

## Instrument Prospective Analysis on BISNIS-27 Index Stocks Using K-Means Cluster Analysis, Forecasting, and Error Correction Model (ECM)

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**Abstract.** Investment is the activity of placing funds in one or several investment objects for a certain period of time to obtain future profits. The important role of investment in supporting economic growth can be seen from its ability to channel funds to sectors in need, thereby increasing productivity, creating jobs, and increasing income. Stock investment has become one of the most popular instruments because of its profit potential, both from dividends and rising stock prices, although it is accompanied by high risk. Technological developments and easy access to information have attracted more people to invest in stocks, especially through stock indices such as the BISNIS27 Index which reflects the performance of the best performing companies. The selection of this index is important as it reflects the overall market performance and provides a strong reference for investors. To analyze stock performance, fundamental and technical analysis approaches are used, which complement each other in providing a complete picture for investors. In addition, forecasting and ECM (Error Correction Model) methods are used to project future stock prices and analyze the long-term relationship between economic variables. The result of this study is that the best forecasting method of ICBP stock is single exponential smoothing with an  $\alpha$  value ( $\alpha = 0.7$ ) because it has the lowest error rate and ICBP stock meets all assumptions of stationarity, cointegration, multicollinearity and IIDN.

**Keywords:** Cointegrity, Error Correction Model, IIDN Assumption, Multicollinearity, Stationarity

### 1. INTRODUCTION

Investment can be interpreted as an activity to place funds in one or several investment objects for a certain period to get future profits (Putra, 2013). Through investment, especially in stocks, there is an increase in productivity, job creation, and increased income that contributes to economic progress. Investment in growing companies allows them to expand their operations, thereby creating more jobs and increasing production efficiency. A developed business world certainly has a positive influence on the country's economy (Cahya, 2019). Thus, this will have a direct impact on economic growth. Stocks are an investment instrument that many investors choose because they can provide attractive returns (Balqis, 2021). The current trend of stock investment is increasingly attracting the attention of many people, especially with the development of technology and easier access to information. With this platform, investors can buy and sell stocks more easily and quickly. One important step in investing in stocks is choosing the right stock index, such as the BISNIS27 Index. This study chose the BISNIS27 Index to calculate the return rate, because the historical data shows that

this index has a positive trend which shows that the BISNIS27 index shows higher stability than other stock indices. In analyzing the performance of stocks in this index, analytical approaches are needed to make the right decision, namely fundamental analysis and technical analysis.

Fundamental analysis is an analysis that considers the fundamental economic indicators of a company and micro and macroeconomic factors. Technical analysis is forecasting stock prices by looking at historical prices (Octasyilva, 2022). These two analyses complement each other so that investors can make wiser investment decisions by considering internal company factors as well as price movement patterns in the market. Combining these two analyses is important to gain a comprehensive understanding, both for long-term and short-term investment decisions. In addition, to maximize the use of these two analyses, forecasting and ECM (*Error Correction Model*) methods will be used.

The objectives of this study are to determine the cluster analysis on the BISNIS27 index, forecasting and modeling analysis of stock instruments of PT Indofood CBP Sukses Makmur Tbk. The analysis carried out later can fulfill the objectives by providing complete information for investors regarding stock price projections and the impact of economic imbalances on the market. Forecasting methods provide an overview of future stock price trends, while ECM allows analysis of the relationships and corrections of economic variables that affect stock price movements. By combining historical data and analysis of economic imbalances, investors get more accurate guidance to make investment decisions based on an in-depth understanding of the factors that affect stock price movements.

## **2. METHODS**

This study uses secondary data consisting of stock instrument data and macroeconomic variables. The stock instrument data used is PT Indofood CBP obtained through the investing.com website. Meanwhile, macroeconomic variable data includes the Consumer Price Index (CPI) for the food sector, BI Rate, and money supply accessed through the official website of Bank Indonesia and the website [www.bps.go.id](http://www.bps.go.id).

The analysis method in this study was carried out in stages and systematically. The first stage begins with collecting stock price data on the BISNIS27 index, which is then visualized in the form of a line chart for the 2021-2023 period. This visualization is complemented by an analysis of data characteristics including average, minimum, maximum, and standard deviation values. Furthermore, the calculation of financial ratios including Cash Ratio, Quick Ratio, ROA, ROE, and Net Profit Margin is carried out to assess the company's financial performance.

The analysis continued with the application of the K-Means clustering method to group the stocks in the selected index. The clustering process includes determining the optimal number of clusters, grouping cluster members, selecting the best cluster, and selecting issuers. To analyze stock price movements, forecasting is done using several time series methods including Moving Average, Single Exponential Smoothing, Double Exponential Smoothing, Trend Analysis, and Winter's Method. The best model selection is based on the MAPE, MAD, and MSD criteria for each issuer.

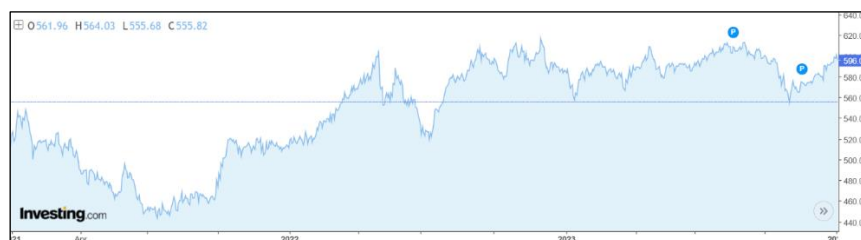
The next stage is the application of the Error Correction Model (ECM) to analyze the long-term and short-term relationships between macroeconomic variables and stock prices or returns. The ECM analysis begins with a multicollinearity check, stationarity test, long-term modeling, cointegration test, short-term modeling, and IIDN residual assumption testing. The results of the analysis are then evaluated based on the goodness of the model and interpreted to produce comprehensive conclusions and recommendations.

### 3. RESULTS AND DISCUSSION

This chapter contains the results of analysis and discussion starting from cluster analysis and selection of issuers on the Bisnis-27 index. The selected issuers are 3 issuers, and each issuer will be further analyzed to determine the variables that affect the price of the issuer and how the model forms for the long term and short term using the Error Correction Model (ECM). The variable data used are 2 general macroeconomic variables and 1 sectoral macroeconomic variable for each issuer.

#### Cluster Analysis and Issuer Selection

The IDX Bisnis-27 Index is one of the stock indices on the Indonesia Stock Exchange (IDX) which includes 27 selected stocks with certain criteria, such as good fundamentals and liquidity. The Business-27 stock index is also important to assess the stability and growth potential of the stocks in it by looking at the historical data from IDX Bisnis-27 from 2021 to 2023, which is shown in figure 1.



**Figure 1.** IDX Business-27 Historical Data, 2021-2023 (Rp)

*Source: id.investing.com*

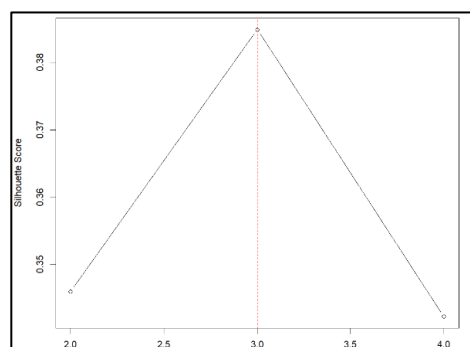
Figure 1 FIGURE 3 shows the fluctuating trend of IDX Bisnis-27 from 2021 to 2023, with a significant drop in early 2021 due to the pandemic. The index then began to recover and experienced a steady upward trend until mid-2022. This period was also characterized by fluctuations such as in mid-2022 and late 2023, indicating a cautious sentiment.

**Table 1.** IDX Business-27 Descriptives Statistics

	Year		
	2021	2022	2023
Average	491.885	569.1935	589.6769
Minimum	444.15	514.99	555.27
Maximum	548.6	617.97	613.71
Standard Deviation	26.94505	27.74144	12.38014

*Source: Authors calculations*

Table 1 shows the trend of increasing average Index value from 491.885 in 2021 to 589.677 in 2023, indicating the growing performance of the issuers in IDX Bisnis-27. Volatility in 2021 and 2022 was quite high as seen from the standard deviation of 26.95 and 27.74, and reduced significantly in 2023 to 12.38, indicating greater stability. This index shows good stability, so it can be said that issuers are also very good in terms of fundamentals and liquidity. Therefore, cluster analysis and issuer selection were conducted to find the best stocks from the 27 stocks in the index-27. Cluster analysis was conducted on all issuers included in the Bisnis-27 stock index, using the results of the calculation of financial ratios of liquidity and profitability in 2023. This cluster analysis uses the k-means method, so that the number of cluster divisions is based on the results of the highest silhouette score, which is shown in Figure 2 below.



**Figure 2.** Silhouette Scores Line Chart

*Source: Authors calculations*

Based on Figure 2, it is found that the optimum number of clusters is 3 clusters. All issuers will be divided into clusters with fellow issuers that have the same characteristics. The results of the distribution of issuers in the three clusters are shown in Table 2.

**Table 2.** Cluster Division

Cluster	Issuers
1	BRPT, ANTM, CTRA, EXCL, SMGR, dan INKP
2	INCO, KLBF, ICBP, MYOR, dan MIKA
3	ASII, AKRA, ADRO, AMRT, TLKM, PGAS, UNTR, TOWR, JSMR, MEDC, dan MAPI

*Source: Authors calculations*

Based on table 2, it is found that there are 6 issuers in cluster 1, namely BRPT, ANTM, CTRA, EXCL, SMGR, and INKP. In cluster 2, there are 5 issuers, namely INCO, KLBF, ICBP, MYOR, and MIKA. Meanwhile, in cluster 3, there are 11 issuers, namely ASII, AKRA, ADRO, AMRT, TLKM, PGAS, UNTR, TOWR, JSMR, MEDC, and MAPI. Each cluster will be calculated on average for its financial ratios, namely CR, QR, ROA, ROE, and NPM. The financial ratio results for each cluster are shown in Table 3 below.

**Table 3.** IDX Business-27 Descriptives Statistics

Cluster	Financial Ratio				
	CR	QR	ROA	ROE	NPM
1	2,035 times	1,631 times	2,2%	4,4%	16,9%
2	4,366 times	3,754 times	16,4%	21,8%	33%
3	1,115 times	0,772 times	11,9%	23,3%	22%

*Source: Authors calculations*

Based on table 3, it is found that the cluster with a CR value of 4.366 times, QR of 3.745 times, ROA of 16.4%, and NPM of 33%. This shows that cluster 2 is the best cluster because almost all financial ratios have greater values than other clusters, where the issuers divided into cluster 2 are INCO, KLBF, MIKA, MYOR, and ICBP. In the selected cluster, cluster 2, the expected return and risk will be calculated to determine the issuers that provide the largest return. The results of the calculation of expected return using geometric mean on 5 issuers and the amount of risk are shown in table 4 below.

**Table 4.** Expected Return and Risk Emiten in Cluster 2

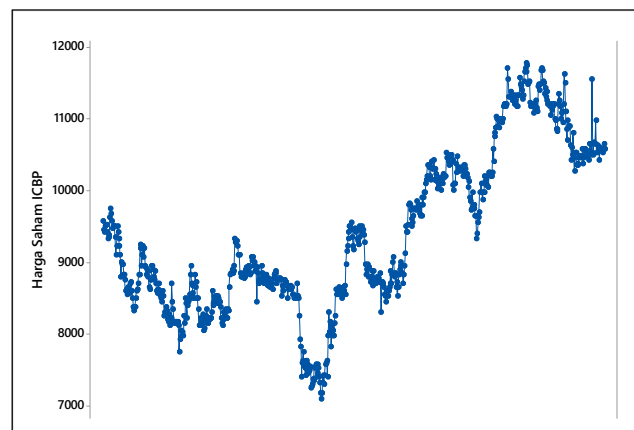
Issuer	Expected Return	Risk
INCO	-0.0333%	2.6578%
KLBF	0.0120%	2.0070%
MIKA	0.0019%	2.3736%
MYOR	-0.0199%	2.0438%
ICBP	0.0136%	1.5713%

*Source: Authors calculations*

Based on the calculation results obtained in table 4.4, it is found that the issuer with the highest expected return is ICBP. Therefore, ICBP stocks will continue to technical and fundamental analysis.

### **ICBP Stock Analysis**

ICBP stock analysis will use technical analysis and fundamental analysis. Technical analysis will be carried out using several forecasting methods and the ICBP stock price will be predicted based on the best model obtained. Fundamental analysis will be carried out using the Error Correction Model method to determine how the influence of macroeconomic and sectoral variables affects ICBP shares in the short and short term. The analysis will be explained in more detail, but it is necessary to see how the trend of ICBP shares from 2021 to 2023 will be shown in Figure 3 below.



**Figure 3.** Time Series Plot ICBP Shares

*Source: id.investing.com*

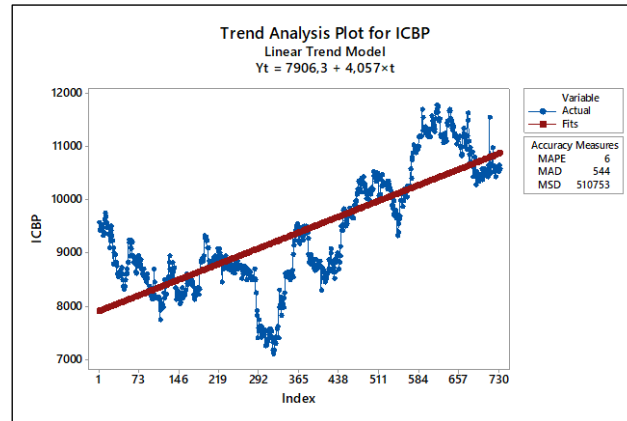
Figure 3 shows the daily movement of ICBP shares from 2021 to 2023. ICBP's stock price from 2021 to 2022 experienced a significant decline, but after that it recovered. The year 2023 experienced a relatively stable upward trend until the peak in the middle of the year. Overall, ICBP shares have fairly high volatility.

#### **3.2.1. ICBP Stock Forecasting**

Forecasting ICBP shares will use trend analysis methods (linear, quadratic, exponential growth, S-curve), moving average, single exponential smoothing, double exponential smoothing, and winters' method.

##### **a. Linear Trend Analysis Model on ICBP Shares**

The results of the ICBP stock forecasting model analysis using linear trend analysis are presented in figure 4 below.



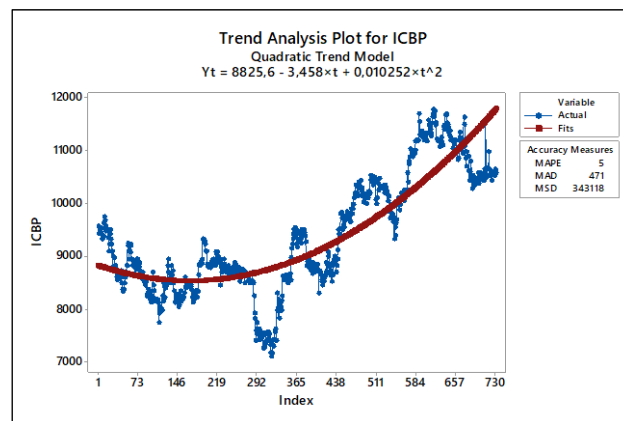
**Figure 4.** Linear Trend Analysis of ICBP Shares

*Source: Authors calculations*

Figure 4 shows that the forecasting model using linear trend analysis is  $Y_t = 7906.3 + 4.047t$ . The model is used to calculate the forecast value of all ICBP daily stock data from 2021 to 2023, in order to determine the error rate. The error rate of the forecasting model is seen through the MAD, MAPE, and MSD values, which in the above model are obtained as 544, 6%, and 510753, respectively.

b. Quadratic Trend Analysis Model on ICBP Shares

The results of the ICBP stock forecasting model analysis using quadratic trend analysis are presented in Figure 5 below..



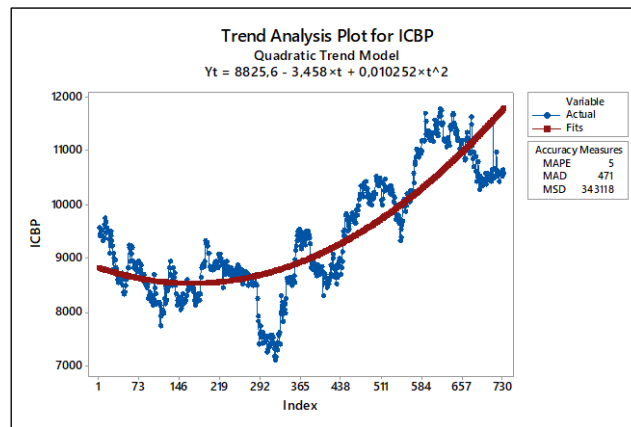
**Figure 5.** Quadratic Trend Analysis of ICBP Shares

*Source: Authors calculations*

Figure 5 shows that the forecasting model using quadratic trend analysis is  $Y_t = 8825.6 - 3.458t + 0.01t^2$ . The model is used to calculate the forecast value of all ICBP daily stock data from 2021 to 2023, in order to determine the error rate. The error rate of the forecasting model is seen through the MAD, MAPE, and MSD values, which in the above model are obtained as 471, 5%, and 343118, respectively.

c. Exponential Trend Analysis Model on ICBP Shares

The results of the ICBP stock forecasting model analysis using exponential trend analysis are presented in Figure 6 below.



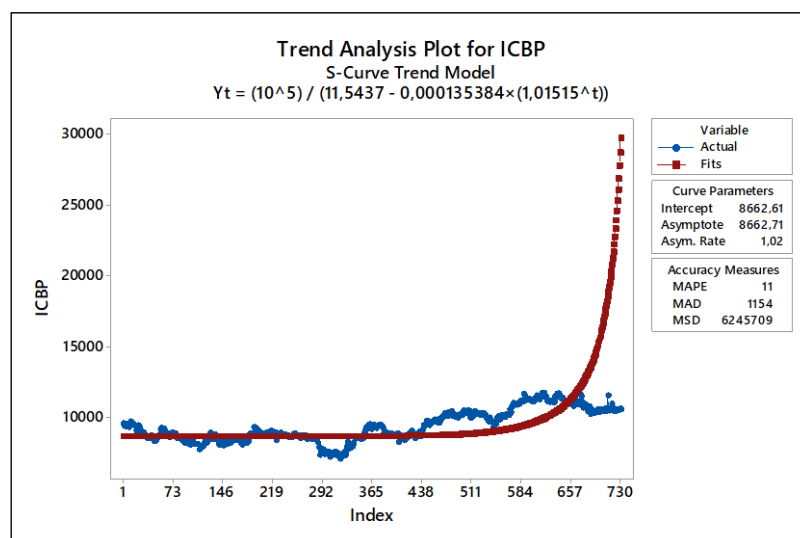
**Figure 6.** Exponential Trend Analysis of ICBP Shares

*Source: Authors calculations*

Figure 6 shows that the forecasting model using exponential trend analysis is  $Y_t = 7994.89 \times (1.00042t)$ . The model is used to calculate the forecast value of all ICBP daily stock data from 2021 to 2023, in order to determine the error rate. The error rate of the forecasting model is seen through the MAD, MAPE, and MSD values, which in the above model are obtained as 535, 6%, and 486815, respectively.

d. S-Growth Trend Analysis Model Pada Saham ICBP

The results of the ICBP stock forecasting model analysis using S-Growth trend analysis are presented in Figure 7 below.



**Figure 7.** Quadratic Trend Analysis of ICBP Shares

*Source: Authors calculations*



Figure 7 shows that the forecasting model using S-Growth trend analysis is  $Y_t = 105 / (11.544 - 0.00014 \times (1.015t))$ . The model is used to calculate the forecast value of all ICBP daily stock data from 2021 to 2023, in order to determine the error rate. The error rate of the forecasting model is seen through the MAD, MAPE, and MSD values, which in the above model are obtained as 1154, 11%, and 6245709, respectively.

e. Moving Average, Single Exponential Smoothing, Double Exponential Smoothing, dan Winters' Method Model on ICBP Shares

The results of the ICBP stock forecasting model analysis using moving average, single exponential smoothing with  $\alpha$  parameters of 0.2 and 0.7, double exponential smoothing, and winters' method are used to calculate the error rate of each method. The error rates evaluated are MAD, MAPE, and MSD which are presented in Table 5 below.

**Table 5.** Error Rates of Moving Average, Single Exponential Smoothing, Double Exponential Smoothing, and Winters' Method of ICBP Shares

Method	MAD	MAPE	MAD
<i>Moving Average (5)</i>	131,3	1,4%	32399,8
<i>Single Exponential Smoothing (<math>\alpha = 0,2</math>)</i>	145,3	1,6%	38719,7
<i>Single Exponential Smoothing (<math>\alpha = 0,7</math>)</i>	101,3	1,1%	20621,3
<i>Double Exponential Smoothing (<math>\alpha = 0,2</math> &amp; <math>\gamma = 0,7</math>)</i>	163,6	1,8%	49200,1
<i>Winters' Method (<math>\alpha = 0,2</math>, <math>\delta = 0,5</math>, &amp; <math>\gamma = 0,7</math>)</i>	167,5	1,8%	46141,8

*Source: Authors calculations*

Table 5 shows that forecasting using the single exponential smoothing method with an  $\alpha$  parameter of 0.7 is the best method for forecasting ICBP stock prices compared to other methods, including trend analysis. This can be concluded because the error rate of the single exponential smoothing method ( $\alpha = 0.7$ ) is the lowest compared to other methods. Therefore, the single exponential smoothing method ( $\alpha = 0.7$ ) was chosen to forecast the ICBP stock price for the next few periods, which is shown in table 6 below.

**Table 6.** Forecast Results of Moving Average, Single Exponential Smoothing, Double Exponential Smoothing, and Winters' Method of ICBP Shares

Period	Lower Limit	Forecast Results	Upper Limit
1	10341,5	10589,7	10837,8
2	10341,5	10589,7	10837,8
3	10341,5	10589,7	10837,8
4	10341,5	10589,7	10837,8
5	10341,5	10589,7	10837,8

*Source: Authors calculations*

Table 6 shows the amount of forecasting results using the single exponential smoothing method with an  $\alpha$  parameter of 0.7 for ICBP stock prices for the next 7 days, complemented by

confidence intervals using 95% confidence intervals.

#### ICBP Stock Modeling

ICBP stock modeling is carried out to find out how macroeconomic and sectoral variables affect ICBP shares in the short and short term. The method used in modeling ICBP shares is the Error Correction Model (ECM). Analysis with the ECM method requires several stages and assumption checks, namely checking multicollinearity and stationarity, long-term modeling, cointegration test, short-term modeling, and testing the IIDN assumption.

#### f. Stationarity Checking Data Variables BI Rate, Money Supply, Food Sector CPI, and ICBP Stock Price for 2021-2023

The results of checking stationarity are seen through the Augmented Dicky-Fuller test at the level and first differentiation, which is shown in table 7 below.

**Table 7.** ICBP Stock Stationarity Check

Variable	Differentiation	P-Value	Variable	Differentiation	P-Value
ICBP Stock Price	0	0,622	ICBP Stock Price	1	0,000
BI Rate	0	0,947	BI Rate	1	0,000
Money Supply	0	0,773	Money Supply	1	0,000
Food Sector CPI	0	0,952	Food Sector CPI	1	0,003

*Source: Authors calculations*

Table 7 shows that the variables BI Rate, money supply, food sector CPI, and ICBP stock price in 2021-2023 at the level have a p-value > 0.05, so it is decided to fail to reject H0 or all variables along with ICBP stock prices are not stationary at the level. However, in the first differentiation, the variables BI Rate, money supply, food sector CPI, and ICBP stock prices in 2021-2023 have a p-value < 0.05, so it is decided to reject H0 or all variables along with ICBP stock prices are stationary in the first differentiation.

#### g. Long-Term Model of the Effect of BI Rate Variables, Money Supply, and Food Sector CPI on ICBP Stock Prices in 2021-2023

The results of the long-term model estimation model of the influence of the BI Rate variable, money supply, and CPI in the food sector on ICBP's stock price in 2021-2023 are shown in the following equation.

$$Y_t = -694,99 + 737,47X_{BI\ Rate,t} + 0,0002X_{Jumlah\ Uang\ Beredar,t} + 48,37X_{IHK\ Makanan,t} + \varepsilon_t$$

Based on the equation above, it will be used to calculate the value of ICBP shares in 2021-2023. The actual ICBP stock value from 2021 to 2023 will be subtracted from the results of the

model calculation for the ICBP stock value to get the residual or ECT from the model which will be used for further testing and modeling. However, the model also needs to be partially tested to determine which variables have a significant effect on ICBP's stock price. The results of the partial test are shown in table 8 below.

**Table 8.** Test Statistics for Partial Testing of the Long-Term ECM Model of ICBP Shares

Variable	t	$t_{0,975;30}$	P-Value	Decision
BI Rate	737,471		0,000	Tolak $H_0$
Money Supply	0,000	2,042	0,662	Gagal tolak $H_0$
Food Sector CPI	48,374		0,270	Gagal tolak $H_0$

*Source: Authors calculations*

Table 8 shows that the BI Rate variable has a |t| value of 737.471, which is greater than  $t_{0,975;30}$  of 2.042, with a p-value of 0.000 which is smaller than 0.05. Therefore, it is decided to reject  $H_0$ , which means that only the BI Rate variable has a significant effect on ICBP's share price in the long run.

#### h. The goodness of the ICBP Stock Long-Term Model

The goodness of the long-term model of the influence of the BI Rate, money supply, and food sector CPI variables on the ICBP stock price for 2021-2023 is seen from the R-squared value. The R-squared result of the long-term model that has been estimated on ICBP shares is 80.11%. This means that the BI Rate, money supply, and food sector CPI variables are able to explain the variability of ICBP stock price data for 2021-2023 by 80.11%, and the remaining 19.89% is explained by variables outside the long-term model. The long-term model of ICBP shares is classified as good because most of the variability in ICBP stock prices is explained by the variables in the model.

#### i. Cointegration Test of the Effect of BI Rate, Money Supply, and Food Sector CPI Variables on ICBP Stock Prices in 2021-2023

The results of cointegration testing for the model of the influence of BI Rate, money supply, and CPI food sector variables on ICBP stock prices in 2021-2023 are shown in table 9 below.

**Table 9.** ICBP Stock Cointegration Testing Test Statistics

P-Value	Decision
0,002	Tolak $H_0$

*Source: Authors calculations*

Table 9 shows that the p-value of 0.002 is smaller than 0.05. Therefore, it is decided to reject  $H_0$  or it means that there is a short-term relationship between variables (cointegrated).

- j. Short-term Model of the Effect of BI Rate, Money Supply, and Food Sector CPI Variables on ICBP Stock Prices in 2021-2023

The results of the short-term model estimation model of the effect of the BI Rate variable, money supply, and CPI in the food sector on ICBP's stock price in 2021-2023 are shown in the following equation.

$$DY_t = 55,43 + 551,268\Delta X_{BI\ Rate,t} - 0,00008\Delta X_{Jumlah\ Uang\ Beredar,t} + 3,894\Delta X_{IHK\ Makanan,t} - 0,627ECT_{t-1} + U_t$$

Based on the estimated short-term model, simultaneous and partial tests will be carried out to determine which variables have a significant effect on ICBP's stock price. The test statistical results of the simultaneous test are shown in table 10 below.

**Table 10.** Test Statistics of Simultaneous Testing of Short-Term ECM Model of ICBP Shares

<b>F</b>	<b>F<sub>0,05;3;30</sub></b>	<b>P-Value</b>
4,212	2,922	0,008

*Source: Authors calculations*

Table 10 shows that the F is 4.212, which is greater than F<sub>0,05;3;30</sub> of 2.922, with a p-value of 0.008 which is smaller than 0.05. Thus, it is decided to reject H<sub>0</sub>, which means that there is at least one of the BI Rate, money supply, and CPI variables in the food sector that has a significant effect on ICBP's stock price in the short term. Partial testing is carried out as a further analysis of the simultaneous test, in order to find out in detail what variables have a significant effect on ICBP's stock price in the short term, where the test statistical results of partial testing on the short-term model are shown in table 11 below.

**Table 11.** Test Statistics of Partial Testing of Short-Term ECM Model of ICBP Shares

<b>Variable</b>	<b> t </b>	<b>t<sub>0,975;30</sub></b>	<b>P-Value</b>	<b>Decision</b>
D(BI Rate)	2,608	2,776	0,014	Reject H <sub>0</sub>
D(Money Supply)	-0,1001		0,921	Fail to reject H <sub>0</sub>
D(Food Sector CPI)	0,053		0,958	Fail to reject H <sub>0</sub>
ECT(-1)	0,169		0,001	Reject H <sub>0</sub>

*Source: Authors calculations*

Table 11 shows that the BI Rate variable has a |t| value of 2.608, which is smaller than t<sub>0,975;4</sub> of 2.776, with a p-value of 0.014 which is smaller than 0.05. Therefore, it is decided to reject H<sub>0</sub>, which means that only the BI Rate variable has a significant effect on ICBP's stock price in the short term.

- k. Goodness of ICBP Stock Long-Term Model

The goodness of the short-term model of the influence of the BI Rate, money supply, and food sector CPI variables on the ICBP stock price for 2021-2023 is seen from the R-squared

value. The R-squared result of the short-term model that has been estimated on ICBP shares is 35.96%. This means that the BI Rate, money supply, and food sector CPI variables are able to explain the variability of ICBP stock price data for 2021-2023 by 35.96%, and the remaining 64.04% is explained by variables outside the long-term model. The short-term model of ICBP shares is still classified as poor because most of the variability in ICBP stock prices is explained by variables outside the model.

1. Testing the IIDN Assumption of the Short-Term Effect of BI Rate, Money Supply, and Food Sector CPI on ICBP Stock Prices for 2021-2023

Testing the residual assumptions on the data of the short-term influence of the BI Rate, money supply, and food sector CPI variables on ICBP's stock price is carried out to determine whether the residuals of the data have met the identical, independent, and normally distributed assumptions. The test statistical results of identical assumption testing are shown in table 12 below.

**Table 12.** ICBP Stock Identical Residual Assumption Testing Test Statistics

<b>F</b>	<b>F<sub>0,05;4;30</sub></b>	<b>P-Value</b>	<b>Decision</b>
1,187	2,69	0,337	Fail to reject H <sub>0</sub>

*Source: Authors calculations*

Table 12 shows that the results of the identical residual assumption test on the data of the effect of BI Rate, money supply, and food sector CPI on ICBP stock prices get an F test statistic of 1.187 which is smaller than the  $F_{0.05;4;30}$  value of 2.69, with a P-value greater than 0.05, which is 0.337 so that it can be decided to fail to reject. This means that the residual data of the effect of the BI Rate, money supply, and food sector CPI on ICBP stock prices are identical. The test statistical results of the independent assumption test are shown in table 13 below.

**Table 13.** Test Statistics Testing Independent Residual Assumptions of ICBP Shares

<b>F</b>	<b>F<sub>0,05;4;30</sub></b>	<b>P-Value</b>	<b>Decision</b>
1,187	2,69	0,337	Fail to reject H <sub>0</sub>

*Source: Authors calculations*

Table 13 shows that the results of the independent residual assumption test on the data on the effect of BI Rate, money supply, and food sector CPI on ICBP stock prices get an F of 1.069 where F is smaller than  $F_{0.05; 2; 28}$  supported by a P-value where the P-value is greater than 0.05, which is 0.357 so it can be decided to fail to reject. This means that the residual data of the effect of the BI Rate, money supply, and food sector CPI on ICBP stock prices are independent. The test statistical results of testing the normal distribution assumption are shown in table 14 below.

**Table 14.** Test Statistics Testing Independent Residual Assumptions of ICBP Shares

<b>Jarque-Bera</b>	<b>P-Value</b>	<b>Decision</b>
0,017	0,992	Fail to reject $H_0$

*Source: Authors calculations*

Table 14 shows that the results of the normal distribution residual assumption test on the data on the effect of BI Rate, money supply, and food sector CPI on ICBP stock prices got a Jarque-Bera of 0.017 where the P-value is greater than 0.05, which is 0.992 so it can be decided to fail to reject. This means that the residual data of the effect of the BI Rate, money supply, and CPI of the food sector on ICBP stock prices are normally distributed.

#### 4. CONCLUSION

Based on the results of k-means cluster analysis, forecasting, and Error Correction Model (ECM) on stocks in the Bisnis-27 index, several important conclusions are obtained. First, the optimum cluster formed is 3 clusters, with the 2nd cluster chosen as the best cluster because it has superior financial ratio values compared to other clusters. The calculation of expected return and risk for each issuer in cluster 2 shows that ICBP has the best performance. Second, the best forecasting method for ICBP's stock price is also single exponential smoothing ( $\alpha = 0.7$ ), with MAD 101.3, MAPE 1.1%, and MSD 20621.3. ECM analysis shows that all assumptions are met and BI Rate is proven to affect ICBP's stock price both in the short and long term.

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