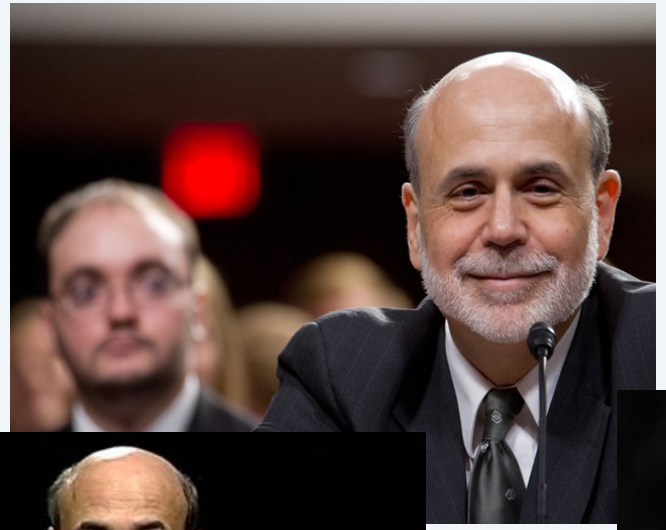
What makes up Communication?

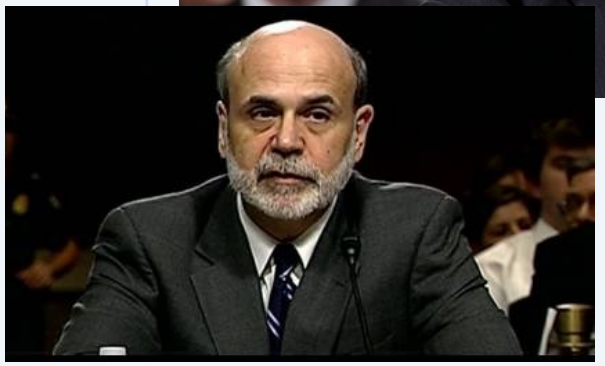


CB Messages Composed of Words and More…

Most communication comes from **body language** & **tone of voice**

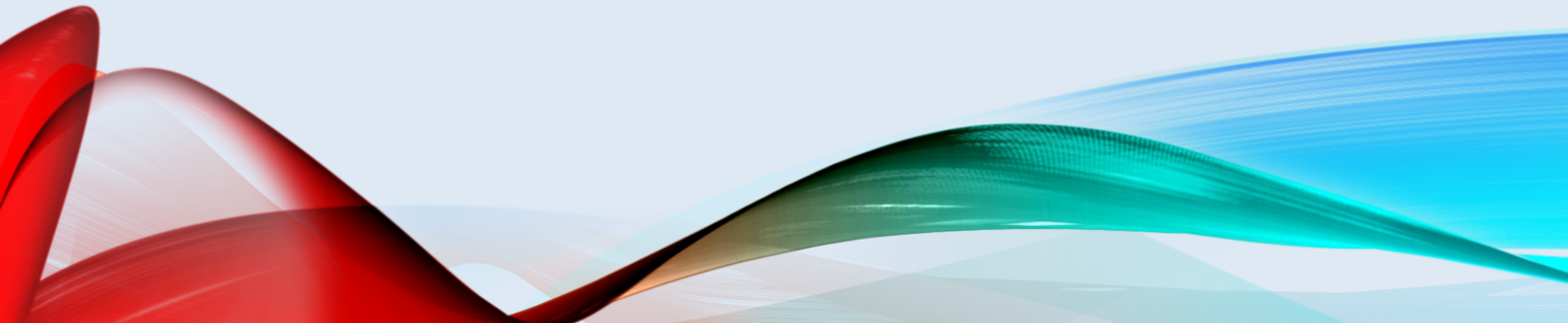
- Mehrabian (1972): 55% body language, 38% tone, 7% words





What Impacts Media Coverage…

Text, Vocal and Facial Emotions?



Imagine you are a reporter in the Press Conference/Testimony

Imagine you are a reporter in the Press Conference/Testimony

- What messages are you **seeing**, **hearing** and **perceiving**?

Economic environment

Remarks or Q&A

Speaker

Topics (monetary policy, inflation, housing, etc)

Monetary policy stance

Text sentiment (positive, neutral, negative)

Voice

Face

Body language (gesture, head movement, eyeblink)

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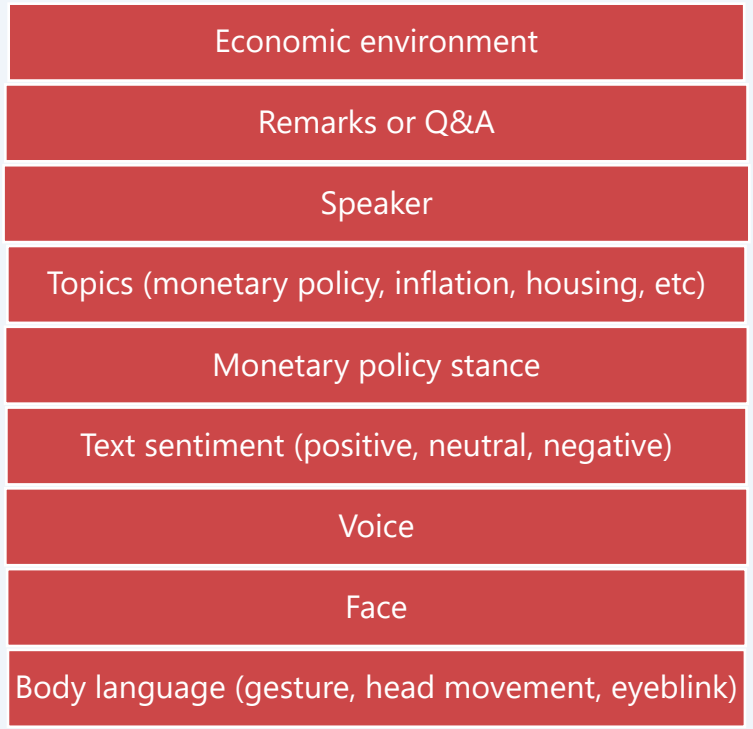

Step 1: **selection**

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Step 1: **selection**

- What messages are you going to report?

Step 2: **reporting**

- How are you going to report them?

- Quote or paraphrase
- Text sentiment of the sentences
- Text sentiment of the article
- Complexity (#of words, avg. word length, etc)
- Semantic meaning (Change words?)

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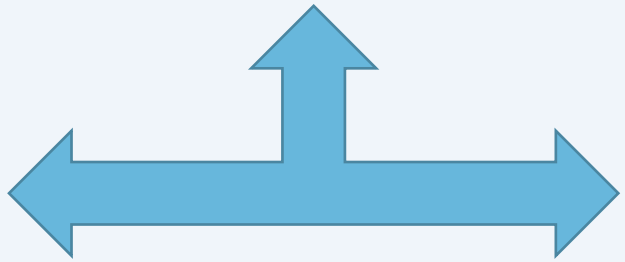


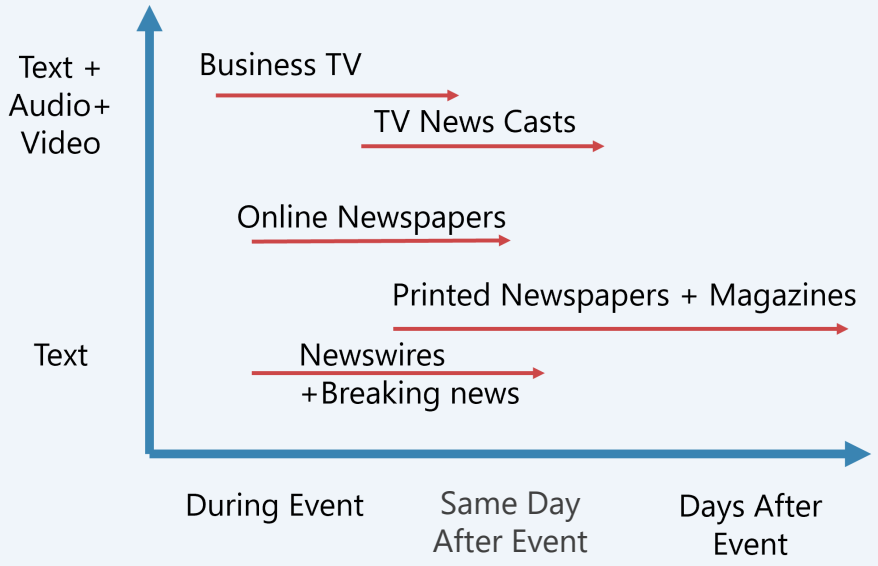
We create measures using ML for all of these at the sentence level

Media's Audience Can Also Influence Coverage Decisions… So We Collect Metadata on Sources

Characteristics

- Political leaning
- Foreign vs Domestic
- Business vs General
- Offline vs online

Demand for Type of Information



Our Data

- 32 semi-annual monetary policy report testimonies from 2010-2017 covering ~82 hours of Bernanke + Yellen
- TV, Newspaper and Newswire data on day of + 9 days
- Metadata on sources to allow for exploration of differences across audiences

Why Testimonies?

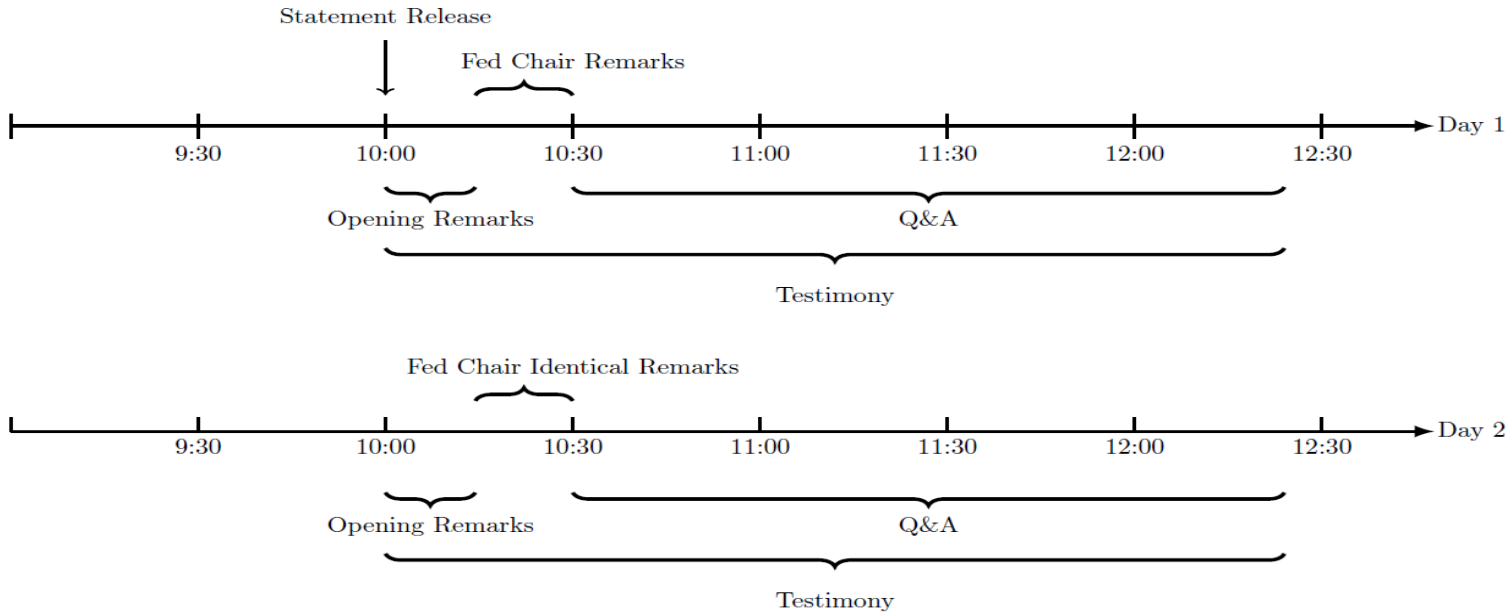
- Important events that don't occur on same day as policy announcements
  -E.g., Swanson & Jagawickrema (2024), Olson & Wessel (2016)+ economic calendars
- Scripted & Unscripted statements
- Testimonies discuss many topics (not only focused on rates)
- Print & social media coverage as high as for testimonies as press conferences & there is a significant viewing audience (TV, terminals, web, etc.)
- Multiple political actors -> can investigate how others' responses impact coverage

Structure of Semi-Annual Testimonies (~2-3Hrs)

Combo of Prepared Remarks & Unscripted Q&A

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

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

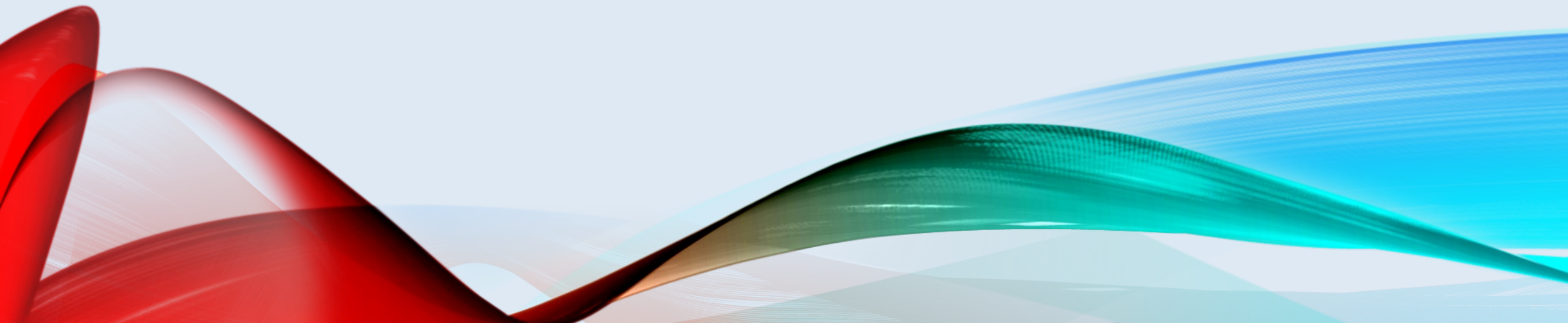


Opening remarks by Members primarily given by Ranking Members

**Same remarks given by Fed Chair Day 1 & 2

Measuring Emotions in Communications

Text, Vocal and Facial Emotions

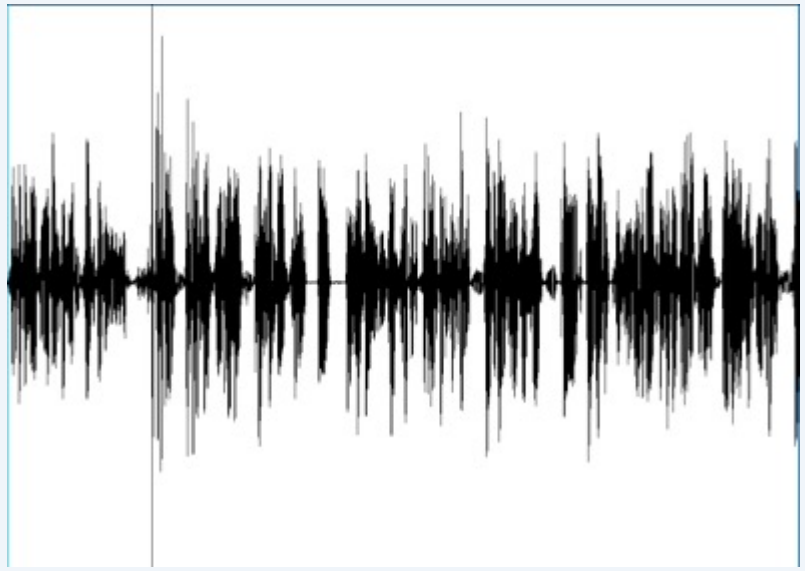


We Measure Fed Chairs' Emotions in Testimonies

Text:

Speaker	Sentence	Sentiment
MENENDEZ:	And so would you give me your view of how the first and second rounds of quantitative easing are working?	0
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.	1 0 1 1 1

Audio:



Video:

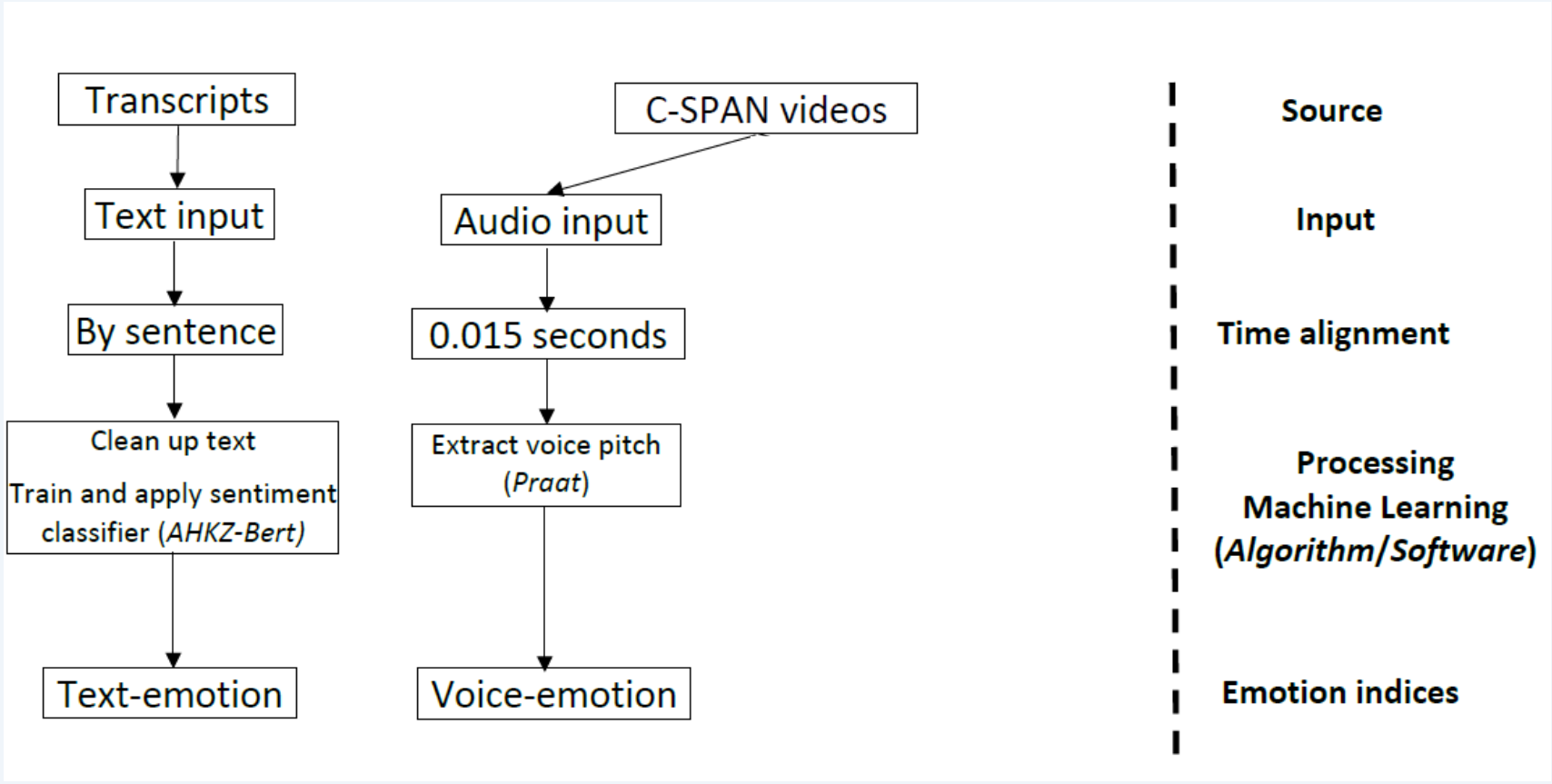
Overview of ML Procedures Used for Data Creation

Text Sentiment & Stance

*Fine Tuned BERT Model trained on sample of testimony sentences for sentiment

** Fine Tuned BERT Model trained for Stance using samples of testimony sentences + Gorodnichenko et al (2023) samples

Overview of ML Procedures Used for Data Creation

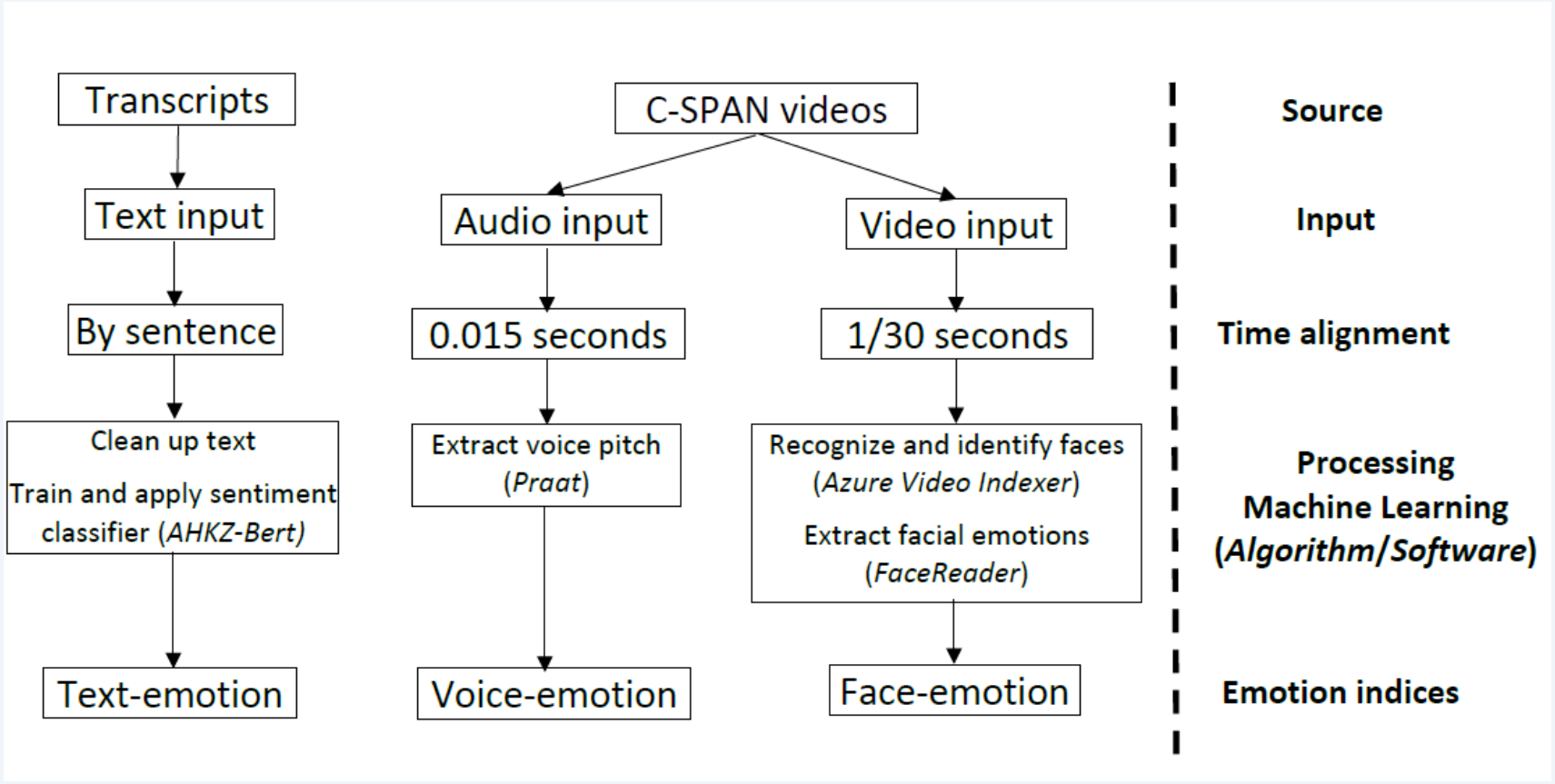


Vocal Activation Measure

Similar approach to Dietrich et al. (2018); Dietrich et al. (2019), Alexopoulos et al (2024)

- ▶️ Sentences timestamps: forced alignment algorithm
- ▶️ Parse audio to sentences level
- ▶️ Demeaned to account for differences in regular pitch (F0- Fundamental frequency)

Overview of ML Procedures Used for Data Creation



AU-Facial Emotions

Facial emotions are the combination of action units

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

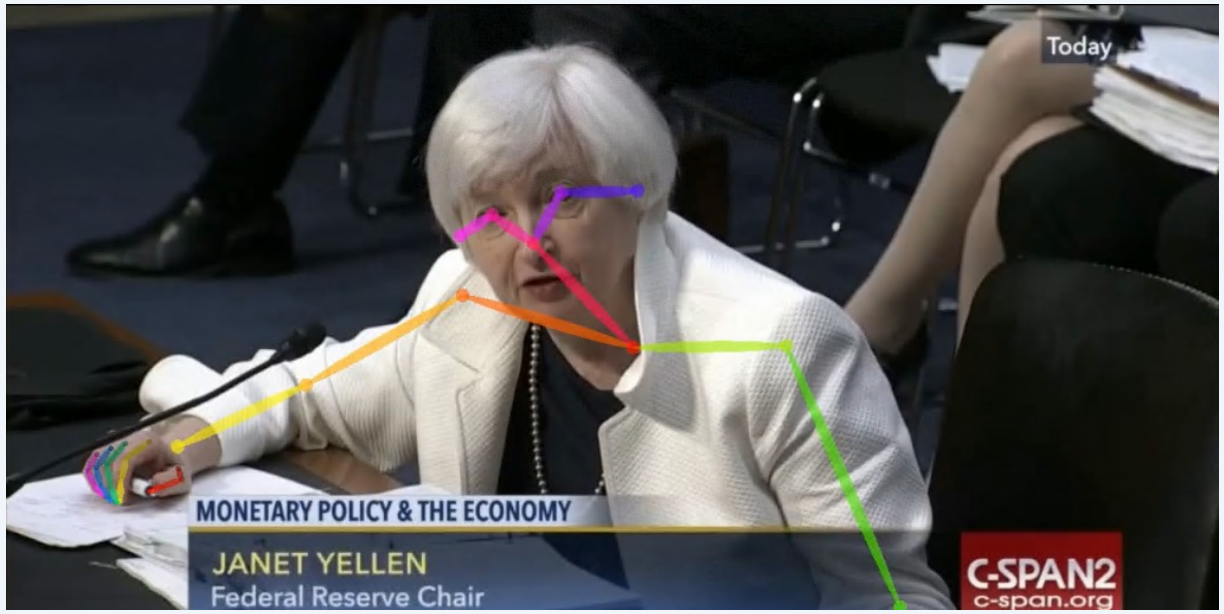
Overview of ML Procedures Used for Data Creation

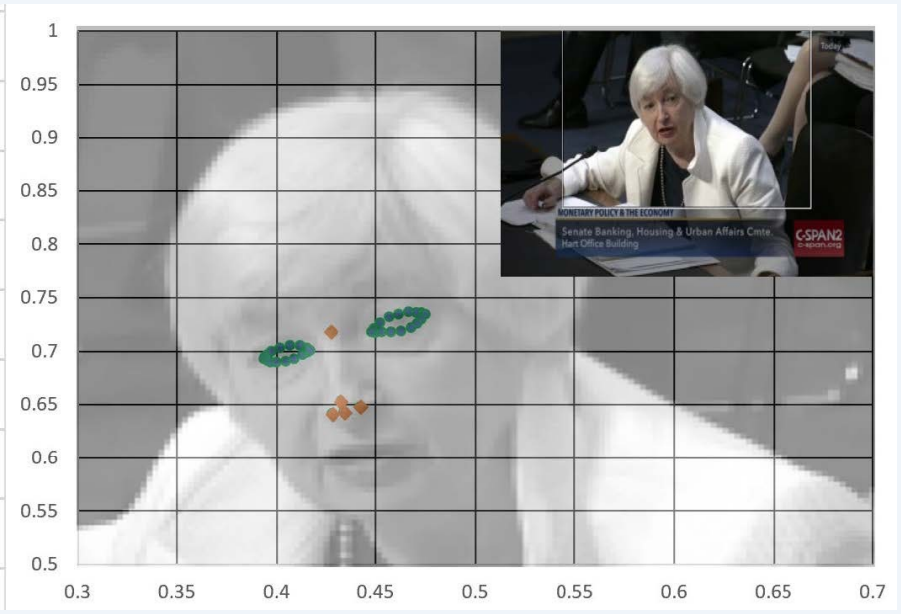
Body Movement also examined:

-Head movement

-Eye blinking

-Hand Gestures (to little identified to be of use)





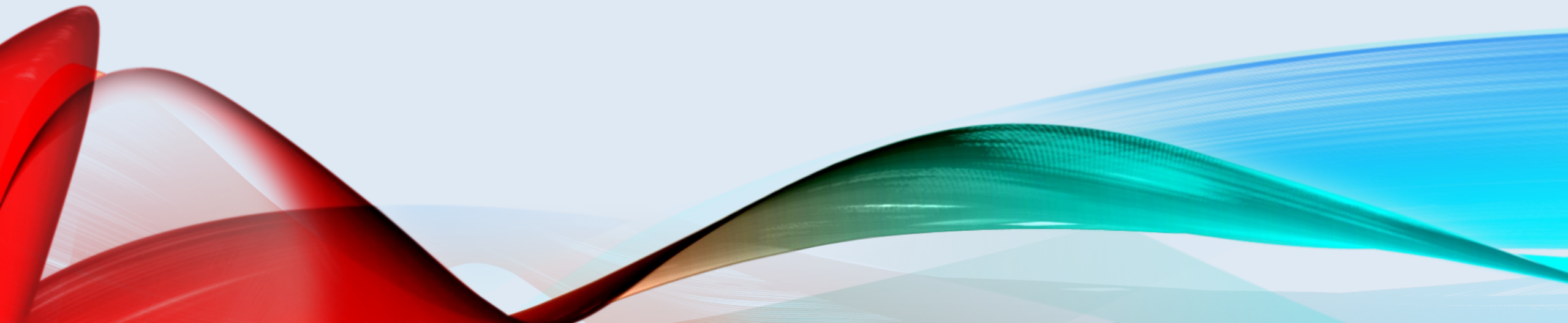
Testimony data (extension of Alexopoulos et al (2024))

Sentence level information:

- House/Senate committee
- First/second day testimony
- Prepared vs. Q&A
- Timestamp
- Speaker name
- Political party, gender, etc. for Congress & Senate members
- Readability

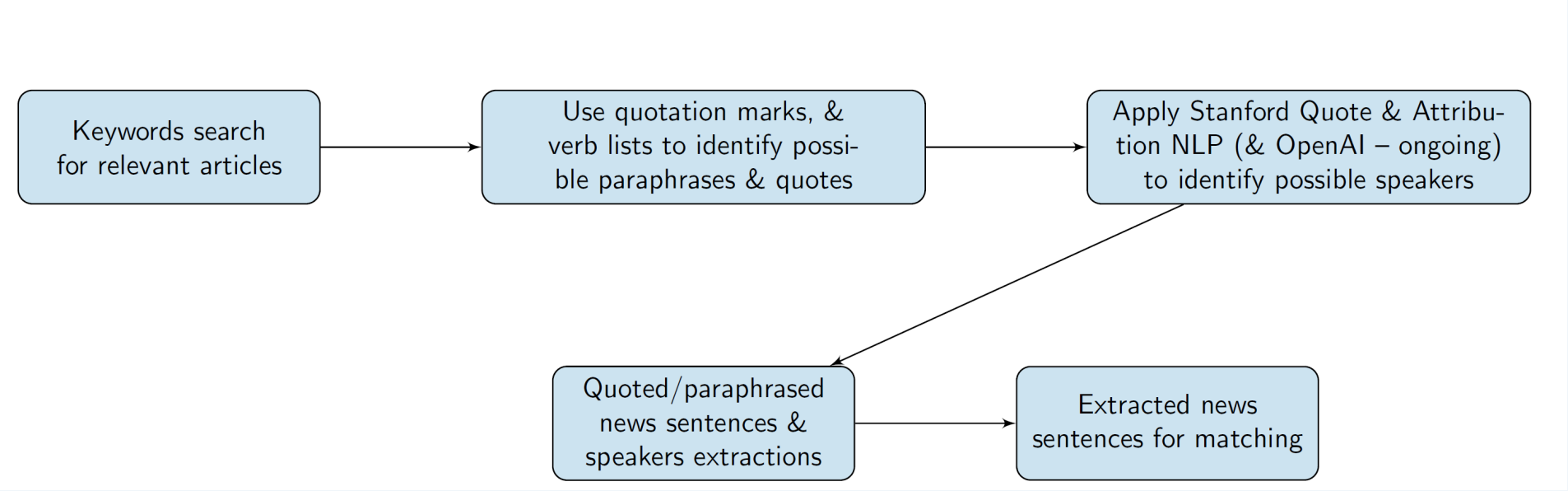
- Textual cues (Fine-tuned BERT models)
  - Sentiment
  - Stance
  - Bert-topics
- Non-textual cues (Demeaned)
  - Voice pitch
  - Face emotion
  - Eye blinking rate (per minute)
  - Head movement

Identification of Testimony Media Coverage



Identification of Newspaper & Newswire Coverage

- Proquest's Global Newstream and Factiva
- Collect all articles published from testimony day +9 days



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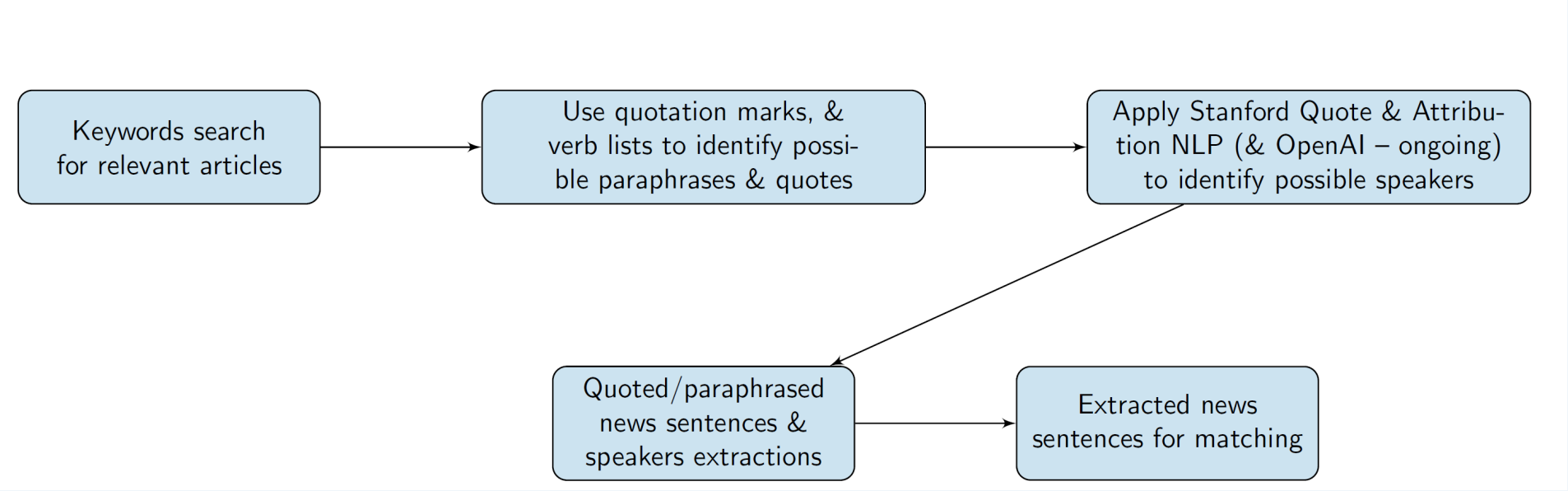
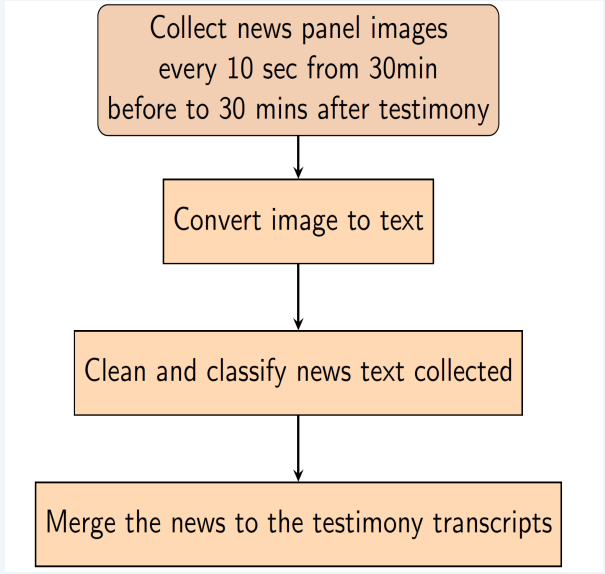


****Sentence Metadata** is inherited from article's source: country of publication, type of publication, political leaning, etc.

Identification of TV Media Coverage

Breaking News



Live & Non-Live TV Coverage

```
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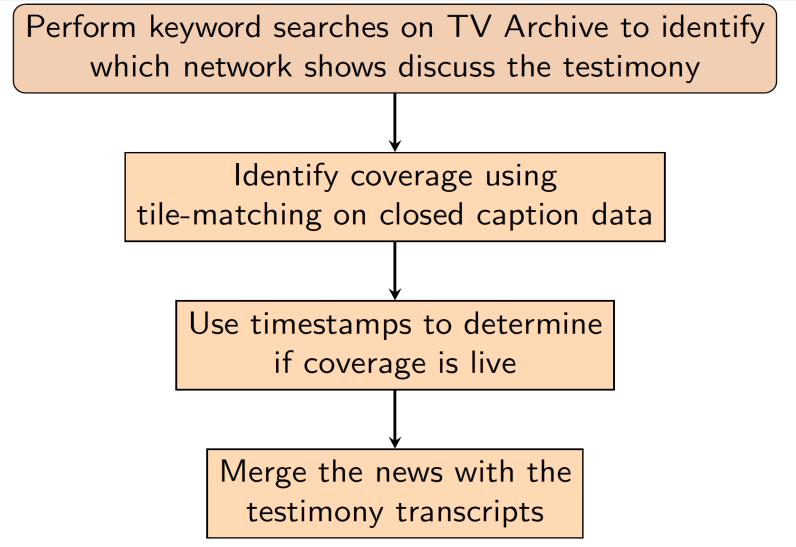


Statement metadata is inherited from its source: Country of production, target audience, political leaning

Matching Testimony to Media Coverage

Sets Matched using combination of:

- Scoring algorithms (E.g., TFIDF, SBERT similarity, tiled matches)
- Speaker attribution, and
- Date & Time information within the article/show (to identify correct match for Day1 vs Day 2)

***Matched sentences scored for sentiment, stance, complexity, …**

Resulting Matched Dataset

- **36,298** Testimony sentences with verbal & non-verbal characteristics

- 6,200+ **newspaper & newswire** articles from 298 unique publishers

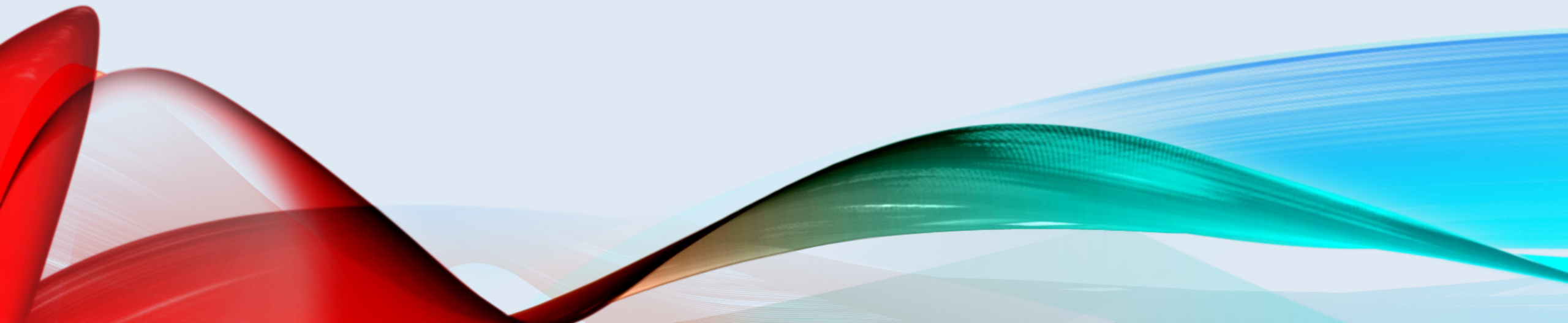
  Extracted 24,640 news sentences quoting from **4,593 unique testimonies sentences

- **Live & non-live TV coverage** from shows on over 38 networks + CNBC TV programs rolling news

  Extracted 57,133 news sentences quoting from **22,526 unique testimonies sentences

Estimation Strategy

Uses Linear regressions and Heckmans



Selection

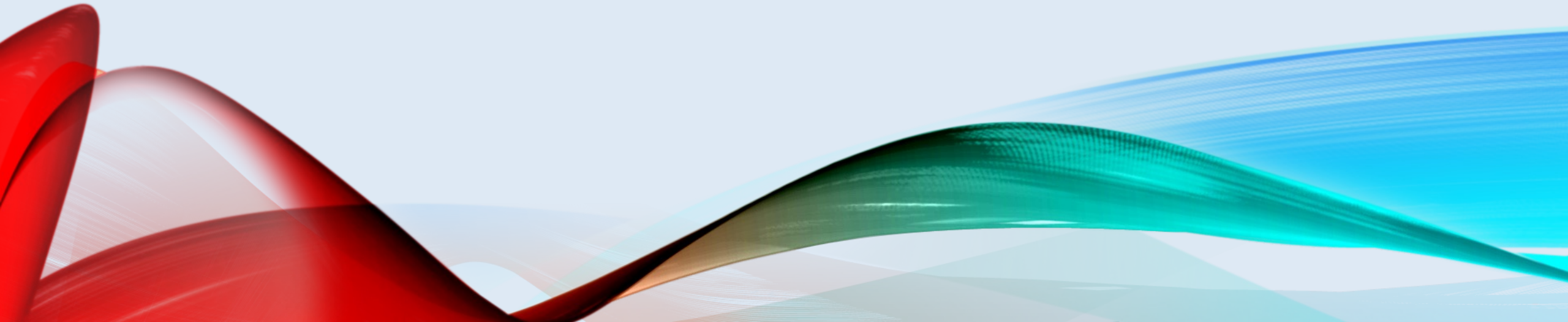
$$\text{Select}_s = \sum_{j \in C} \alpha_j I_{s \in j} + \sum_{j \in C} \beta_j^v I_{s \in j} \overrightarrow{Verbal}_s + \sum_{j \in C} \beta_j^{nv} I_{s \in j} \overrightarrow{NonVerbal}_s$$
$$+ \gamma_s \overrightarrow{Topic}_s + \eta_y + \eta_d + \eta_c + \varepsilon_s$$

where

- Select_s is a dummy variable equal to 1 if testimony sentence s is reported
- $I_{s \in j}$ is a dummy variable equal to 1 if s in section j, for each $j \in C$
  - $C = \{$Chair Prepared session, Mbr Prepared session, Chair Q&A , Mbr Q&A$\}$
- $\overrightarrow{Verbal}$: {Sentiment, Stance}'
- $\overrightarrow{NonVerbal}$: {Voice, Face, Eye blink, Head movement}'
- $\overrightarrow{Topic}_s$: {General, housing, financial stability, monetary policy, fiscal policy, currency}'
- η_y, η_d, η_c: year fixed effects, day 1 or day 2, senate or house committee

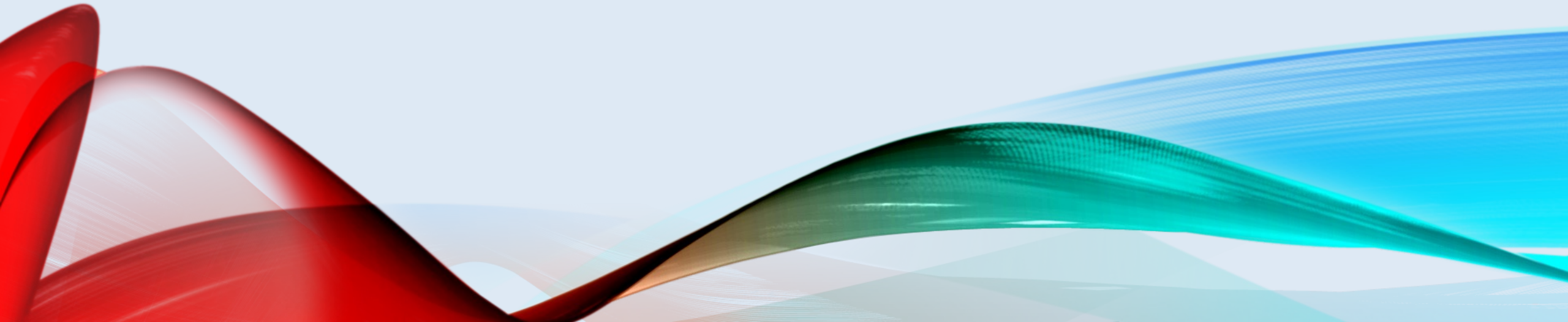
What Testimony sentences are the media more likely to report?

Main Findings for Selection



Selection Result #1: Placement Matters

Remarks v Q&A



What sentences are the media more likely to report?: Placement

- **Prepared Opening Remarks** more commonly selected than Q&A
- **Chair sentences** more likely selected than Congress Members' sentences

Implied ordering from Regressions
Chair Opening Remarks
Chair Q&A
Member Opening
Member Q&A

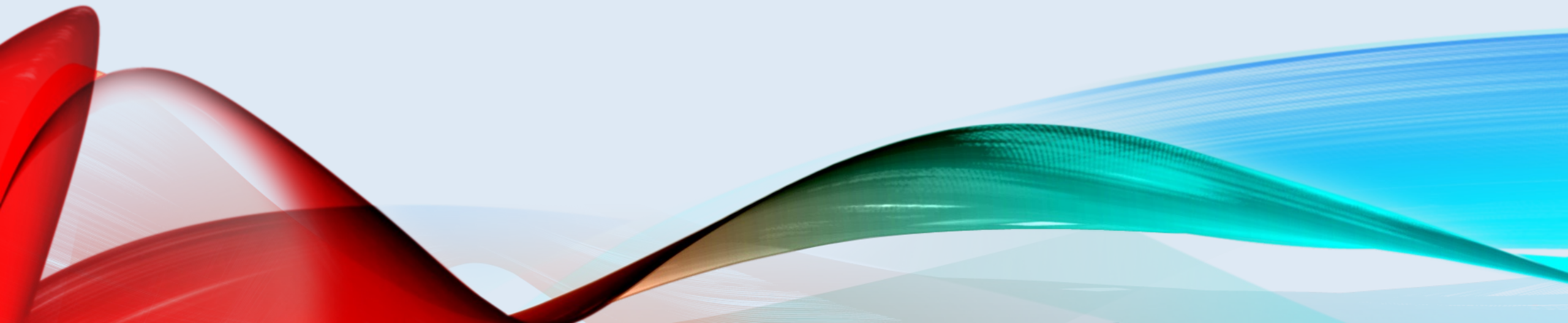
- Similar pattern for different newswire & newspaper subgroups: online vs offline; domestic vs international audience; general audience vs business audience; across political spectrum

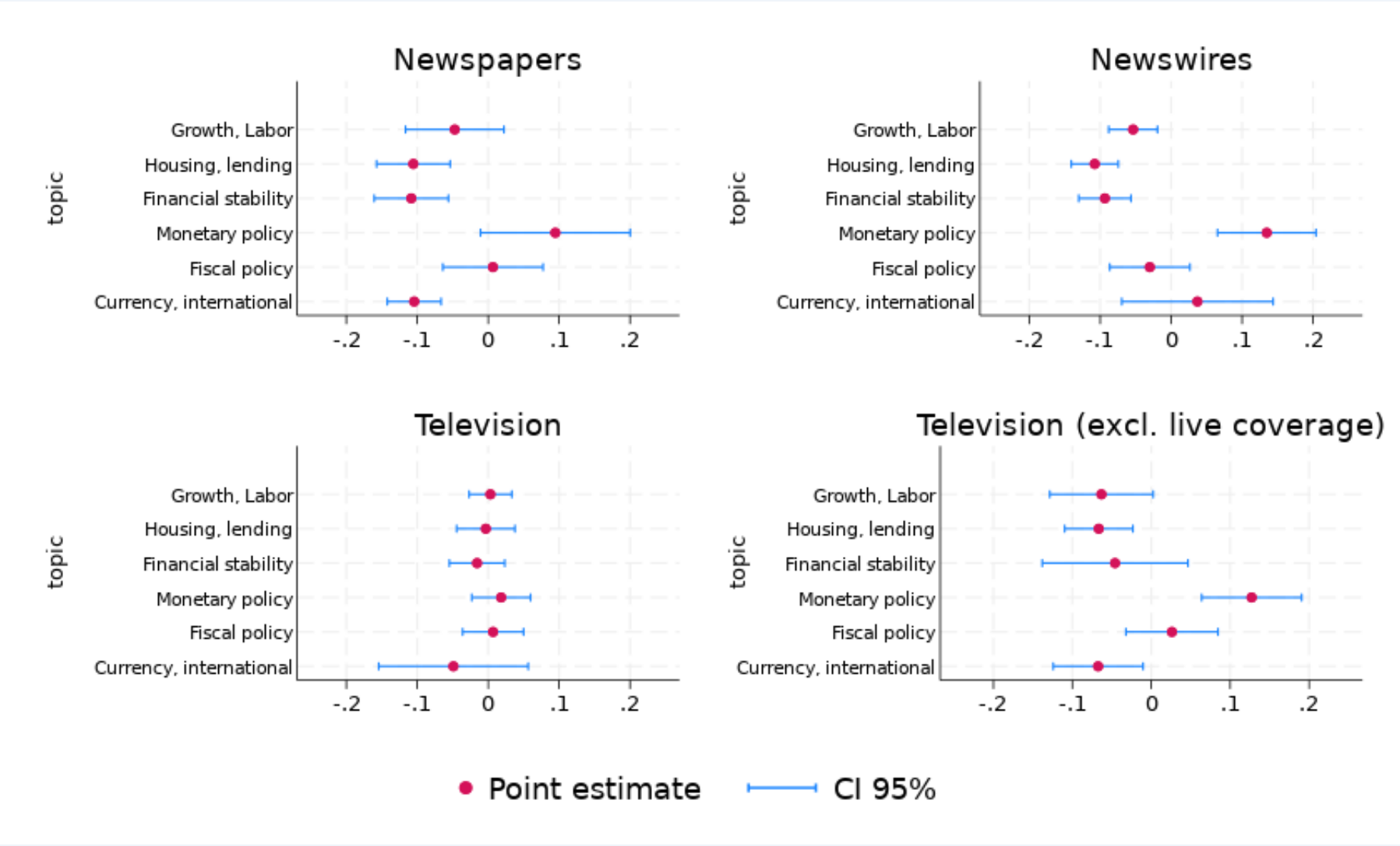
Observation: Significant variation across media types

Placement	Newspapers	Newswires	TV
Chair Opening Remarks	0.65***	0.60***	0.70***
Chair Q&A	0.24***	0.28***	0.80***
Member Opening	0.10***	0.20***	0.53***
Member Q&A	0.04**	0.00	0.74***

***TV is more balanced** since some channels show live coverage of entire event (e.g., business channels and CSPAN)

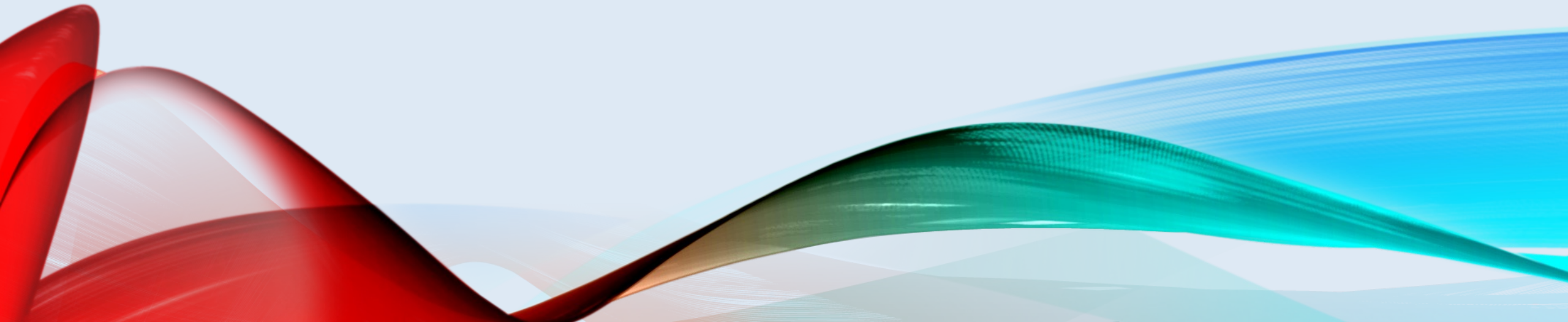
Selection Result #2: Topic matters





Good News: Monetary Policy Topics do get covered the most

Selection Result #3:
Text-sentiment matters for Chair remarks



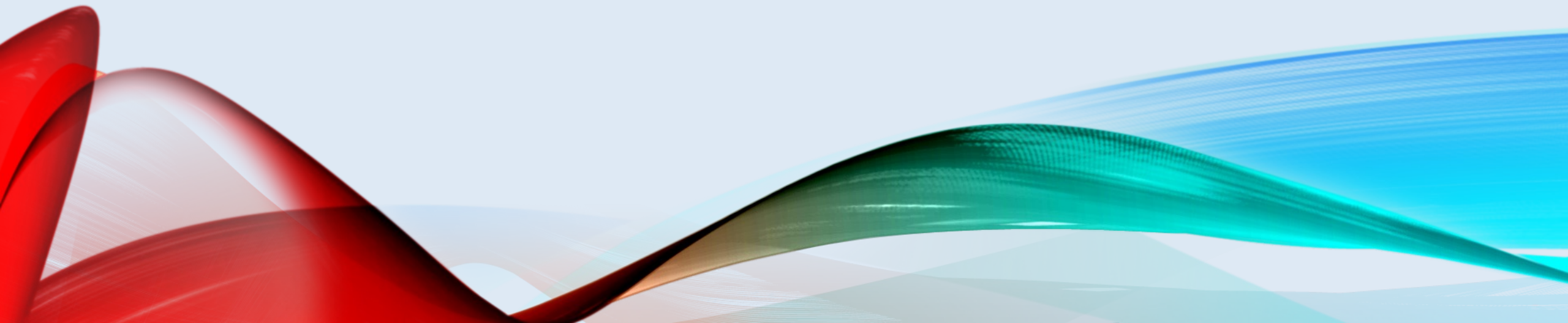
What sentences are the media more likely to report?

- **Negative text sentiment in Chair Remarks** (Newspapers & Newswires)
  - Coefficients: -0.04* to -0.06** imply a one-SD decrease in text sentiment implies ~4-6 ppt increase in likelihood of selection

Similar patterns emerge across subgroups:

		online vs offline		**audience residence**		**target audience**		**political leaning**		
		Online	offline	domestic	international	general	business	left	center	right
Chair Text	Remarks	-0.05**	-0.06**	-0.05**	-0.06**	-0.05**	-0.05**	-0.07**	-0.06**	-0.04**
					***=1%, **=5%, *=10%					

Selection Result #4: Delivery of message matters



What sentences are the media more likely to report?

- **Higher voice pitch** by Chair & Members
  - Coefficients 0.05** to 0.07** for remarks imply a one-SD increase in pitch increases selection ~5-7 ppt
  - For Chair Q&A one-SD increase raises selection 1-4 ppt for newspapers and newswires

- **Limited impact of other non-textual signals** for selection (although coefficients for Chair Face expressions often positive)

What sentences are the media more likely to report?

Similar patterns emerge across subgroups

	online vs offline		audience residence		target audience		political leaning		
More likely to select (with Y)	online	offline	domestic	international	general	business	left	center	right
Higher Chair Voice (in Remarks or Q&A)	Y -Both	Y-Both	Y-Both	Y-Both	Y-Both	Y-Both	Y-Both	Y-Both	Y-Both
Higher Member Voice(in Remarks or Q&A)	Y-Rmks	Y-Rmks	Y-Rmks		Y-Rmks				Y-Q&A
Happier Face		Y-Mbr Q&A	Y-Chair Q&A		Y-Mbr Q&A				Y-Mbr Q&A

What sentences are the media more likely to report?

But magnitudes across newspaper & newswire groups tell a similar message…

		online vs offline		audience residence		target audience		political leaning		
		Online	offline	domestic	International	general	business	left	center	right
Chair Voice	Remarks	0.06***	0.06***	0.05***	0.07***	0.06***	0.06***	0.05*	0.08***	0.05**
	Q&A	0.03**	0.03**	0.03**	0.03*	0.04*	0.03**	0.02**	0.02*	0.01**
Member Voice	Remarks	0.05**	0.05*	0.08**		0.05**				
	Q&A									-0.00*

The vocal effects for Chair Remarks are about twice as large as Q&A

***=1%, **=5%, *=10%

What sentences are the media more likely to report?

TV results for text and voice similar to newspapers & newswires

	Television		
More likely to select (with Y)	Non-live (e.g., Nightly news)	Breaking News	Live
Negative Chair Text Remarks	Y	Y	
Higher Chair Voice (in Remarks or Q&A)	Y -Both	Y-Rmks	Y-Both

Impact of 1-SD increase in Chair Vocal Pitch increases TV selection 8 ppt (Non-live coverage), 16 ppt (Breaking news) in Remarks section and ~3-2 ppt in Q&A

How might we increase selection of desired monetary policy messages by the media?

How might we increase selection of desired monetary policy messages by the media?

"**Potential Strategy**"

- **Placement:** Put it in the Chair's remarks first & potentially repeat in Q&A
- **Delivery:**
  - -Increase coverage using **increased voice pitch** in remarks and Q&A
  - -**Align facial expressions** with messaging (especially for Positive messaging)

****Negative messaging:** More Negative Text Sentiment will increase coverage

*****Positive messaging:** **Need to using delivery & repetition more to increase coverage**

However, to make this “Potential Strategy” a good approach we need to understand how the signals impact the message seen though the media…

Outcome Regressions

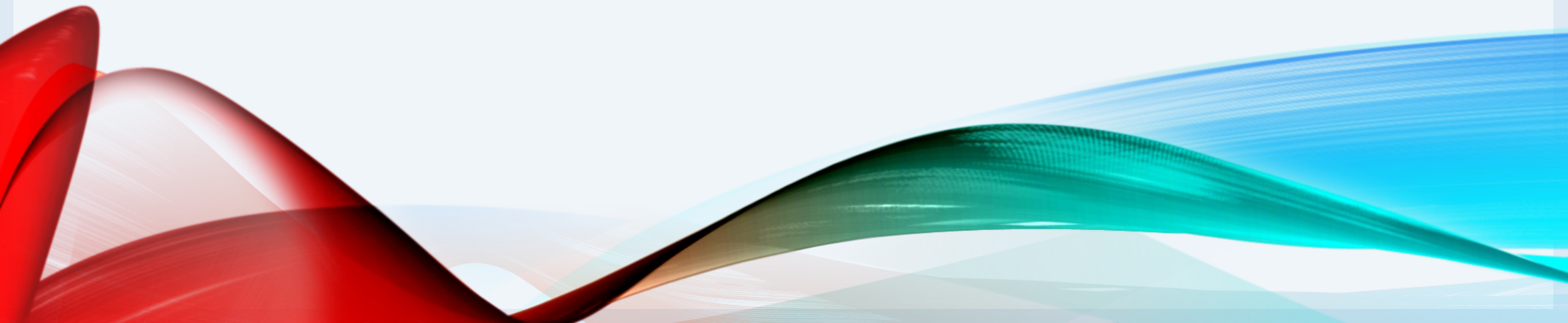
$$E[\text{Outcome}_s|\textit{covariates}, \textit{Select}_s = 1] = \sum_{j \in C} \alpha_j I_{s \in j} + \sum_{j \in C} \beta_j^v I_{s \in j} \overrightarrow{\textit{Verbal}}_s + \sum_{j \in C} \beta_j^{nv} I_{s \in j} \overrightarrow{\textit{NonVerbal}}_s + \eta_y + \eta_d + \eta_c + E[\varepsilon_s|\textit{covariates}, \textit{Select}_s = 1]$$

where Outcome_s refers to

- the **change of complexity** of the news sentence(s) related to testimony sentence *s*
- the **sentiment** of the news sentence(s) related to testimony sentence *s*
- the **similarity** between the quoted news sentence and the original testimony sentence *s*

***Estimated using Heckman & Maximum Likelihood Estimation (MLE) to correct for selection bias**

#1 Changes in Complexity



Coleman-Liau Readability Score: Testimony Sentences

Coleman-Liau score = 5.88*(Avg word length) - 29.6/(sentence length) – 15.8

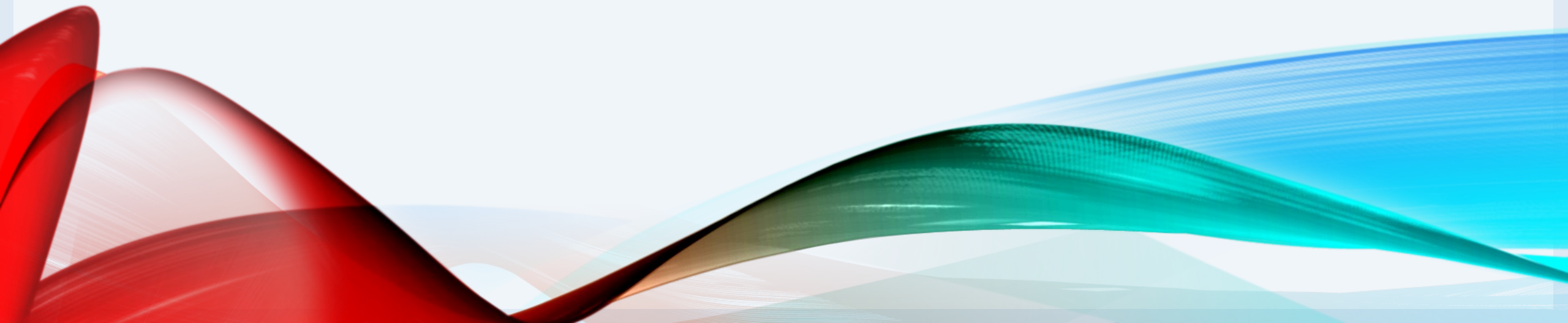
*Measure gives approximate grade level

Original Testimony Scores

	Chair	Member
Prepared Remarks	14.9	12.9
Q&A	10.3	10.0

*Values for Prepared remarks similar to levels seen for FOMC readability scores in the literature e.g., 14.5 suggests 2nd year undergraduate level

Change in Complexity Depends on Placement



Change in Coleman-Liau Readability Score

$$\triangle \text{Readability}_s = \sum_{j \in C} \alpha_j I_{s \in j} + \sum_{j \in C} \beta_j^v I_{s \in j} \overrightarrow{Verbal}_s + \sum_{j \in C} \beta_j^{nv} I_{s \in j} \overrightarrow{NonVerbal}_s + \eta_y + \eta_d + \eta_c + \varepsilon_s$$

Key Results

1. **Media tends to increase complexity**

>related to media placing statements in context for the reader

*E.g., …"**Unemployment is the most important problem we have right now, and we take the dual mandate extremely seriously**," he said Thursday in response to questions at the House financial services committee in the second day of semi-annual congressional testimony on monetary policy….*

Change in Coleman-Liau Readability Score

$$\triangle \text{Readability}_s = \sum_{j \in C} \alpha_j I_{s \in j} + \sum_{j \in C} \beta_j^v I_{s \in j} \overrightarrow{Verbal}_s + \sum_{j \in C} \beta_j^{nv} I_{s \in j} \overrightarrow{NonVerbal}_s + \eta_y + \eta_d + \eta_c + \varepsilon_s$$

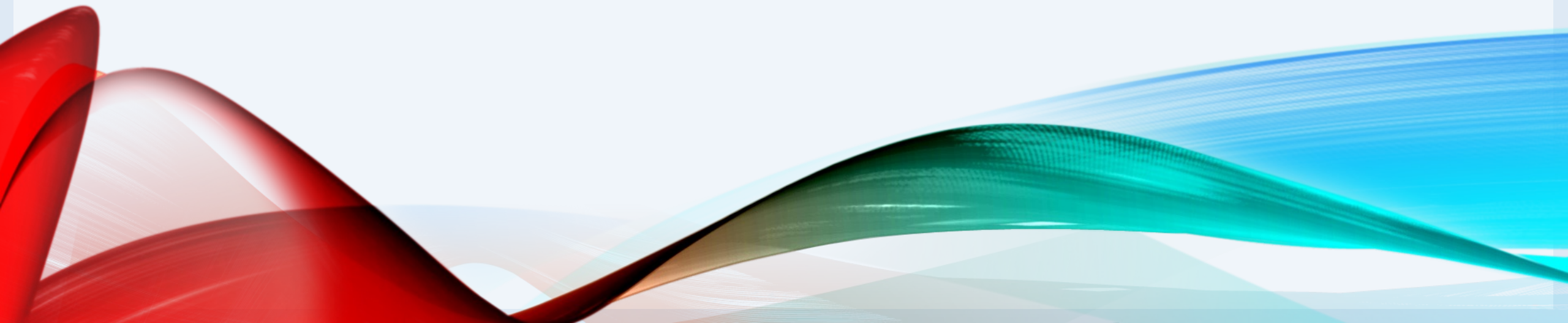
Key Results

1. **Media tends to increase complexity**
   - -Ranges from +6 years for Chair prepared remarks to +8-9 years for Q&A and Member remarks for Newspapers and newswires
   - -Streaming Media (TV) has minimal changes in complexity across sections

Lower complexity for reported Chair prepared remarks

Other Key Complexity Results…

Delivery & Wording



Change in Coleman-Liau Readability Score

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Key Results

2. Chair remarks: **1-SD ↑ voice increases complexity** ~0.45, **1-SD ↑ face lowers complexity** ~0.54

3. Complexity not significantly impacted by stance or sentiment

Change in Coleman-Liau Readability Score

$$\triangle \text{Readability}_s = \sum_{j \in C} \alpha_j I_{s \in j} + \sum_{j \in C} \beta_j^v I_{s \in j} \overrightarrow{Verbal}_s + \sum_{j \in C} \beta_j^{nv} I_{s \in j} \overrightarrow{NonVerbal}_s + \eta_y + \eta_d + \eta_c + \varepsilon_s$$

Key Results

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3. Complexity not significantly impacted by stance or sentiment

Conclusion: Delivery, Placement & word choices in "Potential Strategy" for communication doesn't alter complexity in an adverse manner

#2 Sentiment Pass-through

$$\text{Sentiment}_s = \sum_{j \in C} \alpha_j I_{s \in j} + \sum_{j \in C} \beta_j^v I_{s \in j} \overrightarrow{Verbal}_s + \sum_{j \in C} \beta_j^{nv} I_{s \in j} \overrightarrow{NonVerbal}_s + \eta_y + \eta_d + \eta_c + \varepsilon_s$$

How does the media skew the sentiment of selected testimony messages?

How does the media skew the sentiment of selected testimony messages?

Newspapers & Newswires coverage leans negative

- **Sentiment altered least for statements from Chair Remarks**

Live & Non-Live TV Coverage has less of a negative bias

- **Sentiment not significantly altered for statements from Chair Remarks or Q&A**

How does the media skew the sentiment of selected testimony messages?

- **Positive central bank messages are reported as positive news**
- Media will "rewrite" the messages and **attenuate** the conveyed messages

  e.g., For newspapers and newswires, passthrough to reported sentiment value of ~0.63

How do sentiment scores change with measured text-sentiment from Testimony across Media outlets?

	TV-Non-live	TV Breaking News	Newspapers & Newswires	
	Sentence with the Quote or Paraphrase	Sentence with the Quote or Paraphrase	Sentence with the Quote or Paraphrase	Article Title
Chair Remarks	**0.80*** **	**0.44*** **	**0.63*** **	**0.04***
Chair Q&A	**0.77*** **	**0.48*** **	**0.60*** **	**0.03**
Members Remarks	**0.76*** **		**0.60*** **	**0.03**
Members Q&A	**0.75*** **	0.25	**0.59*** **	**0.01**
			***=1%, **=5%, *=10%	

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	TV-Non-live	TV Breaking News	Newspapers & Newswires	
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			***=1%, **=5%, *=10%	

TV-non live coverage gives the most accurate sentiment pass-through for Chair Remarks

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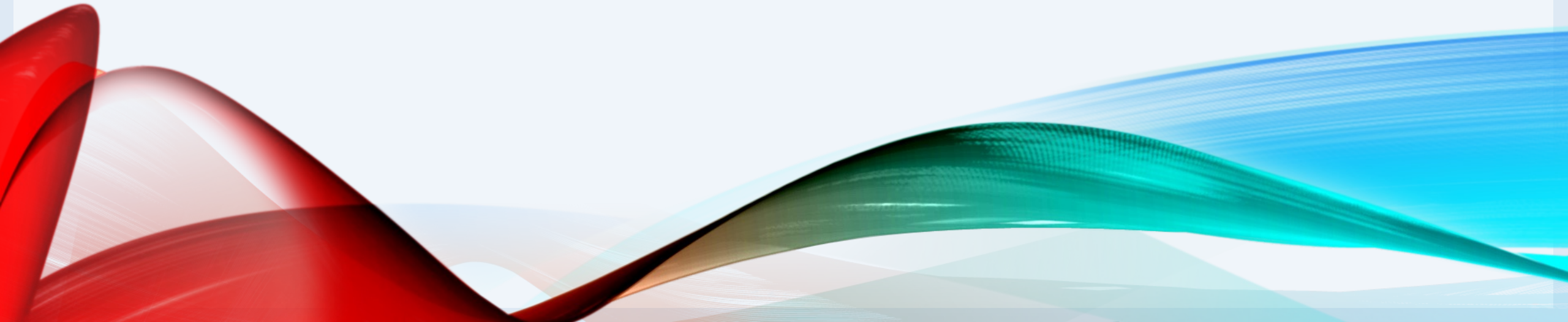
Members Q&A	0.75	0.25	0.59	0.01
			***=1%, **=5%, *=10%	

Pass-through similar for Chair Q&A

Impact of Vocal Pitch & Facial Expressions

ON SENTIMENT



How does the media skew the sentiment of selected testimony messages?

*****No significant evidence Chair Vocal Pitch distorts sentiment of reported Chair Remarks**

- Vocal pitch primarily affects Breaking News reporting for Chair Q&A
  →Coefficient 0.145 suggests increased pitch interpreted positively
- **Facial Expressions can reinforce pass-through** of sentiment in Chair Remarks for newswires or breaking news

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  →Coefficient 0.145 suggests increased pitch interpreted positively
- **Facial Expressions can reinforce pass-through** of sentiment in Chair Remarks for newswires or breaking news

Conclusion: "Potential Strategy" for communication (Placement, words, delivery) appears to deliver best pass-though of original sentiment

SEMANTIC MEANING:
How close in meaning are reported messages to the original statements?

$$\text{Semantic Score}_s = \sum_{j \in C} \alpha_j I_{s \in j} + \sum_{j \in C} \beta_j^v I_{s \in j} \overrightarrow{Verbal}_s + \sum_{j \in C} \beta_j^{nv} I_{s \in j} \overrightarrow{NonVerbal}_s$$

$$\eta_y + \eta_d + \eta_c + \varepsilon_s$$

Cosine Similarity & Word Mover Distance

SBERT Similarity
Source: Mellit (2023)

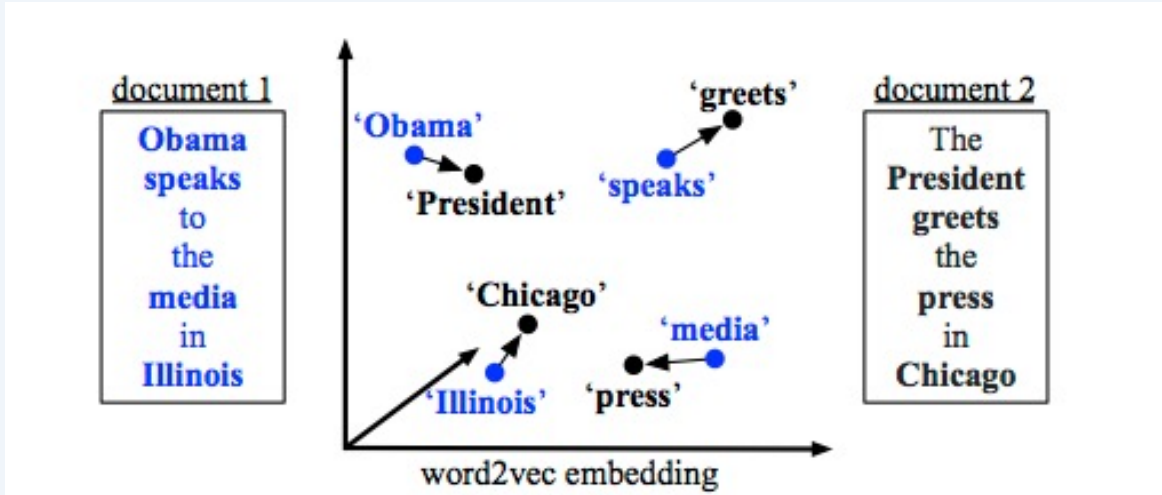


Figure 1. An illustration of the *word mover's distance*. All non-stop words (***bold***) of both documents are embedded into a *word2vec* space. The distance between the two documents is the minimum cumulative distance that all words in document 1 need to travel to exactly match document 2. (Best viewed in color.)

Word Mover Distance Similary
Source: Baumgartner (2017)

How does the media skew the semantic meaning of selected testimony messages?

Key results:

*Degree of similarity depends on the media outlet

**Similarity scores for Chair Remarks and Chair Q&A similar

-> placement not a major factor in determining similarity

	Metric	TV-Breaking News	TV- Non-live coverage			Newspapers	Newswires
			L	C	R		
Chair Prepared Remarks	TFIDF		0.67	**0.81**	0.66		
	SBERT		0.80	**0.88**	0.76		
	FastText-WMD		0.06	**0.04**	0.06		
Chair Q&A	TFIDF		0.68	**0.84**	0.72		
	SBERT		0.79	**0.88**	0.80		
	FastText-WMD		0.07	**0.04**	0.07		
Members Prepared Remarks	TFIDF		0.61	**0.84**	0.51		
	SBERT		0.74	**0.90**	0.80		
	FastText-WMD		0.08	**0.03**	0.08		
Members Q&A	TFIDF		0.73	**0.84**	0.61		
	SBERT		0.79	**0.89**	0.71		
	FastText-WMD		0.08	**0.04**	0.09		

TFIDF & SBERT – Closer to 1 better, FastText-WMD – Closer to 0 better

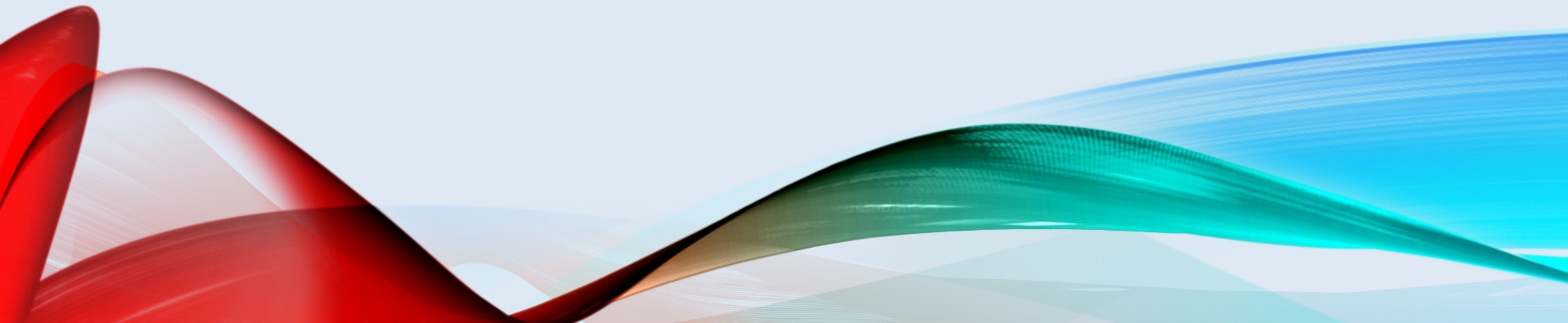
	Metric	TV- Breaking News	TV- Non-live coverage			Newspapers	Newswires
			L	C	R		
Chair Prepared Remarks	TFIDF		0.67	**0.81**	0.66	0.65	0.54
	SBERT		0.80	**0.88**	0.76	0.69	0.67
	FastText-WMD		0.06	**0.04**	0.06	0.07	0.07
Chair Q&A	TFIDF		0.68	**0.84**	0.72	0.60	0.58
	SBERT		0.79	**0.88**	0.80	0.66	0.66
	FastText-WMD		0.07	**0.04**	0.07	0.09	0.09
Members Prepared Remarks	TFIDF		0.61	**0.84**	0.51	0.65	0.68
	SBERT		0.74	**0.90**	0.80	0.74	0.75
	FastText-WMD		0.08	**0.03**	0.08	0.07	0.06
Members Q&A	TFIDF		0.73	**0.84**	0.61	0.55	0.48
	SBERT		0.79	**0.89**	0.71	0.66	0.59
	FastText-WMD		0.08	**0.04**	0.09	0.10	0.10

TFIDF & SBERT – Closer to 1 better, FastText-WMD – Closer to 0 better

	Metric	TV- Breaking News	TV- Non-live coverage			Newspapers	Newswires
			L	C	R		
Chair Prepared Remarks	TFIDF	0.34	0.67	**0.81**	0.66	0.65	0.54
	SBERT	0.52	0.80	**0.88**	0.76	0.69	0.67
	FastText-WMD	0.13	0.06	**0.04**	0.06	0.07	0.07
Chair Q&A	TFIDF	0.38	0.68	**0.84**	0.72	0.60	0.58
	SBERT	0.53	0.79	**0.88**	0.80	0.66	0.66
	FastText-WMD	0.13	0.07	**0.04**	0.07	0.09	0.09
Members Prepared Remarks	TFIDF	0.08	0.61	**0.84**	0.51	0.65	0.68
	SBERT	0.49	0.74	**0.90**	0.80	0.74	0.75
	FastText-WMD	0.19	0.08	**0.03**	0.08	0.07	0.06
Members Q&A	TFIDF	0.12	0.73	**0.84**	0.61	0.55	0.48
	SBERT	0.38	0.79	**0.89**	0.71	0.66	0.59
	FastText-WMD	0.14	0.08	**0.04**	0.09	0.10	0.10

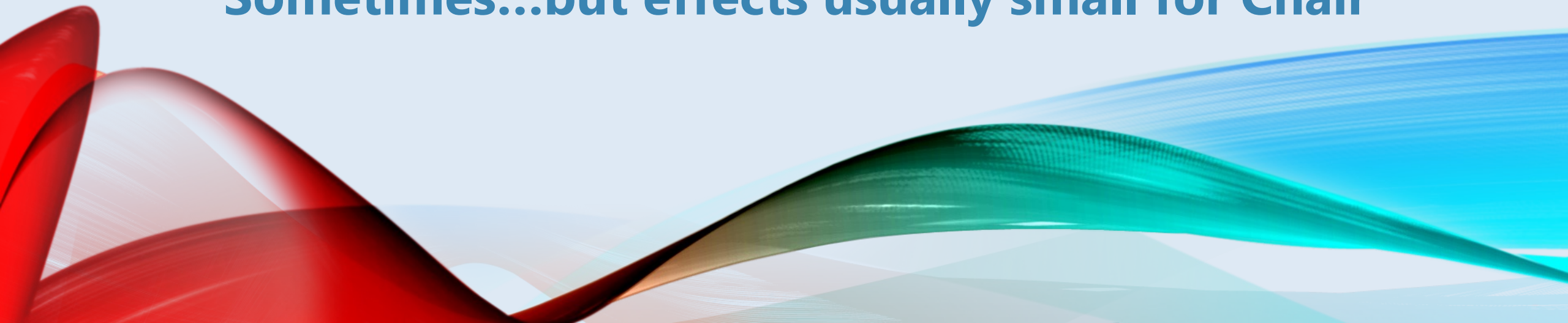
TFIDF & SBERT – Closer to 1 better, FastText-WMD – Closer to 0 better

Does the pass-through of meaning depend on sentiment of text, voice and body language?



Does the pass-through of meaning depend on sentiment of text, voice and body language?

Sometimes…but effects usually small for Chair



How do Similarity scores change with measured *text-sentiment*?

Testimony with negative sentiment:

- Less similar Chair Prepared Remarks
- More similar for Members Prepared Remarks

*Magnitude of effects (from point estimates) range from ~0.01 to 0.14 increase for a one-SD decrease in text-sentiment

****Most estimates are in the 0.01-0.03 range**

*****Highest effect for Members'** Q&A (~0.10-0.14)

How do Similarity scores change with *vocal pitch*?

- Most commonly seen pattern for Chair and Member's prepared remarks:

  Higher voice pitch changes semantic meaning more

- **Magnitudes for Chair are small** and typically range from 0.01 to 0.02 for a one-SD change in pitch

- **Members' messages are altered more**

- E.g., one-SD increase in pitch, typically changes similarity scores 0.01-0.09

How do Similarity scores change with *facial emotions*?

- Variation across Media outlets
- More evidence of an impact for:
  - ***TV reporting***
  - ***Unscripted comments***

E.g., Magnitude of effects (from point estimates) range from 0.01 to 0.05 for a one-SD increase in facial sentiment for TV

Impact of Potential Strategy on Semantic Similarity?

- Placement of message in Chair Remarks section or Q&A has similar pass-through
- Distorting effects of increased vocal pitch for Chair statements small
- Impact on similarity from facial expressions small (especially for remarks)
- Response of similarity to text-sentiment also small

"Potential strategy" for increasing coverage shouldn't distort messages meaning significantly

To increase selection of desired monetary policy messages by the media…

"~~Po~~ial Strategy"

- **Placement:** Put it in the Chair's remarks first & potentially repeat in Q&A
- **Delivery:**
  - -Increase coverage using **increased voice pitch** in remarks and Q&A
  - -**Align facial expressions** with messaging (especially for Positive messaging)

****Negative messaging:** More Negative Text Sentiment will increase coverage

*****Positive messaging:** **Need to using delivery & repetition more to increase coverage**

Contributions

- **Innovative methodology** for evaluating CB message transmission by:
  - Quote and paraphrase analysis
  - Sentiment and semantic similarity assessments
- **Methodology** is widely adoptable to evaluating pass-through in other settings (e.g., political speeches during elections, health announcements)
- Investigate not just the presence of messages in the media but also the reasons and mechanisms for their dissemination
- Novel matched datasets on Testimony media coverage (created with ML)
  - Includes new TV sources, verbal and non-verbal measures, & media characteristics

Main Takeaways

- **Media plays a key role** in shaping CB communications received by public
- **Media reacts to emotional signals** conveyed through Text, Voice, Facial expressions and body language
- Selection, Complexity, Sentiment & Semantics are impacted by these different cues in different ways
- Media filters a lot, relying heavily on the verbal and non-verbal cues
  - Negative sentiment with active voice and body language attracts media coverage
  - Using non-verbals can help get out important CB messages to the media's audience

What do the results suggest might help Central Banks improve communications?

- To get out negative messages with the tone and semantic meaning most intact, said it in the Remarks with an activated voice (higher pitch), and negative facial expressions

- To get out positive messages, make sure the message is in the Remarks, emphasize it with increased vocal pitch, and look more calm (less negative) when conveying the message

- Knowing which audience(s) you are trying to reach with the message at hand may help further refine strategies given some differences across Media outlets

Thank You

Comments & Questions Welcome