



Analysis of the Bollinger Band Mean Regression Trading Strategy

Guanru Su^(✉)

Department of Business, Shandong University, Jinan 264209, Shandong, China
su0712@mail.sdu.edu.cn

Abstract. Stocks have become an indispensable part of people's lives. There are many trading strategies used in trading and investment, among which Bollinger band mean regression trading strategy is a popular one. This article focuses on using this strategy to analyze several leading stocks and partially test them. After analyzing the stock, Bollinger band mean regression trading method is adopted. Ultimately, sharp short-term price movements and potential entry and exit points are identified. Finally, it is concluded that this strategy is flexible and visually intuitive, and they are easy to explain visually. It can be applied to any underlying asset in any time frame indicator, generating signals that not only provide precise entry levels, but also specify stop losses and profit zones. But such a strategy would react to changes in price movements without predicting them. It can therefore be a useful tool for technical analysis. The result could allow traders to make better informed decisions about when to enter and exit by carefully evaluating and adjusting their strategies.

Keywords: Stock · Bollinger Band · Back Test · Mean Regression

1 Introduction

In recent years, the use of trading strategies based on technical indicators has become increasingly prevailing in financial markets. Among these strategies, the Bollinger Bands mean regression trading strategy is a well-known and widely used approach. This strategy involves using Bollinger Bands (BB), a technical indicator that measures volatility, to identify potential trading opportunities based on the principle of mean reversion. This strategy has been studied extensively in various financial markets, including stocks, futures, and currencies. From this, it is necessary to examine the existing research on the BB mean reversion trading strategy and its effectiveness in different financial markets. This paper will begin by discussing the basic principles of the BB indicator and the mean reversion trading strategy. By examining the strengths and limitations of the strategy, this paper hope to provide traders with a better understanding of how to use this technical analysis approach to identify profitable trading opportunities.

Over the years, there have been many studies on the BB mean reversion trading strategy. Several studies have also shown that this strategy is becoming an effective tool for identifying trading opportunities in various financial markets. Chen drew up the BB

trading method to test it while taking into account elements like returns, retracement, income risk ratio, etc. He used the CSI 300 stock index futures as the research object. In addition, the author analysed the price data using wavelet noise reduction and tested the results using the BB trading technique. The Bollinger Band trading method based on wavelet analysis has higher returns and lower risk as compared to the results of the first test [1]. Yan defined the risk from the perspective of the Bollinger belt and discussed the bandwidth and the risk of identifying narrow bandwidth for accurate evaluation of stock market risk [2]. Thangjam evaluated the effectiveness of the usage of BB. It can capture the volatility of stock and can be treated and factored in the support and resistance in the course of analyzing a particular stock [3]. Zhou Xu selected four digital currencies, Btc, Ltc, Eth and Eos as research objects, through the quantification of Hurst index analysis, the Brin channel trend breakthrough strategy and parameter optimization, to explore the feasibility of BB mean reversion trading strategy in the digital currency market [4].

Specifically, Li built the optimized quantitative model through the Bollinger and the corresponding financial data and apply it to the A-share market. Through quantitative investment model of our country stock market history of retrospective test and firm test, to test the quantitative investment is widely used on Wall Street trading technology and related trading strategy in China's a-share stock market exploration has certain significance from [5]. Lento tested the profitability of BB technical indicators and found that after adjusting for transaction costs, the BB is consistently unable to earn profits in excess of the buy-and-hold trading strategy. However, the profitability is improved using a contrarian's approach source [6]. Wang selected the pre-processed stock price time series by using Bollinger band index, determined the buying and selling time points of stocks by taking the upper and lower track line set by the price break as the rule, and improved the specific parameter setting according to the industry characteristics of the selected stocks, so as to achieve the purpose of outperforming the market, and constructed a set of quantitative stock selection and timing strategies [7]. Bernis analyzed the richness of signals generated by the western Bollinger belt and the standard Bollinger belt through an example of credit assets [8]. Song introduced the Bollinger belt channel as the threshold trigger of statistical arbitrage. Compared with the traditional spread trading, the introduction of the Bollinger belt channel can dynamically track the trend change of the spread, and reasonably determine the timing of opening and closing [9]. Based on the theory of Bollinger belt, Liao designed the position building, closing and stop loss signals to construct a complete statistical arbitrage strategy and conclude that the strategy is effective at all three frequencies [10].

Based on this, this paper intends to use some of SP500 stock records to do the analysis to depict and find the possible appropriate entry and exit points of the stock within the specific year, this paper may also include the corresponding plot charts to make our analysis more vivid and convincing and help investors to establish a more perfect and effective market price mechanism, and optimize investors' investment strategies and return.

Table 1. Stock list.

Stock Code	Stock Code	Stock Code	Stock Code	Stock Code
AAPL	TSLA	GOOG	NFLX	MSFT

2 Method

2.1 Data Source and Basic Data Processing

The data of this study includes leading stocks in each of SP500 stock. Each stock includes is in nearly ten years from January 2019 to January 2023 at 6 months intervals. Each stock price data adopts the close price of the forward adjusted option, and the specific stock code is shown in Table 1. The data source is Yahoo Financial Terminal.

In terms of basic data processing, in order to better obtain the final conclusion, the missing data items are not included in the mean value formula, so as to obtain the development situation of each industry in the past years, make a curve with time as the horizontal coordinate and stock price as the vertical coordinate, and then calculate the Basic descriptive statistics.

2.2 Research Method

This study will use a 20-day simple moving average (SMA) for the middle band of the Bollinger Bands mean regression trading strategy, which consists of three lines. The middle band is used to determine the top band, which is then increased by twice the daily standard deviation. By multiplying the middle band's multiplicand by two, the lower band is determined. With stock price charts over several years to see the general relationship of direction and use the range of the Bolling line to determine the timing of buying and selling.

3 Results and Discussion

In order to use Bollinger band mean regression trading strategy to help traders and investors identify potential trading opportunities. This paper analyzes 5 companies stocks.

Figure 1 shows the stock prices of GOOG from 2021–01 to 2023–01, from which traders can see that the upper and lower Bollinger Band of GOOG stock. Probably when the close or low price cross the Bottom band and the current price is in the 'buy zone', traders can go long on the stock.

Figure 2 shows the stock prices of TSLA from 2021–01 to 2023–01. As can be seen from the graph, the overall trend of TSLA stock prices is volatile. Traders can see the Buy and Sell signal of TSLA stock. Probably when the close or high price cross the upper band and the current price is in the 'sell zone', traders go short on the stock.

Figure 3 shows the stock prices of TSLA from 2021–01 to 2023–01, the stock price dropped from 2021–11 to 2022–05. In order to get maximum benefit, traders can find

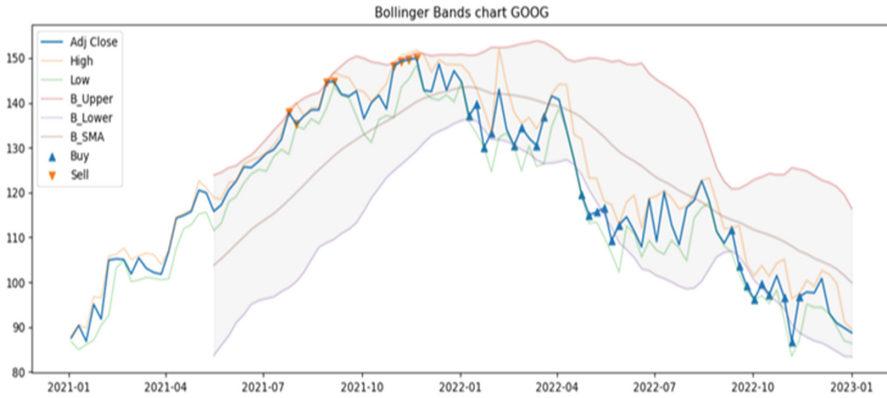


Fig. 1. GOOG stock. (Note: The vertical axis of the chart represents stock prices)

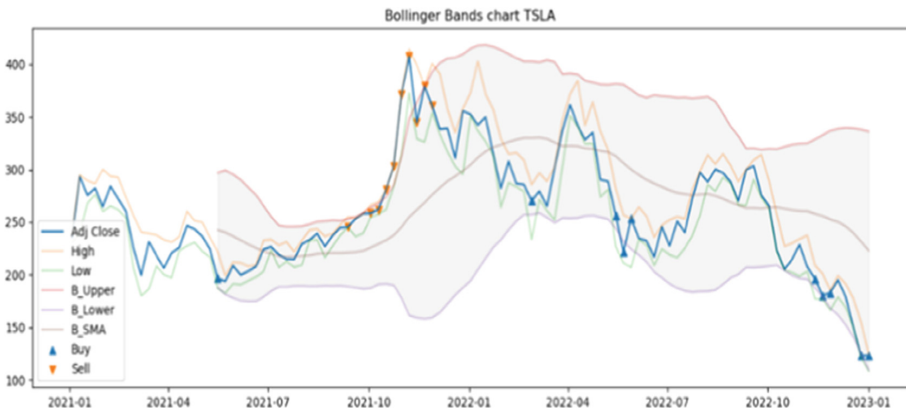


Fig. 2. TSLA Stock. (Note: The vertical axis of the chart represents stock prices)

the upper and lower Bollinger Band of NFLX stock. This allows us to create a back testing environment and define the trading strategy using Python code. Traders can then run the back test and analyze the results.

Figure 4 shows the stock prices of AAPL from 2021-01 to 2023-01, from which traders can see once the break through the upper and lower band, that is to form a buy and sell signal. Probably traders can use it to identify overbought and over-sold conditions.

Figure 5 shows the stock prices of MSFT from 2021-01 to 2023-01. As can be seen from the graph, there is some difficulty in determining when to buy and sell MSFT stock. Probably traders can focus on the upper and lower band, find the close or low price cross the Bottom band to get better benefit.

First of all, carrying out Bollinger band mean regression trading strategy on the above several stocks, traders can find the upper and lower Bollinger Band of each stock. And the Bollinger Band Strategy is a popular technical analysis tool used in trading and investing. It combines mean and standard deviation to identify trading markets. Traders

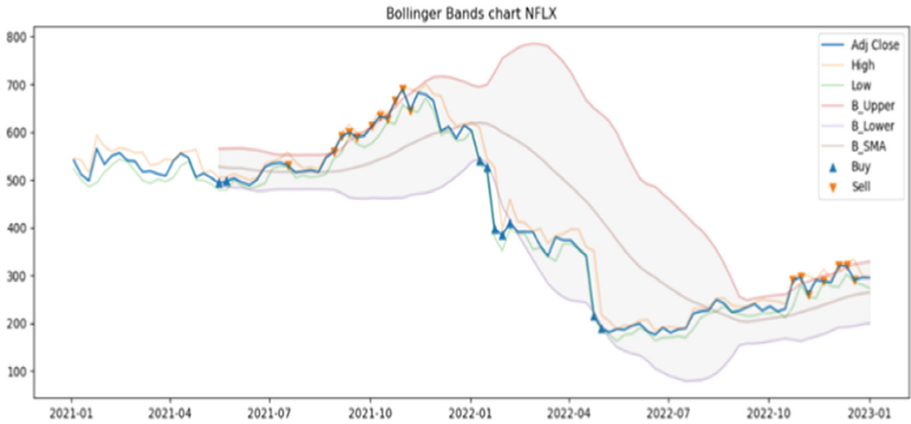


Fig. 3. NFLX Stock. (Note: The vertical axis of the chart represents stock prices)

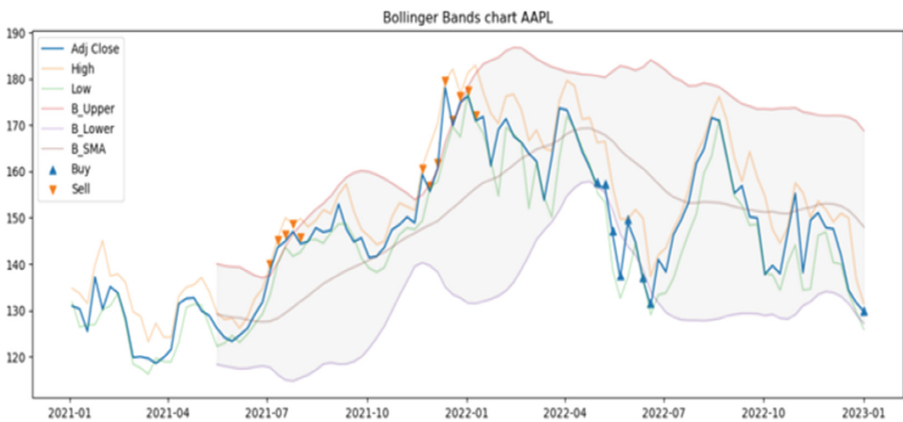


Fig. 4. AAPL Stock. (Note: The vertical axis of the chart represents stock prices)

and investors can use the Bollinger Band Strategy to identify market trends and generate profitable trading signals. Through these signals, traders can roughly determine when to buy and sell stocks in order to achieve a higher return.

According to the trend of stock industries in Figs. 1, 2, 3, 4 and 5 there may have some sharp, short-term price movements and potential entry and exit points. Therefore, this paper will go through the steps of how to perform Bollinger Band analysis and back testing.

To begin with, the first step in performing Bollinger Band analysis is to collect data for the stock in analyzing. In this case, this paper will be analyzing 5 companies' stocks, so it needs to collect data on stock prices. To do this, this paper can use a financial data source, such as Yahoo Finance, and the finance library in Python, just as this paper used. The period argument specifies the time period for which this paper want to download the data. In this case, this paper will use the period from 2021-01 till today to download

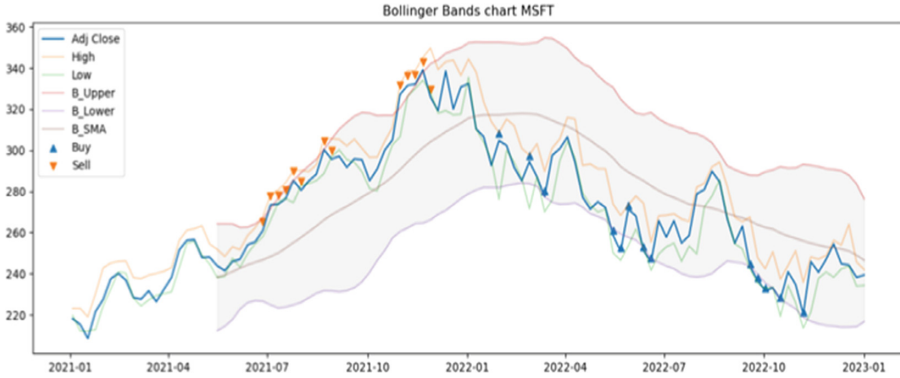


Fig. 5. AAPL Stock. (Note: The vertical axis of the chart represents stock prices)

the historical data for available time period, as this 2-year period could give us a better overview of the plot.

The next step is to calculate the Bollinger Bands. Bollinger Bands are calculated using the following formula:

$$\text{Upper Bollinger Band} = MA(TP, n) + m * \sigma[TP, n] \quad (1)$$

$$\text{Lower Bollinger Band} = MA(TP, n) - m * \sigma[TP, n] \quad (2)$$

$$TP = \text{Adj Closing Price} \quad (3)$$

$$n = \text{Number of days in the smoothing period} \quad (4)$$

$$m = \text{Number of standard deviations} \quad (5)$$

$$\sigma[TP, n] = \text{Standard Deviation over the last } n \text{ periods of } TP \quad (6)$$

To calculate the Bollinger Bands, this paper used the rolling method in pandas to calculate the rolling mean and standard deviation of the closing prices over a specified time period. Traders can then calculate the upper and lower Bollinger Bands using the formula above.

Then once this paper has calculated the Bollinger Bands, this paper can use them to analyze the stock's price movements. When the price of the stock is near the upper Bollinger Band, it is considered to be overbought, and when it is near the lower Bollinger Band, it is considered to be oversold. Traders and investors can use this information to make buy and sell decisions.

In addition to identifying overbought and oversold conditions, Bollinger Bands can also be used to identify trends in the stock's price movements. When the stock price is trending upwards and staying above the middle Bollinger Band, it is considered to be in

Table 2. Back test list.

Stock Code	Annual return	Cumulative return	Sharpe ratio	Calmar ratio
AAPL	11.1%	54.9%	0.48	0.19
MSFT	9.1%	483.7%	0.47	0.14

an uptrend. Conversely, when the stock price is trending downwards and staying below the middle Bollinger Band, it is considered to be in a downtrend.

The concepts to draw the “Entry” and “Exit” points: Sell Signal: if Closing Price < Upper Bollinger Band and Buy Signal: if Closing Price < Upper Bollinger Band.

Once this paper has analyzed the Bollinger Bands, it can back test the strategy to see how it would have performed in the past. Back testing involves applying the strategy to historical data and calculating the hypothetical returns that would have been generated. To back test the Bollinger Band strategy, this paper uses the library in Python. This library allows us to create a back testing environment and define the trading strategy using Python code. Then the back test can be ran and the results can be analyzed.

Table 2 shows that after this paper run the back test, it finds the return and ratio which worthy of reference. AS this paper used SMA 20 days for analysis, the model has certain limitations. Studies have found that only about 88% (85–90%) of security prices remain in the range, so this strategy should be used in con-junction with a number of other indicators combine to draw conclusion.

4 Conclusion

This paper analyzes the Bollinger Bands mean regression trading strategy against the background of several stocks and it helps to identify sharp, short-term price movements and potential entry and exit points. Flexible and visually intuitive to many traders, and they are visually easy to interpret. They can be used as a momentum oscillator as well as a volatility predictor. Bollinger Bands is a technical analysis tool that can be used on any underlying asset and time frame. It produces signals that not only provide exact entry levels but also define stop loss and take-profit zones. Bollinger Bands can be used to spot extreme price values, but they are not the best tool for the job. Although they cannot forecast values, the bands will respond to changes in price movements. Bollinger Bands are a lagging sign, in other words, just like the majority of technical indicators. Due to the fact that it uses the simple moving average. Even though Bollinger Bands can trigger their own signals, it is important to use these signals in concurrence with other aspects of technical analysis that traders should always use the system along with two or three non-correlated tools to predict the trend of the stocks. The fact that not all traders will be able to use Bollinger Bands with the default values is another drawback. The options that enable traders to specify rules for particular stocks they are trading must be found. Traders can change the settings or switch to a different tool if the chosen band settings don’t function. Bollinger Bands’ efficacy differs from market to market, and traders may need to change the settings even if they consistently trade the same security.

With careful evaluation and adjustment of the strategy, traders can make more informed decisions about when to enter and exit.

References

1. Chen, S. Z., et al.: Bollinger Bands Trading Strategy Based on Wavelet Analysis. *Applied Economy and Finance* 5(3), (2018).
2. Chen, H. Y., Yan, C. N.: A Bollinger belt analysis was used to compare stock market risk. *Contemporary Economy* 2, 147-148 (2008).
3. Thangjam, R., Mohsin, H.: Bollinger bands optimal algorithmic strategy in stock trading. *International Journal of Research in Finance and Marketing* 5(1), (2015).
4. Zhou, X.: The application of the trend breakthrough strategy in the digital currency market. Zhejiang Gongshang University; (2021).
5. Li, X.: Construction and Application of quantitative Investment Model based on Boling Belt. University of South China, (2018).
6. Lento, C., Gradojevic, N., Wright, C. S.: Investment information content in Bollinger Bands. *Applied Financial Economics Letters*, 3(4), (2007).
7. Wang, K.: Quantification strategy based on the decision tree and the bolen belt. North China Electric Power University, (2019).
8. Bernis, G., et al.: Stochastic evolution of distributions and functional Bollinger bands. *Applied Stochastic Models in Business and Industry*, 38(2), (2022).
9. Song, G. M.: Research on statistical arbitrage strategy of quantitative trading. Guangdong University of Finance and Economics, (2019).
10. Liao, C. X.: Research on cross-variety arbitrage of Treasury bond futures based on bollinger belt and error correction model. Huazhong University of Science and Technology, (2020).

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