Combine Study of Technical Indicator Bollinger Bands and Moving Average Convergence Divergence in Nepal Stock Exchange Limited

DUSHYANT LAL JOSHI ⓘD | DEVENDRA KUMAR MODI

*Author affiliations can be found in the back matter of this article

CORRESPONDING AUTHOR
Dushyant Lal Joshi
Dr. K.N. Modi University, India
dushyantlaljoshi@gmail.com

KEYWORDS	ABSTRACT
BB MACD NEPSE Technical analysis Buy sell	Stock price forecasting involves predicting a company's future condition based on time series analysis. Investors need precise forecasts of future indices or stock price changes to address the Buy-Sell-Hold problem effectively. Data were collected for Nepal Stock Exchange Limited, Nepse Alpha, and Chukul. For this study, data were collected over six months (December 2023 to May 2024), utilizing technical trading tools like Bollinger Bands (BB) and Moving Average Convergence Divergence (MACD). Combining BB and MACD on a single chart yields better results than analyzing each indicator separately. This integrated approach provides a more thorough understanding of market dynamics, improves decision-making accuracy, and leads to more profitable outcomes. Integrating the analysis of BB and the MACD on one chart can provide more benefits than using each indicator independently. This method offers market behavior and improves decision-making precision, resulting in more profitable outcomes.

1. INTRODUCTION

The Bollinger Band is a technical analysis tool used to forecast price movements in the stock and commodity markets, created by John Bollinger in 1992. This volatility band serves as an indicator of trends and market volatility. Its main function is to identify high and low stock prices, with prices being considered high when they are near the upper band and low when they are near the lower band.

Asking the market what is happening is always better than telling the market what to do. It focuses on volatility as a key variable. The number of volatility steps before choosing the standard deviation as the method by which to set the bandwidth. Bollinger bands are constructed two standard deviations above and below a simple moving average (Bollinger, 1992). The Bollinger Band consists of three lines: the upper, middle, and lower bands. The upper and lower bands are based on the simple moving average, while the middle band is the intermediate line. The distance between these bands indicates market volatility. Typically, the parameters used are 20 periods and two standard deviations (Shah, Nisarg, & Taral, 2015). Bollinger Bands function similarly to price envelopes but offer the advantage of automatically adjusting their width based on changes in volatility. They reflect the random nature of

volatility, expanding during periods of high volatility and contracting during periods of low volatility (Lehtoalho, 2018).

Introduced by Gerald Appel in 1979, MACD is a widely used technical indicator. It measures the momentum of price changes, indicating the strength and direction of stock price trends. As a tool in technical analysis, MACD can influence investment strategies in the stock market, potentially leading to exceptional returns and risk-adjusted profits for certain companies (Anghela, 2015). Regarding signal generation with the "MACD Line" and the "Signal Line," the common interpretation is to 'buy' when the MACD line crosses above the signal line and 'sell' when it crosses below. This trading principle, known as the "signal line crossover," is a fundamental signal. However, investors employ various strategies when using this model for trading (Kang, 2021).

MACD is determined by subtracting the 26-period Exponential Moving Average (EMA) from the 12-period EMA, resulting in the MACD line. The nine-day EMA of the MACD, known as the "signal line," is plotted above the MACD line and serves as a trigger for buy and sell signals (Vishwakarma, Aod, Gaur, & Prof. Thakkar, 2021). The MACD technical indicator shows convergence and divergence using two moving averages: the 12-day EMA (fast line) and the 26-day EMA (slow line). It signals buying and selling opportunities based on the interaction between these lines. These signals occur when the histogram is at, above, or below zero (Singh & Chakraborty, 2022)

1.1 RESEARCH OBJECTIVE

The main objective of this study is to find out how the Bollinger Band (BB) and Moving Average Convergence Divergence (MACD) help to forecast price movement and fluctuation in the stock market. A prominent objective of this study is to assess whether traders' use of this indicator can make a profit in a short period. This study will also help to examine the use of BB and MACD to identify the relatively up and down trend price of securities in Nepal Stock Exchange Ltd.

- To identify the maximum index of NEPSE and to book the profit.
- To minimize the loss and stop the loss.

1.2 LITERATURE REVIEW

This study evaluates the effectiveness of nine technical trading rules on the S&P 500 from January 1950 to March 2008, covering 14,646 daily observations. After accounting for transaction costs, only the moving-average crossover rules (1,200) and (5,150) consistently outperformed the buy-and-hold strategy over the 59 years. However, when a Combined Signal Approach (CSA) was applied to individual trading rules, the returns were significantly higher. (Lento, 2008).

This research introduces and evaluates a stock price prediction model that leverages features from both time series data and social networks to forecast stock prices. The study incorporates factors such as the numerical dynamics of news and comments, overall sentiment analysis of these news and comments, and technical analysis of historical price and volume data. We model stock price movements using these input features and employ a Multiple Kernel Learning regression approach to solve the problem. Experimental results demonstrate that our proposed method surpasses previous baseline models in terms of prediction accuracy, as measured by root mean squared error, mean absolute error, and mean absolute percentage error, for the stocks of three prominent Japanese companies listed on the US stock market. The results indicate that incorporating additional features beyond merely analyzing stock prices enhances performance (Deng, Mitsubuchi, Shioda, Shimada, & Sakurai, 2012).

The prediction of Asian stock markets has been a widely researched topic due to their dynamic nature and significant variability. Given this complexity, it is more practical to consider Asian stock indexes as nonlinear mixed data. This study introduces

a time series prediction model for Asian stock markets that integrates nonlinear independent component analysis (NLICA) with a neural network. In this approach, NLICA is first employed to transform the original time series data into a feature space composed of independent components, which encapsulate the underlying information of the original data. The Japanese and Chinese stock markets, being the largest in Asia, are selected to represent the two types of stock markets. Therefore, the Nikkei 225 closing index and the Shanghai B-share closing index are utilized to evaluate the proposed method's performance. The experimental results demonstrate that the suggested model not only improves the prediction accuracy of the neural network but also surpasses three comparative methods. Consequently, the proposed prediction model for stock indexes appears to be a promising tool for Asian stock markets (Dai, Wu, & Lu, 2012).

This research is to explore the efficacy of MACD in predicting security prices and aiding investment decisions. This approach involves integrating close neighbor classification with established technical analysis tools like stop loss or stop profit. To assess the practical utility of this method, we compare its outcomes with those of the buy-and-hold strategy. The study demonstrates how signals generated by this indicator can mitigate trading risks in markets. Additionally, it examines which model can enhance profitability by implementing additional criteria to filter out false trade signals (Joshi, 2022).

This volatility often makes it challenging for investors to profit from trading. To tackle this issue, investors must accurately predict future changes in stock prices or indices. In the Nepalese context, amidst global economic crises and uncertain political environments, the candlestick pattern yields varying outcomes in bearish markets. While traders may occasionally benefit from it in the short term, it doesn't consistently offer the right guidance for movements (Joshi, 2023). Technical traders employ various indicators to devise trading strategies, and these tools can also benefit everyday investors. With some basic knowledge, anyone can identify optimal buy and sell signals to maximize profits and minimize losses. This can be achieved by combining two key technical indicators: the MACD and BB. This model is especially useful for short-term trading and has demonstrated 98% accuracy in predicting trends (Kothapalli, et al., 2023). Stock price forecasting involves analyzing time series data to predict a company's future condition. Addressing the Buy-Sell-Hold problem requires accurate predictions of future stock price movements. Combining Candlesticks, BB, and MACD charts often yields better results compared to analyzing a single technical indicator. According to the data, 70.97% of respondents agreed that technical analysis provides the right guidance for Buy-Sell-Hold decisions, while 29.03% disagreed. However, examining the actual distribution of "Buy-Sell-Hold" statistically would enhance the analysis and comprehension of the data (Joshi, 2023)

The Moving Average Convergence Divergence (MACD) and Bollinger Bands (BB) are utilized to optimize signal aggregation, define trading rules, and set indicators using Particle Swarm Optimization (PSO) over a commonly used fitness function: the net capital at the end of the trading period. Recent research has introduced straightforward optimization methods by altering only one category of parameters at a time—such as indicator settings, trading rule design, or signal aggregation—while keeping the other parameters constant. Over a multi-year period, we trained and tested our trading system on the Italian index Financial Times Stock Exchange (FTSE), Milano Indice di Borsa (MIB), and selected FTSE MIB-listed financial equities. Our results show improved in-sample and out-of-sample performance, using a conventional technical analysis system as a benchmark. Additionally, we have verified the optimized trading system's ability to classify stock price trends accurately (Corazza, Pizzi, & Marchioni, 2024).

The research gap lacking sufficient research is the integration of BB,

candlesticks, and MACD in predicting market movements or guiding trading decisions. While individual studies explore these indicators independently, there's a dearth of research on their combined effectiveness and whether their synergy can enhance market analysis. Therefore, there's a notable gap in understanding how this combined approach performs in forecasting trends or recommending entry and exit points for trades. Additionally, researchers could explore how adjusting parameters or timeframes for each indicator influences the accuracy of predictions.

1.3 PROBLEM OF STATEMENT

The concept of market efficiency has been tested many times, but previous studies have not yielded any conclusive evidence. Stock price forecasting is done through fundamental and technical analysis. Despite the various tools available, investors and analysts face difficulty in coming out with accurate predictions of stock price movements. It is difficult to predict the movement of stocks especially when the markets are highly volatile. Investors and traders need to create entry and exit strategies to make profits or avoid losses. One can point out that an investor should base his interpretation on both fundamental and technical analysis, but technical indicators play a significant role in predicting stock movements and determining entry and exit points. And stock prices also move in trends and cycles that are never stable. Hence this study is taken to use the technical indicators BB and MACD and suggest buying and selling strategies (trading strategies) to the investors by looking at the price movement in the securities.

1.4 RESEARCH METHODOLOGY

In this research article, secondary data were used for data analysis. Nepal Stock Exchange Ltd., (NEPSE Index) was taken from December 2023 to May 2024, the last 6 months' data for analysis. The data analysis was based on the generated chart patterns of 2 hours daily Candles Stick technical indicator with integrated Bollinger

Band (BB) and Moving Average Convergence Divergence (MACD).

Using Bollinger Bands to identify the relatively high and low prices of security involves noting that the price is considered high when it reaches the upper band and low when it touches the lower band (as shown in Figure 1 below). Bollinger Bands consist of three lines or bands (Bollinger J., 2001);

Middle Band (MiddleB) represents intermediate term trend. It is calculated as N period simple moving. The middle band was a frame of reference for the upper and lower bands.

$$MiddleB = SMA = \frac{1}{N} \cdot \sum_{i=M-N}^{M} x_i$$

Here M total number of observations, x– historical data set.

The Upper Band (UpperB) was shifted up by K standard deviation above the middle band.

$$UpperB = SMA + K \cdot \sigma_N$$

$$\sigma_N = \sqrt{\frac{1}{N} \cdot \sum_{i=M-N}^{M}(x_i - SMA)^2}$$

Here σ n is a standard deviation calculated for the newest N observation.

The Lower Band (LowerB) was shifted down by K standard deviation below the middle band.

$$LowerB = SMA - K \cdot \sigma_N$$

The optimal parameter N is 20 for individual stocks and stock indexes. A satisfactory intermediate-term trend was obtained using this parameterization. For short-term trends, parameter N=10 also works well. For long-term trends, it was a good idea to use N=50. Parameter K was set to 2 in the basic model of the Bollinger bands, although it can be adjusted (in the best case calibrated) according to the specifications of the market. In the case a longer moving average was used parameter K must be increased to 2.1, when N=50. On the contrary, if a shorter moving average is

used, then parameter K should be decreased to 1.9 when N=10.

New metrics can be useful for isolating the appropriate action on each signal. In 2010, John Bollinger introduced new indicators derived from Bollinger Bands, specifically percentage bandwidth (%b). The purpose of %b is to help normalize the size of the upper and lower bounds over time (Williams, 2013). The formula for %b is:

$$\%b = \frac{\text{Last Price} - \text{Lower BB}}{\text{Upper BB} - \text{Lower BB}}$$

The Upper Bollinger Band represents the upper limit, while the Lower Bollinger Band signifies the lower limit. Another measure derived from Bollinger Bands is bandwidth, aiding in the identification of extreme market conditions, like squeezes when bands contract or bulges when they expand. A squeeze occurs when the bandwidth hits a new 125-day low, while a bulge is noted when it hits a new 125-day high, as discussed in a John Bollinger webcast. Bollinger on Bollinger Bands discusses bandwidth as a gauge of volatility, entirely based on standard deviation. Declining bandwidth suggests decreasing volatility as standard deviation decreases while rising bandwidth indicates increasing volatility (Bollinger J., 2001).

One of the most straightforward and powerful momentum indicators, it oscillates around the zero line, reflecting the convergence, crossover, and divergence of moving averages. The standard MACD involves subtracting the 26-day exponential moving average (EMA) from the 12-day EMA. Additionally, a 9-day EMA of the MACD is plotted alongside the MACD itself, creating the signal line (Sudheer, 2015).

Calculation:

MACD line = (12-day EMA – 26-day EMA)

Signal line = 9-day EMA of MACD line

MACD histogram = MACD line – Signal line

The MACD can be formulated as:

$$MACD = \sum_{i=1}^{n} EMA - \sum_{i=1}^{n} EMA_d$$

Where,

k = 12 days

d = 26 days

$$Exponential\ Moving\ Average\ (EMA) = \left[\frac{2}{n} \times (P_t - EMA_{t-1})\right] + EMA_{t-1}$$

Where,

n = no. of period

t = time

Pt = index value at time

2. RESULTS AND DISCUSSION

Figure 1 shows a chart of the NEPSE combining the technical chart of BB, and MACD almost in the technical chart, there are 232 recognized candle sticks generated in the chart, which signifies 232 days stocks were traded in 6 months. Among them, 111 green candles had developed, while the remaining 121 were red candles, indicating that most red candles are high, and stock markets have been in a downtrend over the past six months. However, this article discusses the formation of a candlestick pattern with a combination of BB and MACD on a chart of the last six months (December 2023 to May 2024).

Figure 1: *BB and MACD Chart of NEPSE*
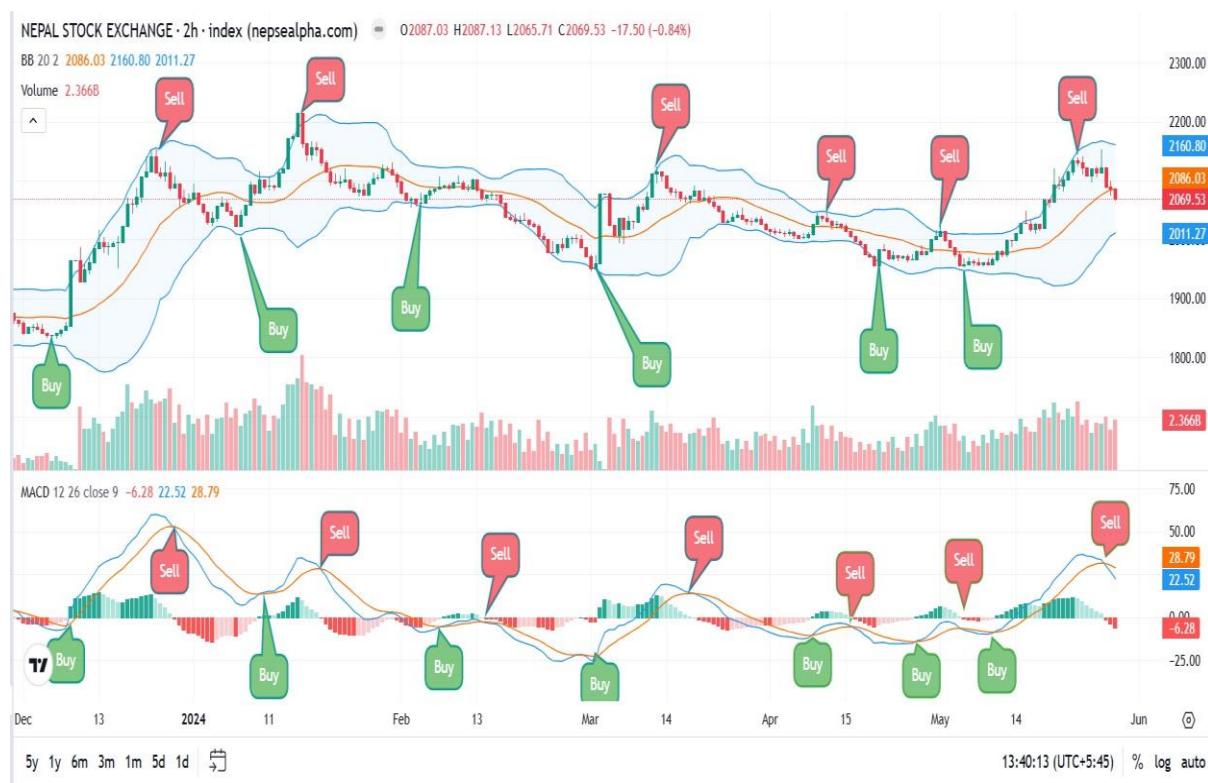
Source: *www.nepsealpha.com/trading/chart*

Figure 1: NEPSE combines a chart of Candle stick, BB, and MACD. In the starting period of December 2023, BB's upper and lower bands were moving down with shrink from the middle band. On December 6, 2023, the candle left the lower band and moved up. At the same time after 1 day, 07 December 2023 the MACD line had a crossover for a buy signal, and histogram charts converted to a green signal. Likewise, in the 6 months, BB has provided 6 buy signals and 6 sell signals.

On the other hand, MACD had signaled 7 times buy and 7 times sell signals. In total 232 of histogram sticks, 116 were green and the positive histogram remaining 116 sticks were red which was below the 0 value, showing the negative histogram. At the start of December NEPSE index was 1856 and at the end of May 2024 was 2069.53. Earned 213.53 index in the 6 months of period.

Finally, if traders and investors watch the BB and MACD charts minutely and buy-sell decisions as per above the chart can earn handsome money. So, watching both BB and MACD plotting at the same chart gets more benefit as compared to single indicators.

Table 1: *Buy Sell Signals Count from BB and MACD.*

Particulars	Number of Observation
Total Trading Days	116
Buy Signals BB	6
Sell Signals BB	6
Buy Signals MACD	7
Sell Signals MACD	7

There were 116 trading days observed or analyzed. There were 6 instances where the Bollinger Bands indicator generated a buy signal. The MACD indicator generated 7 buy signals during the observed period. There were 6 instances where the Bollinger Bands indicator generated a sell signal. Similarly, the MACD indicator generated 7 sell signals. The equal occurrence of buy and sell signals, both in the general market and specifically in MACD signals (each with 6 occurrences), implies fluctuating conditions within a range during the observed period. The balanced nature suggests a market experiencing both upward and downward movements, lacking a clear dominant trend.

The equal occurrence of buy and sell signals in both Bollinger Bands and MACD suggests a market with moderate to high volatility. Bollinger Bands, which gauge volatility, indicate that the market's fluctuations fall within a moderate range. In contrast, MACD, which primarily measures momentum, reflects significant price movements triggering both bullish and bearish signals. This points to a market environment where volatility was notable enough to generate diverse signals indicating both upward and downward momentum. Without further context, assessing the prevailing trend is difficult. Bollinger Bands, commonly employed for trend identification and potential reversals, offer insights into market dynamics. Buy signals indicate potentially undervalued prices relative to recent action, hinting at upward movement possibilities. Conversely, sell signals imply potential overvaluation, signaling a potential downward correction.
In the analyzed period spanning 116 trading days, both Bollinger Bands and MACD indicators displayed an equal occurrence of buy and sell signals, indicating fluctuating conditions without a clear dominant trend. This balance suggests a market experiencing both upward and downward movements. The equal occurrence of signals in both indicators implies moderate to high volatility, with Bollinger Bands indicating moderate fluctuations and MACD reflecting significant

price movements. Assessing the prevailing trend solely from signal numbers was challenging, but buy signals suggest potential upward momentum while sell signals hint at possible downward corrections.

3. CONCLUSION

Using a combination of Candlestick charts, Bollinger Bands (BB), and Moving Average Convergence Divergence (MACD) typically yields more reliable results than relying solely on one technical indicator. In the provided illustration (Figure 1), if two out of the three tools indicate the same Buy, Sell, or Hold signal, it may be advisable to consider following that signal.

However, by closely monitoring both Bollinger Bands (BB) and Moving Average Convergence Divergence (MACD) charts and making buy and sell decisions based on the signals they provide, traders and investors have the potential to generate substantial profits. Therefore, combining the analysis of BB and MACD on a single chart can offer greater advantages than relying solely on individual indicators. This integrated approach allows for a more comprehensive understanding of market dynamics and enhances decision-making accuracy, ultimately leading to more profitable outcomes.

AUTHOR AFFILIATIONS
Dushyant Lal Joshi
PhD scholar, Faculty of Management, Dr. K.N. Modi University, Newai, Rajasthan, India

Prof. (Dr.) Devendra Kumar Modi
Professor Department of Commerce & Management, Dr. K. N. Modi University, Newai, Rajasthan, (India)

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