The Effectiveness of Monetary Policy Communication: Evidence from Textual Analysis of Daily Newspaper Articles

Bisrat Woldesilassie

Western Michigan University

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Dissertation Committee

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Outline of this Presentation

- Overview
- Introduction
- Data
- Methodology
- Empirical analysis
- conclusions

Overview

- The goal of this paper is to measure how effectively the Fed communicates monetary policy through FOMC minutes.
- Using sentiment analysis on daily newspaper articles, I measure the surprise in the daily news sentiment that is caused by FOMC minutes release.
- The surprise in the sentiment is calculated as the change in the news sentiment that is measured over three weeks prior to the release of the FOMC minutes and news sentiment with in one day after the release of the minutes.

Overview…

- Using an event-study methodology, I test whether the sentiment surprise due to the release of the FOMC minutes affect the one-day returns in the S&P 500.
- The analysis is conducted in both the pre- and post- 2011 periods.
- In March of 2011, the Fed began holding a press conference on the day of the FOMC meeting.
- If the Fed effectively communicates its policy stance through the press conference, the new information content of the minutes release should diminish.
- I find that the magnitude and significance of the effect of sentiment changes due to the minutes release on the daily returns falls across the two periods.

Overview

- I am able to disaggregate the sentiment surprises into individual topics.
- I find that the Fed is more effective in communicating about monetary policy and economic growth than about inflation and labor markets.

Introduction

- “Monetary policy is 98 percent talk and only two percent action.” (Bernanke, 2015).
- Goal of monetary policy communications is to manage the public’s expectation and to increase the signal to noise ratio by “creating news” and “reducing the noise” (Blinder et al., 2008).
- Studying monetary policy communication is complex.
- It is yet unclear how effective monetary policy communication is.

Introduction…

- Estimating the effect of monetary policy is challenging econometrically because assuming financial markets are efficient.
- Market is unlikely to respond to policy actions that were already anticipated.
- Separating the monetary policy into anticipated and unanticipated is necessary.
- Two types of instruments: monetary policy action and monetary policy communication.
- To calculate the surprise in the federal funds rate, Kuttner (2001) used the federal funds future rate and Andersen et al. (2003) used the survey expectations from Money Market Services (MMS)

Introduction…

- Few studies employed time series econometric models to proxy the surprise in the monetary policy communication.
- For instance, FA-VAR by Hansen and McMahon (2016), and AR(1) by Vo (2019).
- Time series econometric models:
- are subject to the usual problems stemming from the choice of variables, the ordering of the variables and the restrictions imposed.
- assume that the market participants do not access any information between the two subsequent monetary policy communication events.

Introduction…

- I use news from daily newspapers to quantify the surprise in the news sentiment caused by the release of FOMC minutes.
- The surprise is computed as the change in news sentiment measured before the release of the FOMC minutes and news sentiment measured with in one day after the release of FOMC minutes.
- Thus, by using an event study with a narrow window surrounding the monetary policy communication, I compute a precise measure of the surprise in the daily news sentiment that is caused by the release of the communication.

Using daily news has three advantages.

- First, the surprise measure is **more realistic** because empirical findings support that market participants rely on the information from daily news (Doms and Morin, 2004; Berger et al., 2011; Hayo and Neuenkirch, 2015).
- Secondly, the resulting surprise measure is obtained by **using the textual analysis.**
- Lastly, and most importantly, daily news can track the changes in sentiment in almost **a continuous manner at daily frequency**.

Introduction

- I extended this existing literature by adding the role of media news in monetary policy transmission.
- I empirically test the extent to which the monetary policy communication through the FOMC minutes changes daily news sentiment and
- I examine how changes daily news sentiment in turn influences stock market returns.

Data

- This paper studies only the effectiveness of communication through FOMC minutes for two reasons.
- The study periods range from **January 2005 to January 2020** and **the total number of FOMC minutes are 120.**
- My source of daily news articles is Factiva.com.
- I use a total of **30 newspapers** in this study.

Methodology

Step 1: Identifying the major macroeconomic topics that are discussed in the FOMC minutes.

- This study automates topic searching by clustering similar cooccurring words using techniques from text mining.
- I employ the Latent Dirichlet Allocation (LDA) model of Blei et al. (2003) to uncover the latent topics from each FOMC minutes.
- The implementation of LDA requires **the corpus and the number of topics** as inputs.
- Determining the number of topics is subjective and it is decided by the researcher.
- I identify five distinguishable and interpretable topics.

Figure 1: Word Clouds of the Five Major Topics in the FOMC Minutes Identified by LDA.

Topic 1: Economic Growth

Topic 2: Inflation

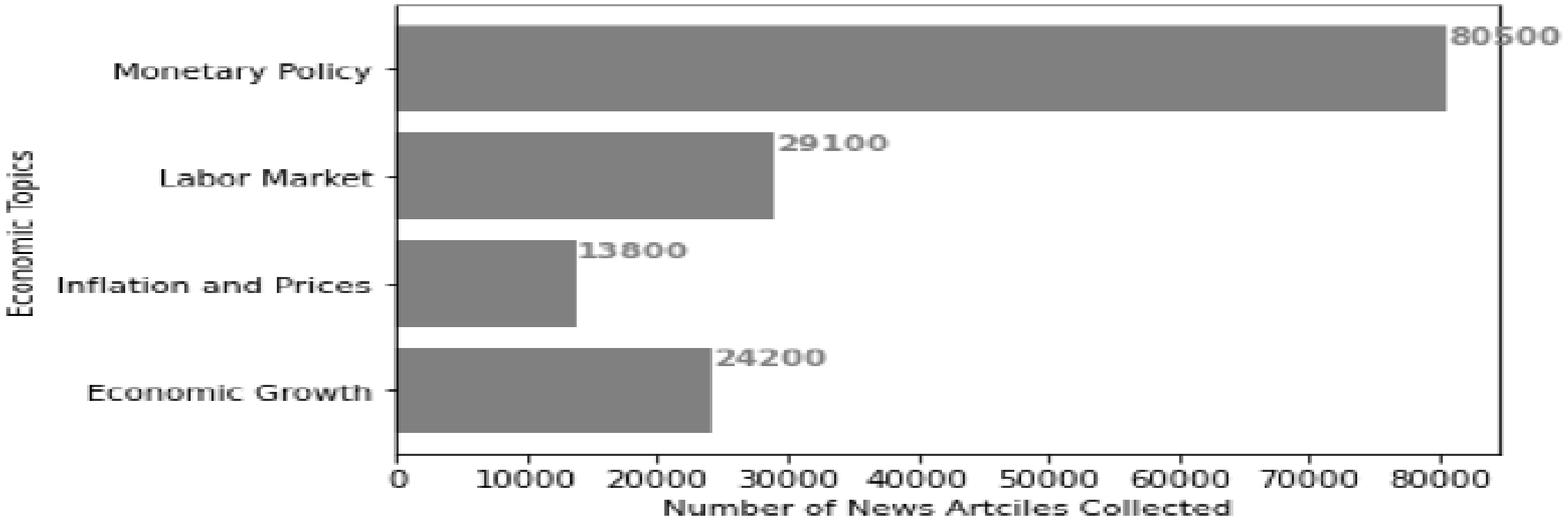
Topic 3: Unemployment

Topic 4: Employment

Topic 5: Monetary Policy

Step 2: News Articles Are Collected.

Figure 2: The Number of News Articles Collected Across the Major Economic Topics from 2005-2020.



Step 3: News Articles Are Preprocessed/Cleaned.

- First, uppercase letters are converted into lowercase.
- Second, all types of punctuations, web and email addresses, numbers and special characters are removed.
- Third, the text is tokenized into words.
- Fourth, common stop words such as “the”, “a”, “an” and words that frequently appear in the text that do not add any important meaning to the text are removed.
- Lastly, the words are stemmed and lemmatized. This refers to converting all other forms of verbs, such as past, into the present and all plurals into singular.

Step 4: Computing Sentiment of News Articles

- Textual information is converted into numerical equivalents using lexical analysis.
- The lexical analysis is a rule-based information extraction method that uses a dictionary of pre-classified positive and negative words.

Table 1: Sample Positive and Negative Words Used in the Sentiment Calculation.[4]

Positive Words	*Negative Words*
Increas	Decreas
Expand	Contract
Gain	Slow
Accelerat	Low
High	Loss
Strong	Decelerate
Fast	Layoff
Appreciat	Exacerbat
Boom	Exaggerat
Positive	Advers
Stabl	Aggravat
Recover	Downward
Upward	Slowdown
Good	Shutdown

Computing Sentiment of News Articles…

- Sentiment is measured by the relative frequency of positive and negative words in the given text.
- **Harvard-IV-4 dictionary (denoted IV-4)** as used in Tetlock (2007) and the **LM** dictionary that was constructed by Loughran and MCdonald (2011) are the two widely used dictionaries in economics and finance studies.
- I constructed a new and more comprehensive dictionary that combines the **IV-4** and **LM** dictionaries and the dictionary used in Hansen and MCMahon (2016).
- The number of positive and negative words used in this study are 3324 and 5258, respectively.

Computing Sentiment of News Articles

$$S_{t,\tau,i} = \frac{\text{number of positive words} - \text{numbers of negative words}}{\text{number of total words in the document}}, \qquad (1)$$

- where S refers to sentiment, t is day index, τ is the topic index with τ =1,..,5 and
- i indexes news article with i=1,…,$N_{t\,\tau}$.
- The resulting sentiment score from (1) ranges from -1 to +1.

Step5: Compute News Sentiment at Daily Frequency

- Aggregate the sentiment of each news article that is released on the same day to generate the daily sentiment.

$$S_{t,\tau} = \frac{\sum_{i=1}^{N_{t,\tau}} S_{t,\tau,i}}{N_{t,\tau}},$$

- $S_{t,\tau}$ is sentiment on each topic that is computed for each day,
- $N_{t\,\tau}$ is the total number of a news article in each day t on each topic τ.

Is it Reasonable to Use Daily News Sentiment?

- I plotted the daily news-based sentiment regarding economic topics against the corresponding quantitative measures for the economic topics.
- To construct the plot, I calculated the data on the change in the unemployment rate on the date it was released by the U.S. Bureau of Labor Statistics.

Figure 3: A Scatter Plot of News Based Unemployment Sentiment Against the Changes in the Unemployment Rate.

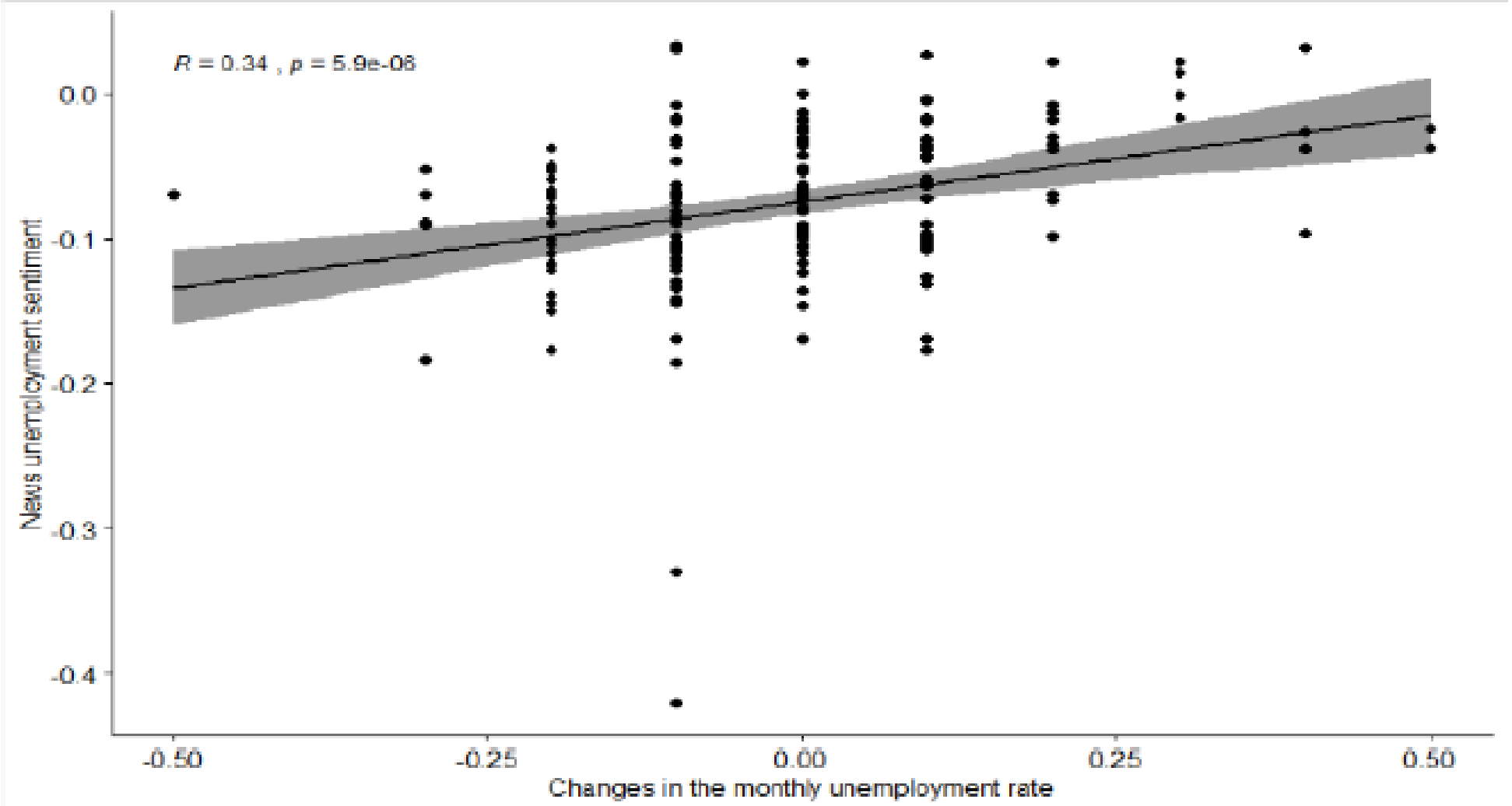
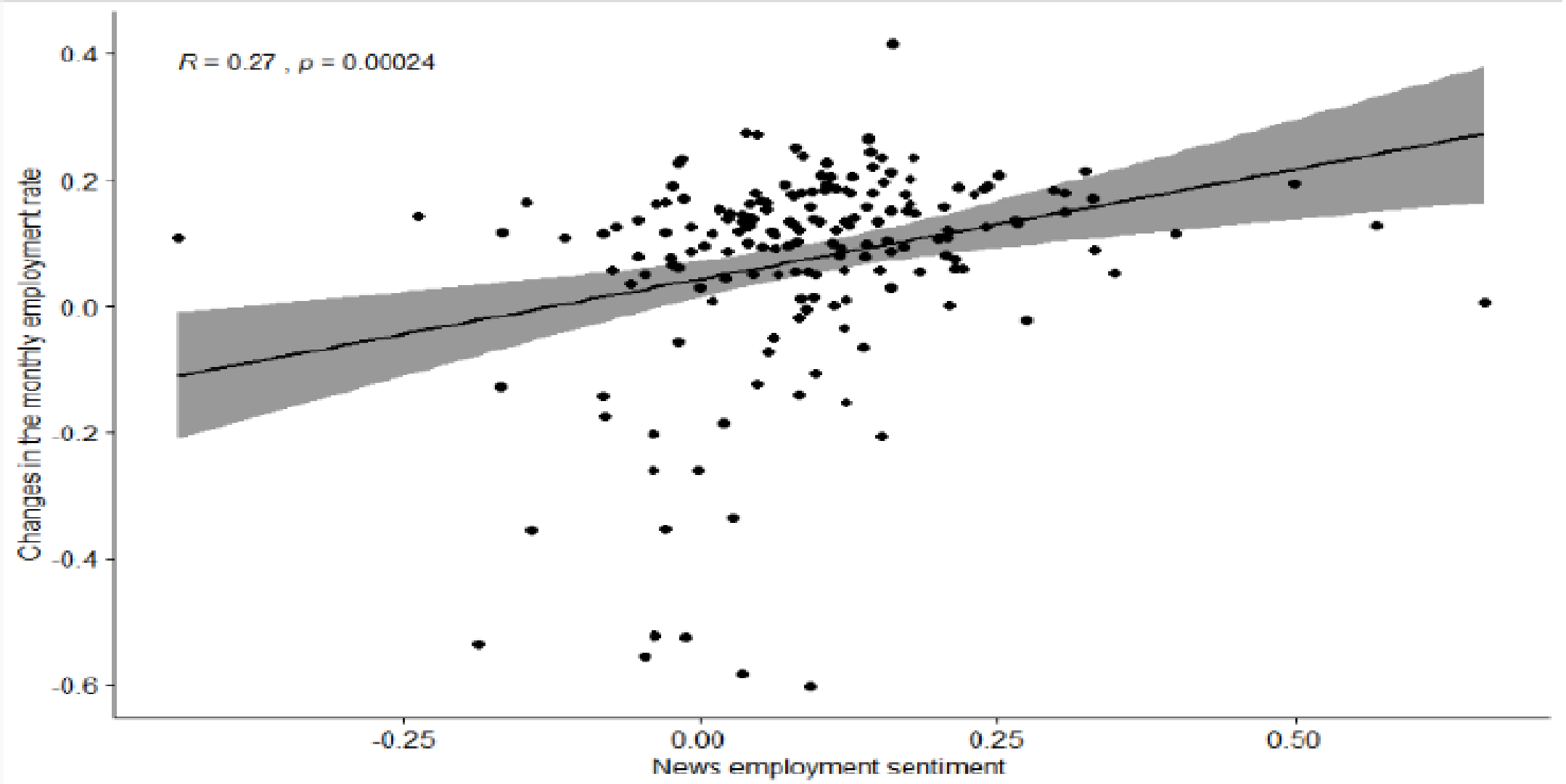


Figure 4: A Scatter Plot of News Based Employment Sentiment Against the Changes in the Employment Rate.

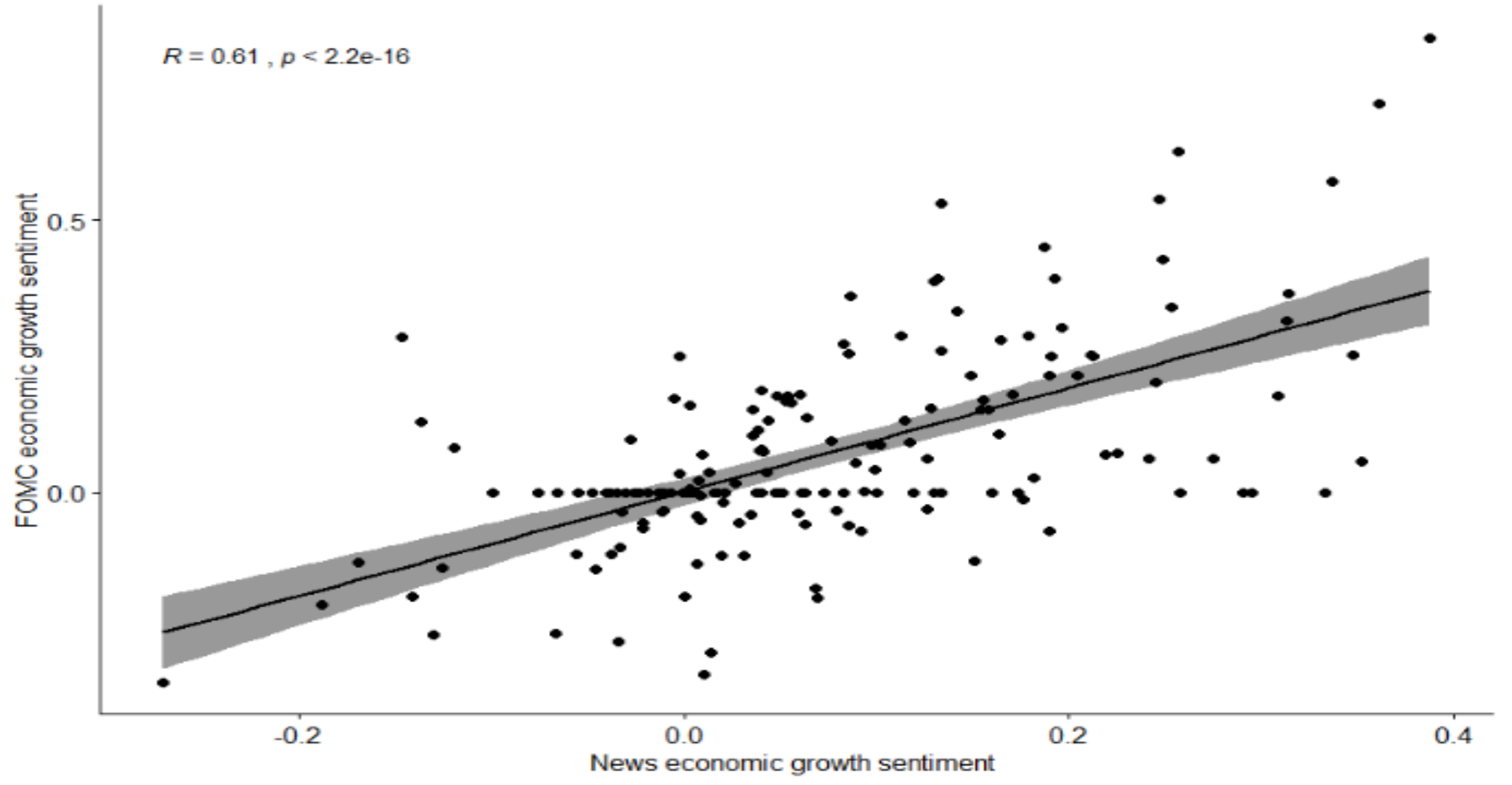


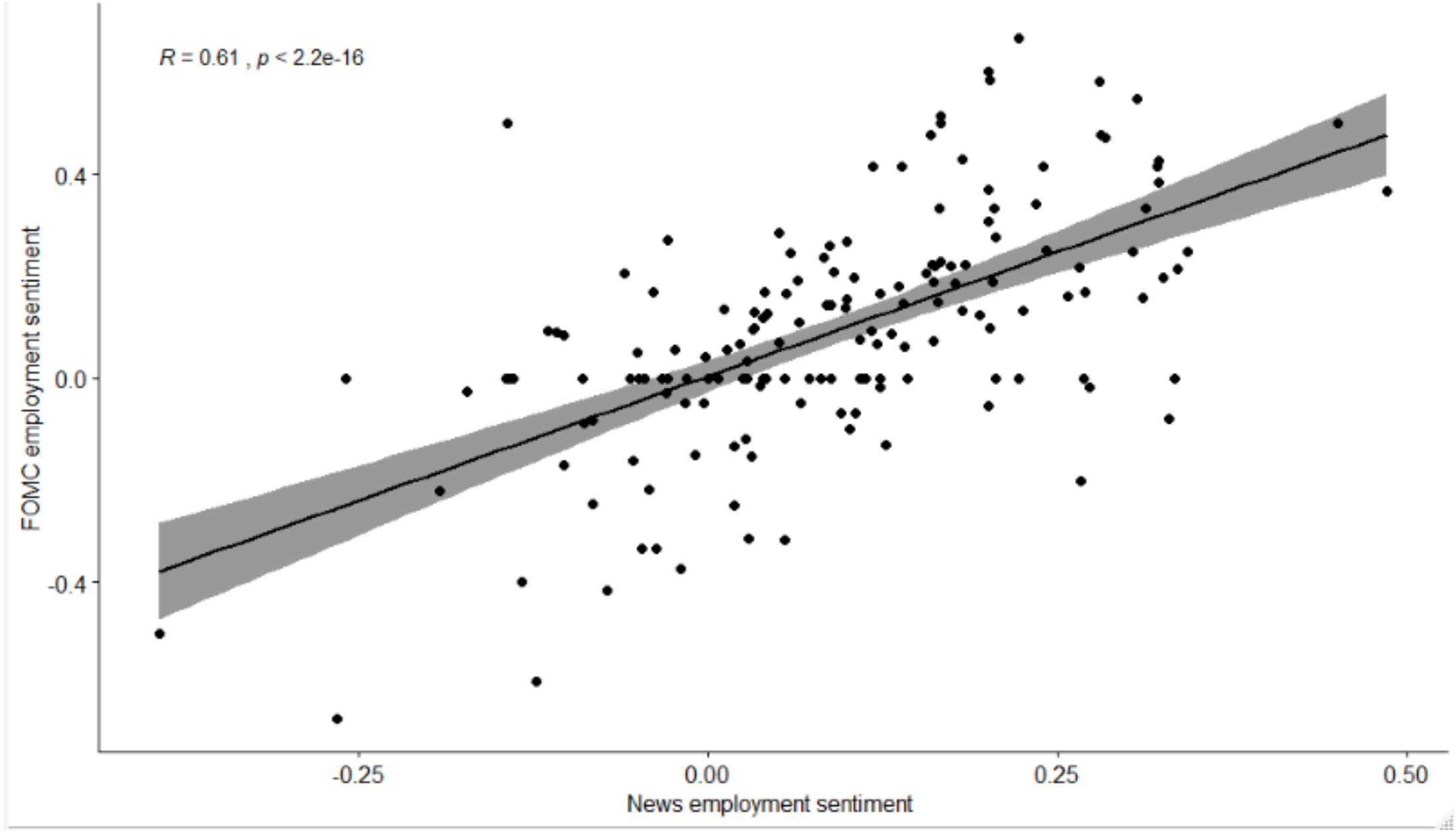
Is it Reasonable to Use Daily News Sentiment?...

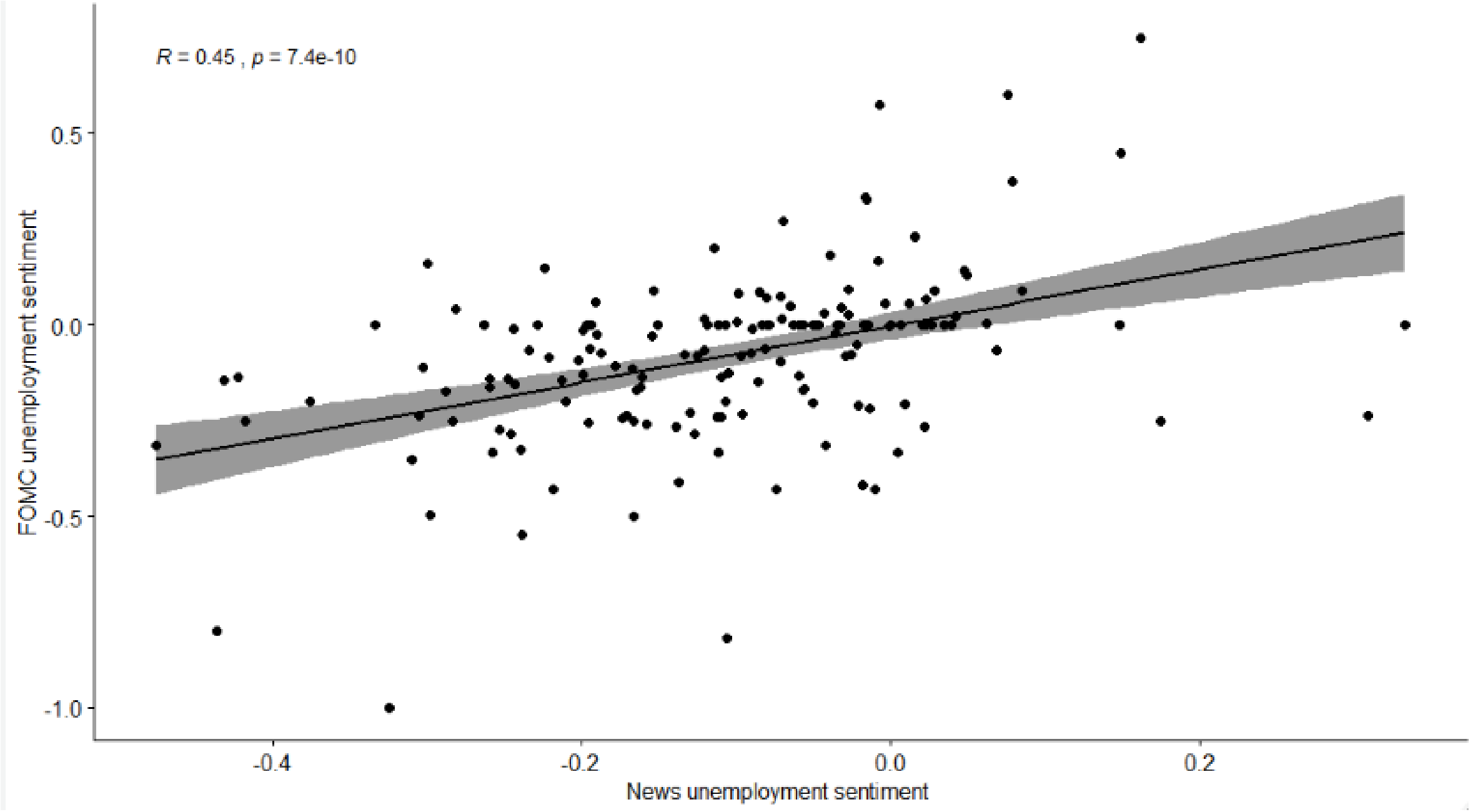
- The result shows there is a significant positive correlation between each quantitative measures and news-based sentiment measures of different economic topics.
- Thus, the result signifies that the news-based sentiment captures the release of major macroeconomic news over time and is an appropriate sentiment measure for this paper.

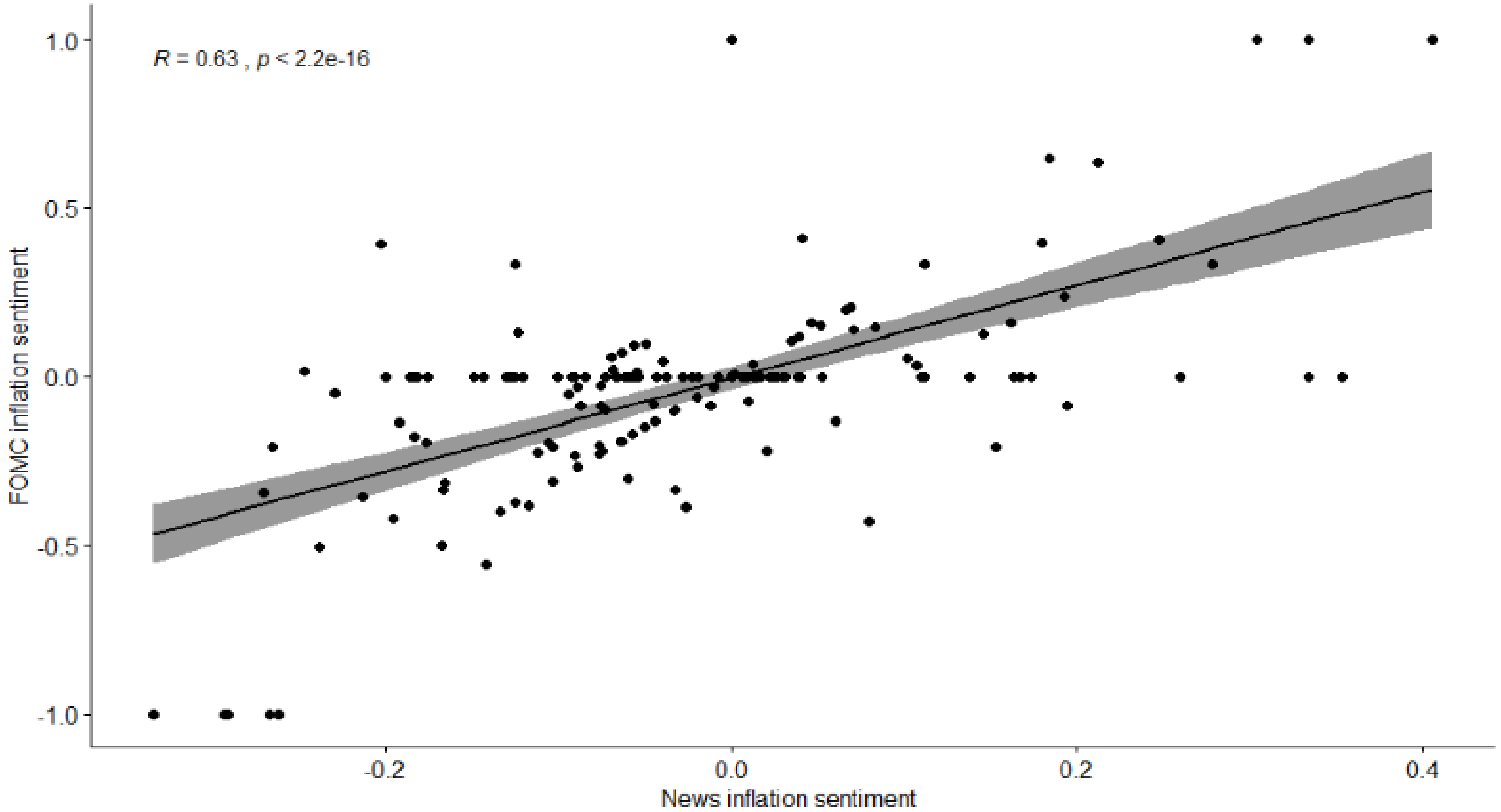
Is it Reasonable to Use Daily News Sentiment?...

- I also examined the extent to which the news-based sentiment score reflects the news released from the FOMC minutes.
- For this purpose, I extracted the daily news sentiment only on the date when the FOMC minutes are released and I also computed the sentiment score on these same economic topics from the FOMC minutes.
- For instance, I computed the sentiment on unemployment from the news articles and FOMC minutes on the days when there are FOMC minute releases.


R = 0.61 , p < 2.2e-16
FOMC economic growth sentiment
0.5
0.0
-0.2
0.0
0.2
0.4
News economic growth sentiment


R = 0.61 , p < 2.2e-16
FOMC employment sentiment
0.4
0.0
-0.4
-0.25
0.00
0.25
0.50
News employment sentiment


R = 0.45 , p = 7.4e-10
0.5
0.0
-0.5
-1.0
FOMC unemployment sentiment
-0.4
-0.2
0.0
0.2
News unemployment sentiment


R = 0.63 , p < 2.2e-16
1.0
0.5
0.0
-0.5
-1.0
FOMC inflation sentiment
-0.2
0.0
0.2
0.4
News inflation sentiment

Is it Reasonable to Use Daily News Sentiment?

- There is a **strongly positive and significant correlation** between the sentiment on different economic topics from the two different sources: news article and FOMC minutes on the day when the FOMC minutes are released.
- This also signifies that the news-based measures of economic sentiment provide a result that **tracks major economic events.**
- Consequently, I use this daily news sentiment to compute the surprise in the news sentiment due to the FOMC minutes.

Step 6: Calculate the News Sentiment Released Before FOMC Minutes

- Include all daily news after the FOMC meeting up to the last day before the corresponding FOMC minute is released.

$$S^{b}_{t^{*}_{k},\ \tau} = \frac{\sum_{j=1}^{D} S_{t^{*}_{k}-j,\ \tau}}{D}, \qquad (3)$$

- D is the number of days between the FOMC meeting and one day before the release of the current FOMC minutes.

Step 7: Calculate the News Sentiment Released <u>After</u> FOMC Minutes

- News articles most likely report the macroeconomic news within 1 day after the news is released from the originally responsible agency.
- I take the average of the news sentiment on the date when FOMC minute is released and one day after it.

$$S^{a}_{t^{*}_{k},\,\tau} = \frac{\sum_{j=0}^{1} S_{t^{*}_{k}+j,\,\tau}}{2}, \tag{4}$$

Step 8: Calculate the Surprise in the News Sentiment

- By Subtracting off the news sentiment for news that are released **before** FOMC minutes from the news sentiment that are released **after** the FOMC minutes.

$$S^{*}_{t_k^*,\tau} = S^{a}_{t_k^*,\tau} - S^{b}_{t_k^*,\tau}, \tag{5}$$

Lastly: Compute the Overall Surprise in the News Sentiment

- After I computed the information innovation in the news sentiment on each economic topic separately,
- I applied the principal component method to construct the overall surprise in the news sentiment due to the release of FOMC minutes.
- The two leading principal factors are taken.

Changes in the FOMC Communication

- Before **2004**, the FOMC released full minutes of the meeting **one week after the subsequent** FOMC meeting.
- **After January 2005**, the FOMC started releasing the minutes three weeks after the corresponding FOMC meeting.
- I excluded all the FOMC minutes before 2005.
- The study period is 2005-2020.
- **Beginning in March 2011** the FOMC started holding a **press conference** immediately after each FOMC meeting.
- ***Hypothesized that FOMC minutes become less important after 2011***.
- I run two separate regressions for the two study periods:2005-2011 and 2011-2020

Empirical Analysis: Event Study Regression

- Response of the S&P 500 stock returns to the surprise in the news sentiment caused by the release of FOMC minutes.
- Uses observation only on the days where FOMC minutes are released.
- Helps to solve the simultaneity and endogeneity problem in establishing the causal effects of the FOMC minutes on the financial asset.

Effect of the Surprise in the News Sentiment on Stock Market

- Regressing $R_{t_k^*}$ on $S_{t_k^*}^*$ using only observation where the FOMC minutes are released.

$$R_{t_k^*} = \alpha + \beta S_{t_k^*}^* + \varepsilon_{t_k^*}, \qquad k = 1, \ldots, 120 \tag{7}$$

- Use observation only on the days where FOMC minutes are released.
- It is event study regression fitted by OLS.
- I run two separate regressions for the pre- and post-2011 periods

Table 2: The Response of S&P 500 Returns to the Surprises in the News Sentiment Caused by the FOMC Minutes Releases.

	January 2005-March 2011	**April 2011-January 2020**
Intercept	-1.37**	0.37
	(-2.35)	(1.59)
Surprises on Economic growth	9.66**	-3.09*
	(2.02)	(-1.70)
Surprises on Inflation	1.90	-0.42
	(0.86)	(-0.58)
Surprises on Unemployment	-10.98*	-0.10
	(-1.98)	(-0.05)
Surprises on Monetary policy	8.65***	-0.84
	(3.19)	(-0.53)
F-statistic	5.29***	0.87
(P-value)	(0.00)	(0.48)
R^2	0.32	0.05

*Note: All values in the parentheses are t-statistics of the estimates and *, **, and *** denotes the level of statistical significance at 0.1, 0.05 and 0.01, respectively.*

Table 3: The Response of S&P 500 Returns to the Surprises in the Overall News Sentiment Caused by the FOMC Minutes Releases.

	January 2005-March 2011	**April 2011-January 2020**
Intercept	-0.20 (-1.02)	0.09 (1.16)
Suprises _comp1	-8.73*** (-3.29)	0.10 (0.08)
Suprises _comp2	12.58*** (3.10)	-3.27* (-1.84)
F-statistic (P-value)	9.57*** (0.00)	1.72 (0.19)
R^2	0.29	0.05

Note: Suprises_*comp1, and Surprises_comp2, are the two leading principal components. All values in the parentheses are t-statistics of the estimates and *, **, and *** denotes the level of statistical significance at 0.1, 0.05 and 0.01, respectively.*

Effects of the News Sentiment Released Before the FOMC Minutes ($S^{b}_{t^{*}_{k}}$):

- Test the financial market efficiency.
- Examined whether the stock market reacts to the news sentiment that are released before the FOMC minutes.

$$R_{t^{*}_{k}} = \alpha + \beta S^{b}_{t^{*}_{k}} + \varepsilon_{t^{*}_{k}}, \quad k=1,\ldots\ldots,120 \qquad (8)$$

Table 4: The Response of S&P 500 Returns to the News Sentiment that Are Released Before the FOMC Minutes.

	January 2005-March 2011	**April 2011-January 2020**
Intercept	0.14 (0.46)	0.07 (0.57)
Sentiment on Economic growth	1.37 (0.50)	0.39 (0.41)
Sentiment on Inflation	4.62 (0.68)	-0.54 (-0.35)
Sentiment on Unemployment	-0.63 (-0.27)	-0.52 (-0.68)
Sentiment on Monetary policy	4.58 (0.87)	-1.65 (-0.77)
F-statistic (P-value)	0.34 (0.85)	0.45 (0.77)
R^2	0.03	0.03

Note: All values in the parentheses are t-statistics of the estimates and none of the coefficients are significant.

Table 5: The Response of S&P 500 Returns to the Overall News Sentiment that Are Released Before the FOMC Minutes Releases.

	January 2005-March 2011	**April 2011-January 2020**
Intercept	-0.21 (-0.81)	0.11 (1.29)
Sentiment_comp1	1.64 (0.61)	0.51 (0.52)
Sentiment_comp2	-6.22 (-0.98)	1.10 (0.79)
F-statistic (P-value)	0.56 (0.57)	0.42 (0.66)
R^2	0.02	0.01

Note: Sentiment_*comp1, and Sentiment_comp2 are the two leading principal components. All values in the parentheses are t-statistics of the estimates and none of the coefficients are significant.*

Conclusions

- The goal of this paper is to measure how effectively the Fed communicates monetary policy through FOMC minutes.
- I measure the surprise in the daily news sentiment that is caused by FOMC minutes release.
- The empirical result shows that surprises in the news sentiment due to the FOMC minutes affects the stock market significantly.
- I find that the stock market reactions to the innovation in the news sentiment is insignificant for post-2011.

Thank you!