Analyzing Interest Rates on BBCA and BMRI Stock Prices Using a Time Series Forecasting Method

Paradise Maghfirah[1], Nur Fitri Rahmayanti[2], Yuli Eni[3]

{paradise.maghfirah@binus.ac.id, nur.rahmayanti@binus.ac.id, yuli.eni@binus.ac.id[1,2,3]}

BINUS Business School, Bina Nusantara University, Jakarta, Indonesia [1,2,3]

Abstract. The Primary objective of this research is to assess the extent of the impact of interest rates on forecasting the stock prices of banking institutions, specifically focusing on Bank Central Asia (BBCA) and Bank Mandiri (BMRI) listed on the Indonesia Stock Exchange (IDX). The study utilizes data from the year 2022 to predict the stock process in 2023 and subsequent years. This research employs a forecasting model approach, utilizing Bank Central Asia (BBCA) and Bank Mandiri (BMRI) as the sample entities. The data processing techniques encompass Descriptive Statistics, Single Moving Averages, Exponential Smoothing, and Regression Analysis. The dataset comprises secondary data from monthly stock data for 2022. Additionally, interest rate values for the year 2022. This research indicates that prospective investors prefer investing in Bank Mandiri (BMRI) stocks over those of Bank Central Asia (BBCA). Further investigation is warranted to explore the factors influencing stock prices, with one notable factor being the interest rates set by Bank Indonesia.

Keywords: Forecasting, Interest Rate, Shares, Prices, Economic.

1 Introduction

The performance of the Indonesian stock market is often measured by the Composite Stock Price Index (IHSG), a composite index comprising various listed companies. The Jakarta Composite Index (JCI) serves as a crucial indicator, reflecting overall market sentiment and performance. The JCI's movements are closely watched by investors and analysts as they provide valuable insights into the dynamic nature of the market.

In Indonesia, the investment landscape is influenced by various factors, with the prevailing interest rate standing out as a key determinant. The relationship between interest rates and stock prices is multifaceted, and fluctuations in interest rates significantly impact investment decisions and overall market sentiment.

UHICEB 2023, December 18-19, Jakarta, Indonesia

DOI 10.4108/eai.18-12-2023.2349315

The influence of interest rates on banking share prices in Indonesia throughout 2023 has garnered significant attention and concern. A comprehensive study conducted by the Indonesian Financial Research Institute [1] has shed light on the pivotal role interest rate fluctuations played in shaping the performance of banking shares during this period. The research reveals that changes in interest rates exert a direct influence on the valuation of banking stocks, subsequently impacting investor confidence and market dynamics. These findings align with the conclusions drawn by [2] and [3], reinforcing the critical importance of considering interest rates in the analysis of stock prices.

As the Indonesian investment landscape continues to evolve, understanding the relationship between interest rates and stock prices becomes essential for investors seeking to make informed decisions. The dynamic interplay between these variables not only shapes individual stock performances but also contributes significantly to broader market dynamics. This study delves into the nuanced interplay between interest rates and the stock prices of two prominent players in the Indonesian stock exchange: Bank Central Asia (BBCA) and Bank Mandiri (BMRI). Through a comprehensive time- series forecast, we aim to analyze the impact of interest rates on the stock prices of these key banking institutions, shedding light on the potential implications for investors and offering valuable insights into the broader economic landscape.

As we navigate the complex web of market dynamics, this research endeavors to contribute to a deeper understanding of the factors influencing stock prices, enabling stakeholders to make more informed and strategic investment choices. The insights presented in this study are drawn from a synthesis of relevant literature, including works by [2], [3], and the comprehensive financial analyses provided by the Indonesian Financial Research Institute [1]. By integrating these perspectives, we aim to provide a robust foundation for our exploration into the relationship between interest rates and the stock prices of BBCA and BMRI.
As we embark on this analytical journey, it is essential to consider the multifaceted nature of financial markets and the diverse factors that contribute to their fluctuations. Through rigorous analysis and the incorporation of reputable sources, we aim to contribute meaningful insights that resonate with both academic discourse and practical investment considerations.

Literature review

Market Capital

The capital market serves as a platform for trading diverse long-term financial instruments, offering avenues for companies and other entities to secure funding and for individuals to engage in investment activities. Its pivotal role in a nation's economy is underscored by the Indonesian Stock Exchange [4]. The capital market has emerged as a catalyst for economic advancement in countries, particularly those following market economic systems. This is because it can serve as an alternative source of funding for companies, thus fostering the development of the capital market. This, in turn, contributes to the growth of Gross Domestic Product (GDP) and, ultimately, propels a country's economic development [5].

Shares

Shares represent a form of investment within the capital market and serve as a tangible indication of an individual or entity's ownership stake in a company or limited liability corporation Indonesian Stock Exchange [4]. Investing in shares is a potentially lucrative endeavour in the long term. However, numerous factors necessitate consideration before embarking on an investment journey in the capital market, as engaging in investment brings forth its unique advantages and risks.

Indonesia Stock Exchange

The Indonesian Stock Exchange is one of Indonesia's major stock exchanges, hosting a variety of industry sectors. Among these sectors, the banking and financial sector has demonstrated strong potential and growth prospects over the years. To illustrate, Forbes 2000 The World's Biggest Companies, a global compilation of the 2000 largest public companies, featured six prominent Indonesian public companies on May 25, 2016. Notably, four out of these six companies were from the banking sector. The included entities were Bank Rakyat Indonesia, Bank Mandiri, Bank Central Asia, Telkom Indonesia, Bank Negara Indonesia, and Gudang Garam, underscoring the prominence of banking companies within the Indonesian market [6].

Interest Rate

Interest rates are a fundamental aspect of financial markets and the broader economy. The determination of interest rates is influenced by various factors, including central bank policies, inflation expectations, and supply and demand for credit [7]. Interest rates are crucial for borrowing and lending and have significant implications for investment decisions, bond prices, and currency exchange rates. [8], also cited in [9], describe interest as a reward provided to individuals for loans or savings, with the amount being determined as a percentage. Consequently, the interest rate is pivotal in deciding savings and investment amounts. An increase in interest rates can diminish the inclination of the public and investors to invest while simultaneously boosting the supply of savings.

Times Series Data

Time series data forecasting methods have developed significantly, including various approaches and techniques [10]. [11] defines time series data as information regarding the values of a variable that is organized sequentially over time, typically on a monthly or yearly basis, symbolized from time t to time t + 1 to time t + n. Additionally, Mondal et al. [12] studied the effectiveness of time series modeling, particularly ARIMA, in forecasting stock prices, highlighting the relevance of statistical methods in financial forecasting [12]. The time series methods employed in this research encompass moving averages and exponential smoothing.

Descriptive Statistics

Descriptive statistics are a fundamental aspect of quantitative data analysis, providing a summary of the critical characteristics of a dataset. It encompasses measures such as central tendency (mean, median, mode), dispersion (range, variance, standard deviation), and distribution shape (skewness, kurtosis) [13]. Descriptive statistics are essential for understanding the basic features of data and form the foundation for more advanced statistical analyses.

Moving Average

The Moving Average method is a forecasting technique that calculates the average of a set of recent actual values and updates this average as new deals become available [14]. The formula for this method is allowed:

$$F_t = MA_n = \frac{\sum_{i=1}^{n} A_{t-i}}{n}$$

Ft	: Prediction for a time period
MAn	: Moving average of n periods
At-i	: Actual value in period t-i
n	: The number of periods (data points) in a moving average

Exponential Smoothing

The Exponential Smoothing method is a method that continuously improves forecasting by taking the smoothing average value of past values from time series data in a decreasing (exponential) manner [14]. The Exponential Smoothing formula is:

$$F_t = F_{t-1} + \alpha(A_{t-1} - F_{t-1})$$

Ft	: Prediction for period t
Ft-1	: Prediction for the previous period
α	: Constant value
At-1	: Actual value for the previous period

Forecasting Errors

The forecast error rate provides a measure of accuracy and a yardstick for comparing alternative methods that may be used. The level of forecasting error can be calculated by Mean Absolute Deviation and Mean Squared Error [15]. Mean absolute deviation (MAD) is

the average absolute value of forecast errors, regardless of the positive or negative sign.

$MAD = \sum | A_t - F_t |$

$\sum$: Amount
At : Observation data for period t
Ft : Forecast for period t

Meanwhile, Mean Squared Error (MSE) is the squared difference average between the predicted and observed values. MSE penalizes more significant errors or amplifies the effect of large error rates but reduces the number. The forecast error is smaller than a unit.

$MSE = \sum (A_t - F_t)\ 2$

$\sum$: Amount
At : Observation data for period
t Ft : Forecast for period t

Mean Absolute Percent Error (MAPE)

Historical prediction errors are calculated using MAPE to measure the accuracy of prediction results. Mean absolute percent error (MAPE) calculates the difference between original and forecast data. The difference is absolute and then calculated as a percentage of the original data. The smaller the MAPE, the more accurate the forecast value. The formula for calculating MAPE is as follows:

$$MAPE = (\frac{1}{n}) \sum \frac{|actual - forecast|}{|actual|}) * 100\%$$

n : Numbers of sample
Actual : Actual value
Forecast : Prediction/ estimate of value

Regression Analysis

Regression analysis is a fundamental statistical method used to test the relationship between a dependent variable and one or more independent variables. It is widely applied in various fields, such as medicine, public health, genetics, and sociology. Cox regression models, for example, are a popular technique for analysing survival data in nephrology [16] In addition, spatial regression models have been extended to analyse spatial-temporal binary data, demonstrating the versatility of regression analysis in demographic analysis [17]. Additionally, using regression analysis in genetics has led to identifying new breast cancer

susceptibility loci, highlighting their significance in biological research [18]. The primary purpose of using this regression is to predict or estimate how influential interest rates will be on the share prices of Bank BBCA and BMRI.

2 Methodology

This research focuses on forecasting models and their application to predict banking share prices at BBCA and BMRI banks. The data utilized in this study consists of secondary data gathered from monthly stock data for the year 2022, which is publicly accessible on the websites www.idx.co.id/id and finance.yahoo.com/. Additionally, the researchers obtained interest rate data for the year 2022 from the official website www.bi.go.id/. The study employs various forecasting methods, including descriptive statistics, Single Moving Averages, Exponential Smoothing, and Regression Analysis. To assess the accuracy of predicting share values in the subsequent period, the researchers utilize MAPE and MSE, which serve as indicators of the appropriateness of the chosen model for predicting future share values. By comparing the forecasting results from the five methods, the aim is to identify the model with the lowest error rate, serving as a guide for future forecasting.

3 Results and Discussion

The actual collection of Closing Stock value data is sourced from the official websites registered at www.idx.co.id and www.finance.yahoo.com. This data spans from January 2022 to December 2022, encompassing the movement of Closing Stock values for BBCA and BMRI banks.

3.1 Descriptive statistics

Data characteristics provide a snapshot of share prices in the banking industry, focusing on BBCA and BMRI, using descriptive statistical methods. The following summarizes the analysis results obtained from Microsoft Excel tests.

Table 1. Characteristics of BBCA and BMRI Bank Share Prices January 2022 – December 2022.

Variable	Mean	Variance	Min	Max	Skewness	Kurtosis
BBCA	8127	362552	7250	9300	0	0
BMRI	8833	1146629	7475	10550	1	-1

Table 1 presents an overview of average share prices for prominent banks in 2022, with a focus on BMRI and BBCA. BMRI exhibited the highest average share price at 8,833, reaching a peak of 10,550 and a low of 7,475. Conversely, BBCA demonstrated an average of 8,127, with a high of 9,300 and a low of 7,250. The data highlights the notably elevated average share prices in the banking sector, crucial for investment decisions. Examining data distribution, both BBCA and BMRI show positive skewness, indicating a tendency toward higher values. BBCA displays a symmetrical distribution, while BMRI exhibits a slight rightward skew. Kurtosis values reveal that BBCA adheres to a normal distribution (kurtosis = 0), while BMRI's data is platykurtic (kurtosis = -1), departing from normality. These insights lay the groundwork for more detailed analyses.

Table 2. Moving Average Calculation Results Period to Average (n) = 2

Forecasting BBCA Closing Stock Value Using the Moving Average Period to Average(n)=2 Method

Bulan (2022)	Closing Stock BBCA	2-Period Moving Average
January	7625	
February	8050	
March	7975	7838
April	8125	8013
May	7750	8050
June	7250	7938
July	7350	7500
August	8200	7300
September	8550	7775
October	8800	8375
November	9300	8675
December	8550	9050
Bulan/Periode Selanjutnya		8925

Table 2 provides a comprehensive overview of the computed estimations for the closing stock, employing a period-to-average (n) of 2. Notably, the absence of an estimated value for January and February is attributable to the methodology used, which leverages data from the preceding months to forecast the subsequent months' worth. Consequently, the estimated value for March is derived from the average closing stock values for January and February. The table unequivocally signifies that the projected closing stock value for the forthcoming month or period is IDR 8,925.

Table 3. Moving Average Calculation Results Period to Average (n) = 2

Forecasting BMRI Closing Stock Value Using the Periodic Moving Average Method up to Average(n) = 2

Bulan (2022)	Closing Stock BMRI	2-Period Moving Average
January	7475	
February	7700	
March	7900	7588
April	8950	7800
May	8500	8425
June	7925	8725
July	8275	8213
August	8850	8100
September	9425	8563
October	10550	9138
November	10525	9988
December	9925	10538
Bulan/Periode Selanjutnya		10225

Table 3 presents the outcomes of a meticulous computational exercise to predict the closing stock's value, employing a period-to-average (n) of 2. Notably, the absence of any forecasted value for January and February is a direct consequence of the employed methodology, which hinges on using data from the two immediately preceding months to predict the value for the subsequent month. Consequently, the forecasted values for March are derived from the computed average of the closing stock values for January and February. The tabulated data in Table 3 unambiguously indicates that the anticipated value of closing stock for the forthcoming month or period stands at IDR 10,225.

Table 4. Exponential Smoothing Calculation Results (n) = 0.2

Forecasting BBCA Closing Stock Value Using the Exponential Smoothing Method (n) = 0.2

Bulan (2022)	Closing Stock BBCA	Exponential Smoothing
January	7625	
February	8050	7625
March	7975	7625
April	8125	7710
May	7750	7763
June	7250	7835
July	7350	7818
August	8200	7705
September	8550	7634
October	8800	7747
November	9300	7908
December	8550	8086
Bulan/Periode Selanjutnya		8329

Table 4 presents the outcomes of a meticulous forecasting endeavor utilizing the Exponential Smoothing method, with a specified alpha (α) value of 0.2, applied to the share price data of BBCA Bank spanning January to December 2022. Within the confines of this table, a discerning analysis reveals a conclusive inference: the projected value of BBCA's closing stock for the forthcoming month or period stands at IDR 8,329.

Table 5. Exponential Smoothing Calculation Results (n) = 0.2

Forecasting the BMRI Closing Stock Value Using the Exponential Smoothing Method (n) = 0.2

Bulan (2022)	Closing Stock BMRI	Exponential Smoothing
January	7475	
February	7700	7475
March	7900	7475
April	8950	7520
May	8500	7596
June	7925	7867
July	8275	7993
August	8850	7980
September	9425	8039
October	10550	8201
November	10525	8446
December	9925	8867
Bulan/Periode Selanjutnya		9198

Table 5 presents the calculated outcomes derived from employing the exponential smoothing method, with a defined alpha (α) value of 0.2, to forecast the closing stock's value based on the stock price data of BBCA Bank from January to December 2022. A discerning table examination allows for a robust conclusion: the anticipated value of BBCA's closing stock for the upcoming month or period is IDR 9,198.

3.2 Forecasting Error

Table 6. Calculation Results of MAD and MSE Values Moving Average Method. Calculation Results of MAD and MSE Values for the Moving Average Method on BBCA Closing Stock

Bulan (2022)	Closing Stock BBCA	2-Period Moving Average	Error	Absolute	Squared	%Error
January	7625					
February	8050					
March	7975	7838	138	138	18906	57
April	8125	8013	113	113	12656	71
May	7750	8050	-300	300	90000	27
June	7250	7938	-688	688	472656	12
July	7350	7500	-150	150	22500	50
August	8200	7300	900	900	810000	8
September	8550	7775	775	775	600625	10
October	8800	8375	425	425	180625	20
November	9300	8675	625	625	390625	14
December	8550	9050	-500	500	250000	18
Bulan/Periode Selanjutnya		8925	-8925	8925	79655625	1
TOTAL				13,538	82,504,219	287
AVERAGE				461	284,859	29
				MAD	MSE	MAPE

Table 7. Calculation Results of MAD and MSE Values Exponential Smoothing Method

Calculation Results of MAD and MSE Exponential Smoothing Values for BBCA Closing Stock

Bulan (2022)	Closing Stock BBCA	Exponential Smoothing	Error	Absolute	Squared	%Error
January	7625					
February	8050	7625	425	425	180625	19
March	7975	7625	350	350	122500	23
April	8125	7710	415	415	172225	20
May	7750	7763	-13	13	169	596
June	7250	7835	-585	585	342693	12
July	7350	7818	-468	468	219324	16
August	8200	7705	495	495	245366	17
September	8550	7634	916	916	839560	9
October	8800	7747	1053	1053	1108851	8
November	9300	7908	1392	1392	1938823	7
December	8550	8086	464	464	215234	18
Bulan/Periode Selanjutnya		8329	-8329	8329	69369804	0
TOTAL				14,907	74,755,173	745
AVERAGE				598	489,579	68
				MAD	MSE	MAPE

Table 8. Calculation Results of MAD and MSE Values Moving Average Method.
Calculation Results of MAD and MSE Values for the Moving Average Method on BMRI Closing Stock

Bulan (2022)	Closing Stock BMRI	2-Period Moving Average	Error	Absolute	Squared	%Error
January	7475					
February	7700					
March	7900	$ 7,588	313	313	97656	24
April	8950	$ 7,800	1150	1150	1322500	7
May	8500	$ 8,425	75	75	5625	112
June	7925	$ 8,725	-800	800	640000	11
July	8275	$ 8,213	63	63	3906	131
August	8850	$ 8,100	750	750	562500	11
September	9425	$ 8,563	863	863	743906	10
October	10550	$ 9,138	1413	1413	1995156	6
November	10525	$ 9,988	538	538	288906	19
December	9925	$ 10,538	-613	613	375156	17
Bulan/Periode Selanjutnya		$ 10,225	-10225	10225	104550625	1
TOTAL				6,575	6,035,313	349
AVERAGE				658	603,531	35
				MAD	MSE	MAPE

Table 9. Calculation Results of MAD and MSE Values Exponential Smoothing Method.

Calculation Results of MAD and MSE Exponential Smoothing Values for BMRI Closing Stock

Bulan (2022)	Closing Stock BMRI	Exponential Smoothing	Error	Absolute	Squared	%Error
January	$ 7,475					
February	$ 7,700	$ 7,475	225	225	50625	34
March	$ 7,900	$ 7,475	425	425	180625	19
April	$ 8,950	$ 7,520	1430	1430	2044900	6
May	$ 8,500	$ 7,596	904	904	817216	9
June	$ 7,925	$ 7,867	58	58	3387	136
July	$ 8,275	$ 7,993	282	282	79276	29
August	$ 8,850	$ 7,980	870	870	757332	10
September	$ 9,425	$ 8,039	1386	1386	1921546	7
October	$ 10,550	$ 8,201	2349	2349	5517607	4
November	$ 10,525	$ 8,446	2079	2079	4322935	5
December	$ 9,925	$ 8,867	1058	1058	1120070	9
Bulan/Periode Selanjutnya		$ 9,198	-9198	9198	84609332	0
TOTAL				11,067	16,815,519	270
AVERAGE				1,006	1,528,684	25
				MAD	MSE	MAPE

3.3 Appropriate Forecasting Methods

Table 10. Comparison of the results of MAD and MSE calculations using the Moving Average and Exponential Smoothing methods.

	Moving Average		Exponential Smoothing	
	MAD	MSE	MAD	MSE
BBCA	461	284,859	598	489,579
BMRI	658	603,531	1,006	1,528,684

Based on the results obtained from the two methodologies, it is evident that the employment of the moving average method yields superior and more viable outcomes for investors seeking to anticipate share prices at Bank BBCA and BMRI in January 2023. This preference arises from the Moving Average method's ability to exhibit a lower error rate than the Exponential Smoothing method. Precisely, when assessing the level of forecasting error as quantified by the Mean Absolute Deviation (MAD), it is discerned that BBCA and BMRI banks record MAD values of 461 and 658, further bolstering the efficacy of the Moving Average method. Additionally, the Mean Square Error (MSE) deals for BBCA and BMRI banks are 284,859 and 603,531, respectively, reinforcing the superiority of the Moving Average method. Consequently, the forecasts for January 2023, as generated by the Moving Average method, stand at 8,925 for Bank BBCA and 8,329 for Bank BMRI, making it the way of choice for astute investors.

3.4 Regression Analysis

Table 11. Regression Analysis Calculation Results of Interest Rate Values for BBCA Bank Closing Stock

Regression Statistics	
Multiple F	0.816218
R Square	0.666211
Adjusted I	0.632833
Standard I	364.8524
Observati	12

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regressio	1	2656900	2656900	19.95909	0.00120196
Residual	10	1331173	133117.3		
Total	11	3988073			

	Coefficients	*tandard Err*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*ower 95.0%*	*Upper 95.0%*
Intercept	5519.083	593.1892	9.304087	3.07E-06	4197.375529	6840.791	4197.376	6840.79114
Suku Bunga	652	145.941	4.46756	0.001202	326.8232551	977.1767	326.8233	977.176745

Based on Table 11, the R-square value indicates that 0,66 or 66% of the variation in BBCA share prices is explained by the interest rate variable, implying that other factors contribute to the remaining 34%. This observation is reinforced by the Sig value of 0.001, which is below the significance level (alpha) of 0.05, affirming a significant influence of the interest rate variable on BBCA share prices. Additionally, the coefficient of 652 suggests that an increase in interest rates correlates with a corresponding rise in BBCA share prices.

Table 12. Regression Analysis Calculation Results of Interest Rate Values for BMRI Bank Closing Stock.

Regression Statistics	
Multiple F	0.871471
R Square	0.759462
Adjusted I	0.735408
Standard I	550.8077
Observati	12

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regressio	1	9579025	9579025	31.57339	0.000221759
Residual	10	3033892	303389.2		
Total	11	12612917			

	Coefficients	*tandard Err*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*ower 95.0%*	*Jpper 95.0%*
Intercept	3881.333	895.5215	4.33416	0.00148	1885.987161	5876.68	1885.987	5876.6795
Suku Bunga	1238	220.3231	5.619021	0.000222	747.0895496	1728.91	747.0895	1728.9105

Results of Regression Analysis of Interest Rate Values on BMRI Bank Closing Share Values

Based on Table 11, the R-square value indicates that 0,75 or 75% of the variation in BMRI share prices is explained by the interest rate variable, implying that other factors contribute to the remaining 25%. This observation is reinforced by the Sig value of 0.000, which is below the significance level (alpha) of 0.05, affirming a significant influence of the interest rate variable on BMRI share prices. Additionally, the coefficient of 1238 suggests that an increase in interest rates correlates with a corresponding rise in BMRI share prices.

4 Conclusion

The study provides valuable insights into stock price forecasting methods and the impact of interest rates on BBCA and BMRI bank stock prices. The Moving Average (MA) method was found to be most suitable for forecasting, with the lowest error rate, as indicated by the Mean Absolute Percentage Error (MAPE) value. The experiment accurately predicted January 2023 stock prices for BBCA and BMRI, outperforming data spanning 3 and 5 years. The predicted stock prices for January 2023 using the Moving Average method were 8.925 for BBCA and 10.225 for BMRI, with actual prices at 8.475 and 9.950, respectively, remaining within a 2% error margin.

The increase in stock prices as of February 15, 2023, reported on official websites, supports the research's high accuracy. The rise in BMRI's stock price suggests a preference for BMRI stock among potential investors. Additionally, the increase in interest rates on the Indonesian capital market has a positive influence, as reported on the website www.liputan6.com.

To further support these conclusions, it is important to consider additional research. For instance, a data science approach using Long Short-Term Memory (LSTM) for stock price forecasting in

Indonesia during COVID-19 has been proposed, indicating the significance of various forecasting methods in the context of market dynamics [19]. Furthermore, a hybrid time series and artificial neural network model have been used for forecasting banking stock prices, which could provide additional insights into improving forecasting accuracy [20]

In conclusion, the study's findings are supported using the Moving Average method for stock price forecasting and the influence of interest rates on stock prices. The additional research on forecasting methods and models further strengthens the importance of considering various approaches to enhance the accuracy of stock price predictions.

References

[1] P. Adam, “éditions verticales 9,” 2011.

[2] J. L. Tonry *et al.*, “Atlas: A high-cadence all-sky survey system,” *Publ. Astron. Soc. Pacific*, vol. 130, no. 988, 2018, doi: 10.1088/1538-3873/aabadf.

[3] X. Wang, S. Ramírez-Hinestrosa, J. Dobnikar, and D. Frenkel, “The Lennard-Jones potential: When (not) to use it,” *Phys. Chem. Chem. Phys.*, vol. 22, no. 19, pp. 10624–10633, 2020, doi: 10.1039/c9cp05445f.

[4] F.T.Kalopo and A. O. Adarmola, “The impact of capital market on economic growth: the Nigerian Perspective,” *Int. J. Dev. Sci.*, vol. 1, no. 1, pp. 11–19, 2012.

[5] A. Rizqia, M. Hubeis, and P. Astuty, “Impact of Indonesian Capital Market Development on Economic Growth Through Labor Absorption and Per Capita Income (Time Series Study 1990 – 2020),” 2022, doi: 10.4108/eai.30-10-2021.2315673.

[6] F. N. Suryana and S. Rahayu, “THE INFLUENCE OF LEVERAGE, PROFITABILITY, AND FIRM SIZE ON FIRM VALUE (Empirical Study of Consumer Goods Industry Sub Sector of Pharmaceuticals Listed in Indonesia Stock Exchange Period 2012-2016),” *eProceedings Manag.*, vol. 5, no. 2, pp. 2262–2269, 2018, [Online]. Available: www.idx.co.id

[7] B. A. Corry, H. P. Minsky, and D. E. Moggridge, “file:///C:/Users/SITI NAQIAH/Desktop/Case Study 1/mcleanp_01_920_313_connell.pdf,” *Econ. J.*, vol. 87, no. 346, p. 335, 2008.

[8] I. Ardiyani and C. Armereo, “Terhadap Harga Saham Perusahaan Indeks Lq45,” *J. Ilm. Orasi Bisnis*, vol. 15, no. ISSN 2085-1375, pp. 44–64, 2018.

[9] H. Dalimunthe, “Pengaruh Price Earning Ratio, Tingkat Suku Bunga, Dan Tingkat Inflasi Terhadap Harga Saham,” *J. Akunt. dan Bisnis*, vol. 1, no. November, pp. 11–25, 2015.

[10] R. J. Hyndman and Y. Khandakar, “Journal of Statistical Software Automatic Time Series Forecasting: The forecast Package for R,” *J. Stat. Softw.*, vol. 27, no. 3, p. 1, 2008, [Online]. Available: http://www.jstatsoft.org/

[11] I. A. I. Trisnayanti and I. K. Jati, “Pengaruh Self Assessment System, Pemeriksaan Pajak, dan Penagihan Pajak Pada Penerimaan Pajak Pertambahan Nilai (PPN),” *E-Jurnal Akunt. Univ. Udayana*, vol. 13, no. 1, pp. 292–310, 2015.

[12] R. Angamuthu Chinnathambi *et al.*, “A Multi-Stage Price Forecasting Model for Day-Ahead Electricity Markets,” *Forecasting*, vol. 1, no. 1, pp. 26–46, 2019, doi: 10.3390/forecast1010003.

[13] J. Martínez-Salazar and F. Toledano-Toledano, “Comparative Analysis of Three Predictive Models of Performance Indicators with Results-Based Management: Cancer Data Statistics in a National Institute of Health,” *Cancers (Basel).*, vol. 15, no. 18, 2023, doi: 10.3390/cancers15184649.

[14] U. A. Saleh and U. A. Saleh, “Digital Commons @ Georgia Southern Transforming the Simple Moving Average Forecasting Technique into a Judgmental Bootstrapping Approach Transforming the Simple Moving Average Forecasting Technique into a Judgmental Bootstrapping Approach Gamal Haikal,” pp. 1–15, 2013.

[15] Y. Iida *et al.*, “Efficacy and Mechanism of Angiotensin II Receptor Blocker Treatment in Experimental Abdominal Aortic Aneurysms,” *PLoS One*, vol. 7, no. 12, 2012, doi: 10.1371/journal.pone.0049642.

[16] T. van Dijk, “A sociocognitive approach,” *Discourse Context a Sociocognitive Approach*, no. 2007, p. 11, 2007, [Online]. Available: http://www.langtoninfo.com/web_content/9780521895590_frontmatter.pdf

[17] G. Chi and J. Zhu, “Spatial regression models for demographic analysis,” *Popul. Res. Policy Rev.*, vol. 27, no. 1, pp. 17–42, 2008, doi: 10.1007/s11113-007-9051-8.

[18] C. Turnbull *et al.*, “Genome-wide association study identifies five new breast cancer susceptibility loci,” *Nat. Genet.*, vol. 42, no. 6, pp. 504–507, 2010, doi:

10.1038/ng.586.

[19] W. Budiharto, “Data science approach to stock prices forecasting in Indonesia during Covid-19 using Long Short-Term Memory (LSTM),” *J. Big Data*, vol. 8, no. 1, 2021, doi: 10.1186/s40537-021-00430-0.

[20] A. T. Haryono, R. Sarno, and K. R. Sungkono, “Stock price forecasting in Indonesia stock exchange using deep learning: A comparative study,” *Int. J. Electr. Comput. Eng.*, vol. 14, no. 1, pp. 861–869, 2024, doi: 10.11591/ijece.v14i1.pp861-869.