Analysis of Central Bank Speeches

Findings and Recommendations

Introduction

Intended Stakeholders: Bank of England Data Science Team

Context:	Speeches delivered by central banks can have significant effects on the economy

Aim:	Determine if sentiment of speeches by the BoE, can provide valuable insights into the banks current and future strategies.

Business Questions

01
- How sentiment has changed over time
- How sentiment correlates with events

02
- How sentiment correlates with major economic indicators

03
- Does sentiment in speeches have the power to predict market behaviour?

Objectives

Refine Bank of England's Communication Strategies:

1. Make more informed data-driven decisions
2. Understand key impacts
3. Better gauge financial indicators
4. Tailor communications to maintain market stability

Methodology

Retrieve & Clean Data

1. Download All Central Bank Speech Data

2. Download Economics Indicators

Exploratory Data Analysis

3. Preliminary Analysis by VADER

4. Preliminary Analysis by Lexicon List
   - Loughran and Mcdonald

Sentiment Analysis

5. Sentiment Analysis Over Time

6. Sentiment Analysis to Financial Events

Correlation & Linear Regression

7. Correlation to Economic Indicators

8. Regression and Classification Model

Methodology

GDP

RPI

Bank Rate

Unemploy-ment

CPI

FTSE

Date	FTSE	Unemployment rate	CPI	RPI	GDP	BoE Interest Rate	GDP (Billions of US $)	GDP Per Capita (US $)	GDP Annual % Change
1997-01	4057.4	7.5	2.1	3.1	63.3	5.94	1561.7	26779.8	4.5
1997-02	4257.8	7.3	1.9	3.2	64.0	5.94	1561.7	26779.8	4.5
1997-03	4307.1	7.2	1.7	3.3	64.0	5.94	1561.7	26779.8	4.5
1997-04	4248.1	7.2	1.6	3	64.6	5.94	1561.7	26779.8	4.5
1997-05	4445	7.2	1.6	3.2	64.1	6.25	1561.7	26779.8	4.5
1997-06	4562.8	7.3	1.6	3.5	64.5	6.5	1561.7	26779.8	4.5
1997-07	4728.3	7.1	1.9	3.8	64.8	6.75	1561.7	26779.8	4.5
1997-08	4899.3	6.8	1.9	4.1	64.9	7	1561.7	26779.8	4.5
1997-09	4870.2	6.7	1.9	4	65.0	7	1561.7	26779.8	4.5
1997-10	5317.1	6.6	1.8	4.1	65.4	7	1561.7	26779.8	4.5
1997-11	4906.4	6.5	1.8	4.1	65.7	7.25	1561.7	26779.8	4.5
1997-12	4921.8	6.4	1.8	4	66.2	7.25	1561.7	26779.8	4.5
1998-01	5193.5	6.4	1.6	3.7	66.0	7.25	1655.0	28296.8	3.2
1998-02	5599	6.4	1.6	3.9	66.6	7.25	1655.0	28296.8	3.2
1998-03	5820.6	6.3	1.6	3.8	66.4	7.25	1655.0	28296.8	3.2
1998-04	6017.6	6.3	1.8	4.5	66.9	7.25	1655.0	28296.8	3.2
1998-05	6010.3	6.3	1.8	4.6	66.7	7.25	1655.0	28296.8	3.2
1998-06	5837.9	6.3	1.8	4.2	66.8	7.5	1655.0	28296.8	3.2
1998-07	5919.9	6.3	1.4	3.9	66.9	7.5	1655.0	28296.8	3.2
1998-08	5809.7	6.2	1.4	3.6	67.1	7.5	1655.0	28296.8	3.2
1998-09	5169.1	6.2	1.4	3.5	67.1	7.5	1655.0	28296.8	3.2
1998-10	4908.2	6.2	1.4	3.4	67.3	7.25	1655.0	28296.8	3.2
1998-11	5525.5	6.1	1.4	3.2	67.7	6.75	1655.0	28296.8	3.2
1998-12	5537.45	6.2	1.4	2.8	67.8	6.25	1655.0	28296.8	3.2
1999-01	5879.44	6.2	1.6	2.4	67.9	6	1689.4	28789.0	3.0

Methodology

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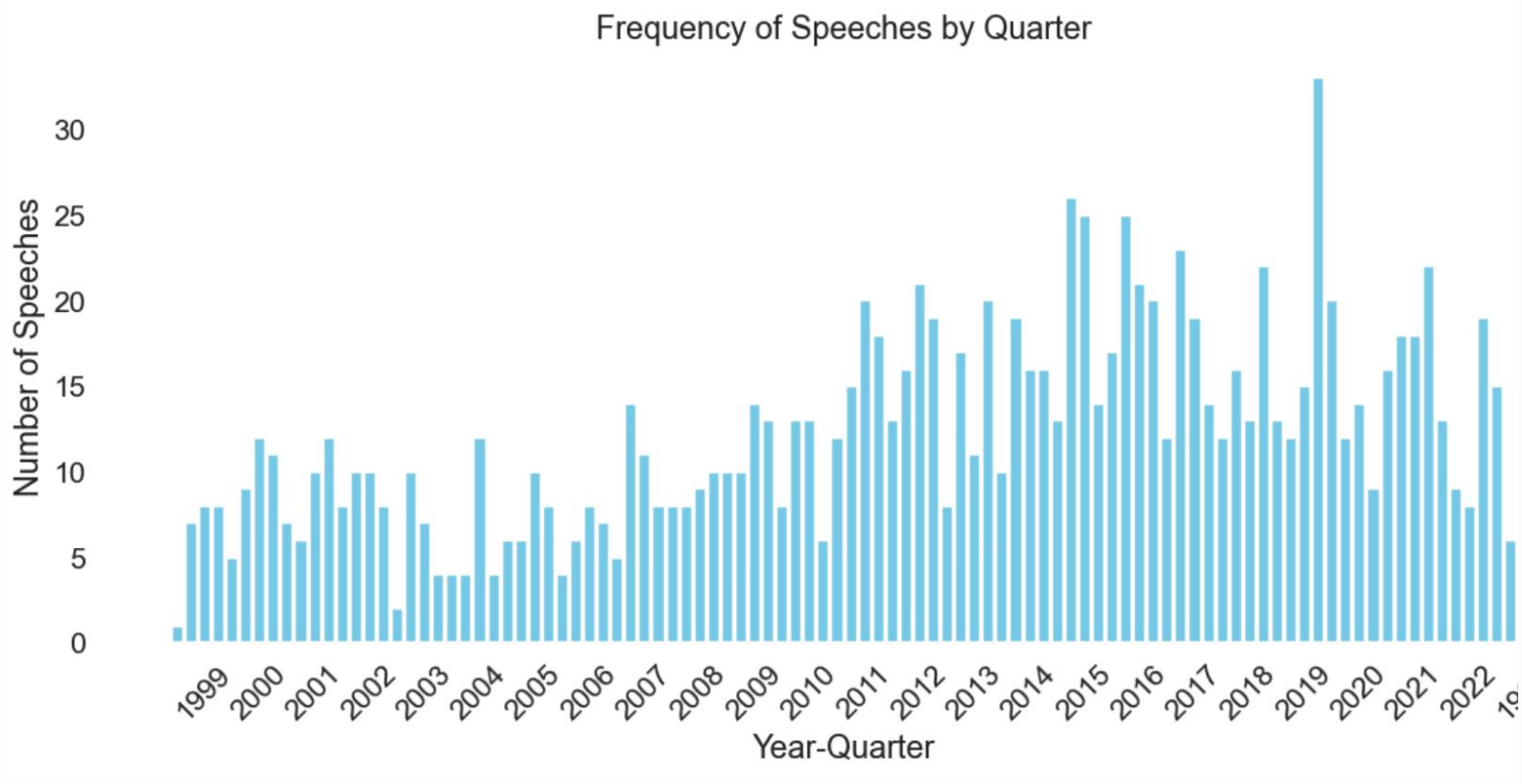
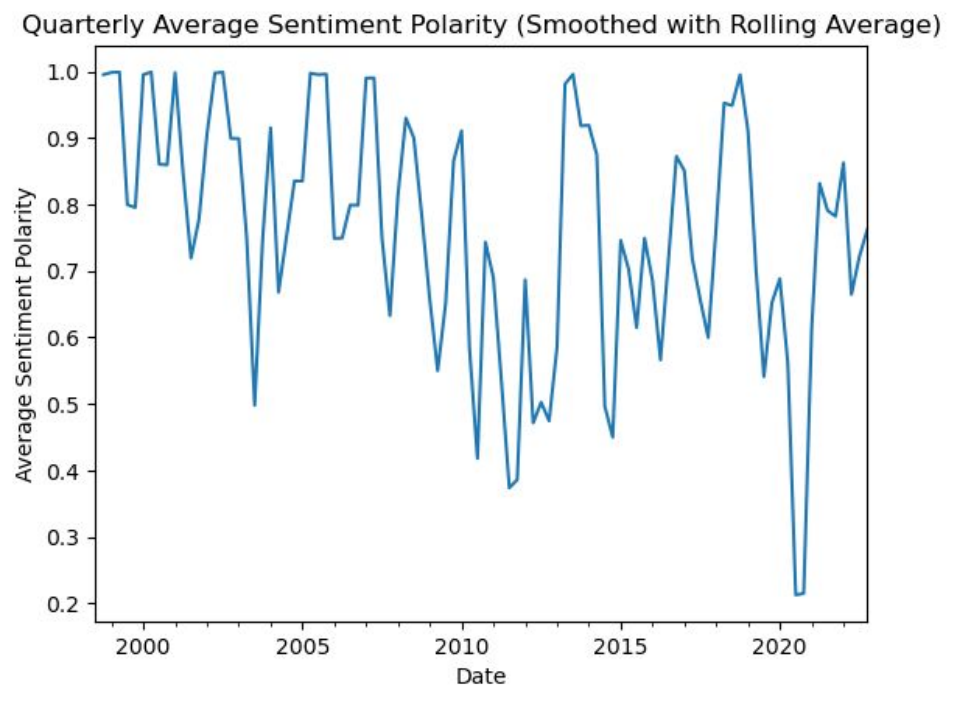


Total No. of Speeches: 1209

Average per Year: 48

Sentiment Analysis (VADER)

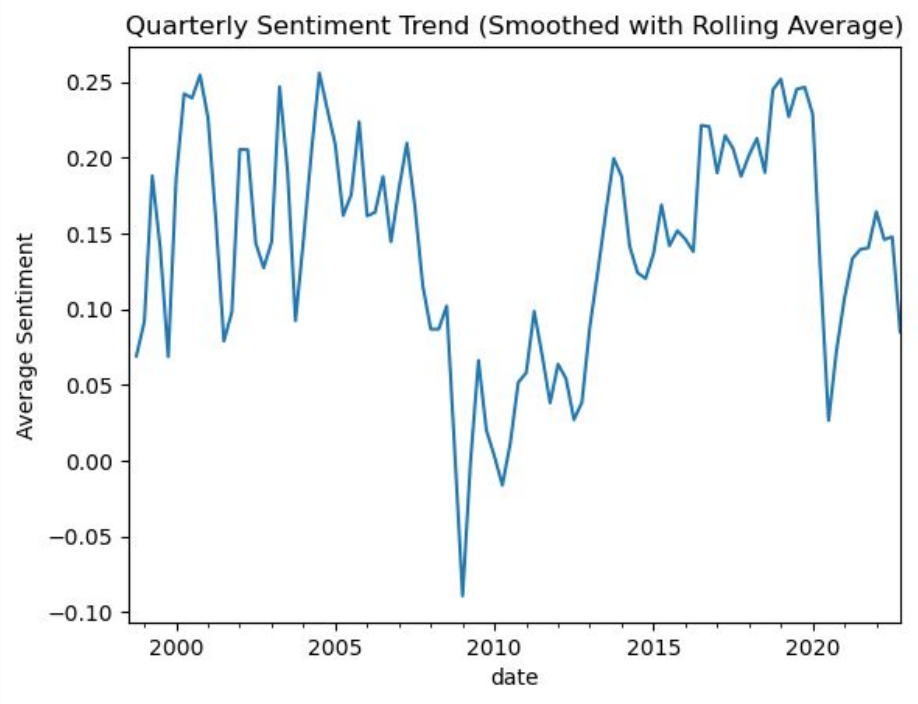


Summary and Insights

- **Average Score: 0.73 (Positive Tone)**
- **Key Finding:** Positive Sentiment
- Insight: Wide sentiment range aligns with diverse economic responses
- **Further Exploration:** Correlate sentiment peaks and troughs with key financial events for deeper insights
- **Overall Impression:** Strategic optimism in Bank's communications, emphasising stability and resilience

How sentiment has changed over time

Sentiment Analysis (Loughran)

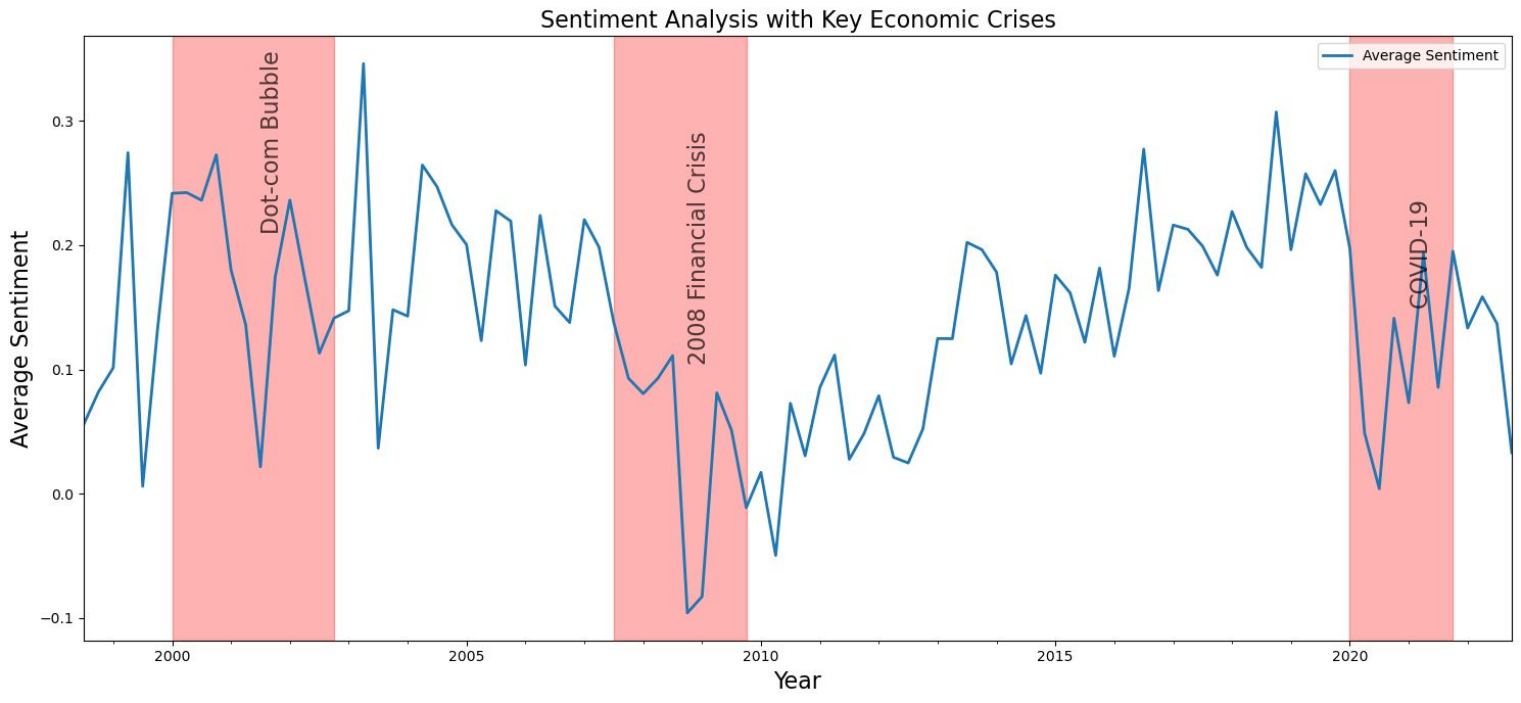


Summary and Insights

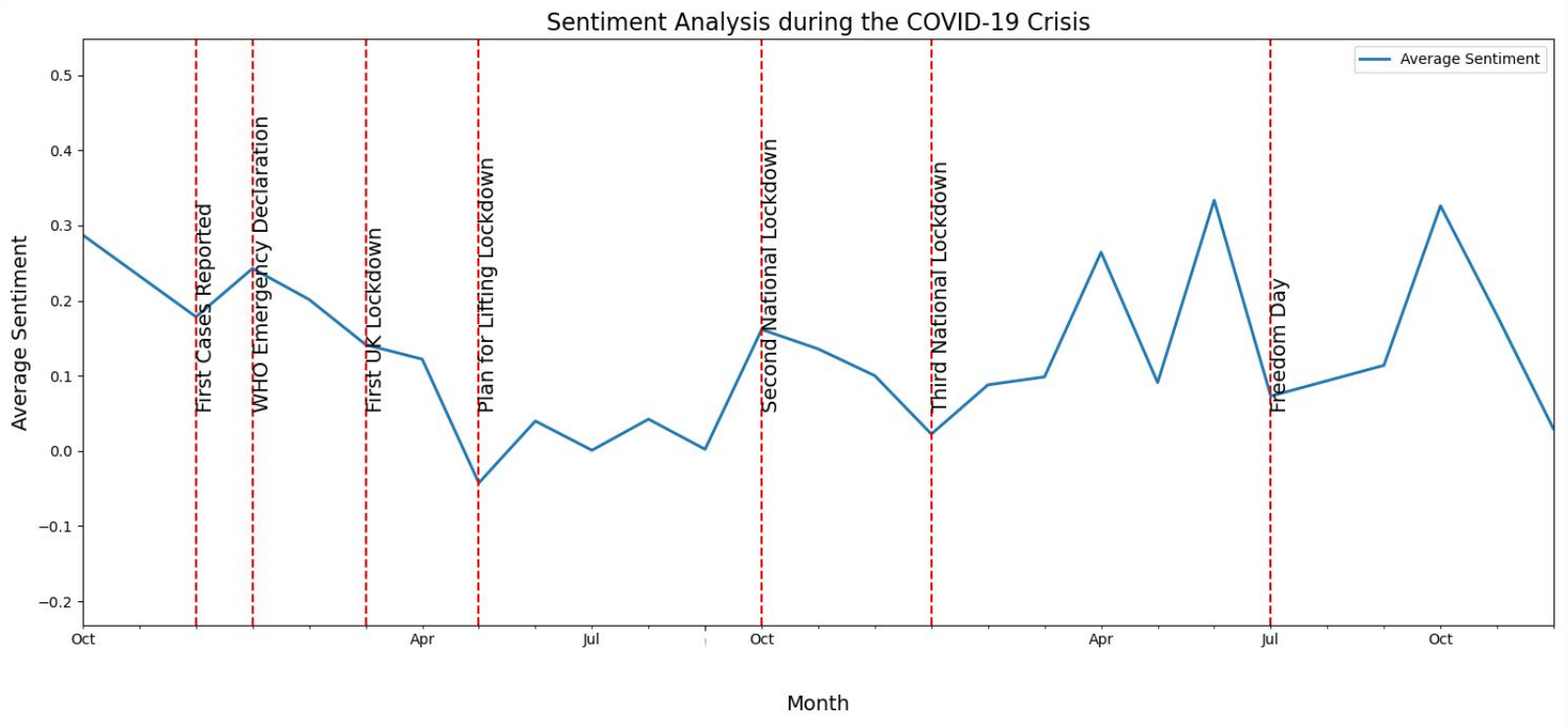
- **Method:** Loughran and McDonald word list
- **Average Sentiment:** 0.141, (Positive)
- **Observations:**
  - Steady sentiment trend, signaling consistent communication.
  - Extreme scores reflect specific economic events/policies, e.g Dot Com Bubble and COVID-19 Response

How sentiment has changed over time

Sentiment & Economic Crises

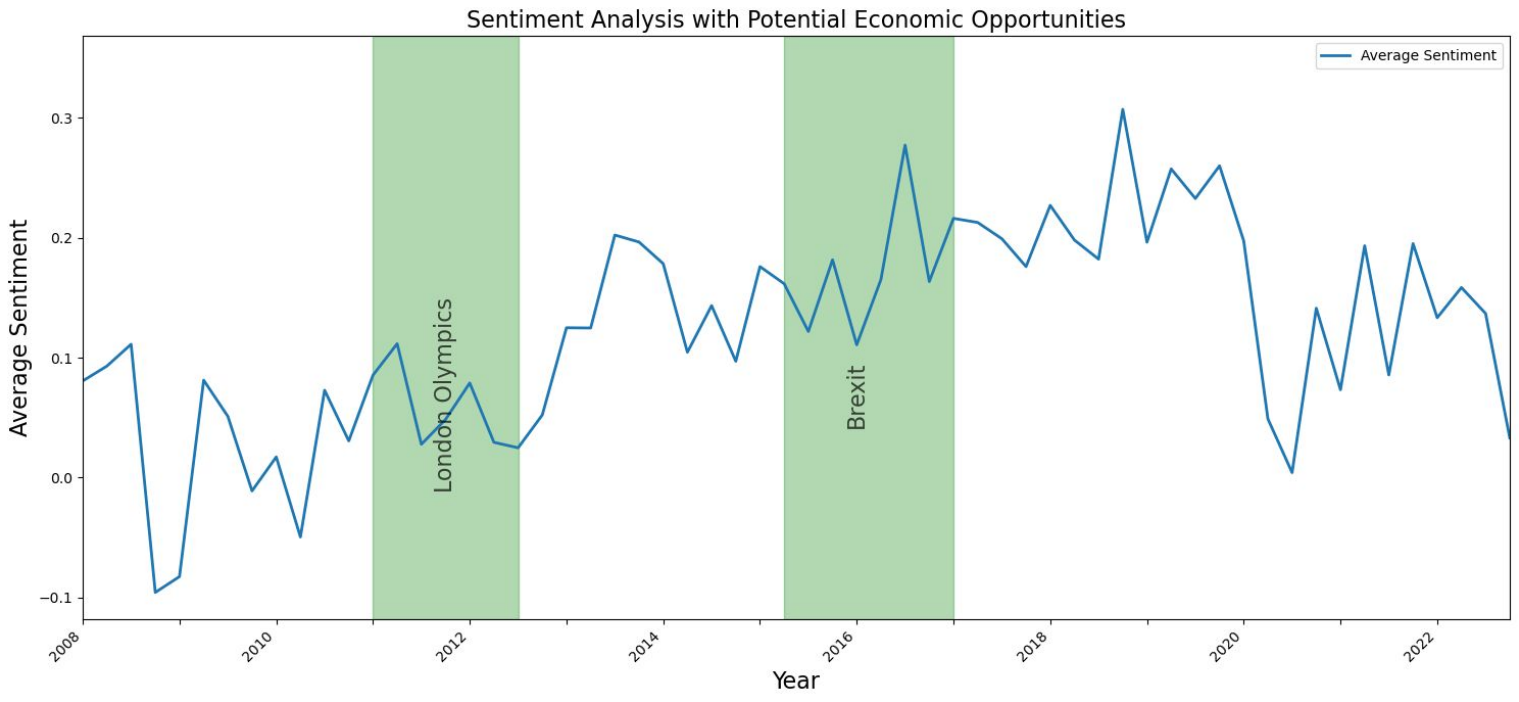


Sentiment & COVID



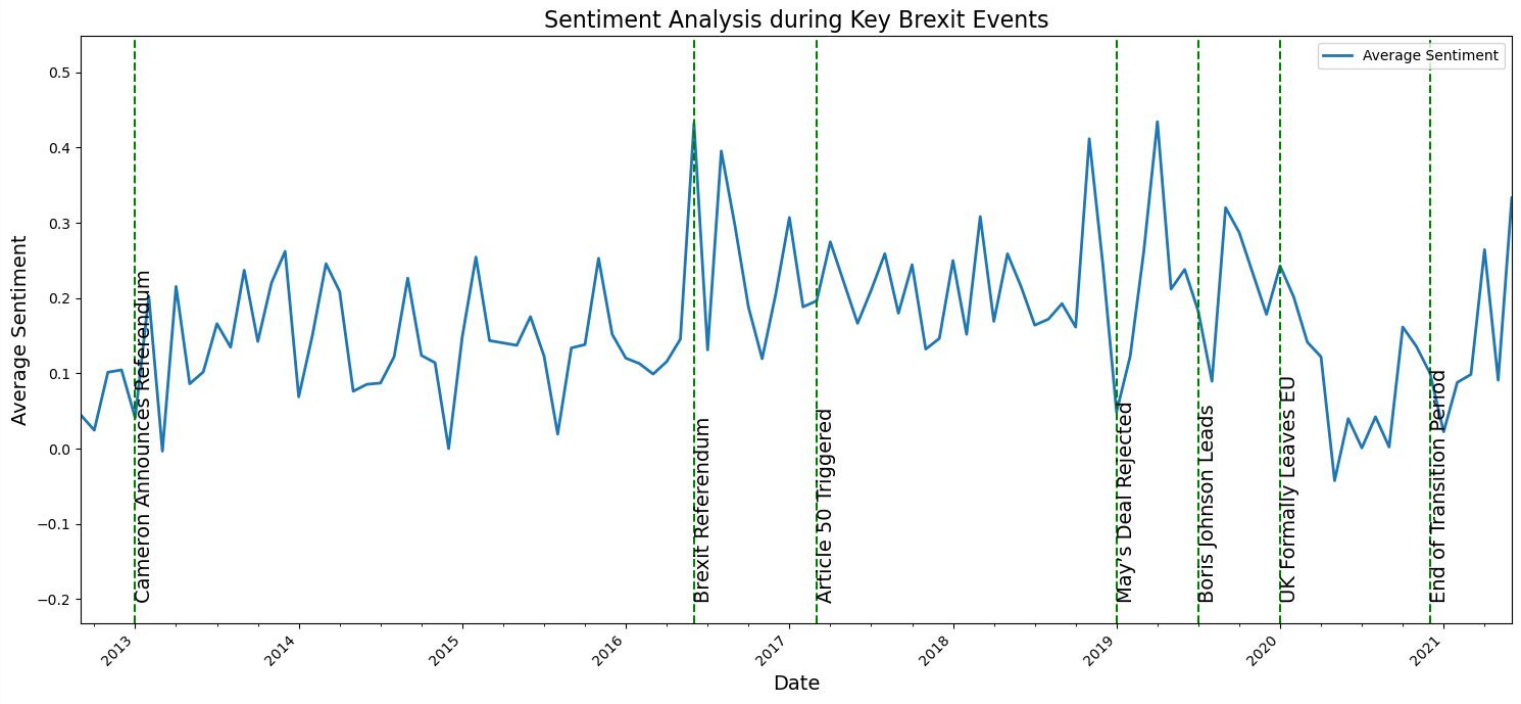
How sentiment correlates with economic crises

Sentiment & Positive Economic Events



How sentiment correlates with economic opportunities

Sentiment & Brexit



How sentiment correlates with economic opportunities

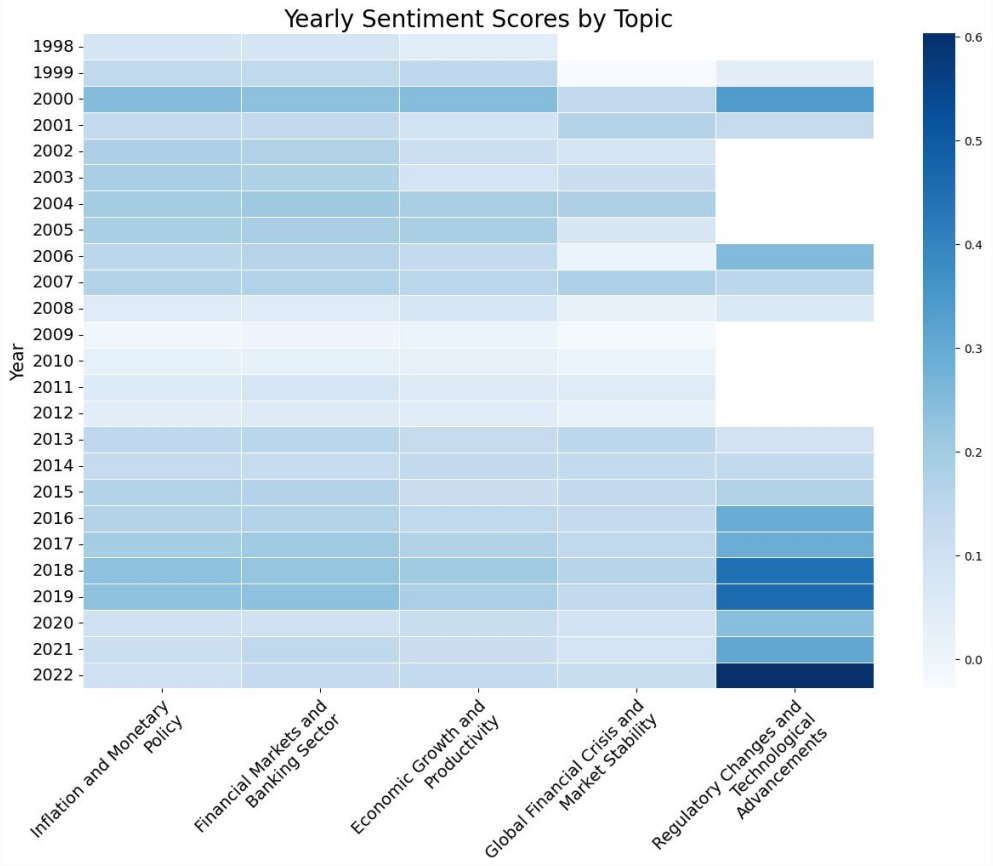
Topic Analysis

Methodology Insight: Employed NLP and LDA

Major Topics Identified:

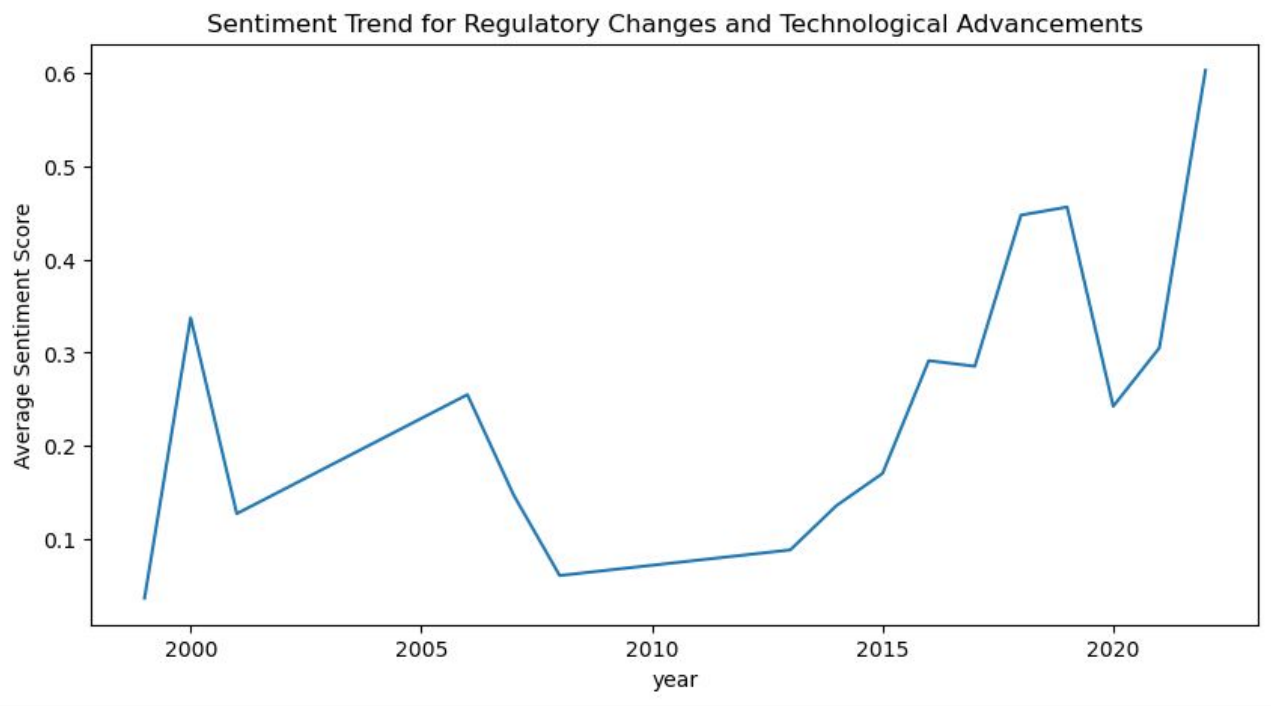
- Inflation/Monetary Policy
- Financial Markets/Banking
- Economic Growth/Productivity
- Crisis Management/Market Stability,
- Regulatory Changes/Technological Advancements.

Sentiment Trends: Notable sentiment spikes during 2008 financial crisis; consistent focus on economic growth and regulatory / innovation evolution post-2017.



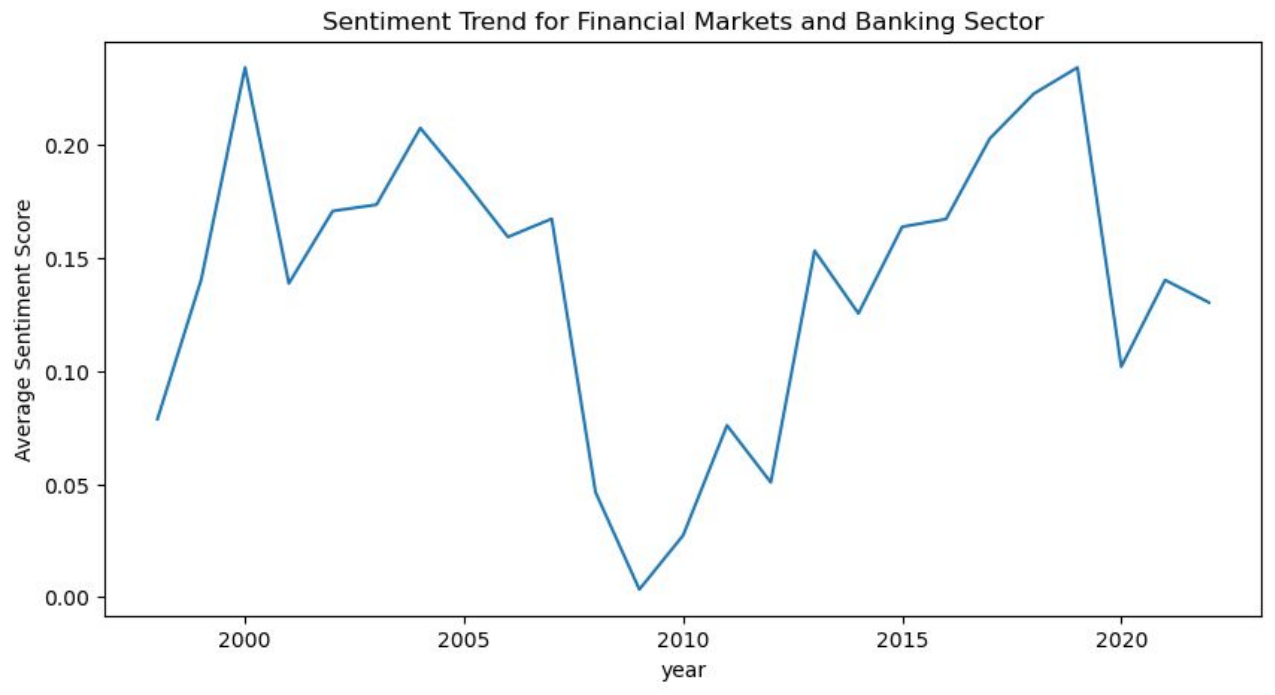
How sentiment has changed over time

Topic Analysis - Innovation & Regulation



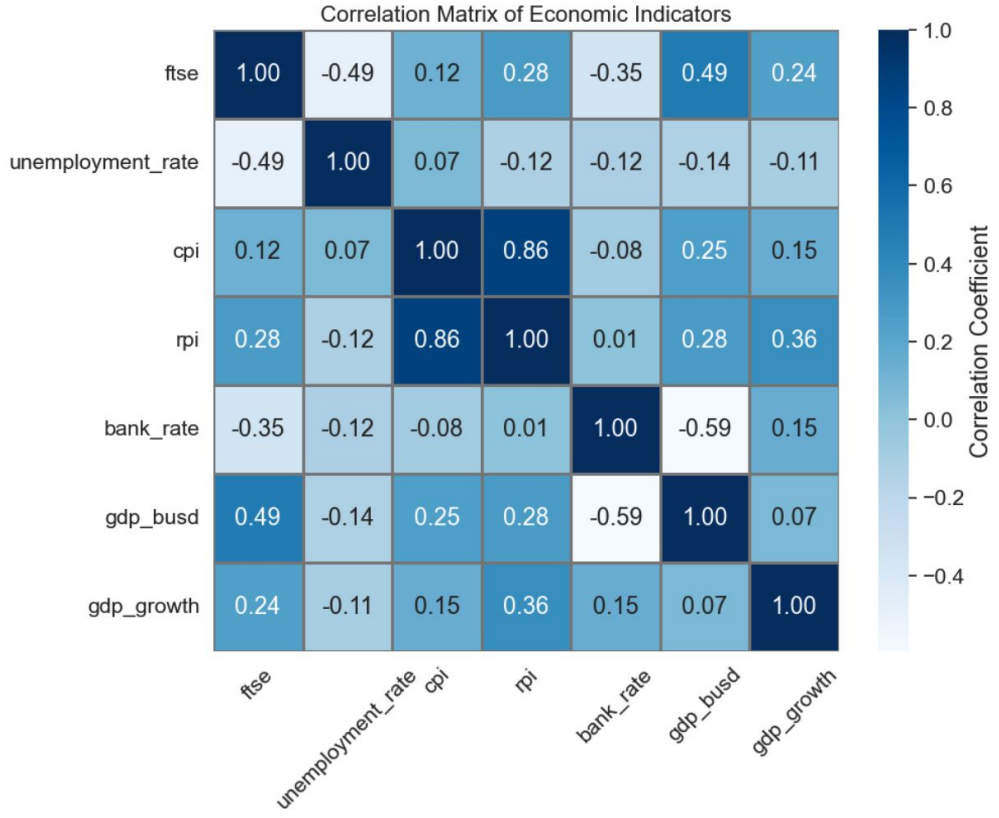
How sentiment has changed over time

Topic Analysis - Markets & Banking



How sentiment has changed over time

Correlation Between Indicators



- High correlations may indicate **multicollinearity**
  - Between cpi and rpi (0.89)
- **Data Exploration:** Identifying strong correlations may indicate inverse relationships
- Variable Selection & Hypothesis Generation

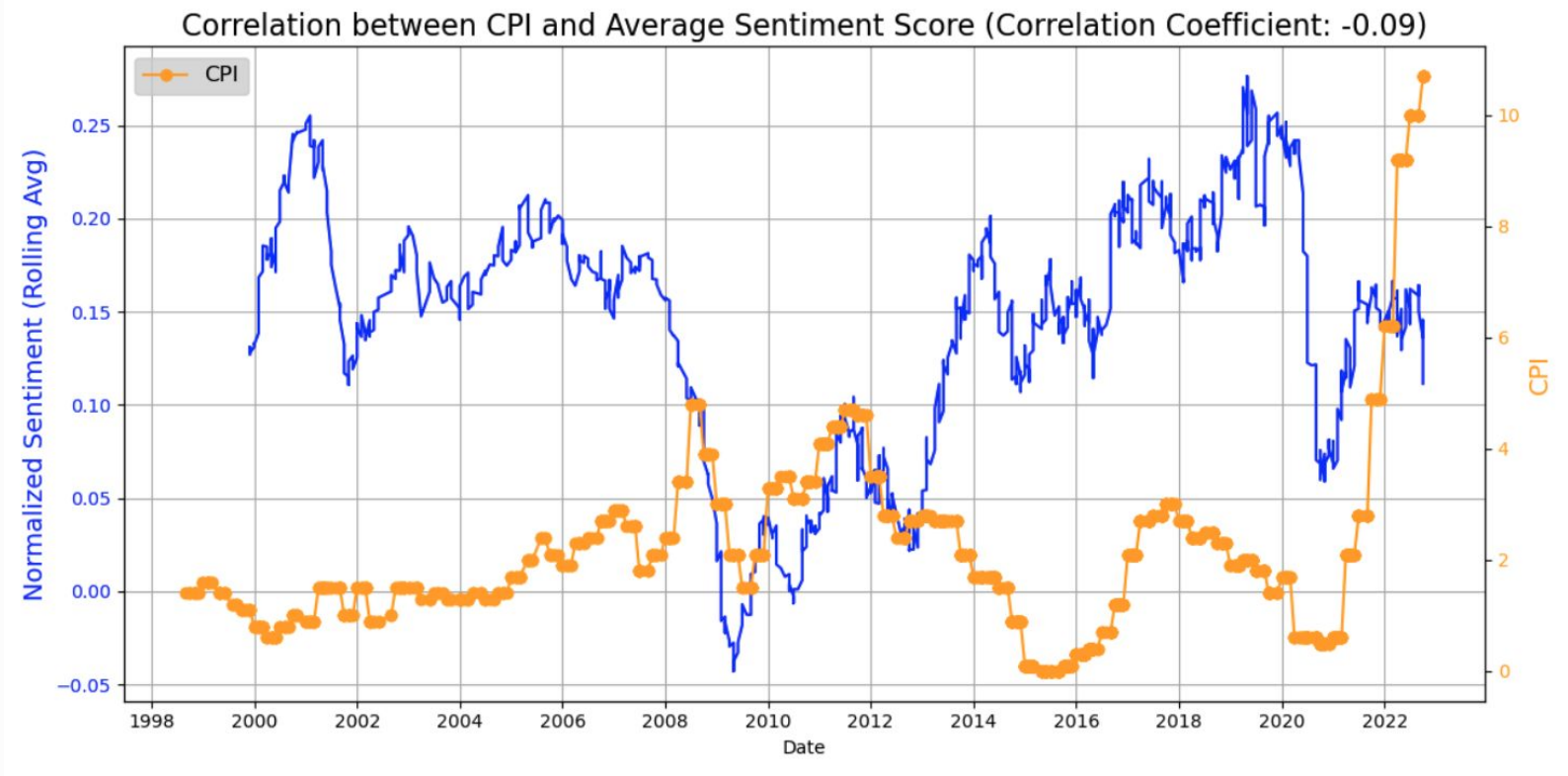
Correlation does not imply causation

Correlation with Sentiment

	GDP	GDP Growth	CPI	RPI	Bank Rate	Unemployment	FTSE
Pearson Coefficient	**-0.1**	**0.11**	**-0.09**	**-0.1**	**0.05**	**-0.25**	**0.2**
Pearson P-value	0.82	0.001	0.002	0.73	0.067	0.0	0.0
Spearman Coefficient	0.04	0.11	-0.13	-0.4	0.07	-0.23	0.21
Spearman P-Value	0.14	0.0002	0.0	0.14	0.011	0	0.0

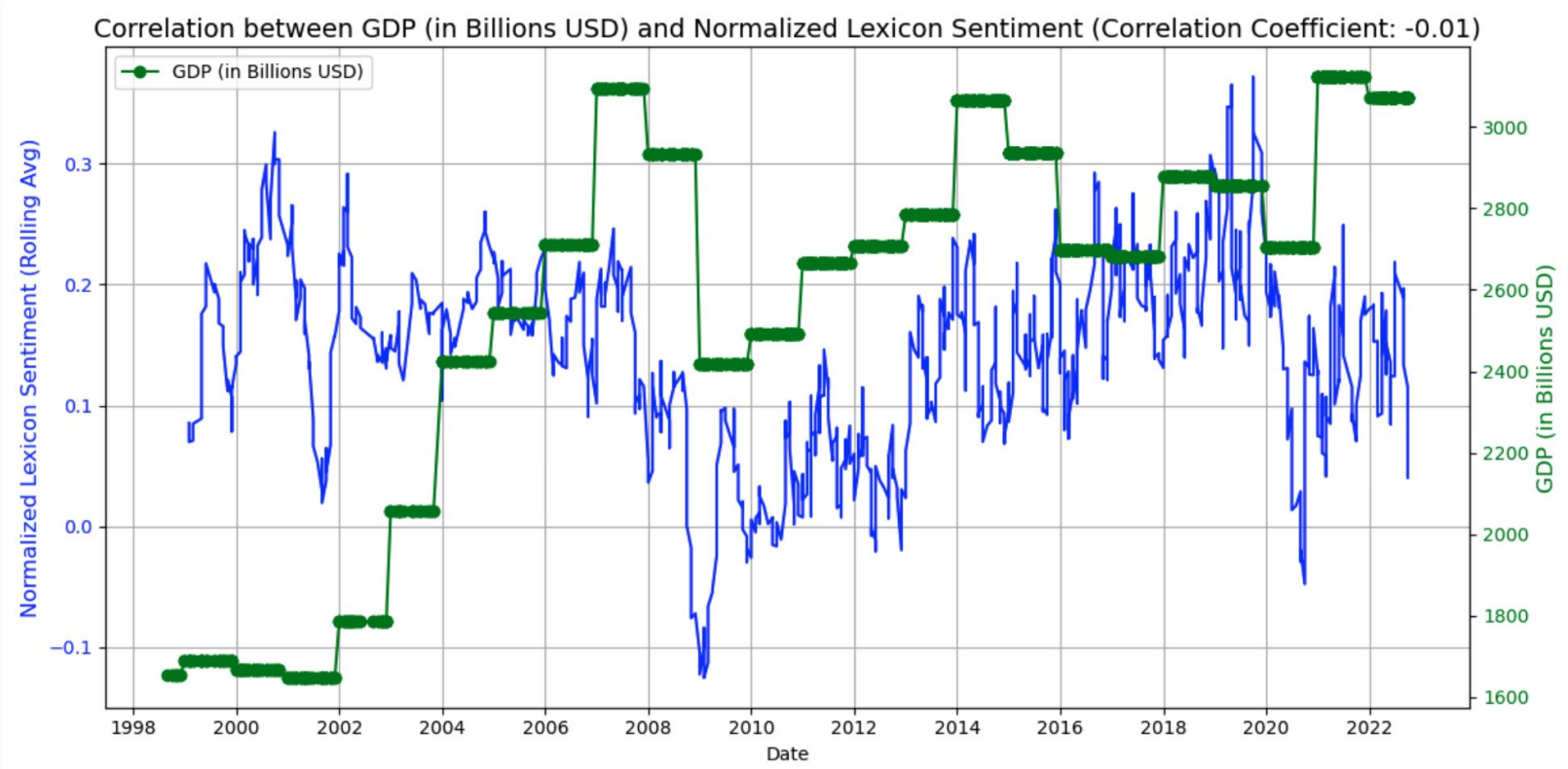
weak or no correlation between normalised sentiment and economic indicators

Inflation: CPI



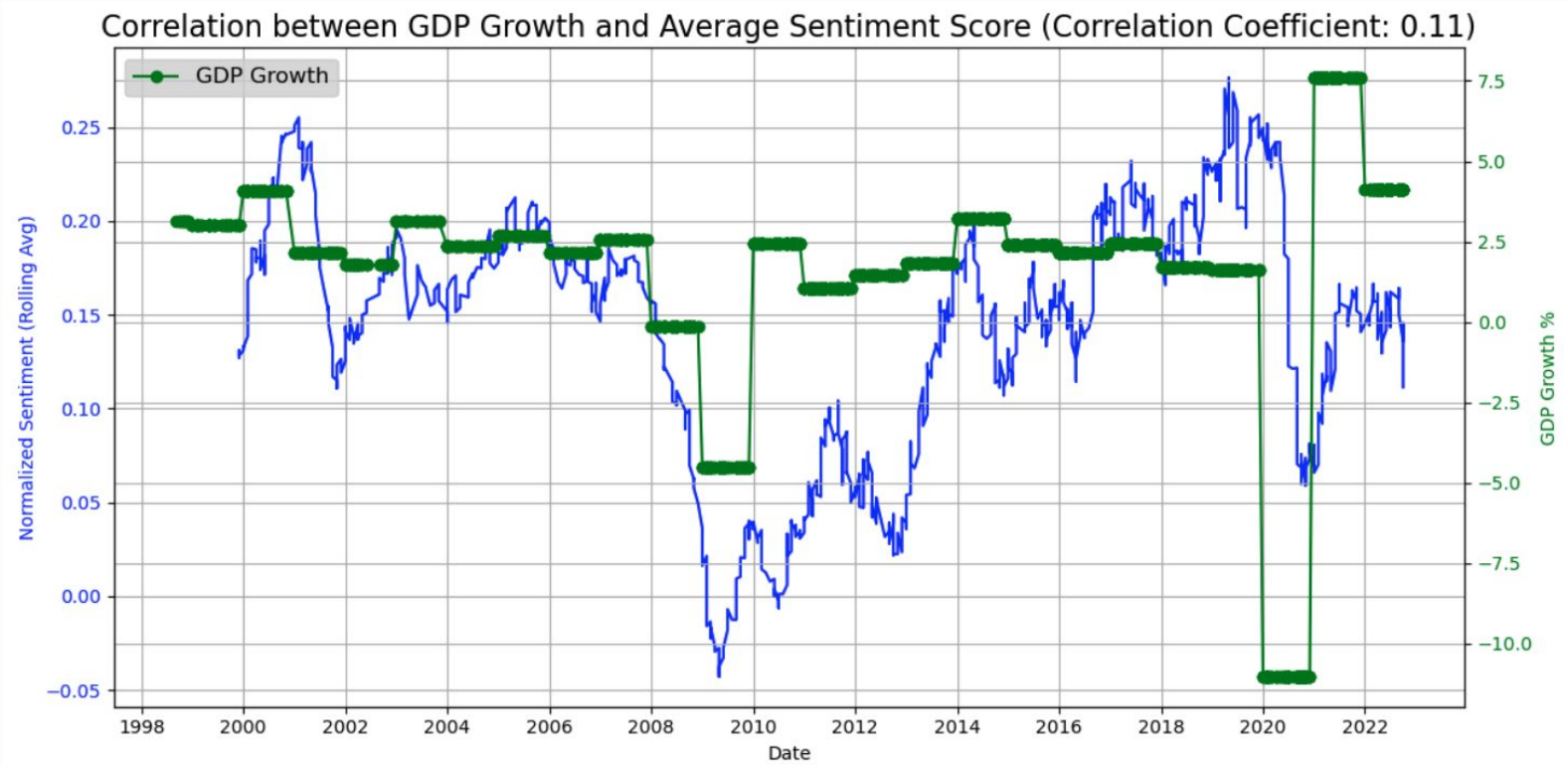
How sentiment correlated with economic indicators

GDP ($ Billions)



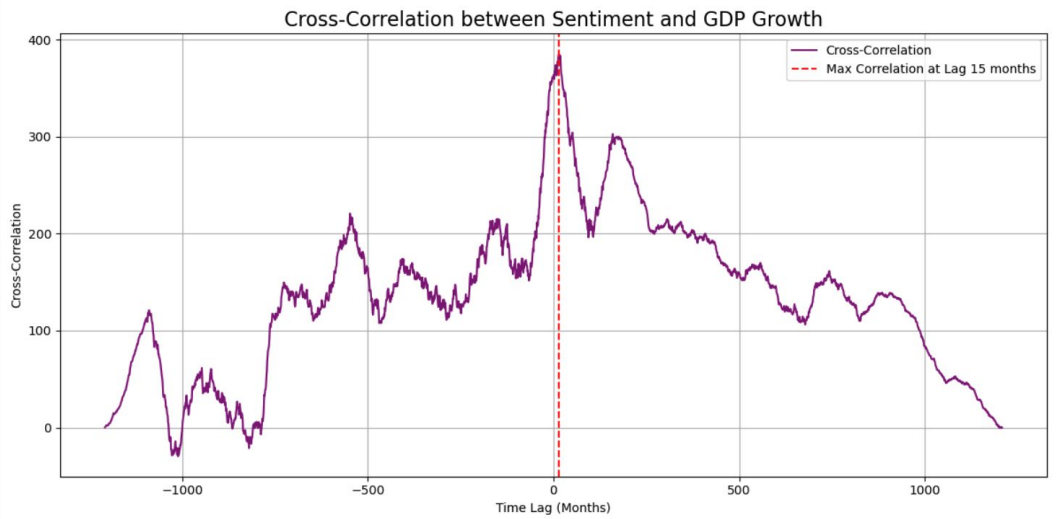
How sentiment correlated with economic indicators

GDP Growth (%)



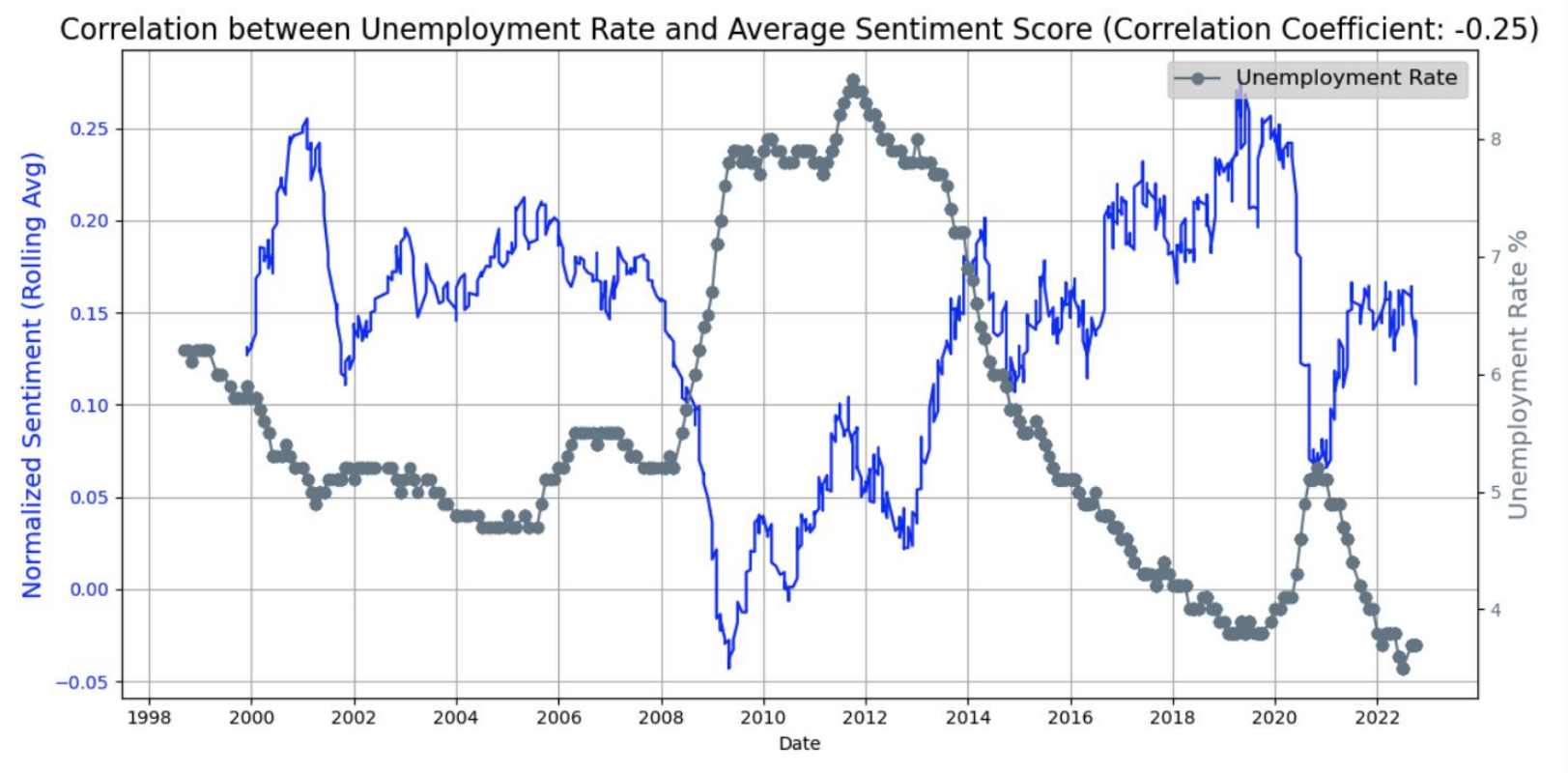
How sentiment correlated with economic indicators

GDP Growth (%)



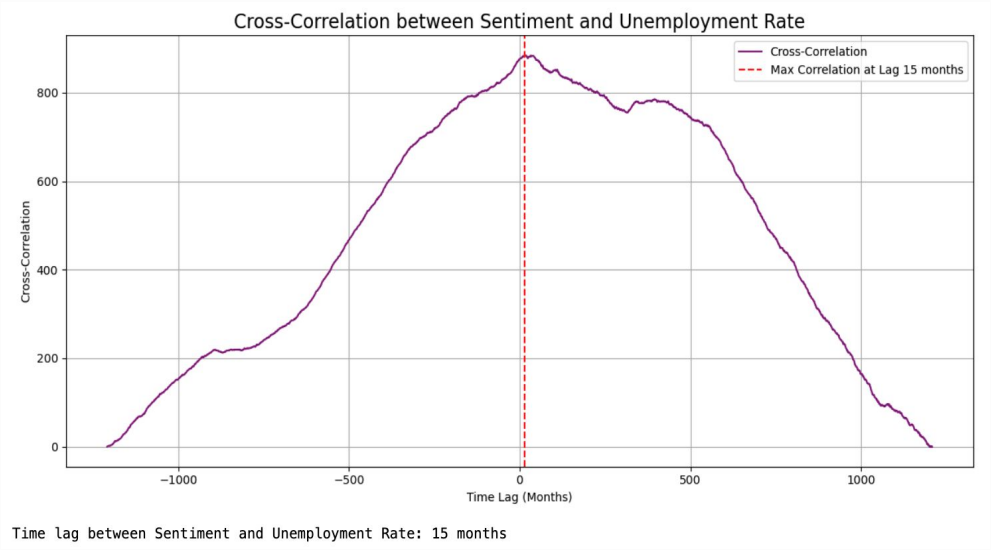
- **15 months** time lag between Sentiment and GDP Growth
- **Granger causality test:** no evidence of a causal relationship between at various lag values.
- Linear Regression and Time Series Regression Assumption were not met

Unemployment



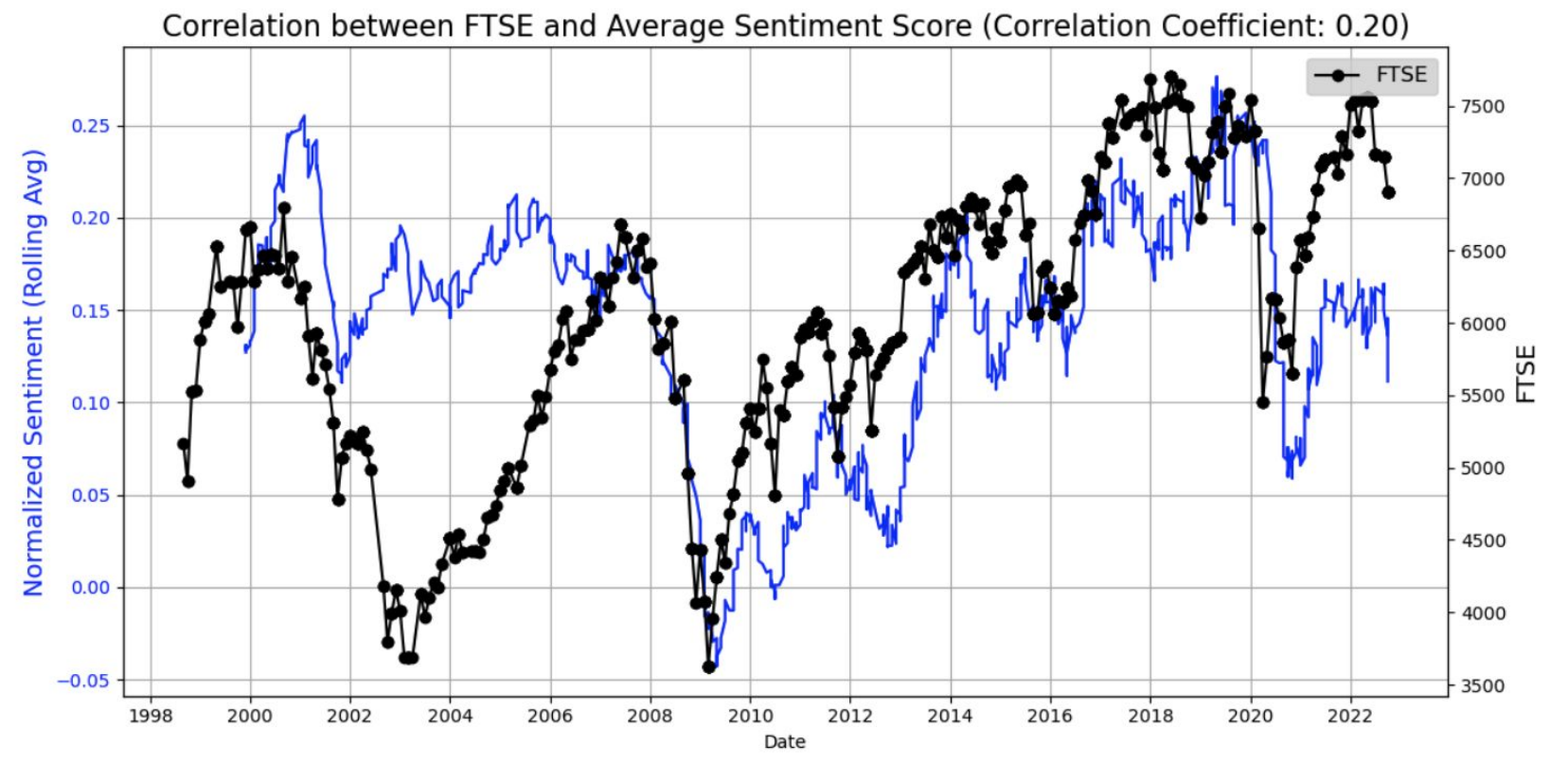
How sentiment correlated with economic indicators

Unemployment



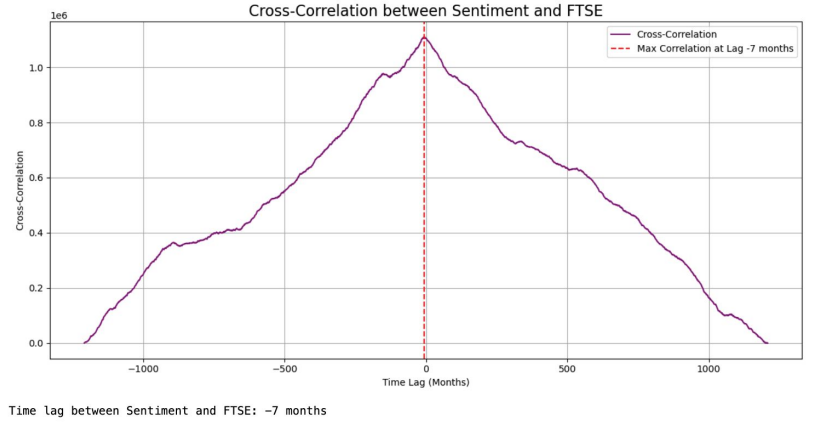
- **15 months** time lag between Sentiment and Unemployment
- **Granger causality test:** Sentiment contains information to predict unemployment with a lag of 4 months
- **Linear Regression**: As sentiment' increases, unemployment tends to decrease
- **Time series:** model explains 22.6% of the variance in unemployment

FTSE



How sentiment correlated with economic indicators

FTSE



- **Time lag of -7 months** suggests a noticeable and significant relationship
    - Sentiment Leads FTSE by 7 months
- **Granger causality test:** some weak evidence that changes in sentiment can act as a leading indicator for the FTSE index
- **Seasonal Decomposition**: relationship not statistically significant
- **Regression**: non-normality of residuals, multicollinearity and overfitting.

Predictive Models & Limitations

Current Analysis

- **Weak correlations between sentiment and economic indicators**
- **Regression assumptions are not met:**
  - Multicollinearity
  - Heteroscedasticity
  - Non-normality of residuals
- **Further analysis or alternative modeling approaches need to be explored**

Future Analysis

- **Address Multicollinearity**
  - Transformation
  - Regularisation
  - Principal Component Analysis
- **ML Models**
  - Random Forests
  - Gradient Boosting
  - LSTM Networks
  - Support Vector Machines
- **Feature Engineering**
- **Multi layered feedforward deep neural network**

Future Work / Recommendations

Creating a More Optimised Wordlist

- Utilising Machine Learning Techniques to create adaptive dictionary terms for a more optimised wordlist

Dynamic Topic Modelling (DTM)

- Tracking how topics emerge, evolve, and decline over time.

Expand The Corpus

- Including other documents by financial/ policy bodies (Hansson Et. al)

Conclusion

01 Sentiment fluctuates, mirroring economic events, periods and policies

02 Communication is reactive and dynamically adjusts

03 No statistical evidence of significant relationship between sentiment and economic indicators

Thank You