J-BOM

Accuracy Level of Technical Analysis Indicators: Case on the Stock Prices of Telecommunication Companies Listed in the Indonesian Stock Exchange

Muhammad Benarbia Ramadhan[1], Aryono Yacobus[2]

Abstract

This study aims to test and provide empirical evidence of the accuracy of technical analysis indicators Moving Average Convergence Divergence, Bollinger Bands, and Stochastic Oscillators in predicting the direction of stock price movements. This research focuses on stocks listed on the Telecomunication Subsector with observation intervals from January to December 2022. The research data was obtained from the tradingview.com platform. The Mann-Whitney Non-parametric test is used to test research hypotheses regarding the accuracy of the Moving Average, Bollinger Bands, and Stochastic Oscillator indicators which can statistically prove whether there is a difference between the predicted price and the actual indicator price. The results showed that there was no difference between the predictions of the direction of stock price movements produced by the three indicators and actual prices, which means that the three indicators are accurate. From the results of the analysis and comparison of the performance of the three indicators from the number of signals and the average level of return, it can be concluded that the Relative Strength Index indicator has a more optimal rate of return than the other two indicators. The results of this research can be a reference for capital market investors in choosing technical analysis methods that can help make more appropriate investment decisions.

Key Words *: Technical Analyst, Moving Average Convergence Divergence, Bollinger Bands, dan Relative Strength Index.*

Introduction

Investment has become one of the strategies in this era of globalization to gain capital profits in the future within a specific time frame. According to Adnyana (2020), investment is essentially the placement of a certain amount of funds at present with the expectation of gaining profits in the future.

The development of the capital market in Indonesia continues to rise, as per data from PT Kustodian Sentral Efek Indonesia (KSEI, 2023). The number of investors in the Indonesian capital market, referring to the Single Investor Identification (SID), has reached 11,188,847. The number of capital market investors has increased by 49.59% from 7,489,337 at the end of 2021.

When choosing or analyzing a stock, investors commonly use two general approaches: Fundamental Analysis and Technical Analysis. Fundamental Analysis involves analyzing fundamental financial variables to estimate the intrinsic value of

---

[1,2] UPN "Veteran" Yogyakarta

* *Corresponding author, email:* aryonoyac@gmail.com

a company. Technical Analysis can be defined as the use of specific market-generated data for analyzing aggregate stock prices (market indices or industry averages) and individual stocks. Technical Analysis is considered to represent the risk profile of the majority of investors in the Indonesian Capital Market, where market conditions are not fully efficient. In markets that are not fully efficient, there is asymmetric information, allowing technical analysis to be used since past stock prices can be used to predict future stock price movements.

One well-known investment option in the capital market is stocks. Stocks represent a person's or entity's participation in the capital of a company or limited liability company. With the advancement of technology and digital transformation (digitization), some investors are shifting their investment choices to indices or sectors related to digital transformation. As reported in the e-Conomy SEA Report (2022), technology has impacted all aspects of life, ranging from e-commerce, online media, online transportation, digital financial services, to emerging services such as digital healthcare (HealthTech), Web 3, and digital education (EdTech). This is perceived as a positive sentiment for the telecommunications sector, as the internet network is a key element in utilizing various aspects of online services.

In modern technical analysis, there is a fundamental component known as indicators. Indicators are analytical methods derived from the calculation of a formula based on previous data to predict future price movements. With indicators, investors can determine buy and sell signals for stock prices (Ong, 2016). Based on their functions, technical analysis indicators are generally divided into Trend Indicators, Oscillator Indicators, and Volatility Indicators.

Trend Indicators are used to monitor the occurrence of price movement trends generated by these technical analysis indicators, including Moving Average (SMA, WMA, EMA), Moving Average Convergence Divergence, and Parabolic SAR. Oscillator Indicators are used to recondition stock levels when they touch oversold or overbought conditions. Indicators included in Oscillator Indicators are the Relative Strength Index and Stochastic Oscillator. Volatility Indicators are used to measure market strength formed by stock price volatility in a specific period. Indicators included in Volatility Indicators are Bollinger Bands, Average True Range, and Chaikin Volatility. The researcher employs all three types of technical analysis indicators, each represented by one commonly used indicator in each type: Moving Average, Bollinger Bands, and Stochastic Oscillator (Schlotmann & Czubatinski, 2019).

Research conducted by Roy & Hermuningsih (2016) explains that the Relative Strength Index indicator is more accurate than the Bollinger Bands indicator. However, Baining & Fadhillah (2017) contradicts this by providing empirical evidence that the Bollinger Bands indicator is proven to be more optimal in observing signals and provides higher returns compared to the Relative Strength Index and Moving Average. Bollinger Bands are able to generate an average return of 40.77%, whereas the Moving Average indicator yields an average of 12.19%, and the Relative Strength Index is at 23.07%.

Subsequent research in the following period by Asthri et al. (2016) explains that the Moving Average Convergence Divergence (MACD) indicator obtains accurate results

and can be used to observe buy and sell signals for stock prices. However, Suryanto (2021) disputes this by providing empirical evidence that there is no difference in buy and sell signals before and after using MACD and RSI. The study provides guidance that an investor does not need to rely solely on the use of MACD or RSI. This research aims to address gaps in the literature by further testing the accuracy of these three indicators through a difference test between the predicted price signals of the indicators and the actual prices.

Literature Review

Capital Market

According to Undang-undang Pasar Modal (UUPM), Law Number 8 of 1995 concerning the Capital Market. The capital market is defined as activities related to public offerings and trading of securities, public companies related to the securities they issue, and institutions and professions related to securities. Tandelilin (2010) explains that the capital market plays a significant role in the economy, with investors being parties with surplus funds investing in various securities with the expectation of receiving returns.

Asymmetric Information

Asymmetric information is a condition where one party has more information than another. For example, company management has more information than investors in the capital market. The level of information asymmetry varies from very high to very low and has a significant impact on financial decisions (Atmaja, 2008).

Efficient Market Hypothesis

An efficient market is defined as a market where the prices of all securities quickly and fully reflect all relevant available information (Jones, 2013). According to Fama, the concept of an efficient market means that current stock prices reflect all existing information. This includes information from the past, present, and additional information provided by the company itself (insider information).

Fama (1970) explains the main forms of market efficiency based on three types of information: 1) Weak Form of the Efficient Market Hypothesis, 2) Semi-Strong Form of the Efficient Market Hypothesis, and 3) Strong Form of the Efficient Market Hypothesis.

Dow Theory

Dow Theory was developed by Charles Dow, the editor, and co-founder of The Wall Street Journal in the 19th century. Dow's ideas, expressed through a series of editorials in the daily newspaper, are recognized and valued as the foundation for modern technical analysis. Dow believed that the overall stock market serves as a reliable measure to gauge the overall business conditions in the economy. By analyzing the market as a whole, one can accurately

measure these conditions and identify the main trends in the market and the likely directions of individual stocks. Dow Theory aims to investigate the ongoing trends in the stock market, both for individual stocks and the market as a whole. The theory consists of six main principles: Market Action Discounts Everything, The Market is Comprised of Three Trends, Primary Trend Has Three Phases, The Average Must Confirm Each Other, The Volume Confirms the Trend, and A Trend Remains Intact Until It Gives a Definite Reversal (Murphy, 1999).

Technical Analysis

Technical analysis is a technique used to predict the direction of stock movements and other stock market indicators based on historical data (Tandelilin, 2010). It is a method for forecasting stock price movements and predicting market trends in the future by studying stock price charts, trading volumes, and composite stock price indices (Susanto & Sabardi, 2010). Six commonly used tools in technical analysis are: 1) Charts, 2) Trendlines, 3) Support and Resistance, 4) Volume, 5) Chart Patterns, and 6) Technical Indicators.

Moving Average Convergence Divergence

This indicator was created by Gerald Appel in the 1960s by assessing the correlation between two Exponential Moving Averages (EMA) with different time periods. The more commonly used combination of EMA periods is EMA-26 with EMA-12, along with EMA for 9 days, referred to as the signal line or trigger, known as EMA-9. The MACD (Moving Average Convergence Divergence) technique transforms Moving Averages, which are essentially Lagging Indicators, into a form of momentum oscillator (Leading Indicator). The oscillator chart is divided into two parts that have no lower or upper limits, marked by the zero (0) level line. It is considered a buy signal when the MACD line crosses above the signal line. Conversely, a sell signal is obtained when the MACD line crosses below the signal line.

Bollinger Band

This indicator is a development of MA (Moving Average) into two lines, namely the upper band and the lower band. If the price movement is outside the upper bands, it confirms that the price is in an overbought or overbought condition. If the price is outside the lower band, it confirms that the condition is oversold. For the standard recommendation by John Bollinger, it is 20 – 2. This means using MA-20 with 2 Standard Deviations. The upper band is the result of adding 2 Standard Deviations to MA-20, while the lower band is the result of subtracting 2 Standard Deviations from MA-20. Deviation is a term used to display the volatility of a stock. The higher the value of standard deviation, the higher the volatility. This high volatility in the Bollinger Bands will be reflected in both lines that open (widen or diverge). The closer the closing price is to the average price, the lower the standard deviation will be, indicating low volatility. This will be reflected in both Bollinger Bands lines that converge (narrow or come closer) (Ong, 2016).

Relative Strength Index

The RSI indicator was first introduced by J. Welles Wilder in 1978 through his book titled "New Concepts in Technical Trading Systems," published in the prominent Commodities magazine (now Futures Magazine). RSI is an oscillator with lower and upper level constraints, ranging from 0 to 100. Wilder recommended that the range "above 70" indicates overbought conditions, while "below 30" indicates oversold conditions. The standard period for RSI set by Wilder is 14 days. However, for short-term trading purposes, shorter periods are used to generate more sensitive results. If the RSI line crosses below "level 70" from above, it gives a bearish signal. Conversely, it is considered a bullish signal when the line crosses above "level 30". The 30-70 range is often changed to 20-80 by some traders to mitigate false signals obtained from RSI.

The hypotheses in this study are as follows:

H1. The Moving Average Convergence Divergence indicator is accurate in predicting the direction of the technology index stock price movement.

H2. The Bollinger Bands indicator is accurate in predicting the direction of the technology index stock price movement.

H3. The Relative Strength Index indicator is accurate in predicting the direction of the technology index stock price movement.

H4. There are differences in the accuracy of each indicator in predicting the direction of the technology index stock price movement.

Methods

This research employs a comparative research design by comparing the buy/sell signals of the three indicators with actual market prices. The population for this study comprises all companies listed on the Technology Index (IDX TECHNO) of the Indonesia Stock Exchange during the effective period from January to March 2023, totaling 28 companies. The sample for this study is selected using non-probability sampling techniques with purposive sampling, involving 20 companies. Data used in this research are secondary data in the form of weekly closing stock prices when buy or sell signals occur from the indicators and the closing stock prices two weeks after the buy or sell signals from the indicators. Data collection is conducted through the documentation method, obtained from historical stock price charts from tradingview.com. This study employs a unique code to convert qualitative data into quantitative data, aiming to highlight the average difference for each signal and facilitate data analysis. The independent variable assigned this unique code is:

Actual Price

Within the actual price, there is a probability of bullish (BL) when there is a positive stock price movement or bearish (BR) when there is a negative stock price movement. Observations of bearish and bullish prices are made over two weekly candles after the indicator prediction signal. In this study, the researcher assigns code 1 for an upward actual price and code 2 for a downward actual price.

Prediction Signal

Moving Average

In the Moving Average indicator, there are bullish signals, namely the Golden Cross, and bearish signals, namely the Death Cross. The researcher uses MA 10 and MA 50 in the indicator settings for this study. Measurement of the Moving Average indicator prediction signal variable uses a unique code. When a bullish signal occurs, it is assigned code 1, and when a bearish signal occurs, it is assigned code 2.

Bollinger Bands

In the Bollinger Bands indicator, a bullish signal occurs when the price has penetrated the lower bands and there is a reversal of the price direction towards the upside. A bearish signal occurs when the price penetrates the upper bands, followed by a reversal of the price direction downwards. Measurement of the Bollinger Bands variable involves assigning a unique code. A bullish signal is assigned code 1, and a bearish signal is assigned code 2.

Stochastic Oscillator

A bullish signal occurs when, in the oversold zone, the %K line crosses above the %D line, and a bearish signal occurs when, in the overbought zone, the %K line crosses below the %D line. To mitigate bad signals, most traders or investors wait for the %K line to cross the 20-80 lines on the oscillator as confirmation of buy and sell signals. Measurement of the Stochastic Oscillator variable involves assigning a unique code. A bullish signal is assigned code 1, and a bearish signal is assigned code 2.

To answer the research hypotheses, a non-parametric test using the Mann-Whitney U test is conducted. The Mann-Whitney U test is employed to examine the significance of comparative hypotheses between two independent samples, providing statistical evidence regarding the presence or absence of differences between the predicted price signals from the three indicators and the actual stock prices (Siegel, 1997:116-126).

Table 1. Mann-Whitney U Test for Moving Average Convergence Divergence

Ranks				
	Group	N	Mean Rank	Sum of Rank
Values	Prediction Signal	48	48.00	2304
	Actual Price MACD	48	49.00	2352
	Total	96		

Test Statistics[a]	
	Values
Mann-Whitney U	1128.00
Wilcoxon W	2304.00
Z	-0.203
Asym. Sig. (2 Tailed)	0.839
a. Grouping Variable : Group	

Source: Data Processed, 2023

Results and Discussion

Accuracy Moving Average Convergence Divergence

Based on documentation, all companies showed signals from the Moving Average Convergence Divergence (MACD) indicator. There were a total of 48 signals, consisting of 25 bullish signals (MACD-BL) and 23 bearish signals (MACD-BR).

The Mann-Whitney U test results shown in Table 4.1 indicate a mean rank of 48.00 for MACD prediction signals and a mean rank of 49.00 for actual prices. The Mann-Whitney U value generated is 1128, and the significance value (Asymp. Sig. 2-tailed) is 0.839. From these results, it can be concluded that the significance value of 0.839 > 0.05, so H1 is accepted, meaning there is no difference between MACD prediction signals and actual prices. This suggests that the use of technical analysis with the Moving Average Convergence Divergence indicator is accurate in predicting the direction of stock price movements.

Accuracy of Bollinger Bands

Based on documentation, out of 14 companies sampled, a total of 12 companies showed signals from the Bollinger Bands indicator. There were a total of 41 signals, consisting of 22 bullish signals (BB-BL) and 19 bearish signals (BB-BR). Following the documentation results of the Bollinger Bands indicator, a Mann-Whitney statistical test was conducted to observe the level of difference between the prediction signals of the Bollinger Bands indicator and actual prices. The statistical test results can be seen in Table 2.

The Mann-Whitney U test results shown in Table 3 indicate a mean rank of 40.50 for Bollinger Bands prediction signals and a mean rank of 42.50 for actual prices. The Mann-Whitney U value generated is 799.500, and the significance value (Asymp. Sig. 2-tailed) is 0.661. From these results, it can be concluded that the significance value of 0.661 > 0.05, so H2 is accepted, meaning there is no difference between Bollinger Bands prediction signals and actual prices. This suggests that the use of technical analysis with the Bollinger Bands indicator is accurate in predicting the direction of stock price movements.

Table 2. Mann Whitney U Moving Average Convergence Divergence Test

Ranks				
	Group	N	Mean Rank	Sum of Rank
Values	Prediction Signal	41	40.50	1660.50
	Actual Price BB	41	42.50	1742.50
	Total	96		
Test Statiscs^a				

Test Statiscsª	Values
Mann-Whitney U	799.500
Willcoxon W	1660.500
Z	-0.439
Asymp. Sig. (2 Tailed)	0.661

a. Grouping Variable: Group

Source: Data Processed, 2023

Table 3. Mann Whitney U for *Relative Strength Index*

Ranks				
	Group	N	Mean Rank	Sum of Rank
Values	Prediction Signal	19	18.50	351.50
	Actual Price RSI	19	20.50	389.50
	Total	38		
Test Stastics[a]				
			Values	
Mann-Whitney U			161.500	
Wilcoxon W			351.500	
Z			-0.641	
Asymp. Sig. (2 Tailed)			0.521	
a. Grouping Variable: Group				

Source: Data Processed, 2023

Table 4. Total Return of Indicators

Indicator	Signal Type	Average Return Value
Moving Average Convergence	MACD-BL	7%
Divergence	MACD-BR	-2%
Bollinger Bands	BB-BL	7%
	BB-BR	-10%
Relative Strenght Index	RSI-BL	12%
	RSI-BR	-12%

Source : Data Sourcing, 2023

Accuracy of Relative Strength Index (RSI)

Based on the parameters above, the observation results of the Relative Strength Index (RSI) indicator for 14 stocks listed in the LQ45 index were obtained. Out of the 14 companies, 10 companies showed signals from the Relative Strength Index indicator. There were 19 signals, consisting of 10 bullish signals (RSI-BL) and 9 bearish signals (RSI-BR). Subsequently, a Mann-Whitney statistical test was conducted to assess the level of difference between the prediction signals of the Relative Strength Index indicator and actual prices. The statistical test results can be seen in Table 3.

The data processing results show that the mean rank for Relative Strength Index prediction signals is 18.50, and for actual prices, it is 20.50. The Mann-Whitney U value generated is 161.500, and the significance value (Asymp. Sig. 2-tailed) is 0.521. From these results, it can be concluded that the significance value of 0.521 > 0.05; thus, there is no difference between Relative Strength Index prediction signals and actual prices. This means H3 is accepted, indicating that the use of technical analysis with the Relative Strength Index indicator is accurate in predicting the direction of stock price changes or movements.

Comparison of Indicator Accuracy

The cumulative performance of the indicators is shown in Table 4. From the cumulative documentation results shown in Table 4, the indicator that generated the most signals is Moving Average Convergence Divergence (MACD) with a total of 48

Table 5. Number of Indicator Signals

Indicator	Indicator Type	Number of Signal	Total Signals
Moving Average Convergence Divergence	MACD-BL	25	48
	MACD-BR	23	
Bollinger Bands	BB-BL	22	41
	BB-BR	19	
Relative Strenght Index	RSI-BL	10	19
	RSI-BR	9	

Source: Data Processed, 2023

signals, followed by Bollinger Bands (BB) with 41 signals, and lastly, Relative Strength Index (RSI) with 19 signals. Looking at each signal, for bullish signals (BL), the indicator that generated the most signals is MACD with 25 signals, followed by Bollinger Bands with 22 signals, and finally RSI with 10 signals. For bearish signals (BR), MACD produced the most signals with 23, followed by Bollinger Bands with 19 signals, and RSI with the fewest signals at 9.

Apart from the number of signals generated, the measurement of the accuracy performance of the indicator that needs attention is the prediction of returns generated by the indicators. The return level can be determined by looking at the average return of both bullish and bearish signals. By examining the average return for each indicator signal, it can provide an overview of the indicator's performance in measuring the potential risk and return.

In the table above, the order of the indicators that perform best in optimizing the returns of stocks listed in the telecommunications sub-index is Relative Strength Index with 12%, followed by Bollinger Bands and Moving Average Convergence Divergence with 7%. For the order of indicator performance that is best at minimizing risks, Relative Strength Index is -12%, followed by Bollinger Bands at -10%, and Moving Average Convergence Divergence at 2%. From these results, H4 is supported, indicating that there is a difference in the accuracy of each indicator in predicting the direction of stock price movements.

Conclusion

☑ The Moving Average Convergence Divergence, Bollinger Bands, and Relative Strength Index indicators are accurate in predicting the direction of changes or movements in stock prices.

☑ There are differences in the accuracy of each indicator in predicting the direction of changes or movements in stock prices. The order of indicators that provide a large number of prediction signals is Moving Average Convergence Divergence, followed by Bollinger Bands and Relative Strength Index. The order of indicators that perform well in optimizing stock returns is Relative Strength Index, Bollinger Bands, and finally, Moving Average Convergence Divergence. Meanwhile, the order of indicators that are effective in minimizing risks is Relative Strength Index, Bollinger Bands, and finally, Moving Average Convergence Divergence. Based on this analysis, Moving Average Convergence Divergence has the most signals, and Relative Strength Index has the most optimal return and risk minimization compared to the other two indicators.

References

Adnyana, I. M. (2020). *Manajemen Investasi dan Portofolio*. Lembaga Penerbitan Universitas Nasional (LPU-UNAS).

Asthri, D. P., Topowijono, & Sulasmiyati, S. (2016). Analisis Teknikal Dengan Indikator Moving Average Convergence Divergence Untuk Menentukan Sinyal Membeli Dan Menjual Dalam Perdagangan Saham (Studi Pada Perusahaan Sub Sekto Makanan Dan Minuman Di Bei Tahun 2013-2015). *Jurnal Administrasi Bisnis* , *33*(2).

Atmaja, L. S. (2008). *Teori dan Praktek Manajemen Keuangan*. CV Andi.

Baijal, A., Hoppe, F., Chang, W., Davis, S., & Hoong, F. W. (2022). *e-Conomy SEA 2022*. Baining, M. E., & Fadhillah, M. S. (2017). Analisis Teknik Penggunaan Moving Avarage, Relative Strangth Index dan Bollinger Bands dalam Menghasilkan Return Saham Pada Perusahaan Yang Terdaftar Di Jakarta Islamic Index (JII). *Jurnal Syari'ah*, *V*(2).

Jones, C. P. (2013). *Investments : Analysis and Management*. John Wiley & Sons. KSEI. (2023). *Statistik Pasar Modal*.

Murphy, J. J. (1999). Technical Analysis Of The Financial Markets : A Comprehensive

Roy, G. W., & Hermuningsih, Dr. S. M. (2016). Analisis Teknikal Saham Menggunakan Indikator Bollinger Bands Dan Relative Strength Index Untuk Pengambilan Keputusan Investasi. *JURNAL MANAJEMEN*, *6*(1).

Guide to Trading Methods and Applications. New York Institute of Finance. Ong, E. (2016). *Teknikal Analisis for Mega Profit*. PT Gramedia Pustaka Utama.

Schlotmann, R., & Czubatinski, M. (2019). *TRADING: TECHNICAL ANALYSIS MASTERCLASS-Master The Financial Markets*. www.tradingview.com.

Siegel, S. (1997). *Non Paramet Statistics : For The Behavioral Sciences*. McGraw-Hill Book Company, Inc.

Suryanto, S. (2021). Analisis Teknikal Dengan Menggunakan Moving Average Convergence-Divergence Dan Relative Strength Index Pada Saham Perbankan Program Studi Manajemen Fakultas Ekonomi Dan Bisnis Universitas Komputer Indonesia Bandung. *Jurnal Ilmu Keuangan Dan Perbankan (JIKA), 11*(1).

Susanto, D., & Sabardi, A. (2010). *Analisis Teknikal di Bursa Efek*. STIE YPKP. Tandelilin, E. (2010). *Portofolio dan Investasi : Teori dan Aplikasi* (1st ed.). Kanisius.

Zakamulin, V. (2016). *Market Timing with Moving Averages: Anatomy and Performance of Trading Rules*. https://ssrn.com/abstract=2585056.