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Genetic programming optimization for a sentiment feedback strength based trading strategy

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ABSTRACT

This study is motivated by the empirical findings that news and social media Twitter messages (tweets) exhibit persistent predictive power on financial market movement. Based on the evidence that tweets are faster than news in revealing new market information, whereas news is regarded broadly a more reliable source of information than tweets, we propose a superior trading strategy based on the sentiment feedback strength between the news and tweets using generic programming optimization method. The key intuition behind this feedback strength based approach is that the joint momentum of the two sentiment series leads to significant market signals, which can be exploited to generate superior trading profits. With the trade-off between information speed and its reliability, this study aims to develop an optimal trading strategy using investors' sentiment feedback strength with the objective to maximize risk adjusted return measured by the Sterling ratio. We find that the sentiment feedback based strategies yield superior market returns with low maximum drawdown over the period from 2012 to 2015. In comparison, the strategies based on the sentiment feedback indicator generate over 14.7% Sterling ratio compared with 10.4% and 13.6% from the technical indicator-based strategies and the basic buy-and-hold strategy respectively. After considering transaction costs, the sentiment indicator based strategy outperforms the technical indicator based strategy consistently. Backtesting shows that the advantage is statistically significant. The result suggests that the sentiment feedback indicator provides support in controlling loss with lower maximum drawdown.

1. Introduction

The fundamental role of investor sentiment on market anomalies has been well documented in the field of behavioral finance [1,2]. Studies have shown that sentiment is linked to investor's cognitive and psychological traits and has impact towards financial market movement [1]. With the increasing digitization of textual information, news and social media have become major resources that investors use to gather information on important financial events and to make their corresponding investment decisions. This changing landscape of the way information is delivered has prompted the growing influence of news and social media among multiple stakeholders. For instance, major media publishers such as the Wall Street Journal and the Associated Press use Twitter to disseminate headlines of breaking and regular news to their subscribers. Financial data vendors including Bloomberg and Thomson Reuters incorporate feeds from Twitter and various news sources to meet the demand of clients who want to receive and analyze the most up-to-date and reliable information. On the receiving end, there are numerous claims that high frequency traders and hedge funds are actively monitoring Twitter and news feeds for trading signals. Moreover, an increasing linkage between social media and financial markets has been observed where a number of individual tweets between 2011 and 2013 were found to trigger abrupt market movements.[1]

This study is motivated by three main areas of research findings. First, the mechanism of how sentiment affects financial market movements has been studied in the form of theoretical frame-

[1] The April 23, 2013 flash crash triggered by the Associated Press Hoax incident is a good example that demonstrates the direct relevance of social media in the financial market. At 1:07pm, the Associated Press (AP) Twitter account tweeted a malicious message regarding an attack to the White House that President Obama was injured. The message was found to be a hoax with rapid spread on the social media platform. Subsequently, it exert significant downward pressure on the U.S. stock market, which suffered a large intraday decline of more than 2%. Within minutes, the market quickly rebounded to its original level after it was determined that the AP account was hacked.

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work and empirical evidence. Barberis et al. [2] initially developed a theory of investor sentiment to illustrate the effect of investor overreaction and underreaction to public information on generating post-earnings announcement drift, momentum and long-term reversals. Daniel et al. [3,4] further enriched the theory with the psychological premise that investors with private information are overconfident about its precision. On the empirical front, a number of studies found quantitative measures of investor sentiment significant in explaining asset price and volatility movements. Chopra et al. [5] showed that prior losing portfolios significantly outperform prior winning portfolio by 5–10% annually for 5 years, validating the overreaction effect, while Porta et al. [6] displayed evidence that the correction of the extreme investor sentiment tends to revert during earnings announcements when investors realize their initial beliefs were too extreme. Shleifer [7] pointed out that investor sentiment influences prices and the inefficiency of the financial markets are evident across theoretical and empirical literature. In more recent studies, Tetlock [8] argued that negative expressions in news stories have stronger correlation to stock market than positive ones. According to the finding, Tetlock et al. [9] quantified investor sentiment as the fraction of negative words in news stories, and justified the predictability of investor sentiment to individual company's stock price movements with news from Dow Jones News Service (DJNS) and Wall Street Journal (WSJ). In a similar study, Engelberg et al. [10] indicated higher abnormal returns of short sells based on news events in the Dow Jones archive. Baker et al. [11] showed that investor sentiment for major stock markets has predictive power of the cross-sectional returns within markets, and Brown and Cliff [12] demonstrated that investor sentiment predicts market returns with its explanatory power on the deviations of stock prices from intrinsic value. García [13] tracked the New York Times financial news columns from 1905 to demonstrate that news content is more robust in predicting stock returns in recessions. Kurov [14] further illustrated the impact of investor sentiment on monetary policy decisions and the stock market. These studies are instrumental in demonstrating the existence of investor sentiment along with its impact on the financial markets.

Furthermore, the second area of literature focused on the empirical observations that media is an important factor of influencing investor sentiment [15], and news and tweets sentiments exhibit persistent predictive power on financial market movement. For tweets sentiment, Bollen et al. [16] showed that tweet messages have shown an accuracy 87.6% in predicting changes in DJIA with a reduction of prediction error. Zhang et al. [17] further showed that the emotional outbursts of tweet activities can predict the next day movement in the financial market. Our previous study constructed a financial community in the Twitter universe where its constituents' interests are aligned with the financial market, and we found that their tweet sentiment has significant correlation with market returns and volatility [18]. On the other hand, a number of empirical studies have demonstrated the significance of news sentiment towards the financial market. Li et al. [19] quantified the media influence on the market and concluded that news sentiment has a notable impact on the emotions and decision-making of investors. Piškorec et al. [20] developed a measure of collective behaviors based on financial news and showed that a news-based index can be used as a volatility indicator. The authors further illustrated that the cohesiveness in financial news has high correlation with market volatility [20]. In addition, corporate news events related to earnings announcements exhibit clustering behavior and trigger significant short-term price changes [21]. Smales [22,23] illustrated that the empirical sentiment series can explain market returns and volatility. In a former study, we presented evidence that there exists a feedback mechanism between news sentiment and market returns among the major U.S. financial market indices, namely S&P 500, NASDAQ, and Dow Jones Industrial Average [24].

As a natural extension of these empirical findings, there has been a growing number of academic studies that showcase the potential of using sentiments for developing and implementing trading strategies with advanced statistical methods. Dempster and Jones [25] developed a real-time quantitative trading system based on six technical indicators and it generates positive returns with statistical significance. Tetlock [8] developed a trading strategy based on the content of each firm's news stories during the prior trading day, and concluded that the negative fraction of the media content is a significant factor in earning substantial risk-adjusted returns. On a related study, Khadjeh Nassirtoussi et al. [26] applied a multi-layer dimension reduction algorithm on breaking news headlines to predict the intraday direction of the USD-EUR pair in the foreign exchange market with an accuracy of 83.33%. Ferguson et al. [27] demonstrated that the long-short trading strategy with news sentiment has statistically significant daily risk-adjusted returns of 14.2 to 19 basis points. Chen et al. [28] applied genetic programming for performing dynamic proportion portfolio insurance and the approach showed promise over the traditional constant proportion portfolio insurance strategy. Mitra et al. [29] incorporated news sentiment in estimating equity portfolio volatility along with market information. Genetic programming has also been used in the area of technical trading, but has not been previously explored with analysis on sentiment. Healy and Lo [30] demonstrated a real-time news analytics framework to manage investment risks and returns with Thomson Reuters NewsScope data. Leinweber and Sisk [31] leveraged the predictability of market returns based on extracted news media sentiment and designed portfolio based trading strategies from sentiment signals.

The major contribution of this paper is to bridge the gap in the literature to develop a trading strategy with the use of sentiment feedback between news and tweets sentiment through genetic programming optimization. We argue that there is an opportunity to unravel the potential of their interaction effects because of the unique nature of the two information sources and their evident relationships with financial market movement. Using both sentiment sources, this study presents a novel framework for applying genetic programming method to optimize the performance of the trading strategy based on the sentiment indicator. The framework leverages existing empirical findings on the relationships observed among news sentiment, tweets sentiment and market returns. The key intuition behind the sentiment indicator is that the joint momentum of the two sentiment series leads to a robust signal for market anomalies which can be exploited in the form of above-average trading profits. For instance, if both news and tweets sentiments show strong momentum trending in one direction, the market return is likely to follow in the same direction. An investor can therefore establish a long position when the sentiment indicator generates such signal and exits when the reversal appears. In addition, the two information sources also display key distinguishable characteristics that the trading rules can be constructed by choosing the optimal trade-off between the speed of information release and the reliability of the information. In the study, we find that the sentiment indicator based genetic programming optimization approach yields a superior trading performance. The out-performance suggests that the sentiment-based indicator can be regarded as a valuable source of information and further validates the value of both news and tweets sentiment in exploiting trading opportunities. In addition, we conduct two experiments to evaluate the influence of trading costs on the profitability of the proposed trading strategies. The first experiment is to compute the break-even cost that eliminates the profits generated by the trading strategy. It captures the maximum cost percentage which the trading strategy can outperform the benchmark. The second experiment is a sensitivity