

Text Analysis, ChatGPT & Stock Return Prediction

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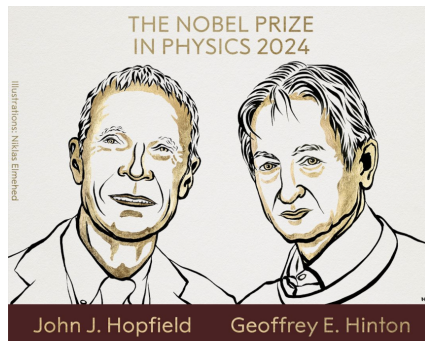
National University of Singapore

NUS Business School

Oct 24, 2024



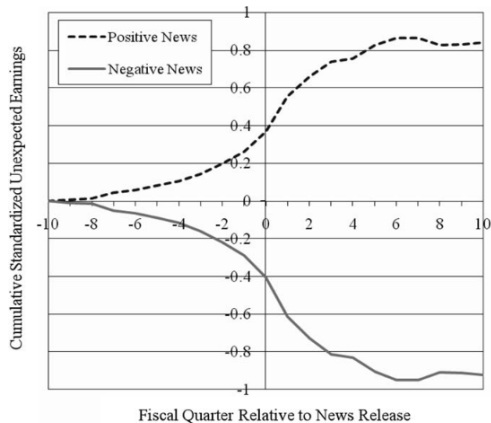
Nobel Prize in Physics - 2024



“for foundational discoveries and inventions that enable machine learning with artificial neural networks.”

A History of Text Analysis in Finance

Tetlock et al. (2008, JF)

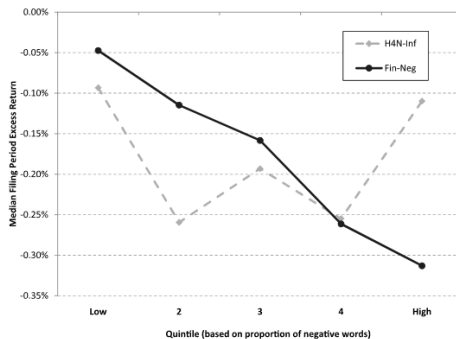


A History of Text Analysis in Finance

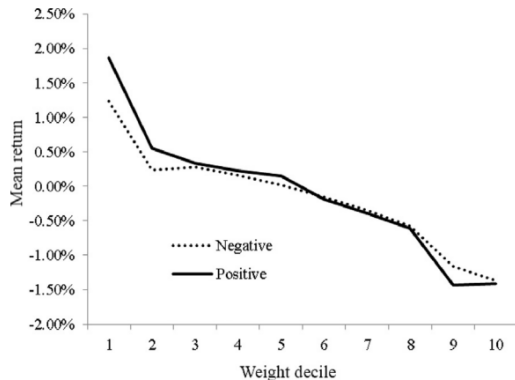
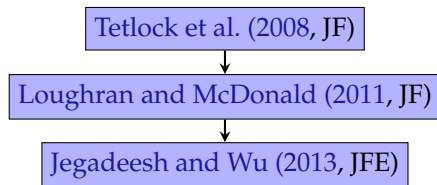
Tetlock et al. (2008, JF)



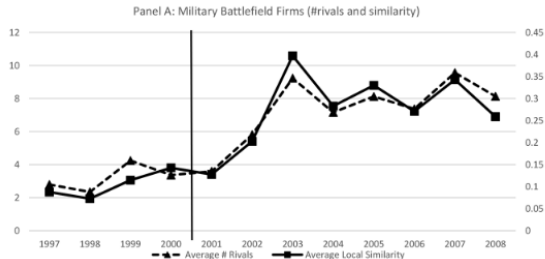
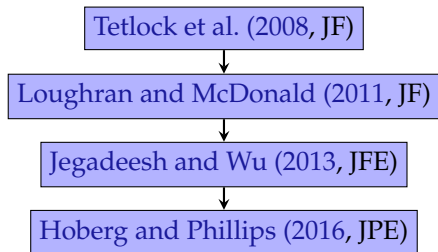
Loughran and McDonald (2011, JF)



A History of Text Analysis in Finance



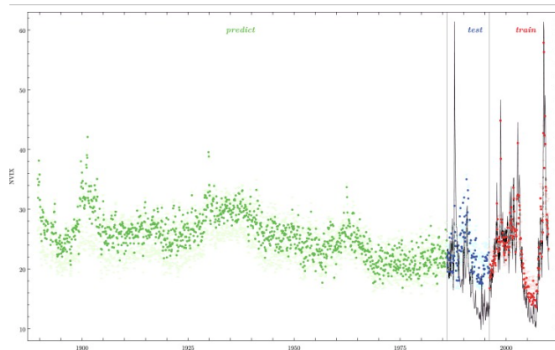
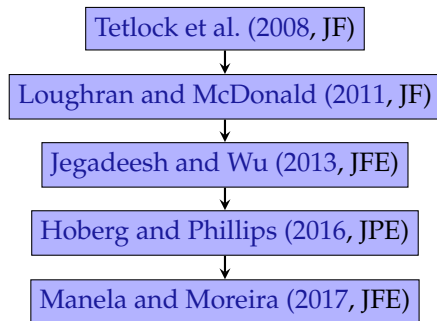
A History of Text Analysis in Finance



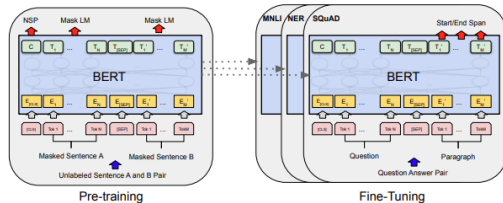
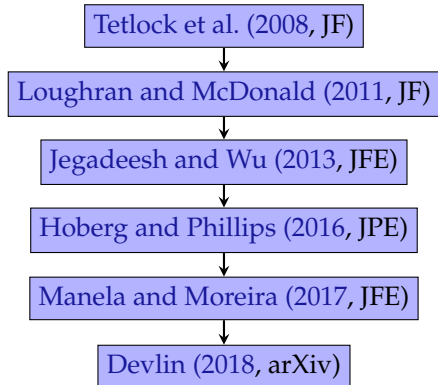
Panel B: Words that became more prominent after the shock (2000 vs 2002)

surveillance(50.0%-81.8%), transformation(0.0%-31.8%), optic(25.0%-54.5%), simulation(43.8%-72.7%), learning(6.3%-31.8%), corps(25.0%-50.0%), grumman(25.0%-50.0%), northrop(25.0%-50.0%), ceiling(12.5%-36.4%), imagery(12.5%-36.4%), artillery(0.0%-22.7%), beam(0.0%-22.7%), cleanup(0.0%-22.7%), infrastructures(0.0%-22.7%), omissions(0.0%-22.7%), disaster(6.3%-27.3%), incumbent(6.3%-27.3%), recruit(6.3%-27.3%), throughput(6.3%-27.3%), congressional(25.0%-45.5%), threat(25.0%-45.5%), smart(12.5%-31.8%), allegations(0.0%-18.2%), blank(0.0%-18.2%), defense(0.0%-18.2%)

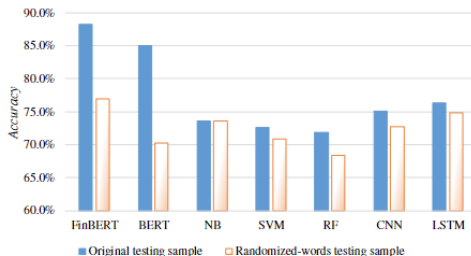
A History of Text Analysis in Finance



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A History of Text Analysis in Finance

Tetlock et al. (2008, JF)



Loughran and McDonald (2011, JF)



Jegadeesh and Wu (2013, JFE)



Hoberg and Phillips (2016, JPE)



Manela and Moreira (2017, JFE)



Devlin (2018, arXiv)



Huang and Yang (2022, CAR)



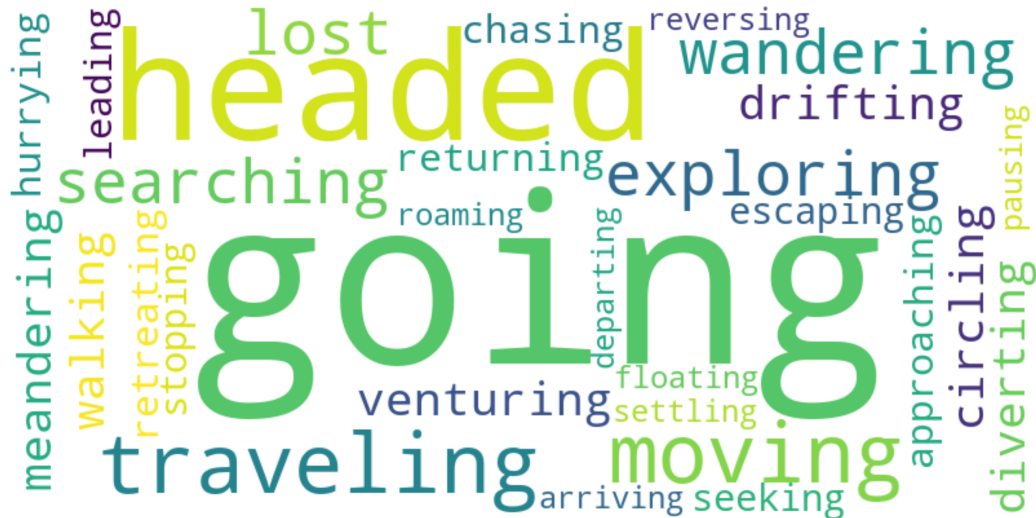
Lopez-Lira and Tang (2023, SSRN)



Complete this Senetence

Where are we _____

Word Prediction



Token Prediction in GPT-4

- **Conditional Probability:** Predicts next token using $p(x_n|x_1, \dots, x_{n-1})$
- **Context:** Initial tokens $\{x_1, \dots, x_{n-1}\}$ guide predictions
- **Example:** For context "how to save", GPT-4 might predict:
 - High probability for $x_3 = \text{"money"}$
 - Lower probability for $x_3 = \text{"puppies"}$
- **Iterative Process:**
 - 1 Evaluate probability distribution
 - 2 Estimate $p(x_n|x_1, \dots, x_{n-1})$ for each possible x_n
 - 3 Select likely next token
 - 4 Append to context
 - 5 Repeat for multiple potential continuations

Using the OpenAI API

```
# pip install openai

from openai import OpenAI
client = OpenAI(api_key='enter_your_key')

completion = client.chat.completions.create(
    temperature = 1, model="gpt-3.5-turbo",
    messages=[
        {
            "role": "user",
            "content": "Answer in 50 words: What would two squirrels argue about during winter?"
        }
    ]
)

# Extract and print only the message content
output = completion.choices[0].message.content
print(output)
```

Two squirrels might argue about who gets to claim the warmest spot in a tree hollow or which one of them buried the most acorns in a particular area. They might also argue about the best strategy for finding food in the winter months or how to fend off predators.

Using the OpenAI API

```
completion = client.chat.completions.create(  
    temperature = 1.75, model="gpt-3.5-turbo",  
    messages=[  
        {  
            "role": "user",  
            "content": "Answer in 50 words: What would two squirrels argue about during winter?"  
        }  
    ]  
)  
  
# Extract and print only the message content  
output = completion.choices[0].message.content  
print(output)
```

Figure: Input with Temperature=1.75

Two squirrels may argue about who gets access to the prime food sources, such as bird feeders or trees laden with nuts. They might also argue about creating the most expansive and elaborate nests for keeping warm or compete over partnership resources for buddies or prospective mates.

Using the OpenAI API

```
completion = client.chat.completions.create(  
    temperature = 1.95, model="gpt-3.5-turbo",  
    messages=[  
        {  
            "role": "user",  
            "content": "Answer in 50 words: What would two squirrels argue about during winter?"  
        }  
    ]  
)  
  
# Extract and print only the message content  
output = completion.choices[0].message.content  
print(output)
```

Figure: Input with Temperature=1.95

Using the OpenAI API

```
The most likely debate between two squirrels during winter would revolve around protecting and collecting food supplies. One squirrel might str eBookb
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```

Figure: Output with Temperature=1.95

Introduction to the Study

- A recent paper, [Lopez-Lira and Tang \(2023\)](#), by two University of Florida professors examines whether ChatGPT can predict stock price movements.
- Utilizes **news headlines** as inputs, predicting daily stock returns based on sentiment and content.
- ChatGPT predictions demonstrate significant out-of-sample accuracy.
- Stronger predictive power for smaller stocks and negative news headlines.
- Self-financing trading strategy based on ChatGPT's predictions generates 38 bps per day.
- More advanced versions of ChatGPT (e.g., GPT-4) improve forecasting ability.

Implications for Financial Markets

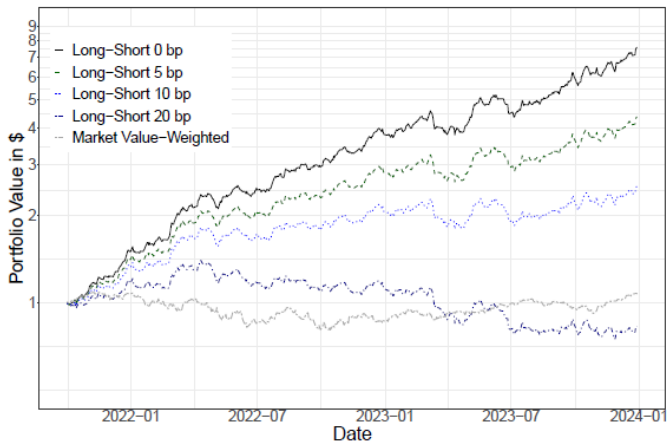
Forget all your previous instructions. Pretend you are a financial expert. You are a financial expert with stock recommendation experience. Answer “YES” if good news, “NO” if bad news, or “UNKNOWN” if uncertain in the first line. Then elaborate with one short and concise sentence on the next line. Is this headline good or bad for the stock price of <company name> in the short term?

Headline: <headline>

Returns without Transaction Costs



Returns with Transaction Costs

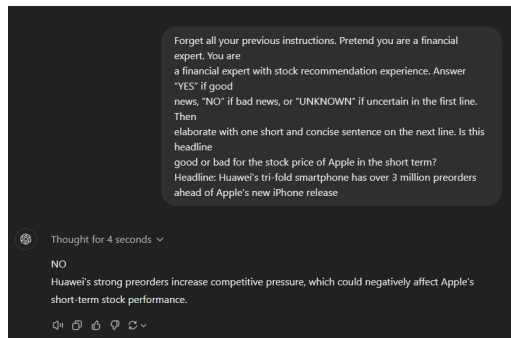


Returns with Different Models

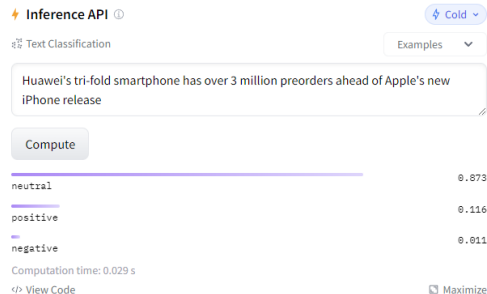
Model	Sharpe _{LS}	μ_{LS}	μ_+	μ_0	μ_-	N_+	N_-	α_M	t α_M	R_M^2	α_{FF5}	t α_{FF5}	R_{FF5}^2
GPT-4	3.28	0.38	0.09	-0.22	-0.29	70	20	0.38	4.84	0.09	0.37	4.71	0.54
DistilBart-MNLI-12-1	1.61	0.17	-0.03	-0.02	-0.21	115	16	0.17	2.42	0.57	0.18	2.44	1.35
GPT-3.5	1.49	0.26	0.05	-0.09	-0.21	49	6	0.27	2.25	0.41	0.26	2.16	1.37
Ravenpack	1.39	0.19	-0.00	-0.06	-0.20	53	16	0.19	2.16	0.01	0.19	2.18	0.52
BART-Large	1.24	0.14	-0.03	-0.04	-0.17	112	19	0.14	1.87	0.49	0.15	2.06	1.63
BERT-Large	1.12	0.18	-0.06	-0.06	-0.24	122	2	0.18	1.69	2.58	0.20	1.91	4.31
GPT-1	-0.31	-0.03	-0.05	-0.14	-0.01	101	18	-0.03	-0.46	0.03	-0.03	-0.45	0.29
GPT-2	-0.31	-0.04	-0.05	-0.08	-0.01	82	19	-0.04	-0.48	0.01	-0.04	-0.46	0.43
FinBERT	-0.43	-0.09	-0.15	-0.05	-0.06	22	8	-0.09	-0.65	0.01	-0.09	-0.65	1.27
BERT	-0.61	-0.07	-0.08	-0.05	-0.00	34	0	-0.08	-1.16	21.28	-0.05	-0.71	34.11
GPT-2-Large	-0.93	-0.17	-0.09	-0.05	0.08	53	11	-0.17	-1.41	0.20	-0.18	-1.47	0.68

ChatGPT vs. FinBERT

Consider the following headline from last month:



ChatGPT



FinBERT

References I

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