(Almost) 200 Years of News-Based Economic Sentiment

Jules H. van Binsbergen

Svetlana Bryzgalova

Mayukh Mukhopadhyay

Varun Sharma

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By **Derek Poustka** for **Insper's Finance Hub**

Introduction

- Although measures of economic sentiment have been widely studied, their applications have been somewhat limited because of a **short time series span** and a **lack of granularity**

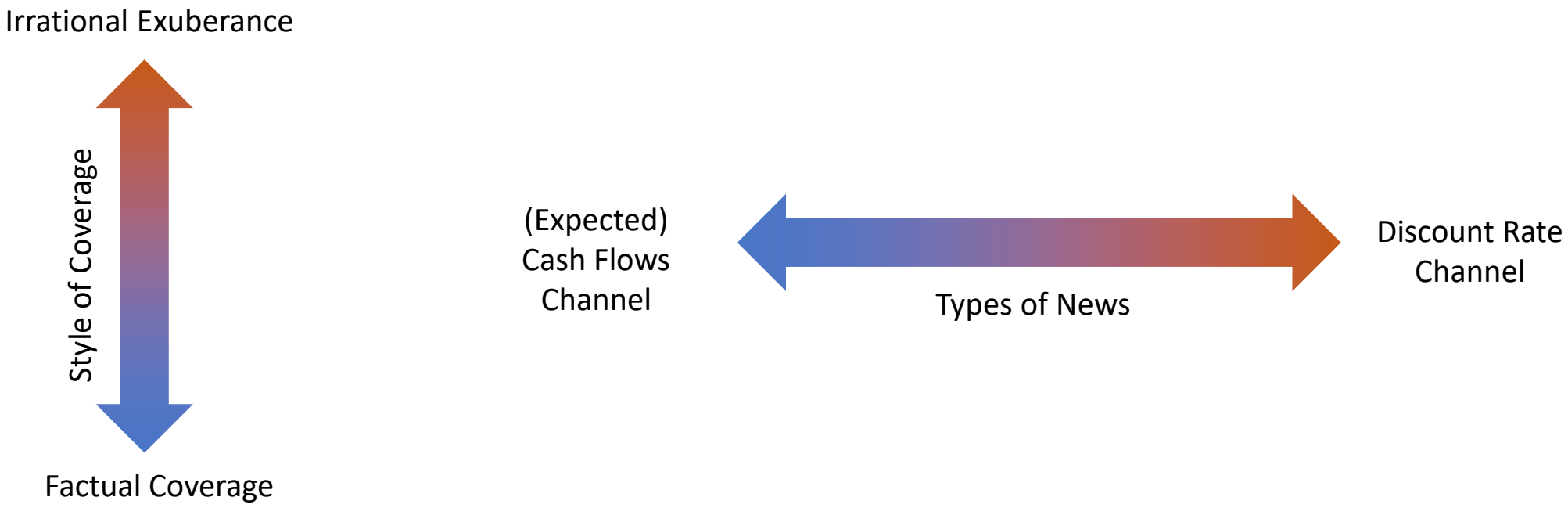
Example: *Michigan Survey of Consumer Sentiment*, the oldest and most prominent survey, is available only from 1966 and has no state-level variation

- **Question:** Is it possible to measure sentiment for a **longer period** and at a **more granular level**?
  - Newspapers are available for **longer periods**
  - Local newspapers are available at a **much granular level**
  - Newspapers may contain information about the national and/or local economy

The paper uses **machine learning methods** to construct a **new measure of economic sentiment** from **US local newspaper** pages published in the **past 170 years**, that **expands** existing measures in both the **time series** (by more than a century) and the **cross-section**

Introduction

- "Sentiment" is a **loaded word** in Economics and Finance, especially in behavioral terms



Caveat: They broadly define sentiment as **"the positivity/negativity of economic news coverage"** and they **won't** talk about **causation** (only predictive power and informational content)

Introduction

Main result: Economic sentiment is important for understanding the **business cycle** at both **local** and **national levels**

- They find that **economic sentiment**:

a) predicts **economic fundamentals** (e.g. GDP, employment and consumption growth) at the **country** and **state level**

b) leads **consensus GDP forecasts** (“incremental predictive power”)

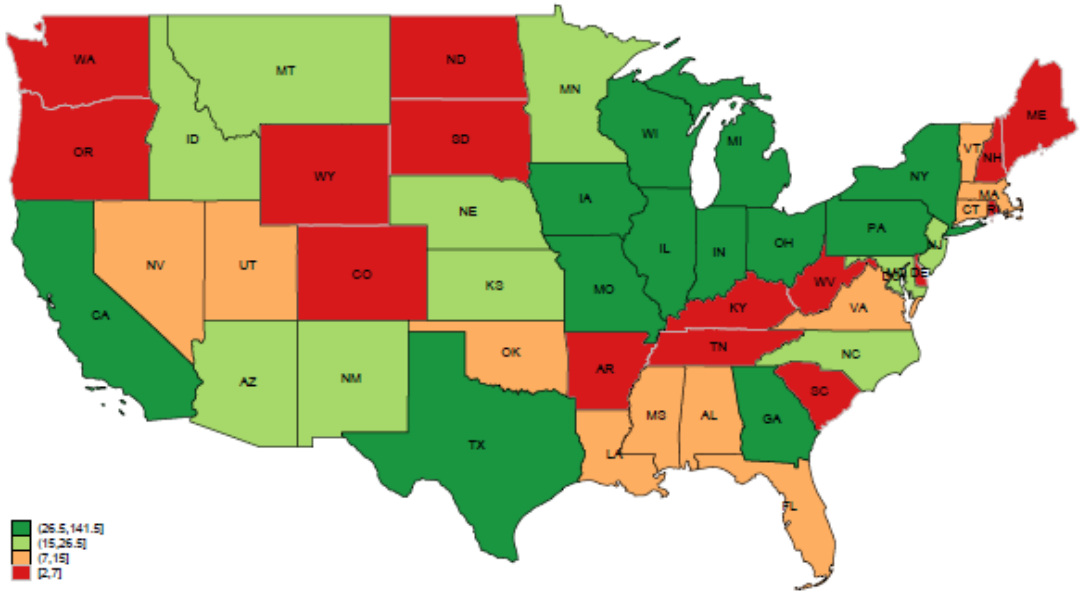
c) exhibits large **cross-sectional variation** across states, with the nationwide component driving only 35% of the state variation

- They are mostly interested on the effects of **economic sentiment** on **economic fundamentals** and **monetary policy**, i.e., on decisions of **real agents**

Dataset

- Historical collection of **digitized newspapers** from **1850-2019** in the USA, first introduced in **Singla and Mukhopadhyay (2022)**

Newspaper Coverage Across States



The figure shows the median number of available newspapers per year for the U.S. states and territories.

- **High degree of granularity:**
  - 13,000 **local newspapers** across thousands of communities
  - Around 1 **billion** newspaper articles (WSJ corpus contains 1 **million** articles)
  - The corpus is **95 times larger** than all of English Language Wikipedia entries

- **Madison Project** database for long-term annual GDP data
- Data from **FRED**, **BEA**, **Michigan University**, **SPF**, and expanded **Romer and Romer** (2004) monetary policy shock series

Roadmap for Measuring Economic Sentiment

Step 1
Create a dictionary of relevant words for the topic

Step 2
Identify the words that are positive or negative

Step 3
Apply this dictionary to measure the intensity of positive and negative sentiment in a particular document

Step 1: Automated Dictionary

- **Algorithm *Word2vec:*** semantic information about every word is captured by its **vector representation**
  - Rely on a **natural language processing (NLP) technique** called ***word embeddings***

> **Principle from linguistics:** “you shall know a word by the company it keeps"

  - **Objective function** ensures that **similar words** have **similar vector representations**, which implies **similar meanings**
  - Applies to **phrases** as well as standalone **words**

- Create a **dictionary** of the most similar words:
  - Use **distances between the vector representations** of words to measure their similarities

Example: KING + WOMAN - MAN ≈ QUEEN

Word Cloud of Words related to the Word “Economy"

The figure shows a word cloud of the 1000 most similar words to the word economy calculated from the Word2vec trained vectors.

Closest associations: "economic growth", "inflation", "economic", "recession", "economic recovery", "consumer spending", etc.

Step 2: Automated Measure of Word Sentiment

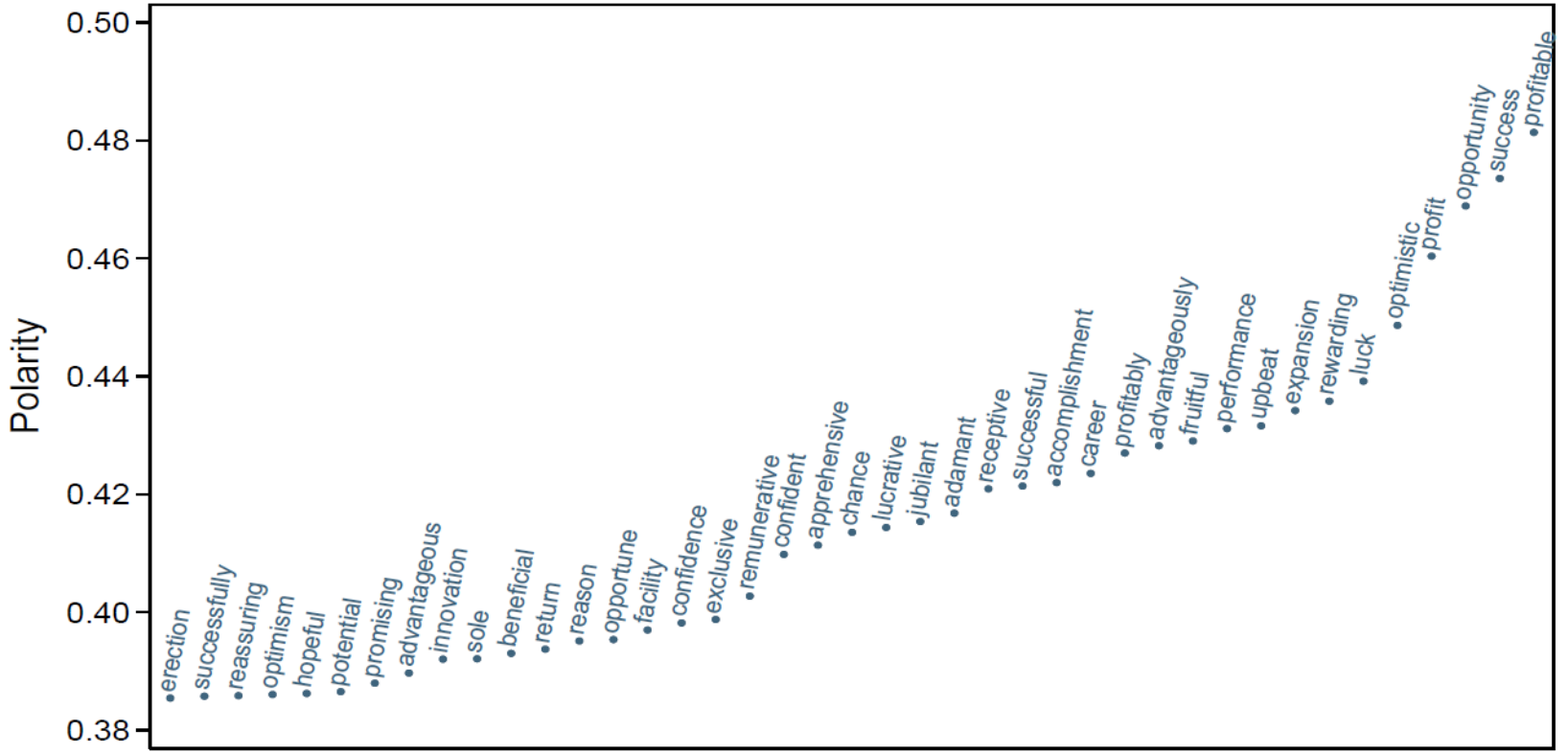
- Isolate **positive** or **negative** words to measure economic sentiment

- ***Sentprop*: is a **label propagation algorithm** that **classifies** all the words in the dictionary, beginning with a few **initial seed words.** It produces a sentiment dictionary of positive and negative words

  - **Positive seed words:** expansion, boom, growth, profit, optimistic, optimism, opportunity, success, successful, profitable, prosperity, profitability, bullish
  - **Negative seed words:** recession, bankrupt, shrinking, unemployment, loss, bankruptcy, cutback, layoff, redundancy, pessimism, contraction, unsuccessful, failure, insolvent, insolvency, bearish

- **Sentiment score:** produce a **continuous measure of sentiment** for each word/phrase in the dictionary, following **Hamilton *et al.* (2016)**

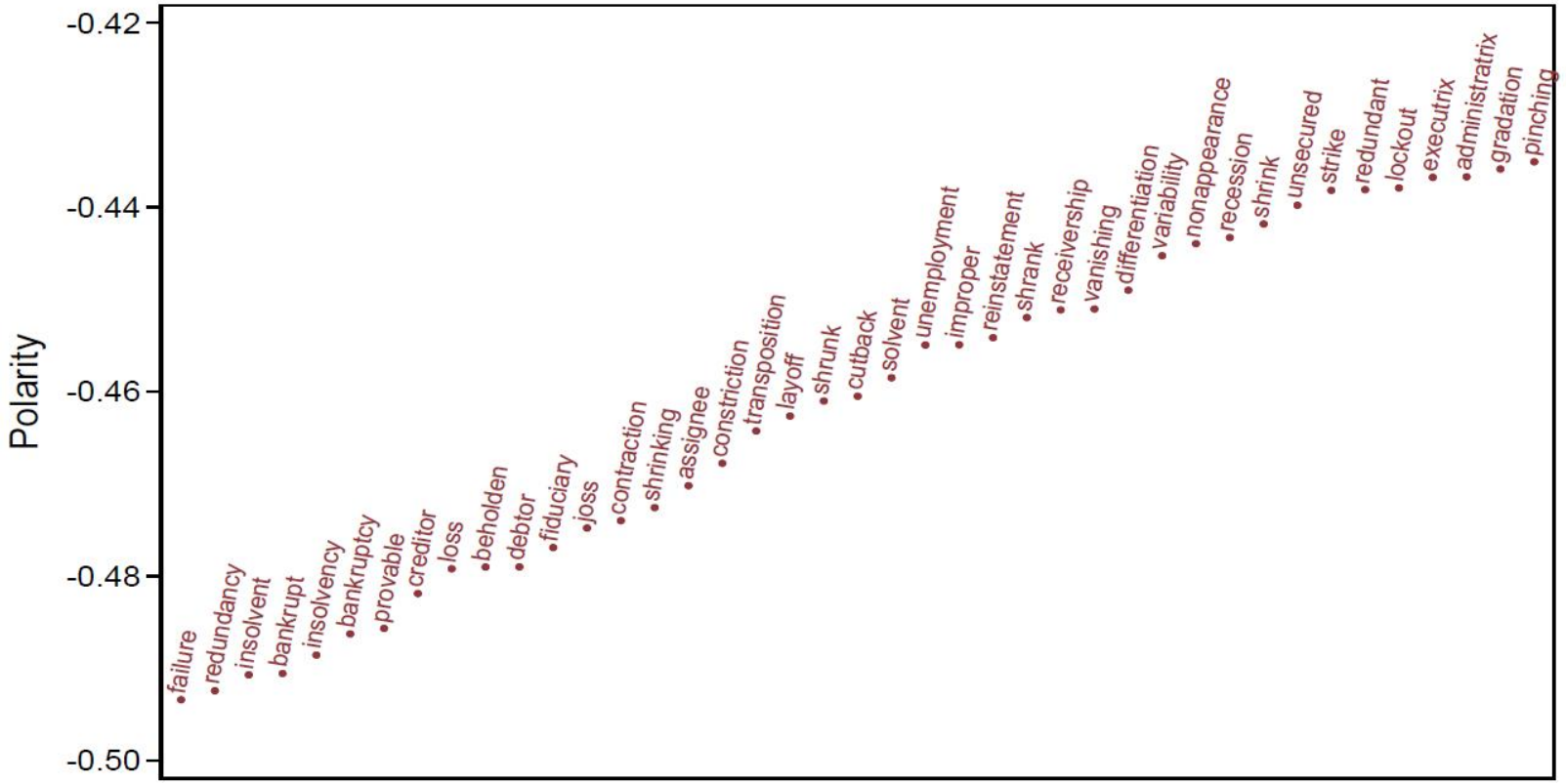
Sentiment Polarity Score



The figure plots the polarity of the most positive words. The most positive words are defined as words in the top 0.1 percentile in terms of their polarity score.

Most positive words/phrases: "successful", "success", "profit", "opportunity", "profitable", "proven", "expansion", "interview", "rewarding"

Sentiment Polarity Score



The figure plots the polarity of the most negative words. The most negative words are defined as words in the bottom 0.1 percentile in terms of their polarity score.

Most negative words/phrases: "failure", "unsuccessful", "insolvent", "earnest", "redundancy", "bankrupt", "bankruptcy", "insolvent debtor", "contraction".

Step 3: Aggregating Sentiment Score of a Document

- Produce a **vector representation** of the **document**, following **Arora, Liang, and Ma (2017)**

- Measure the **similarity** between the vector representation of each newspaper page and economic dictionary (**weighted by the word sentiment score**)

- **Aggregate** the measure to **different levels:** city → county → **state** → **country**

- **Standardize** the measure to have a mean of zero and a standard deviation of one

- S**easonally adjust** the measure

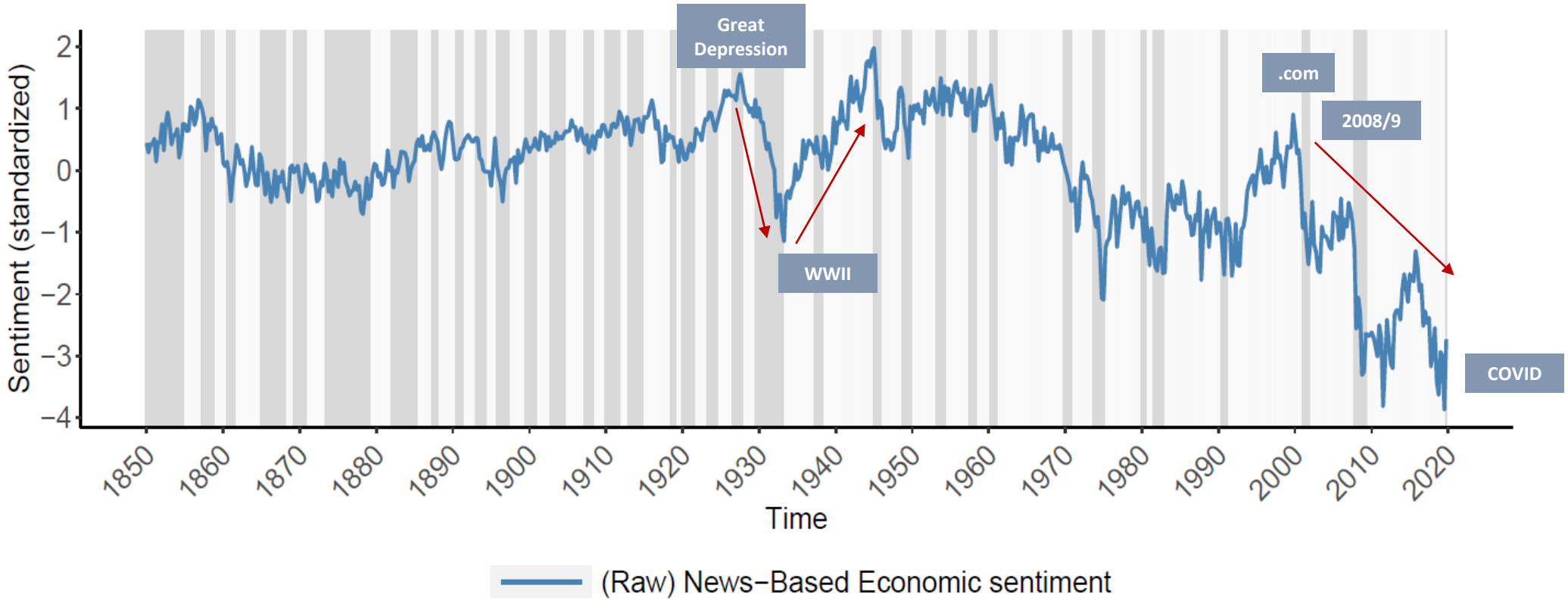
Key Advantages of the Methodology

Traditional approaches: rely on **manually created sentiment dictionaries** and **simple counts** of these **words and phrases** in a text document

- Their approach allows for an **almost fully automated construction topic-specific dictionaries**
- It reflects the **context** in which words/phrases are used
- It automatically deals with **negation** (e.g., good vs. not good), a common challenge for word counts
- It automatically generates a **continuous measure of word sentiment score** (e.g., good vs. excellent)

Quarterly Measure of Raw Economic Sentiment

- Shaded areas indicate NBER **recessions**

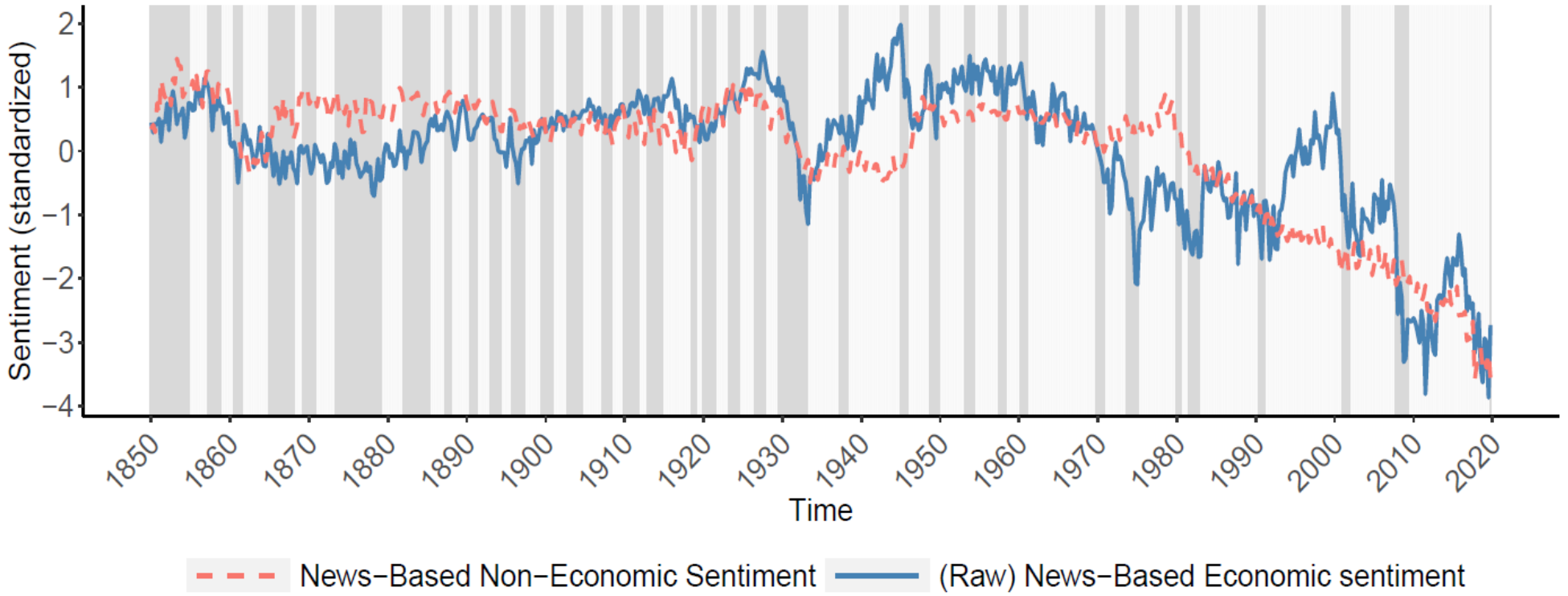


- Sentiment varies a lot and exhibits **business cycle variation** as well as **time trend**
- In recent years, economic sentiment is getting **more negative** and **doesn't recover as much** after drops

Quarterly Measure of Raw Economic and Non-Economic Sentiment

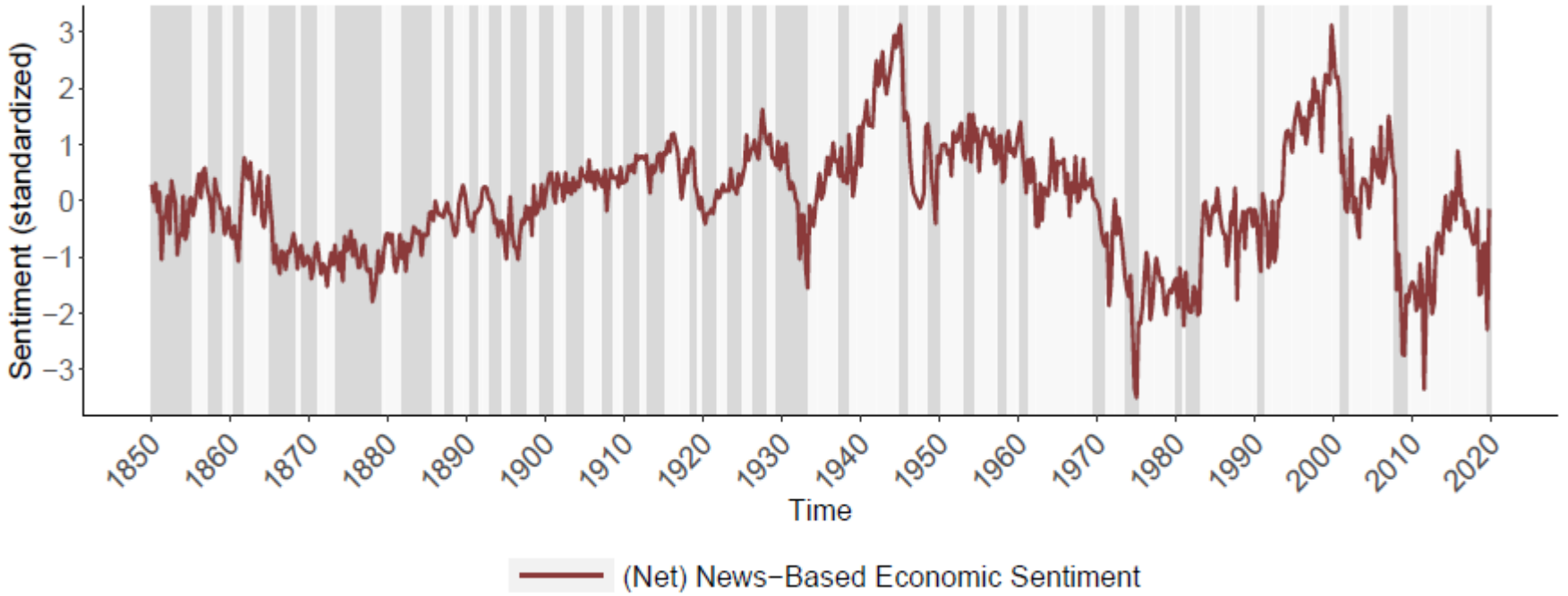
But isn't **general sentiment** getting more **negative** as well?

- **Increased negativity:** Non-econ sentiment is trending downwards since the 1980s



- **Debiasing the original measure:** They will be using the **orthogonalized version** of **blue line** with respect to the **red line**

News–Based Economic Sentiment (NBES)

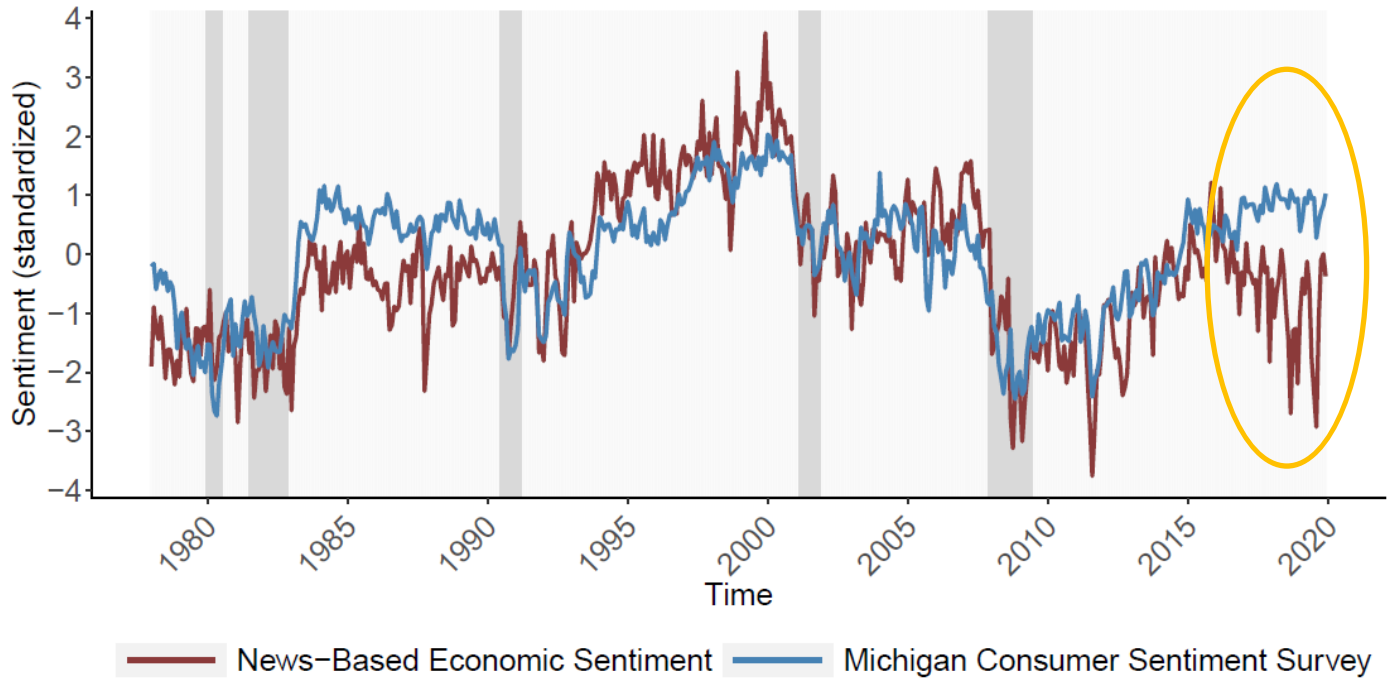


NBES

(Net) News-Based Economic Sentiment

- Orthogonalising *Economic* with respect to *Non-economic Sentiment* produces a **stationary time series**
- The series **declines** after **key events** that triggered **economic** and **financial crises**
- But it **no** longer exhibits a **significant downward trend** over the last several decades

NBES and Michigan Consumer Survey

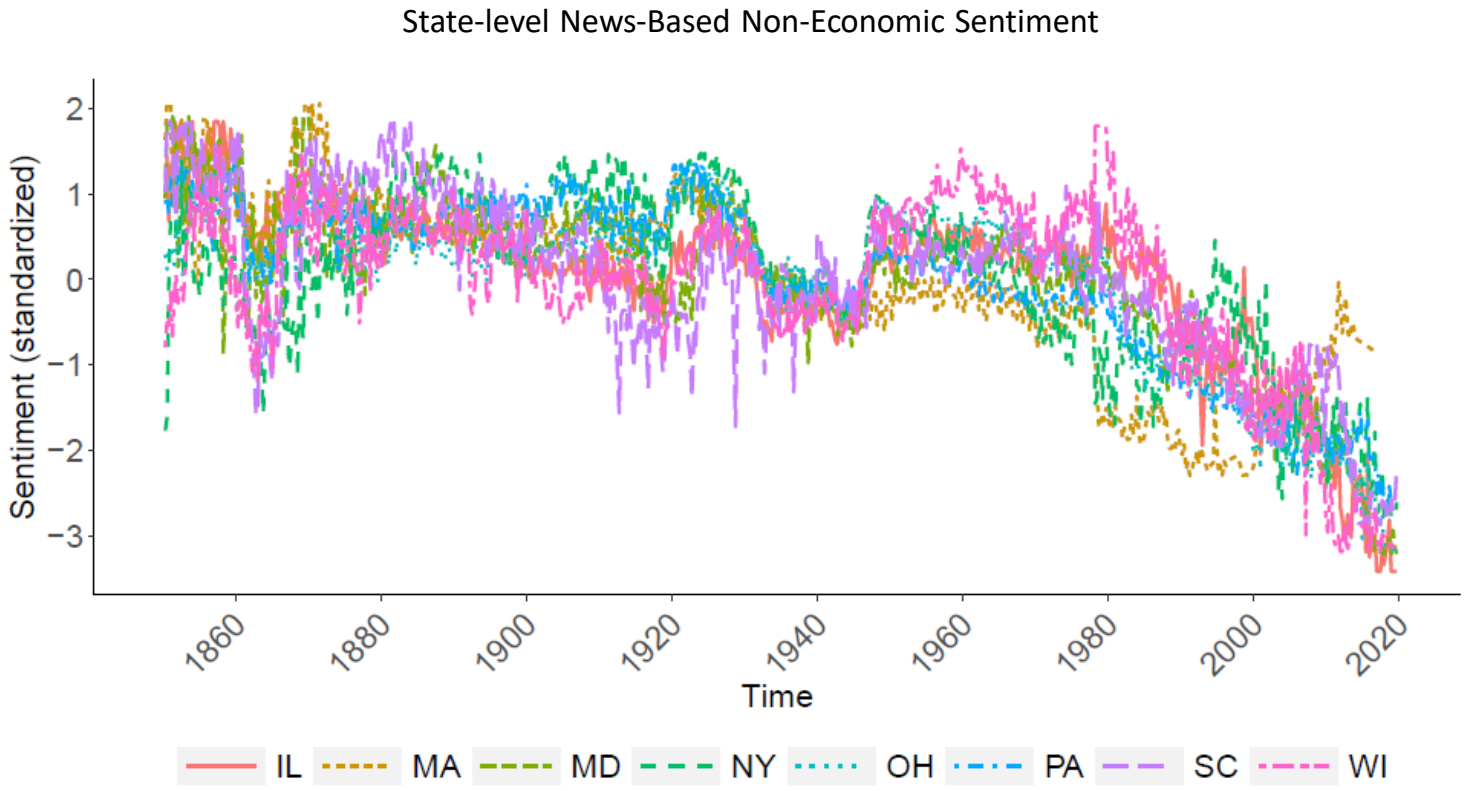


The figure plots the levels of (net) news-based economic sentiment and the Michigan Consumer Sentiment Survey at a monthly frequency. Shaded areas indicate NBER recessions. Sample size is 1978M1–2020M1.

- **Mid and late 80s (savings and loans crisis):** NBES was **more negative**
- **Dot-com bubble:** NBES was **more optimistic**
- **End of sample:** NBES and *Michigan Survey* **diverge**

- **Validation: 71% correlation** with *Michigan Consumer Sentiment Survey* (**68% during recessions**)

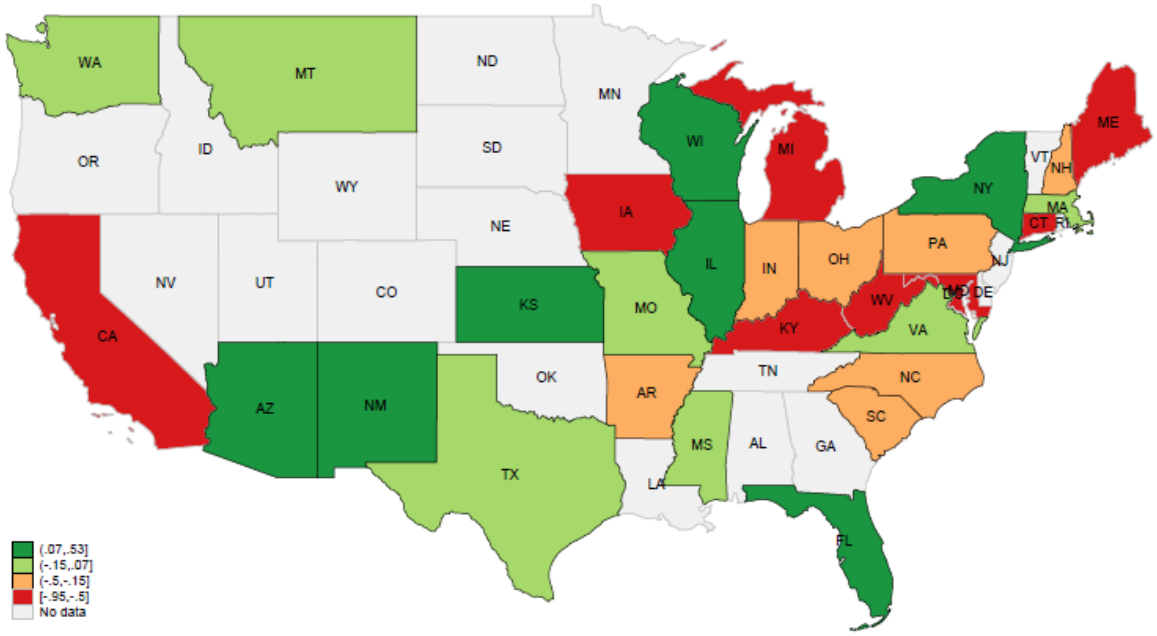
Local NBES



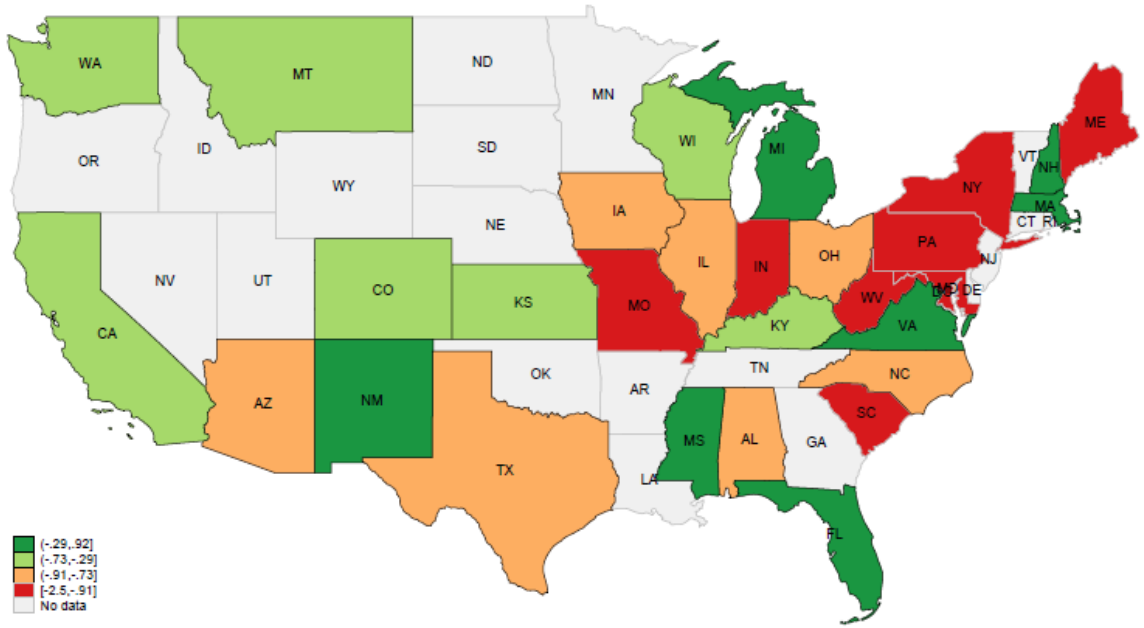
The figure shows state-level news-based non-economic sentiment for Illiois (IL), Massachusetts (MA), Maryland (MD), New York (NY), Ohio (OH), Pennsylvania (PA), South Carolina (SC), and Wisconsin

- **Same negative bias** in the *State-Level Non-Economic Sentiment* across almost all the U.S. states
- **Same procedure as National NBES:**
  - Remove the (negative) bias from the *Local Economic Sentiment Measures* using the *Local Non-Economic Sentiment Measures,* generating a *Local (Net) Economic Sentiment*
- Substantial **variation** in the *Local (Net) Economic Sentiment*
- **National trend** explains only around **35% of the variation in state sentiment**

Changes in Local NBES



(a) Dot-com crash



(b) Global Financial Crisis

The figure plots the changes in the quarterly state economic sentiment during the dot-com crash (2002 Q4, panel (a)) and the Global Financial Crisis (2008 Q4, panel (b)).

- As expected, the NBES **declined more** in **California** during the **Dot-com crash** and in **New York** during the **Global Financial Crisis (GFC)**

(National) NBES and GDP Growth

	$\Delta ln(GDP_t)$								
	I	II	III	IV	V	VI	VII	VIII	IX
$\Delta ln(GDP_{t-1})$	0.355***	0.356***		0.333***	0.335***			0.327***	0.330***
	(5.91)	(5.79)		(5.57)	(5.48)			(5.17)	(5.15)
$Term\ Spread_{t-1}$		0.072*			0.063*			0.060	0.060
		(1.97)			(1.69)			(1.59)	(1.58)
$\Delta Sent_{t-1}$			0.333***	0.255***	0.242***	0.421***	0.390***	0.288***	0.250**
			(3.88)	(2.78)	(2.60)	(4.05)	(3.53)	(2.73)	(2.23)
$\Delta Sent_{t-2}$						0.167*	0.176*	-0.015	-0.006
						(1.67)	(1.73)	(-0.16)	(-0.06)
$\Delta Sent_{t-3}$						0.317***	0.316**	0.225**	0.223**
						(2.60)	(2.58)	(2.04)	(2.01)
$\Delta Sent_{t-4}$						0.267**	0.267**	0.152	0.151
						(2.23)	(2.20)	(1.37)	(1.35)
$\Delta Sent_{t-5}$						0.074	0.055	0.007	-0.017
						(0.74)	(0.54)	(0.08)	(-0.18)
Q4 Dummy							-0.107		-0.131
							(-0.90)		(-1.05)
$\Delta Sent_{t-1} \times Q4Dummy$							0.051		0.057
							(0.25)		(0.30)
F statistic ($\Delta Sent$ (t-2 to t-n))						2.235	2.242	2.499	2.435
P-value (all $\Delta Sent$ (t-2 to t-n))						0.065	0.065	0.043	0.048
Observations	290	290	290	290	290	290	290	290	290
Adjusted R-squared	0.12	0.13	0.04	0.14	0.15	0.06	0.06	0.16	0.16

The table reports a linear predictive model for GDP per capita. t-statistics based on Newey and West (1987) standard errors are reported in parentheses. Significance levels are indicated by * (10%), ** (5%), and *** (1%).

Interpretation: think of $\Delta Sent$ as measured in standard deviations (s.d.) and the coefficient as measured in per cent (%)

- **Sample:** 1947Q1 - 2019Q4 (Quarterly)
- Changes in NBES **leads GDP growth** (has **predictive power**)
- Even when controlling for leading business cycle indicators (past GDP growth and/or term spread)
- 1 s.d. increase in the **previous quarter's** NBES leads to a 0.25%-0.42% **increase** in GDP growth in the **following quarter**

NBES and the Professional Forecast Predictability

	$GDP\ Forecast_{t,t+1}$						
	I	II	III	IV	V	VI	VII
$GDP\ Forecast_{t-1}$	0.786***	0.727***		0.770***	0.716***		0.726***
	(13.15)	(12.52)		(11.90)	(11.82)		(12.43)
$Term\ Spread_{t-1}$		0.057***			0.054***		0.054***
		(3.85)			(3.68)		(3.73)
$\Delta Sent_{t-1}$			0.154***	0.094***	0.084***	0.205***	0.082***
			(3.35)	(3.10)	(3.05)	(3.98)	(2.89)
$\Delta Sent_{t-2}$						0.151***	-0.038
						(3.39)	(-1.06)
$\Delta Sent_{t-3}$						0.163***	0.020
						(3.30)	(0.47)
$\Delta Sent_{t-4}$						0.118**	0.004
						(2.31)	(0.12)
$\Delta Sent_{t-5}$						0.058	-0.001
						(1.28)	(-0.04)
F statistic ($\Delta Sent$ (t-2 to t-n))						3.708	0.971
P-value ($\Delta Sent$ (t-2 to t-n))						0.006	0.425
Observations	204	204	204	204	204	204	204
Adjusted R-squared	0.62	0.65	0.05	0.63	0.67	0.11	0.67

The table shows the predictive regression of the GDP forecast by its previous quarter values, term spread, and changes in economic sentiment. t-statistics based on Newey and West (1987) standard errors are reported in parentheses. Significance levels are indicated by * (10%), ** (5%), and *** (1%).

- **Survey of Professional Forecasters (SPF):** oldest quarterly survey of macroeconomic forecasts in the United States (available since 1968)
- Changes in NBES also **leads the SPF Consensus Forecasts:**
- Even when controlling for the GDP forecasts NBES
  - 1 s.d. increase in NBES leads to an **increase** in forecasted GDP growth by 0.08% - 0.20%

That might indicate that professional forecasters are **missing out** on the **information** incorporated by NBES

NBES and GDP Growth: Current and Future Sentiments

	$\Delta ln(GDP_t)$				
	I	II	III	IV	V
$\Delta ln(GDP_{t-1})$	0.355***	0.356***		0.335***	0.338***
	(5.91)	(5.79)		(5.51)	(5.43)
Term Spread_{t-1}		0.072*			0.065*
		(1.97)			(1.73)
$\Delta Current\ News\ Sent\ (gross)_{t-1}$			-0.232	-0.091	-0.111
			(-0.45)	(-0.20)	(-0.25)
$\Delta Future\ News\ Sent\ (gross)_{t-1}$			0.416***	0.295**	0.278**
			(3.41)	(2.45)	(2.28)
$\Delta Non-Econ\ Sent_{t-1}$			0.031	-0.080	-0.104
			(0.12)	(-0.31)	(-0.40)
Observations	290	290	290	290	290
Adjusted R-squared	0.12	0.13	0.02	0.13	0.14

Table reports a linear predictive model for national GDP growth and economic sentiment measured from text about current and future events. t-statistics based on Newey and West (1987) standard errors are reported in parentheses. Significance levels are indicated by * (10%), ** (5%), and *** (1%).

- To better understand the source of **predictability** of NBES measure, they **decompose** it into a **current** and a **future component**
  - Predictability findings are **driven** by the measure's **future component**
  - The current events coverage has **little to no predictive power** for macroeconomic variables
- This suggests that their measure can capture **forward-looking news** about economic fundamentals

What if we focus on **individual GDP components** to see what economic sentiment affects?

NBES and GDP Components: Capital vs. Labor Channel

	$\Delta ln(Employment_t)$					$\Delta ln(Consumption_t)$				
	I	II	III	IV	V	VI	VII	VIII	IX	X
$\Delta ln(Employment_{t-1})$	0.757***			0.748***	0.748***					
	(14.73)			(14.65)	(16.61)					
$Term\ Spread_{t-1}$	0.042**			0.036*	0.036*	0.068			0.064	0.059
	(2.29)			(1.94)	(1.85)	(1.50)			(1.40)	(1.27)
$\Delta Sent_{t-1}$		0.249***	0.339***	0.154***	0.159***		0.135**	0.202**	0.106	0.173*
		(3.11)	(3.67)	(3.06)	(2.92)		(2.04)	(2.55)	(1.34)	(1.74)
$\Delta Sent_{t-2}$			0.315***		0.005			0.185**		0.164*
			(2.71)		(0.06)			(2.13)		(1.76)
$\Delta Sent_{t-3}$			0.258*		-0.014			0.234**		0.216*
			(1.79)		(-0.16)			(2.21)		(1.75)
$\Delta Sent_{t-4}$			0.241*		0.049			0.126		0.115
			(1.76)		(0.70)			(1.11)		(1.18)
$\Delta Sent_{t-5}$			0.107		-0.029			0.097		0.100
			(0.97)		(-0.52)			(1.19)		(1.14)
$\Delta ln(Consumption_{t-1})$						0.083			0.071	0.039
						(0.52)			(0.44)	(0.25)
F statistic ($\Delta Sent$ (t-2 to t-n))			2.234		0.736			1.581		1.075
P-value ($\Delta Sent$ (t-2 to t-n))			0.065		0.568			0.179		0.369
Observations	322	322	322	322	322	290	290	290	290	290
Adjusted R-squared	0.56	0.02	0.06	0.57	0.57	0.01	0.01	0.02	0.02	0.02

The table shows the linear predictive model for employment and total consumption growth on term spread and economic sentiment. t-statistics based on Newey and West (1987) standard errors are reported in parentheses. Significance levels are indicated by * (10%), ** (5%), and *** (1%).

- Changes in NBES **significantly predicts employment growth**
- 1 s.d. increase in NBES leads to a 0.15%-0.16% increase in employment growth rate over the **next quarter**
  - Even when controlling for past employment growth and term spread
- **Similar results** for the **total consumption growth**
- Empirical evidence suggests that economic sentiment affects the economy through to the **labor channel, not the capital (investment) channel**

These findings are essential for developing **macroeconomic models with sentiment**

Local NBES and Local GDP Growth

	$\Delta ln(GSP_{s,t})$					
	I	II	III	IV	V	VI
$\Delta Sentiment_{s,t-1}$	0.263	0.648**	0.723**	-0.153	0.182	0.247
	(0.268)	(0.273)	(0.287)	(0.320)	(0.342)	(0.357)
$\Delta Sentiment_{s,t-2}$		1.244***	1.362***		0.777***	0.901***
		(0.246)	(0.273)		(0.274)	(0.302)
$\Delta Sentiment_{s,t-3}$		1.156***	1.321***		1.017***	1.173***
		(0.289)	(0.329)		(0.289)	(0.330)
$\Delta Sentiment_{s,t-4}$		1.301***	1.455***		1.281***	1.424***
		(0.283)	(0.288)		(0.289)	(0.293)
$\Delta Sentiment_{s,t-5}$			0.334			0.353
			(0.257)			(0.266)
$\Delta Sentiment_{s,t-6}$			0.740**			0.611*
			(0.319)			(0.321)
$\Delta ln(GSP_{s,t-1})$				0.028	0.013	0.010
				(0.022)	(0.024)	(0.025)
$\Delta ln(GDP_{t-1})$				0.488***	0.421***	0.404***
				(0.055)	(0.071)	(0.075)
$\Delta NationalSentiment_{t-1}$				0.229	0.276	0.305
				(0.186)	(0.192)	(0.193)
Controls	No	No	No	Yes	Yes	Yes
Observations	1,172	1,172	1,172	1,172	1,172	1,172
R-squared	0.00	0.03	0.03	0.03	0.04	0.05

Table reports a linear predictive model for state-level GDP. State-level clustered standard errors are reported in parentheses. Significance levels are indicated by * (10%), ** (5%), and *** (1%).

- Local NBES has **more persistent predictability for Local GDP** as it can predict local GDP growth **up to six years** in the future.
- Local NBES predicts *Local GDP growth* even after controlling for national sentiment and national and state GDP growth

Local NBES Dispersion and GDP Growth

	$\Delta ln(GDP_t)$		$\Delta ln(CPI_t)$	
	I	II	III	IV
$\Delta Sentiment_{t-1}$	0.339***	0.248***	0.021	0.067
	(3.95)	(2.69)	(0.32)	(1.57)
$Dispersion_{t-1}$	-0.551*	-0.497*	-0.473	-0.083
	(-1.68)	(-1.90)	(-1.51)	(-0.57)
$\Delta ln(GDP_{t-1})$		0.334***		
		(5.40)		
Term $Spread_{t-1}$		0.069*		-0.074***
		(1.82)		(-3.06)
$\Delta ln(CPI_{t-1})$				0.695***
				(10.24)
Controls	No	Yes	No	Yes
Observations	290	290	290	290
Adjusted R-squared	0.05	0.16	0.00	0.55

The table reports a linear predictive model for national GDP and CPI. t-statistics based on Newey and West (1987) standard errors are reported in parentheses. Significance levels are indicated by * (10%), ** (5%), and *** (1%).

The **cross-sectional dispersion** in NBES can be used for measuring **heterogeneity in sentiment across states**

- **Higher dispersion** of Local NBES predicts **lower *National GDP growth*** even after controlling for national sentiment and current national GDP growth
- **No evidence** of any predictability was found for inflation

Conclusion

NBES significantly **extends** the **time series availability** and **granularity** at which economic sentiment can be measured

- The measure also:

a) predicts **economic fundamentals** (e.g., GDP, employment growth and consumption growth) at the **country** and **state level**

b) leads **consensus GDP forecasts** (“has incremental predictive power”)

c) exhibits large **cross-sectional variation** across states, with the **nationwide component** driving only **35% of the state variation**

Their results indicate the **importance of sentiment** at both **local** and **national levels** in understanding the **business cycle**

Thank You!


Derek Poustka


derek.dp@usp.br

(Almost) 200 Years of News-Based Economic Sentiment

Jules H. van Binsbergen

Svetlana Bryzgalova

Mayukh Mukhopadhyay

Varun Sharma

By Derek Poustka

About the Authors

- **Jules H. van Binsbergen**
  - Nippon Life Professor in Finance at the *Wharton School* of the *University of Pennsylvania*
  - Research associate at the *National Bureau of Economic Research* (NBER)
  - Research fellow at the *Center for Economic and Policy Research* (CEPR)
  - Co-host of the podcast series *All Else Equal: Making Better Decisions*

- **Svetlana Bryzgalova**
  - Assistant Professor of Finance at *London Business School* (LBS)

- **Mayukh Mukhopadhyay**
  - PhD student in Financial Economics at *London Business School* (LBS)

- **Varun Sharma**
  - Assistant Professor of Finance at the *Kelley School of Business* of the *Indiana University*