Fact Check: Analyzing Financial Events from Multilingual News Sources

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Abstract
The explosion in the sheer magnitude and complexity of financial news data in recent years makes it increasingly challenging for investment analysts to extract valuable insights and perform analysis. We propose FactCheck in finance, a web-based news aggregator with deep learning models, to provide analysts with a holistic view of important financial events from multilingual news sources and extract events using an unsupervised clustering method. A web interface is provided to examine the credibility of news articles using a transformer-based fact checker. The performance of the fact checker is evaluated using a dataset related to merger and acquisition (M&A) events and is shown to outperform several strong baselines.

1 Introduction
A tremendous amount of financial news sources are available online nowadays. The large weave of information generated by these news sources can be overwhelming and confusing for financial investors, which makes the discrimination of useful information out of tons of worthless or repetitive data a challenging and tedious task. While an investor can rely on a particular news source to learn about current financial events, the coverage of the events will not be comprehensive and may be constrained to the geographic location of the news source. On the other hand, the use of a financial news aggregator can provide investors with a coverage of the same financial events from multiple news sources.

Recently, the use of deep learning and natural language processing (NLP) in the analysis of unstructured data has attracted much research interests in the financial domain [Ding et al., 2014; Yang et al., 2018; Yang et al., 2020b; Yang et al., 2020c]. Motivated by the impressive success in the applications of these methods, we propose an event-based financial news aggregator along with a novel, transformer-based architecture for assessing the validity of events. While various general purpose and domain-specific news aggregators are available, our objective is to develop a financial news aggregator which gathers relevant news information from multiple sources in different languages. Unlike many general purpose aggregators[Zhang et al., 2019], the news aggregator we introduce identifies and constructs actual events that are being discussed in the articles from various news sources, which aims to provide investors with a holistic view of important events. Figure 1 describes an example of cross-lingual linking of news articles related to accounting scandal of Luckin Coffee which caused its share price to tumble as much as 83%.

Figure 1: News articles related to the accounting scandal of Luckin Coffee in both English and Chinese language.

The accuracy of each constructed event is assessed using a transformer-based fact checker. Existing fact checking of news events in the financial domain is typically performed by human experts¹², which is constrained by the experience of the journalists and lacks scalability. The transformer-based fact checker overcomes these shortcomings and achieved reliable results, as demonstrated in our case study.

2 Detailed Implementations
In this section, we describe our data first. Then, we introduce the process of building our system based on AllenNLP³ with a micro web framework, Flask. Lastly, a novel transformer-based prediction model will be discussed.

The architecture of our system is sketched in Figure 2. Our system mainly contains two components: News Aggregator, and Fact Checker. In addition, we have translated all news in bilingual of English and Simplified Chinese by an online API-based translator⁴. The primary technical contributions

¹http://www.factcheck.org/
²http://www.snopes.com/
³https://github.com/allenai/allennlp
⁴https://fanyi-api.baidu.com/
include a event-based financial news aggregator and a fact checker based on a novel, transformer-based architecture.

2.1 Data
We collected news articles published between January 1st, 2020 and April 22nd, 2020 from Reuters, Fox and Sina. The resulting dataset contains a total of 183,991 news articles with 116,390 in English and 67,601 in Chinese.

2.2 News Aggregator
Our website provides both English and Chinese language versions. Non-English news articles are first translated into English, and event extraction is subsequently performed using an unsupervised news clustering model proposed by [Ribeiro et al., 2017]. More specifically, hashtags, which correspond to the events that are mentioned in the news article, are assigned to each article. The result of each search query depends on both the hashtags and the content of the news articles, and news articles mentioning the same events in different languages will be jointly displayed (as shown in Figure 3).

2.3 Fact Checker
In order to assess the credibility of each news article, we adopt a transformer-based fact checker. We leverage the adversarial training strategy, namely, projected gradient descent (PGD) [Madry et al., 2018] for training the transformer. The adversarial training is implemented on WWM-BERT, whereby perturbations are added to the input embedding to improve the robustness of the model.

As a case study, we train a transformer-based classifier to predict the outcome of an merger and acquisition (M&A) event [Yang et al., 2020a] using relevant news articles. A dataset which contains news articles related to 14,539 M&A deals between January 1st, 2007 and August 12th, 2019 were collected from Zephyr. After preprocessing, the final dataset contains 4,098 instances which were further divided into a training, validation and test set.

3 A Case Study on M&A Predictions
We evaluate the performance of the binary classification task described above. The adversarial transformer is compared with several deep learning based methods and an original transformer where the results are summarized in Table 1.

| Evaluation          | MCC  | Acc  | F1   |
|---------------------|------|------|------|
| Random Guess        | 0.013| 0.510| 0.462|
| Baselines           |      |      |      |
| CNN-Text            | 0.729| 0.848| 0.847|
| BiGRU               | 0.734| 0.836| 0.849|
| HAN                 | 0.742| 0.848| 0.853|
| BERT-WWM            | 0.751| 0.874| 0.879|
| Ours                | 0.788| 0.894| 0.894|
|       BERT-WWM+adv. | 0.788| 0.894| 0.894|

Table 1: “MCC” is the score of Matthews Correlation Coefficient and “adv” is short for the adversarial training by using Projected Gradient Descent (PGD).

The proposed model achieves significant improvement over strong baselines in terms of MCC, accuracy and F1 scores. Additionally, the improvement over the original transformer is statistically significant according to an independent t-test (with a p-value of 0.014). The fine-tuned transformer model can be leveraged to assess the credibility of news articles for a wide range of financial events.

4 Discussion
A website for aggregating financial news articles and assessing the credibility of news articles is described in this paper. The developed adversarial transformer-based fact checker is shown to outperform a range of strong baselines in terms of predicting the outcomes of M&A deals. The trained transformer is readily applicable to predict the outcomes of various financial events.

For future work, the developed system can be expanded to include additional news sources in multiple languages. Furthermore, the pre-trained transformer can be transferred to a
wide range of financial event prediction problems.

With the development of Large-scale Language Models, the fact-check ability of models is re-defined and can be measured in different settings, such as the previous attempts to identify pitfalls in current natural language understanding systems using counterfactual explanations [Yang et al., 2020a; Yang et al., 2021], and design unified OOD benchmarks [Yang et al., 2023; Wang et al., 2023a] as well as causality-inspired evaluation tools [Niu et al., 2023]. Also, human-in-the-loop and rationale-based methods have received decent focus in recent [Yang et al., 2022a; Wang et al., 2022; Yang et al., 2022b; Yang et al., 2022c]. Besides, the evaluation of the fact-check ability of LLMs [Chang et al., 2023; Zhu et al., 2023; Wang et al., 2023b; Yidong et al., 2023], as well as hallucinations, need to be paid more attention.

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