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The Accuracy Test of Technical Analysis of *Moving Average*, *Bollinger Bands*, and *Relative Strength Index* on Stock Prices of Companies Listed In LQ45 Index

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Abstract

This study aims to test and provide empirical evidence of the accuracy of the technical analysis indicators Moving Average, Bollinger Bands, and Relative Strength Index in predicting the direction of stock price movements. This research focuses on stocks that represent the Indonesian stock Market, namely the LQ45 stock index for the period February 2021 - July 2021. Data were collected through the tradingview.com platform. To test the research hypothesis, the statistical differences between the predictions and the reality of stock price movement were tested using Mann-Whitney non-parametric test. The results of this study found that there was no difference between the predictions of the direction of stock price movements produced by the three indicators and the 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, the average rate of return, and the sample observations, it can be concluded that the Relative Strength Index indicator has a more optimal accuracy performance compared to the other two indicators. The results of this study can be used as a reference for capital market investors in choosing technical analysis methods that can help make more appropriate investment decisions.

INTRODUCTION

Based on data from PT Kustodian Sentral Efek Indonesia (KSEI, 2021) the number of capital market investors as of June 2021 there is 5,597,760 Single Investor Identification (SID). There was an increase of 44.24% when compared to the total number of stock investors at the end of 2020, which was 3,880,753 SID. Over the last 5 years, the capital market SID has grown at around 50%. These potential numbers reflect the interest of the Indonesian people to start investing in the capital market, especially stocks. By buying shares, investors expect returns that can be obtained in the form of dividends or capital gains. In making investment decisions, investors must analyze stock price movements to get an optimal return. There are two ways to analyze stock price movements, namely fundamental analysis, and technical analysis.

Fundamental analysis is an analysis based on the state of the global economy, industrial economy, and conditions that are influenced by the policies taken by the company. According to Zakamunlin (2017) fundamental analysis believes that the stock price will deviate from its intrinsic value at one time, if the stock price is greater than its intrinsic value, it is considered overvalued so it is worth selling, whereas if the stock price is lower than its intrinsic value, then it is considered undervalued so it is worth to buy it.

Technical analysis according to Tandelilin (2010) is an analytical method for

estimating the movement of stock values through historical data such as volume and stock price information. Zakamunlin (2017) argues that the basic principle of technical analysis is that price patterns reappear and tend to produce the same results consistently. The basic component in conducting technical analysis is a chart (Kahn, 2010). By reading charts investors will be able to see opportunities and make strategies in determining investment decisions.

Consideration of the use of fundamental and technical analysis is influenced by various aspects that are adjusted to the investor's risk profile. In this study, the researcher uses technical analysis because it is considered to represent the risk profile of the majority of investors in the Indonesian capital market which are not yet fully efficient. In markets that are not yet fully efficient information asymmetry occurs, so technical analysis can be applied because past stock prices can be used to predict future stock price movements.

In addition, in stock market activities, the most important thing is the movement of stock prices, because the movement or volatility of stock prices shows the performance of an issuer. Price movement or volatility can be used to measure the risk of a stock. High volatility indicates a higher probability of making gains or losses in the short term. Compared to other investment instruments, stocks have higher volatility. Based on the investment principle, namely high-risk high-return, low-risk low-return, the high return means it contains risk as well. Stock prices that have high volatility can change at any time and the changes are difficult to predict, so an analytical tool is needed to make investment decisions.

In modern technical analysis, there are basic components, namely Indicators. Indicators according to Schlotmann, R., & Czubatinski (2019) are tools that help investors in making decisions through price analysis using formulas and direct visual evaluation from charts. With indicators, investors can determine sell signals and buy signals for stock prices. Moving Average, Relative Strength Index, and Bollinger Bands are indicators that are commonly used by investors. Moving Average is categorized as Trend Indicators that are used to monitor the occurrence of trends. Bollinger Bands is useful for identifying whether stock prices are relatively high or low (Sadewa, 2013). Relative Strength Index is a type of Oscillator Indicator that is used to recognize stock levels when they touch oversold or overbought.

Research conducted (Dessy, 2015) and (Stevin & Handoyo, 2013) explains the accuracy of the Simple Moving Average, which has an accuracy rate of 95% and 90%. However, these two studies were refuted by Baining & Fadhillah (2017) which showed that the Moving Average is less reliable in generating returns on stocks. Baining & Fadhillah (2017) proved that the Bollinger Bands are more optimal in viewing signals and provide returns higher. However, this study is not in accordance with the results of research conducted by Roy & Hermuningsih (2016) which provides evidence that the use of Bollinger Bands is not accurate compared to the use of the Relative Strength Index. Research by Roy & Hermuningsih (2016) which explains that the RSI indicator is more accurate is also supported by the results of research by Richard & Sarwo (2012) which states that the RSI accuracy is clearer. However, this result is contradicted by research by Stevin & Handoyo (2013) and Dessy (2015) which provide empirical evidence of the accuracy of the MA indicator, compared to other indicators.

Previous studies have provided additional insight regarding the advantages and disadvantages as well as the accuracy of technical analysis indicators. However, there are some differences in research results that show inconsistent accuracy results regarding the use

of technical indicators Moving Average, Bollinger Bands, and Relative Strength Index. Therefore, this study aims to fill the gap in the literature by further testing the accuracy of the three technical analysis methods through a different test between the indicator's price prediction signal and the actual price. To achieve the research objectives, four research hypotheses will be tested in this study, namely:

H1 : Moving Average accurate in predicting the stock price movements.

H2 : Bollinger Band is accurate in predicting the stock price movements

H3 : Relative Strength Index is accurate in predicting the stock price movements.

H4 : There is a comparison of the accuracy of each indicator in predicting the stock price movements.

LITERATUR REVIEW

Efficient Market Hypothesis

The concept of an efficient market was first proposed and popularized by Eugene Fama in 1970. The *Efficient Market Hypothesis* reveals that stock prices are formed from a reflection of all information collected, both *insider information* and fundamentals. According to Fama, the concept of an efficient market is when the current stock price reflects all available information. Gumanti & Utami (2002) explained further the main form of market efficiency according to Fama based on three types of information, namely efficiency in the weak form, *semi-strong form*, and strong form. Several studies examine market efficiency, including research conducted by Nurliani (2016) which shows that all major stock markets in ASEAN are inefficient markets in weak form. Another study also conducted by Kusumaningrum (2019) concluded that the capital market in Indonesia is not yet fully efficient in its semi-strong form. Some of these studies show that the capital market in Indonesia is still not fully efficient in responding to market information.

The Dow Theory

The technical analysis used today comes from The Dow Theory developed by Charles Dow (Murphy, 1999). From 1900 to 1902 The Dow Theory was formulated by Charles Dow from a collection of articles in the Wall Street Journal. In his article, Dow describes how the stock market behaves and is used to view a business environment because the stock market as a whole is a benchmark for business conditions in an economy. Through stock market analysis, one can predict economic conditions and predict market movements.

Analisis Teknikal

Technical analysis is an analytical method for estimating the movement of stock values through historical data such as volume and stock price information (Tandelilin, 2010). According to Baining & Fadhillah (2017), technical analysis is a tool used to predict future prices using daily stock prices. According to Kahn (2010), the basic component in conducting technical analysis is a graph. By reading charts investors will be able to see opportunities and make strategies in determining investment decisions.

Moving Average

Moving Average is formed by the average value of certain periods. Moving Average is often used to indicate an ongoing trend. MA shows the average value of the price over a certain time. In the use of MA, we can use one-line, two-line, or even three or more lines. Commonly used periods are 200, 100, 50, 20, and 5.

Bollinger Bands

Bollinger Bands was developed by John Bollinger in the 1980s. This indicator consists of three bands, namely the middle band, upper band, and lower band (Simple Moving Average minus 2 times the standard deviation). In using this indicator John Bollinger

suggests using the Simple MA 20 periods and 2 standard deviations. BB is useful for identifying whether the stock price is relatively high or low.

Relative Strength Index

Relative was developed by J Welles Wilder in 1978. Where this indicator is the most frequently used momentum oscillator indicator. RSI is useful for identifying oversold and overbought areas as market entry and exit areas. The RSI indicator compares the amount of profit earned from stock to the amount of loss experienced by the product (Sadewa, 2013).

RESEARCH METHODS

This research uses a type of comparative research to examine the differences that occur between two or more variables. The comparison in this study is used to determine the level of accuracy of the technical analysis indicators MA, BB, and RSI by comparing the buy/sell signals of the three indicators with the actual market prices. The object of this research is a company listed on the LQ45 index of the Indonesia Stock Exchange for the period February - July 2021. Data processing is carried out based on information obtained through historical stock price movements on tradingview.com.

In this study, researchers used a unique code to convert qualitative data into quantitative ones. Giving unique code to show the average difference for each signal so that it can facilitate data analysis. The independent variable will be given a unique code These are:

Real Prices

In reality prices, there is a bullish price probability (BL) is when there is a positive stock price movement or bearish (BR) when a negative stock price movement occurs. Bearish and bullish price observations are observed up to 2-3 candles after the indicator's prediction signal occurs. In this study, the researcher gave code 1 for a bullish signal, and code 2 for a bearish signal.

Prediction Signal

(1) Moving Average.

Bullish signal in Moving Average, namely the golden cross. While death cross is a signal of price decline (bearish). The golden cross (bullish) occurs when the smaller MA crosses the larger MA at the bottom. Meanwhile, the death cross occurs when the smaller MA crosses the larger MA in the up. In this study, researchers used MA 20 and MA 5 in setting indicators. In this study, the researcher gave code 1 for a bullish signal, and code 2 for a bearish signal.

(2) Relative Strength Index

On the Relative Strength Index, there is a line that moves according to the movement of stock prices. The overbought and oversold conditions according to the RSI are obtained when the line has entered the limits of 30 and 70, namely below 30 for oversold and above 70 for overbought. A bearish signal occurs when the RSI has touched a level above 70 and experienced a reversal to form the 'M' pattern. On the contrary, a bullish will occur at level 30 and form the 'W' pattern. The researcher uses 5 period RSI setting to strengthen the sensitivity of the indicator. RSI variable measurement this by providing a unique code if there is a bullish signal in the Relative Strength Index (RSI-BL) prediction signal and the actual price (BL) is coded 1. When there is a bearish prediction signal Relative Strength Index and the real price (BR) are coded 2.

(3) Bollinger Bands

Bollinger Bands signal occurs bullish when the price has broken through the lower bands

and there is a price reversal to the top. Meanwhile bearish occurs when the price breaks through the upper bands which are then followed by a reversal of the price downwards. In this study, researchers used MA 20 and MA 5 in setting indicators. In this study, the researcher gave code 1 for a bullish signal, and code 2 for a bearish signal.

To answer the hypothesis study, a non-parametric test was carried out with the Mann-Whitney Test which can prove statistically the difference between the predicted price signals from the three indicators and the actual stock price. The Mann-Whitney is one form of testing in non-parametric statistical analysis (Sofia Teti, 2007: 55). The Mann-Whitney test is used to test the comparative hypothesis of two independent samples if the data is in ordinal form.

RESULT AND DISCUSSION

Accuracy of Moving Average

From 45 companies, 44 show signals from the MA indicator. Based on the observations, there are a total of 97 signals from the MA indicator consisting of 35 bullish (MA-BL) and 62 bearish (MA-BR). From the results of the MA indicator observation, the Mann-Whitney to see the level of difference between the MA indicator's prediction signal and the real price. Based on statistical tests, the following results were obtained:

Tabel 1. Mann-Whitney Test Result on Moving Average

		Ranks		
Nilai	Group	N	Mean Rank	Sum of Ranks
	Sinyal Prediksi MA	97	104.18	10105.50
	Harga Kenyataan	97	90.82	8809.50
	Total	194		
		Test Statistic		
	Mann-Whitney U		4056.500	
	Wilcoxon W		8809.500	
	Z		-1.925	
	Asymp. Sig. (2-tailed)		.054	
a. Grouping Variable: Group				

Sumber : Processed Data, 2022

The results of data processing in Table 4.3 show that the MA prediction signal gets an average value of 104.18 and for reality prices get an average value of 90.82. The Mann-Whitney value is 4056.5 and Asymp Sig. (2-tailed) of 0.054 > 0.05 then there is no significant difference between the MA prediction signal and the real price. This means that H1 is accepted, where the use of technical analysis of the Moving Average is accurate in predicting the direction of change or movement of stock prices.

The Moving Average indicator in this condition can be interpreted that the Moving Average signal movement trend is quite accurate when used in weekly time frames fluctuations trend tend to be more sensitive than daily time frames. The results of this study support the research of Cahyani & Mahuni (2020) where the Moving Average indicator is accurate in predicting stock price movements. On the other hand, the results of this study reject the results of research from Ahmad et al (2018). and Baining & Fadhillah (2017) which proves that the Moving Average indicator is less accurate.

Accuracy of Bollinger Bands

Of the 45 companies that were sampled, 29 companies showed signals from the BB

indicator. 37 signals are consisting of 22 bullish (BB-BL) and 15 bearish (BB-BR). The results of the BB indicator observation were then carried out with the Mann-Whitney to see the level of difference between the BB indicator's prediction signal and the actual price. Based on the statistical test results, the following results were obtained:

Tabel 2. Mann-Whitney Test Result on Bollinger Bands

Ranks				
	Group	N	Mean Rank	Sum of Ranks
Nilai	Sinyal Prediksi BB	37	35.00	1295.00
	Harga Kenyataan	37	40.00	1480.00
	Total	74		
Test Statistics				
			Nilai	
	Mann-Whitney U		592.000	
	Wilcoxon W		1295.000	
	Z		-1.156	
	Asymp. Sig. (2-tailed)		.248	
	a. Grouping Variable: Group			

Sumber : Processed Data, 2022

The results of data processing show that Bollinger Bands get an average value of 35.00 and real prices get an average value of 40.00. The Mann Whitney value is 592 and the significance value is $0.248 > 0.05$, so there is no significant difference between the BB prediction signal and the real price. This means that H2 is accepted, where the use of technical analysis of the BB indicator is accurate in predicting the direction of change or movement of stock prices.

BB indicator which is categorized as a volatility indicator can accurately read the reversal of the direction of stock price movements when touching the upper and lower bands. The results of this study support the research of Baining & Fadhillah (2017) and Muis et al (2021) who prove the Bollinger Bands indicator accurate in its use to see signals and optimal in getting returns. However, research by Roy & Hermuningsih (2016) provides evidence that the use of BB is not accurate compared to the use of other indicators.

Accuracy of Relative Strength Index

From 45 companies, 40 companies showed signals from the Relative Strength Index. 72 signals are consisting of 49 bullish (RSI-BL) and 23 bearish (RSI-BR). The results of the observation of the Relative Strength Index statistical Mann-Whitney Test to see the level of difference between the prediction signal of the Bollinger Bands indicator and the actual price. Based on the statistical test results, the following results were obtained:

Tabel 3. Mann-Whitney Test Result on Relative Strength Index

Ranks				
	Group	N	Mean Rank	Sum of Ranks
Nilai	Sinyal Prediksi RSI	72	72.50	5220.00
	Harga Kenyataan	72	72.50	5220.00
	Total	144		
Test Statistics				
			Nilai	
	Mann-Whitney U		2592.000	
	Wilcoxon W		5220.000	

Z	.000
Asymp. Sig. (2-tailed)	1.000
a. Grouping Variable: Group	

Sumber : Processed Data, 2022

The results of data processing show that the Relative Strength Index gets an average value of 72.50 and for real prices, it gets an average value of 72.50. The Man-Whitney value is 2592.5 and the significance value is $1.00 > 0.05$, so there is no significant difference between the RSI prediction signal and the real price. This means that H3 is accepted, where the use of technical analysis of the RSI indicator is accurate in predicting the direction of change or movement of stock prices.

RSI can accurately recognize stock levels when they touch oversold or overbought stocks with a weekly time frame that more sensitive so Oscillator Indicator can reach 100%. The results of this study are supported by empirical studies conducted by Kuswardhani (2018) and Santoso (2018), where the Relative Strength Index indicator has a significant effect on the buy and sell signals of stocks. On the other hand, this study rejects the empirical study conducted by Baining & Fadhillah (2017).

Comparison of the Accuracy of Each Indicator in Predicting the Direction of Change or Movement of Stock Prices

The accuracy performance of each indicator is different because basically, each indicator has a different function. MA indicator (MA) categorized as Trend Indicators has a function to monitor the occurrence of trends. BB is included in the Volatility Indicators which are used to measure market power that is formed from volatility. While the RSI Indicator is a type of Oscillator Indicators that are used to recognize when it hits oversold or overbought. However, the use of indicators has the same purpose, namely to predict stock price movements which help investors in making buying and selling decisions. So that the performance measurement of each indicator can still be compared using the same measurement. One of the indicators' performance measurements can be seen from the number of bullish and bearish that each indicator produces.

From the results of the cumulative indicator observations shown in Table 4.5. shows the number of signals for each indicator obtained from 45 company shares listed in the LQ45 index. Based on Table 4.5 it can be seen that MA generates the most total signals as many as 97 signals, then followed by the RSI indicator which generates 72 signals and the BB indicator produces at least 37 signals.

Tabel 4. Number of Signals per Indicator

Indikator	Sinyal Indikator	Jumlah Sinyal	Total Sinyal
Moving Average	MA-BL	35	97
	MA-BR	62	
Bollinger Bands	BB-BL	22	37
	BB-BR	15	
Relative Strength Index	RSI-BL	49	72
	RSI-BR	23	

Sumber :Data Diolah, 2022

Apart from the number of signals that can be generated, performance measurement indicators that need to be considered are the accuracy of the prediction signals with actual price movements. Table 4.6. shows the average return generated from bearish and bullish indicators. Where the average return signal bullish shows the level of return that may be generated by the indicator. The higher the value, the better because it reflects the performance of the indicator in generating returns. While the average return signal bearish reflects how much risk can be avoided by using an indicator, this means that the higher value is better.

Tabel 5. Predictive Rate of Average Return of each Indicator

Indikator	Sinyal Indikator	Nilai Rata-rata Return
<i>Moving Average</i>	MA-BL	1,20%
	MA-BR	-4,38%
<i>Bollinger Bands</i>	BB-BL	5,36%
	BB-BR	-4,11%
<i>Relative Strength Index</i>	RSI-BL	8,31%
	RSI-BR	-7,06%

Sumber : Processed Data, 2022

In Table 4.6. it can be seen that the order of indicators that have performed well in optimizing returns listed in the LQ45 index during the period February 2021 – July 2021 is the Relative Strength Index 8.31%, Bollinger Bands 5.36%, and the last MA 1.20%. While the order of good indicators in minimizing risk is the Relative Strength Index can be minimized to -7.0%, Moving Average -4.38%, and finally Bollinger Bands -4.11%.



Figure 1. BTPS Stock Price Movement Chart

Practically, the use of the three indicators can also be compared by looking at the sample observation sample from Bank BTPN Syariah stock price movement chart (Figure 1). In the sample observation, the MA indicator provides 3 predictive signals consisting of 2 bearish and 1 bullish signal. Of the 3 signals, 2 of them experienced a false signal or the indicator was wrong in predicting the direction of change and movement of stock prices. On the BB indicator, predictive signals are bullish with 1 of them giving false signals. RSI Indicator prediction signals are bullish which are both accurate without any false signals.

Based on the analysis and comparison of the performance of the three indicators from the number of signals, the average rate of return, and sample observations, it can be concluded that the Relative Strength Index indicator has a more optimal accuracy performance than the other two indicators. Where RSI has an optimal indicator performance in predicting stock prices by providing a large number of signals with a high level of accuracy and can generate returns optimal results of this study support the research conducted by Kuswardhani (2018) and Santoso (2018), where the RSI indicator has a significant effect on the buy and sell signals of stocks. On the other hand, this study rejects the empirical study conducted by Baining & Fadhillah (2017), where the RSI indicator is less optimal in predicting than other indicators.

CONCLUSION

Based on the results of the study, the following conclusions can be drawn:

- a. Moving Average is accurate in predicting the stock price movements.
- b. Bollinger Bands is accurate in predicting the stock price movements.
- c. Relative Strength Index is accurate in predicting the stock price movements.
- d. Moving Average gives 97 predictive signals, Relative Strength Index 72 predictive signals, Bollinger Bands 37 predictive signals. The order of indicators that have good performance in optimizing returns stock Relative Strength Index 8.31%, Bollinger Bands 5.36%, and finally Moving Average 1.20%. While the order of good indicators in minimizing risk is the Relative Strength Index can be minimized to -7.0%, Moving Average -4.38%, and finally Bollinger Bands -4.11%. Based on this analysis, the Relative Strength Index has more optimal accuracy in predicting the direction of change or movement of stock prices compared to the other two indicators.

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