Predicting Period Stock Spread Ranking Using Revenue Indicators and Machine Learning Techniques

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Abstract. Predicting stock market movements is a well-known problem of the machine learning field. In general, there are two primary methods used to analyze stocks and make investment decisions: fundamental analysis and technical analysis. But fewer researchers focus on monthly revenue indicators and different time period prediction. We collect and organize financial data extracted from Taiwan and U.S n companies’ monthly and quarterly financial reports across a period of 10 years. In addition, we successfully use fundamental and technical indicators as training model’s features. Among experiment results, which has good performance. The annualized profitability (annualized rate of return) can reach 2.56%, the Sharpe ratio is 2.01, the maximum amplitude is - 20.8%. Compared with other strategies, our strategy is relatively stable and achieves ideal results. The more important is we used monthly revenue indicators based features to improve model performance.

1. Introduction

The purpose for predicting stock price trends is the gross spread. Many researchers have been researching this field. Computer science’s researchers hope to create more effective models. Investors hope that they could predict stock price and increase profit by selling stock. General methods to stock price prediction are fundamental and technical analysis. Fundamental analysis, which is study companies through their published financial reports. Technical analysis, which analyzed only the historical prices and volumes [1][2]. Technical analysis usually used for short-term prediction (hours or days). Fundamental analysis used for mid-term and long-term prediction (seasons or years). In recent years, the application of hybrid market indicators to financial fore- casting have been very popular [3][4][5]. However, no matter in the computer science or financial field, In forecasting researches are rarely made monthly strategies. This study contrasts previous studies by exploring the com- bination of the technical indicators, fundamental indicators and experts’ opinion. We would achieve some purpose:

1) Using monthly revenue information to design monthly trading strategies.
2) Establish a machine learning model, which could be used in two countries’ stock trading market.
   In addition, the return on investment’s performance is good.
3) Comparing the performance of the model used in this paper and the pure monthly revenue indicator

2. Literature Review

2.1. Fundamentals and Technical Analysis
In general, there are two primary methods used to analyze stocks and make investment decisions: fundamental analysis and technical analysis. Fundamental analysis involves analyzing a company’s financial statements to determine the fair value of the business \cite{6}\cite{7}\cite{8}, while technical analysis assumes that a stock’s price already reflects all publicly-available information and instead focuses on the statistical analysis \cite{3}\cite{4}\cite{5}. Formally, technical analysis is the study of how past and present price action in a given financial market may help determine its future direction. So fundamental and technical analysis could help investors to make decisions.

Finally, we select some indicators and proceed with the fundamentals and technical analysis. The following are model’s features in this paper:

### Table 1. The Experient of Fundamental Indicators

| Fundamental Indicators   | Explanation                                                                 |
|--------------------------|-----------------------------------------------------------------------------|
| ROA                      | The return on assets (ROA) shows the percentage of how profitable a company’s assets are in generating revenue. |
| ROE                      | In corporate finance, the return on equity (ROE) is a measure of the profitability of a business in relation to the equity. ROE is a metric of how well the company utilizes its equity to generate profits. |
| EPS                      | A portion of a company’s profit divided by the number of issued shares. Earnings per share serves as an indicator of a company’s profitability. |
| Operating margin         | This ratio used to measure a company’s pricing strategy and operating efficiency. It is a measurement of what proportion of a company’s revenue is left over after paying for variable costs of production such as wages, raw materials, etc. |
| Price to book ratio      | Compares a company’s current market price to its book value. |
| Price/sales ratio (P/S)  | This ratio ascertains if a share price of a stock depicts stock’s value. |
| Dividend per share       | This indicator is the total dividends paid out over an entire year divided by the number of ordinary shares issued. |
| Net revenue growth       | The growth of Net revenue over the year, month and season period. |
| Debt/equity ratio (D/E)  | Reveals the power of the available capital as opposed to the capital engaged. A low value of D/E means the credit accessible was not used. |
| Market capitalization (MC)| MC measures the total stocks transacted in the market. Concerning MC, stocks can be categorised into three groups, namely: small-cap, medium-cap, and large-cap. |

### Table 2. The Experient of Technical Indicators

| Technical Indicators   | Explanation                                                                                                                                 |
|------------------------|--------------------------------------------------------------------------------------------------------------------------------------------|
| Momentum               | Momentum, as the name suggests, reflects the amount of change experienced by the stock price over the previous period.                      |
| SMA                    | The SMA is ascertained by totalling the most recent closing prices of a stock and then dividing that by the number “n” of periods in the calculation average. |
| EMA                    | The EMA is similar to the SMA line except the given day’s EMA determination depends on the EMA calculations for all the days preceding that day. |
| MACD                   | The MACD indicator was a momentum indicator; it tries to predict stock market trends by a comparison between short and long-term trends. To ascertain MACD, find the difference between a 26-day EMA and a 12-day. |
| RSI                    | This is an indicator that measures whether a stock bought is oversold or overbought. The following equation shows how is obtained. |
| OBV                    | The OBV indicator is also a momentum indicator that employs volume-flow to predict movements in stock.                                      |
2.2. Profitability Indicators
Profitability growth trends represent a firm’s performance. Profitability also shows the ability of a firm to generate profits during the period [9]. Profitability and growth influence a company’s value. If a company has high profits, investors are often perceived that this company’s future is positive, otherwise a low profit’s firm would be considered to have business risks. In addition, profitability related to the company’s competitive position. If a company has high profits, it would be considered to have a higher competitive position than other firms. Most countries publish financial reports once a quarter. Such as the United States. Some countries publish company financial reports in a shorter period of time (once a month), such as Taiwan. We have seen previous studies pointed out revenue indicators have a high impact on the stock price [10]. However, no one designs strategies based on different timing periods of the financial reports release. Therefore, this paper uses monthly revenue indicators to create a monthly revenue strategy model. The following are revenue indicators in this paper:

Year on Year (YOY), Quarter on quarter (QOQ), Month on month (MOM) are financial comparison indicators, which could compare multiple measurable financial target’s performance on different time periods. Observing these indicators, investors could know a company’s financial performance is improving, static, or worsening.

\[
\text{Growth of Decline} = (\frac{\text{Current Year}}{\text{Previous Year}} - 1) \times 100 \%
\]

(1)

MOM12 is an indicator, which compares a company’s financial performance last year in the same month. This indicator reflects the difference in company’s performance in the same off-season or peak season.

Unexpected earnings is an indicator, which represents the difference between a company’s actual earnings and expected to generate.

\[
\text{SUE} = \frac{E_t - E_{\text{est}}}{\sigma_t}
\]

(2)

3. Experiment
3.1. Data Collection
This paper uses two datasets. First one is Taiwan’s stock information, and the other is U.S. stock’s information. The purpose of using two datasets is to verify the effectiveness of our method and model strategy.

We select S&P500 be the U.S stock dataset, which includes 500 leading U.S. There are two reasons for selecting the S&P 500 components as our U.S. dataset. First, the S&P 500 has relatively complete and large financial fundamental information. Second, the S&P 500 components are balanced on different industries and sectors. Therefore, we use the S&P 500 from December 2018 as our stock dataset.

Our Taiwan stock dataset is (publicly) listed corporations, which contains 900 company’s the basic information. We use these data from December 2018. It provides the stock information, including the prices, technical indicators, and fundamental analysis of securities of Taiwan stock market.
3.2. Model
This paper uses deep learning to be our model. We use three Fully Connected Layer (FCL) in our deep learning model. FCL is a network layer, where all neurons of the layer are connected to all neurons of the previous layer. Through the calculation of this layer, the features can be connected with the output label. FCL have linear regression and non-linearity regression. FCL are frequently used in state-of-the-art DAM predictors.

3.3. Revenue strategies
We design two different revenue strategies, which are Taiwan monthly revenue strategy and US quarterly revenue strategy. These models use deep learning, and the input uses Technical and fundamental indicators. In the output label part, we use each stock’s value spread ranking. Let’s use Taiwan’s monthly revenue strategy as an example. Taiwan’s companies release financial reports around the 10th of the month, then we extract each company’s stock spread between the 11th this month and the 10th of the previous month. After the above calculation, we rank all the company’s stock spread and normalize the value between 0 and 1. The higher ranking represents this company’s stock value has a high probability of increase, the lower ranking represents this company’s stock value has a high probability of decline.

4. Results and Discussion

4.1. Experiment Results and Evaluation
The evaluation method of this paper does not choose the traditional machine learning indicators, like accuracy or confusion matrix etc. Instead, we use investment’s evaluation methods. Such as profit rate, annualized profit rate, monthly (quarterly) profit, Sharpe index, and the max drop amplitude. The results are shown in the table below.

| Stock ID | Date | Value | Date | Value |
|---------|------|-------|------|-------|
| AAPL    | 2015-04-03 | 100 | 2015-04-10 | 105 |
| AIG     | 2015-04-03 | 95  | 2015-04-10 | 98  |
| CHN     | 2015-04-03 | 110 | 2015-04-10 | 115 |
| OSI     | 2015-04-03 | 120 | 2015-04-10 | 125 |
| ALDN    | 2015-04-03 | 130 | 2015-04-10 | 135 |
| AIL     | 2015-04-03 | 140 | 2015-04-10 | 145 |
| ABF     | 2015-04-03 | 150 | 2015-04-10 | 155 |

Figure 1. Flow Chart of the proposed analysis

| Stock ID | Date | Value | Date | Value |
|---------|------|-------|------|-------|
| AAPL    | 2015-04-03 | 100 | 2015-04-10 | 105 |
| AIG     | 2015-04-03 | 95  | 2015-04-10 | 98  |
| CHN     | 2015-04-03 | 110 | 2015-04-10 | 115 |
| OSI     | 2015-04-03 | 120 | 2015-04-10 | 125 |
| ALDN    | 2015-04-03 | 130 | 2015-04-10 | 135 |
| AIL     | 2015-04-03 | 140 | 2015-04-10 | 145 |
| ABF     | 2015-04-03 | 150 | 2015-04-10 | 155 |

Table 3. Taiwan Stock Market Monthly Revenue Strategy

| Stock ID | Date | Value | Date | Value |
|---------|------|-------|------|-------|
| AAPL    | 2015-04-03 | 100 | 2015-04-10 | 105 |
| AIG     | 2015-04-03 | 95  | 2015-04-10 | 98  |
| CHN     | 2015-04-03 | 110 | 2015-04-10 | 115 |
| OSI     | 2015-04-03 | 120 | 2015-04-10 | 125 |
| ALDN    | 2015-04-03 | 130 | 2015-04-10 | 135 |
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| AIL     | 2015-04-03 | 140 | 2015-04-10 | 145 |
| ABF     | 2015-04-03 | 150 | 2015-04-10 | 155 |

Table 3. Taiwan Stock Market Monthly Revenue Strategy

In the table, TOP n represents the top n good performance stocks predicted by the model. Observing the experimental results, the annualized profit rate of the Taiwan monthly revenue strategy is 1.75% ~ 2.56%, and the maximum drop is -8.78% ~ -20.81%. The Sharpe ratio is 1.8 ~ 2.3. As Table 3.

| Stock ID | Date | Value | Date | Value |
|---------|------|-------|------|-------|
| AAPL    | 2015-04-03 | 100 | 2015-04-10 | 105 |
| AIG     | 2015-04-03 | 95  | 2015-04-10 | 98  |
| CHN     | 2015-04-03 | 110 | 2015-04-10 | 115 |
| OSI     | 2015-04-03 | 120 | 2015-04-10 | 125 |
| ALDN    | 2015-04-03 | 130 | 2015-04-10 | 135 |
| AIL     | 2015-04-03 | 140 | 2015-04-10 | 145 |
| ABF     | 2015-04-03 | 150 | 2015-04-10 | 155 |

Table 4. U.S Stock Market Monthly Revenue Strategy

| Stock ID | Date | Value | Date | Value |
|---------|------|-------|------|-------|
| AAPL    | 2015-04-03 | 100 | 2015-04-10 | 105 |
| AIG     | 2015-04-03 | 95  | 2015-04-10 | 98  |
| CHN     | 2015-04-03 | 110 | 2015-04-10 | 115 |
| OSI     | 2015-04-03 | 120 | 2015-04-10 | 125 |
| ALDN    | 2015-04-03 | 130 | 2015-04-10 | 135 |
| AIL     | 2015-04-03 | 140 | 2015-04-10 | 145 |
| ABF     | 2015-04-03 | 150 | 2015-04-10 | 155 |
The annualized profit rate of the US quarterly revenue strategy is 1.42% ~ 2.25%, and the maximum drop is -8.8% ~ -25.3%. The Sharpe ratio is 2.6 ~ 5. As Table 4. From the performance of profitability, which is greater than 1, That is present the model is effective.

In addition, If the strategy selects fewer stocks, the results can get higher profit margins, the standard deviation and maximum transaction fallback are also the largest, and the Sharpe index is smaller. When the strategy selects more stocks, the earnings rate should fall, and the standard deviation and maximum trade fall will also be much smaller, and the Sharpe index would be larger. We observe that a high profit margin does not mean a higher monthly transaction winning rate, and a high monthly transaction winning rate does not mean a higher profit margin.

The testing dataset’s time period has two stock market crises, one is China-US trade war from September 2018 to October 2018 and the other is new coronavirus from 2020.1 to March 2020. In these time period, the back-test performance is not good but our revenue strategy could effectively avoid heavy loss due to the weakness of the market.

4.2. Feature importance

In addition, we use the OOB (Out of Bag) method to calculate and estimation the importance of features in the model. We want to observe the monthly revenue indicator has a significant impact on the model and trading strategy.

Among our features, taking the top 15 features of feature importance, we observe month-revenue indicators are all in the top 15 of feature importance. Table is training Taiwan market model’s feature importance top 15. As Table 5.

Among Taiwan market conditions, the Taiwan company has a relatively short release time for financial reports, so it is observed that the importance of monthly revenue indicators is higher, and the performance of the model strategy is relatively good.

| Table 5. The Important Features Ranking of 1-15 |
|-----------------------------------------------|
| 1–5 Important Features | 6–10 Important Features | 11–15 Important Features |
|------------------------|------------------------|------------------------|
| RSI                    | SUS                    | YOY                    |
| MOM12                  | MACD                   | EPS                    |
| SMA 60                 | Momentum 30            | SMA 30                 |
| KD                     | MOM                    | P/S                    |
| SMA 240                | ROA                    | QOQ                    |

4.3. Comparative Analysis

This paper selects other strategies for comparison. First one strategy would use some fundamental data to select stocks. The selection conditions are shown in Table 6.

| Table 6. The Important Features Ranking of 1-15 |
|-----------------------------------------------|
| Filter Condition                             |
| P/E ratio <15                                |
| EPS >last monthly EPS                        |
| monthly revenue >last year same month revenue|

The second strategy is Taiwan ETF 0050, which is an ETF formed by combining the top 50 companies in Taiwan. The timing of stock buying and selling is the same as the strategy in our strategy. Buying on the 11th of each month and selling on the 10th of the following month. Fundamental selection strategy selection averages about 5.31 stock per month. Therefore, the strategy model of this paper selects the top 5 and the top 10 stock for comparison. Observing the results of the back-testing in Table 7, the strategy model of this paper still get better profits.
Table 7. Strategy Comparison

|                    | TOP 5 | TOP 10 | Fundamental Selection Strategy | Taiwan ETF 0050 |
|--------------------|-------|--------|-------------------------------|-----------------|
| Average Monthly Profit Rate | 1.06  | 1.053  | 1.03                          | 1.006           |
| Annualized Profit Rate     | 1.95  | 1.79   | 1.5                           | 1.79            |
| Sharpe index              | 2.37  | 2.03   | 1.89                          | 0.5             |
| Max Drop Amplitude        | -8.7  | -9.6   | -15.1                         | -12.3           |

5. Conclusion

Based on the above research, this paper successfully uses fundamental and technical indicators as training model’s features. The ranking of monthly stock price spread as a label. Model training uses deep learning. We use Taiwan market characteristics, using monthly revenue indicators to design monthly revenue strategies. Buy on the 11th of the month and sell on the 10th of the following month. Among experiment results, the top 1 has good performance. The annualized profitability (annualized rate of return) can reach 2.56%, the Sharpe ratio is 2.01, the maximum amplitude is -20.8%. Compared with other strategies, our strategy is relatively stable and achieves ideal results. This paper use OOB method and experiment results to confirmed that the monthly revenue indicator is indeed a useful indicator.

5.1. Contributions

The main contributions of this thesis can be summarized as follows:
1. We collect and organize financial data extracted from Taiwan and U.S n companies’ monthly and quarterly financial reports across a period of 10 years.
2. We used monthly revenue indicators based features to improve model performance. In addition, the financial evaluation is good. Such as profit rate, annualized profit rate, monthly (quarterly) profit and loss, Sharpe index, and the max drop amplitude.

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