

Correlation Analysis of Twitter Sentiment and Fossil Fuel Stock Valuation

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1. Abstract

Using natural language processing techniques and modified time-series modeling, this paper aims to establish a methodology to test whether twitter sentiment is informative in predicting stock price movement and its volatility for the Chevron Corporation(CVX). The following QR Code links to the file repository.



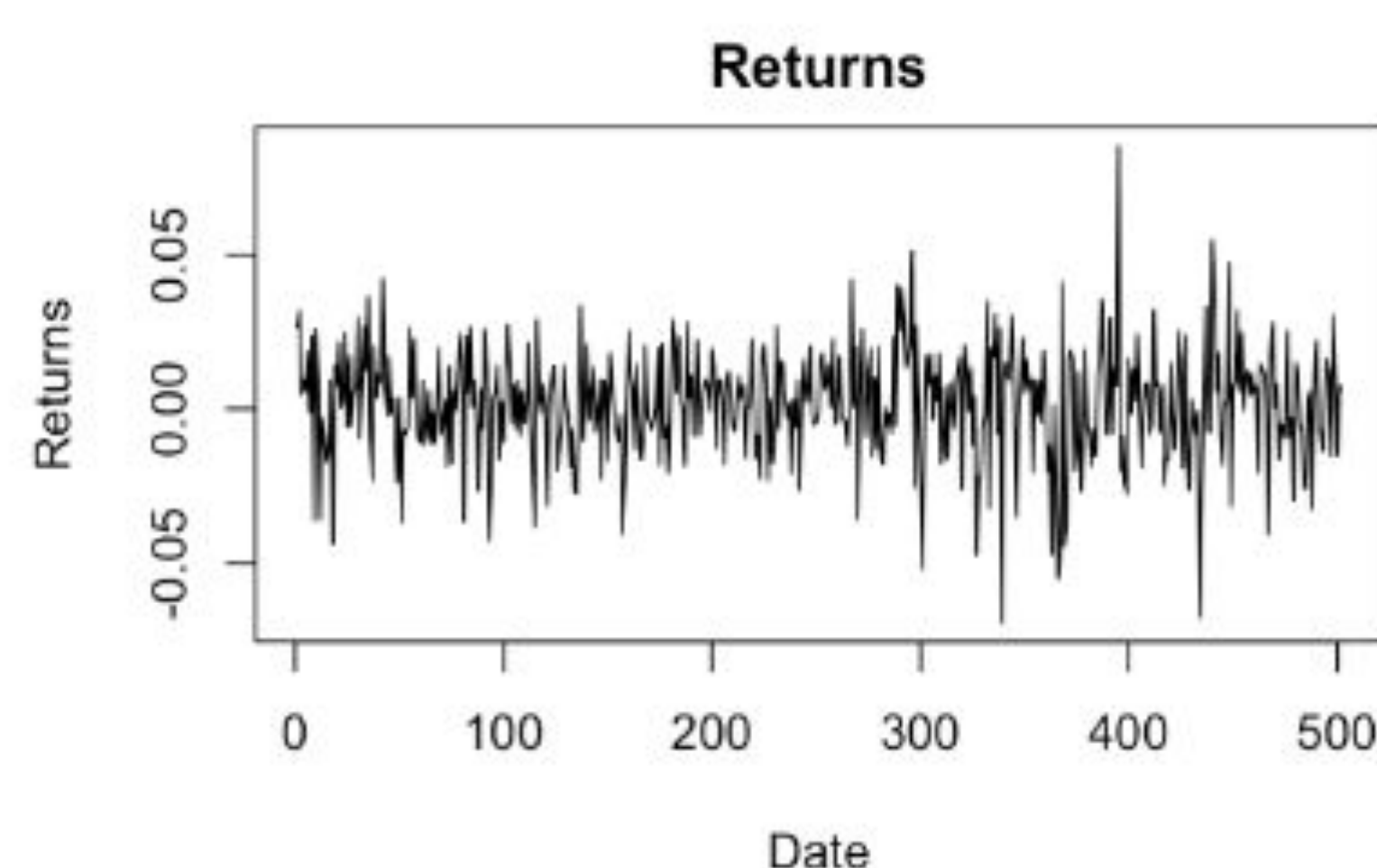
2. Introduction

This paper aims to determine if there is a correlation between public sentiment on Twitter and Chevron's stock price. It will use a machine learning technique called sentiment analysis with a BERT Transformer model to analyze Twitter data from January 1st, 2021-December 31st, 2022 and compare it with Chevron's stock prices in the same years. The paper includes sections on data collection, statistical methods, results, and further discussion.

3. Methods

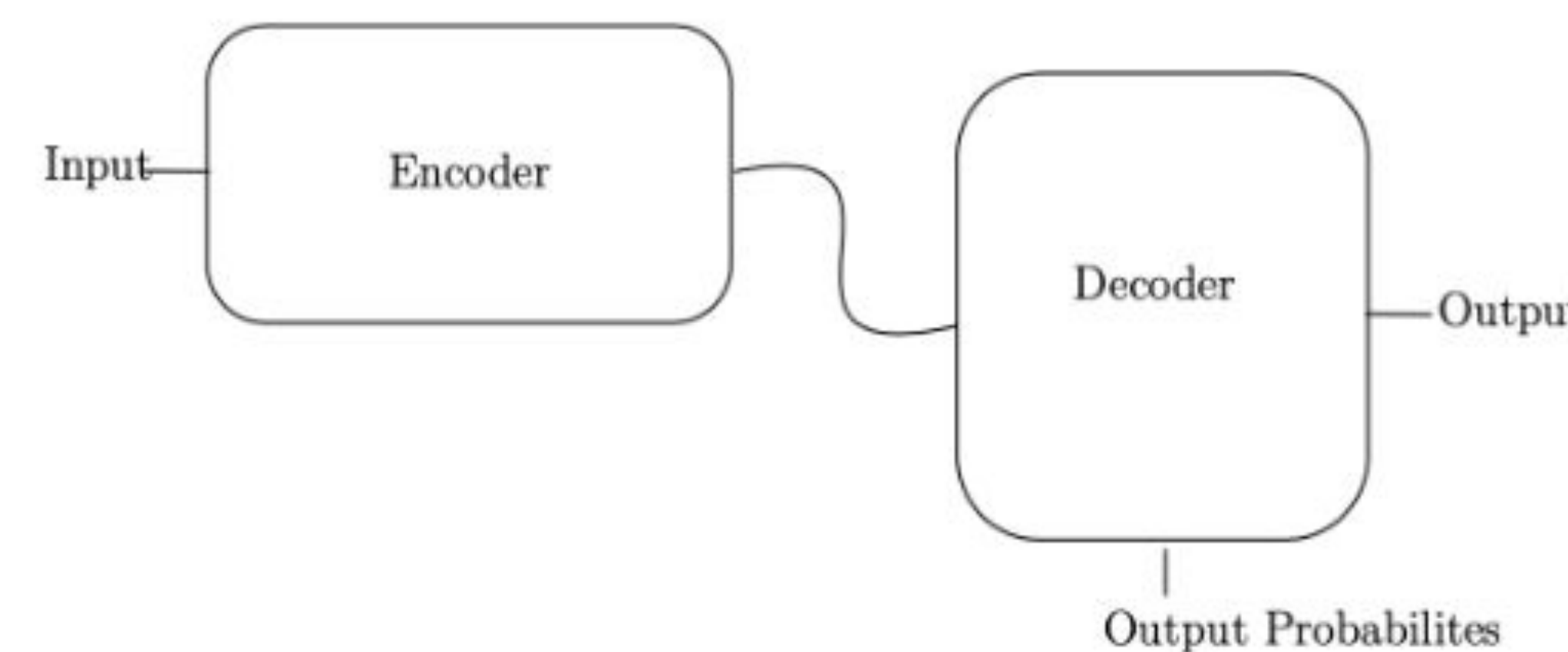
3.1. Data Collection

- Twitter data collected for Chevron Corporation using web scraping and the snsrape Python wrapper(JustAnotherArchivist 2022).
- Tweets containing "CVX" extracted from Twitter for 2-year period: January 1, 2021 to December 31, 2022, 10 tweets collected per day.
- Financial stock data also collected for Chevron for same period.
- Returns calculated by taking log difference of daily closing prices for analysis.



3.2. Sentiment Analysis

- Hugging Face's BERT transformer architecture used. (HuggingFace 2023)
- Self-attention mechanisms (encoders and decoders) were used to process input sequences in parallel.
- Transformers use attention are very effective for capturing long-range dependencies and relationships between words. Conceptualized in (Vaswani et al. 2017)
- BERT used for sentiment analysis in this study. (Devlin et al. 2018)



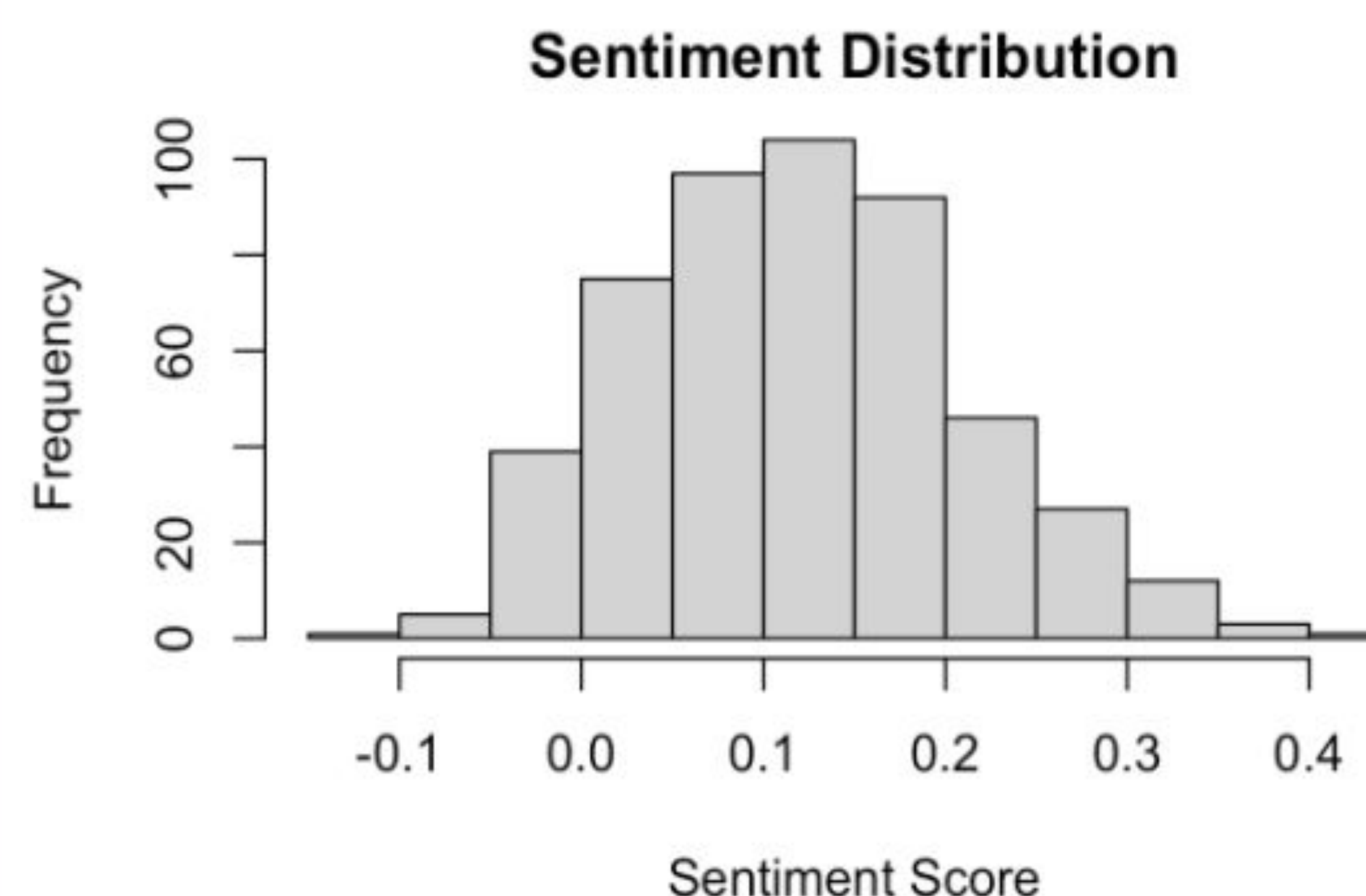
3.3. ARMA-GARCH

ARMA-GARCH is a time-series modeling approach that combines Autoregressive Moving Average (ARMA) models for capturing time-dependent patterns with Generalized Autoregressive Conditional Heteroskedasticity (GARCH) models for modeling time-varying volatility.

4. Results

- Data selected for 502 dates when stock market was open.
- 10 Sentiment scores calculated and averaged for each day.

Histogram showing normal distribution observed in the data.



- Conducted Likelihood ratio test to determine effect of daily sentiment as exogenous variable.
- Chosen significance value: 0.05.

- Likelihood ratio test gave a p-value above 0.05, indicating no significant effect of exogenous variable on the model.
- A weighted sentiment was also tried and similar results were concluded.

5. Conclusion

5.1. Possible Expansions

- Increase sample size for more robust analysis.
- Test for causality using techniques like the Granger causality test.
- Conduct meta-analysis of multiple companies in the fossil fuel industry for broader insights.

5.2. Takeaway

While both weighted and unweighted sentiment score might not have been effective in predicting stock price movement and volatility of CVX, this paper establishes a novel methodology that can be applied to determine whether twitter sentiment is informative in predicting stock movement and volatility across many industries and sectors.

6. References

- Devlin, Jacob, Ming-Wei Chang, Kenton Lee, and Kristina Toutanova. 2018. "Bert: Pre-Training of Deep Bidirectional Transformers for Language Understanding." *arXiv Preprint arXiv:1810.04805*.
- HuggingFace. 2023. *Pipeline: High-Level API for Text Classification and NER in Transformers* (version 0.0.16). <https://github.com/huggingface/transformers>.
- JustAnotherArchivist. 2022. *Snsrape*. <https://github.com/JustAnotherArchivist/snsrape>.
- Vaswani, Ashish, Noam Shazeer, Niki Parmar, Jakob Uszkoreit, Llion Jones, Aidan N Gomez, Łukasz Kaiser, and Illia Polosukhin. 2017. "Attention Is All You Need." *Advances in Neural Information Processing Systems* 30.