JISS Journal of Indonesian Social Science

Vol. 5, No. 11, November 2024
E-ISSN: 2723 - 6692
P-ISSN: 2723 - 6595
http://jiss.publikasiindonesia.id/

Analysis of Optimal Stock Performance Using the Discounted Cash Flow Method and Stock Price Forecasting Using the Holt-Winters Method (Case Study: Shares of PT Perusahaan Gas Negara Tbk)

Sekar Miasih, Embay Rohaeti, Hagni Wijayanti
Universitas Pakuan, Bogor, Indonesia
Email: Sekarmiasih0503@gmail.com, embay.rohaeti@unpak.ac.id, Hagnijantix@unpak.ac.id
Correspondence: Sekarmiasih0503@gmail.com*

KEYWORDS

Stock performance, PT Perusahaan Gas Negara Tbk, discounted cash flow (DCF); Holt-Winters; MAPE

ABSTRACT

The high liquidity of PT Perusahaan Gas Negara Tbk shares and significant fluctuations in share prices create uncertainty that requires in-depth analysis. Stock performance analysis is carried out with 2 stages in outline, namely the stages of fundamental analysis and technical analysis. Fundamental analysis is carried out to analyze optimal stock performance, one of which is by using the discounted cash flow (DCF) method. Technical analysis is used to determine the condition of stock performance in the future by forecasting stock prices using the Holt-Winters forecasting method. The objectives of this study are to analyze optimal stock performance, forecast stock prices, and evaluate forecasting results. The data used is PGN's 2023 annual report and daily data on PGN's stock price for the period January 1, 2019, to December 31, 2023, totalling 1,231 data. The results of the optimal stock performance analysis show that PGN's stock performance is declared optimal with an intrinsic value of 3,149.18, which is greater than the current stock price (undervalued). The results of stock price forecasting show that the forecasting results follow the actual data pattern, with an accuracy value using MAPE (mean absolute percentage error) of 10.9%, it is stated that the forecasting performance has performed well.

Introduction

The stock price movement of PT Perusahaan Gas Negara Tbk (PGN) shows interesting dynamics to be analyzed. PGN as one of the major companies in Indonesia has shares that are in great demand by investors. As outlined in PGN's 2023 annual report which states that the liquidity of PGN shares (code PGAS) is very high with an average daily trading volume reaching 486 thousand lots during 2023 (PT Perusahaan Gas Negara Tbk, 2024).

PGN's share price has fluctuated significantly in the last four years, influenced by various internal and external factors. The annual report of PT Perusahaan Gas Negara Tbk (2024) shows that

in 2020 the highest share price was at Rp2,200 thanks to positive financial performance. However, in 2021, the highest share price was at Rp1,640 due to global economic dynamics and the COVID-19 pandemic which reduced energy demand. In 2022, the highest share price was at Rp1,995, showing signs of economic recovery, but PGN shares still faced regulatory challenges and infrastructure investment needs. In 2023, the highest share price was at Rp1,770 and again experienced a significant decline. Stock volatility creates uncertainty that requires further analysis.

Analysis of optimal stock performance is crucial due to the high number of PGN stock enthusiasts compared to fluctuations in current stock performance, to ensure that investments made by investors have good prospects and can get the expected benefits. Stock performance analysis is carried out with 2 broad analyses, namely fundamental analysis and technical analysis. Various methods can be used to analyze optimal stock performance with fundamental analysis, one of which is using the discounted cash flow (DCF) method. This method was chosen because it is able to provide a comprehensive assessment of the intrinsic value of shares based on projected future cash flows (Sutjipto et al., 2020). However, the DCF method is highly dependent on investor assumptions, so the resulting value can vary (Martia et al., 2018). Therefore, further analysis is needed, namely technical analysis to ascertain whether in the future the stock performance will remain in the optimal position. One of the technical analysis that can be used to determine the condition of the stock performance is by forecasting future stock prices. The Holt-Winters time series forecasting method can be used in this case, taking into account the trend and seasonal patterns of historical data as well as data nonstationarity in PGN's stock price movements.

There are several previous studies that have conducted research on optimal stock performance analysis and stock price forecasting, including Sutjipto et al (2020) regarding the DCF method on the Indonesia Stock Exchange. Research by Anindya (2023) regarding the analysis of the fair price valuation of shares using the DCF method at PT Kalbe Farma. Anggraeni et al. (2022) research on the Holt-Winters method on Apple.inc shares. Based on these three studies, it can be concluded that the DCF method has a weakness that lies in the assumptions used, while the Holt-Winters method has a drawback, namely that it requires quite long historical data. Therefore, the analysis that can be done in this study is to combine the two methods, in other words, this research is a renewal of previous research because previous research is limited only to determining optimal stock performance.

This research aims as additional information for investors in making investment decisions in PT Perusahaan Gas Negara Tbk. Through fundamental analysis and technical analysis, this research can provide a comprehensive overview of optimal stock performance. In addition, this research can also provide insight into predicting future stock prices with the right forecasting model. Based on the description that has been presented, the title to be used in this research is "Analysis of Optimal Stock Performance with the Discounted Cash Flow Method and Stock Price Forecasting with the Holt-Winters Method".

Research Methods

The data in this study used secondary data taken from 2 main sources. The first source, PGN daily closing stock price data for the period January 1 to December 31, 2023, was obtained from the Yahoo Finance website (2024). This data includes detailed information on daily stock price fluctuations that are very important for analyzing stock movements. The second source, PGN 2023 annual report downloaded from the official website of PT Perusahaan Gas Negara Tbk. The data used

in the 2023 PGN annual report includes cash flow data, fixed assets and intangible assets data in the cash flow statement section, as well as total funding debt data, cash and cash equivalents data in the balance sheet assets and liabilities section.

Research Stages

This study consists of 2 stages of analysis in outline, namely the fundamental analysis stage and the technical analysis stage. The fundamental analysis stage used the discounted cash flow (DCF) method, while the technical analysis stage used the Holt-Winters method. Fundamental analysis with the DCF method is carried out to analyze the performance of optimal stocks, and technical analysis with the Holt-Winters method is used to test the performance of optimal stocks in the future.

Results and Discussion

Optimal Stock Performance Analysis

The optimal stock performance analysis of PT Perusahaan Gas Negara Tbk was carried out using the discounted cash flow (DCF) method. The optimal stock performance analysis with DCF is a fundamental analysis that uses PGN company data listed on the cash flow statement and balance sheet report. The result of the analysis using DCF is the intrinsic value of PGN shares, as a measure of the company's stock performance. The stock performance valuation with DCF is carried out as follows:

a. Determination of free cash flow

In the calculation of free cash flow, cash flow data from operating activities, as well as purchases of fixed assets and intangible assets of the PGN company in the 2023 PGN annual report consisting of data from 2019 to 2023. The data needed in the PGN 2023 annual report is the data section of the cash flow statement. The data in the PGN 2023 cash flow statement is presented in Table 2.

Table 2. Required Data in PGN Cash Flow Statement

Year	Net Cash Flow from Operating Activities (Rp)	Addition of Fixed Assets (Rp)
2019	13.282.566.096.240	3.906.507.964.800
2020	6.770.043.991.200	4.594.514.931.440
2021	1.197.165.956.700	1.000.462.252.300
2022	4.517.048.631.900	611.122.928.500
2023	782.567.855.300	311.997.740.600

The calculation of free cash flow in this analysis requires calculations for the last 5 years which are then averaged. In the next process, the value will be used for projections with a certain rate. This is done so that in the projection process, the calculation is neither too high nor too low, so the use of the average free cash flow for the last 5 years needs to be used. The free cash flow calculation uses equation (2), with the following calculation:

1. Free cash flow calculation in 2019

$$FCF = OCF - CAPEX$$

$$FCF_{2019} = OCF_{2019} - CAPEX_{2019}$$

$$= 13.282.566.096.240 - 3.906.507.964.800$$

$$= 9.376.058.131.440$$

The results of the calculation of free cash flow in 2019 obtained amounted to Rp. 9,376,058,131,440. This shows that PGN's financial performance is good, because the company produces positive FCF. The nominal result shows that after fulfilling operational needs and investing in fixed assets, the company still has enough cash for other activities in 2019.

2. Calculation of free cash flow in 2020

$$\text{FCF} = \text{OCF} - \text{CAPEX}$$
$$\text{FCF}_{2020} = \text{OCF}_{2020} - \text{CAPEX}_{2020}$$
$$= 6.770.043.991.200 - 4.594.514.931.440$$
$$= 2.175.529.059.760$$

The results of the calculation of free cash flow in 2020 amounted to Rp. 2,175,529,059,760. This shows that PGN's financial performance is good, with the company found to produce positive FCF. The nominal result shows that after meeting operational needs and investing in fixed assets, the company still has enough cash for other activities in 2020.

The calculation of free cash flow for 2021 to 2023 is carried out in the same process. The results of the free cash flow calculation are presented in Table 3.

Table 3. Free Cash Flow Calculation Results

Year	Free Cash Flow
2019	Rp 9,376,058,131,440
2020	IDR 2,175,529,059,760
2021	IDR 196,703,704,400
2022	IDR 3,905,925,703,400
2023	IDR 470,570,114,700

The results of the calculation of free cash flow for the past 5 years are then averaged; the average serves as the free cash flow used to be projected in the next process. The average calculation of free cash flow for the past 5 years is as follows:

$$\underline{\text{FCF}} = \frac{9.376.058.131.440 + 2.175.529.059.760 + \cdots + 470.570.114.700}{5}$$
$$\underline{\text{FCF}} = 3.224.957.342.740$$

The results of the calculation of the average free cash flow for the past 5 years amounted to Rp. 3,224,957,342,740, this value will be used in the free cash flow projection process with a certain rate in the DCF analysis.

b. Determination of net debt

In this study, the determination of net debt is determined for the year 2023. In calculating net debt, total debt data and cash and cash equivalents data for PGN are required. The data is contained in the balance sheet report in the 2023 PGN annual report. The data needed in PGN's balance sheet report is as follows:

Table 4. Required Data in PGN Balance Sheet Report

Component	Year 2023
Total Debt (IDR)	10.550.884.006.250

Cash and Cash Equivalents (Rp)	5.073.913.275.200

The net debt calculation used in the DCF analysis is only done for the last year's obligations. In this case, the net debt calculation is carried out for 2023. In the 2023 net debt calculation, equation (3) is used as follows:

$$ND = TD - C$$
$$ND = 10.550.884.006.250 - 5.073.913.275.200$$
$$ND = 5.476.970.731.050$$

The results of PGN 2023 net debt calculation amounted to Rp. 5,476,970,731,050, indicating that the total debt is greater than the cash owned. This condition indicates that the company's total liabilities exceed the amount of cash and cash equivalents available, so the company needs a strategy for proper debt management.

c. Free cash flow projection with growth rate

The free cash flow projection process with the growth component is used to illustrate the future value of the cash flow generated by the company. In this process, the growth rate plays a role in reflecting the expected growth of cash flow in the future. The stages of free cash flow projections are carried out as follows:

i. Determination of growth rate
At this stage, the growth rate for the first stage is 12% and for the second stage is 11%. The determination of the growth rate with the concept of two stages of growth has gone through a process of rate experiments from a range of 8% to 15% with the experimental results presented in Appendix 3.

ii. Free cash flow data
The data needed in this projection process is the average free cash flow data for the past 5 years obtained previously.

iii. Projection calculation
In this process, projections will be made for the next 5 years using equation (4) with the following calculations:

1. 1st year free cash flow projection

$$FCF_{t+1} = FCF_t \times (1 + g)$$
$$FCF_1 = 3.224.957.342.740 \times (1 + 12\%)$$
$$FCF_1 = 3.611.952.223.869$$

The results of the first-year free cash flow projection with a growth rate of 12% amounted to Rp. 3,611,952,223,869. This is a positive number, reflecting the PGN company's ability to increase cash flow.

2. Projected free cash flow year 2

$$FCF_{t+1} = FCF_t \times (1 + g)$$
$$FCF_2 = 3.611.952.223.869 \times (1 + 12\%)$$
$$FCF_2 = 4.045.386.490.733$$

The results of the second-year free cash flow projection with a growth rate of 12% amounted to Rp. 4,045,386,490,733. This is a positive number, reflecting the PGN company's ability to increase cash flow.

3. 3rd year free cash flow projection

$$FCF_{t+1} = FCF_t \times (1 + g)$$
$$FCF_3 = 3.611.952.223.869 \times (1 + 11\%)$$
$$FCF_3 = 4.045.386.490.733$$

Free cash flow projections for year 4 to year 5 with the same process as the same projection with a growth rate of 11%. The results of free cash flow projections with the growth rate component are presented in Table 5.

Table 5. Free Cash Flow Projection Results with Growth Rate Component

Year	Growth Rate	Free Cash Flow
1	12%	IDR 3,611,952,223,869
2	12%	IDR 4,045,386,490,733
3	11%	IDR 4,490,379,004,714
4	11%	IDR 4,984,320,695,232
5	11%	IDR 5,532,595,971,708

The results of free cash flow projections with a growth rate show the potential growth of the company's cash flow in the next 5 years. Based on the calculation results, free cash flow is expected to increase with a growth rate of 12% and 11%.

d. Present value projection with discount rate

The process of projecting present value with a discount rate component in DCF analysis aims to determine the present value of the free cash flow that has been projected previously. The discount rate acts as a determining factor, reflecting risk and the time value of money. The stages of the present value projection are carried out as follows:

i. Determination of discount rate

At this stage, a discount rate of 8% was determined for the projection.

The determination of the discount rate has gone through a process of rate experiments from a range of 8% to 15% with the experimental results presented in Appendix 3.

ii. Projection calculation

The process of projecting the present value using equation (5) with a discount rate of 8% is done as follows:

1. Projected present value of year 1

$$PV = \frac{CF_Y}{(1+d)^Y}$$
$$PV_1 = \frac{3.611.952.223.869}{(1 + 8\%)^1}$$
$$PV_1 = 3.344.400.207.286$$

The projected present value of the free cash flow expected in year 1 using a discount rate of 8% is Rp. 3,344,400,207,286. This condition states that the free cash flow of Rp. 3,611,952,223,8693 has a present value of Rp. 3,344,400,207,286.

2. Projected present value of year 2

$$PV = \frac{CF_Y}{(1+d)^Y}$$

$$PV_2 = \frac{4.045.386.490.733}{(1+8\%)^2}$$

$$PV_2 = 3.468.266.881.630$$

The projected present value of free cash flow expected in year 2 using a discount rate of 8% is Rp. 3,468,266,881,630. This condition states that the free cash flow of Rp. 4,045,386,490,733 has a present value of Rp. 3,468,266,881,630.

The calculation process is carried out with the same process for the projected present value of year 3 to year 5 with a discount rate of 8%. The present value results with the discount rate component are presented in Table 6.

Table 6. Present Value Projection Results with Discount Rate

Year	Discount Rate	Present Value
1	8%	IDR 3,344,400,207,286
2	8%	IDR 3,468,266,881,630
3	8%	IDR 3,564,607,628,342
4	8%	IDR 3,663,624,506,907
5	8%	Rp 3,765,391,854,321

e. Cash flow projection with terminal rate

The projection results reflect the value of all future cash flows beyond the free cash flow projection period that has been carried out, assuming that the company will continue to operate sustainably. The cash flow projection process is carried out using equation (6) with a terminal rate of 2% based on the experiment in Appendix 3.

Calculation of cash flow projections with the terminal rate as follows:

$$TV = \frac{FCF_5 \times (1+t)}{(d-t)}$$

$$TV = \frac{5.532.595.971.708 \times (1+2\%)}{(8\%-2\%)}$$

$$TV = 94.054.131.519.032$$

The results of cash flow projections with a terminal rate of 2% obtained Rp. 94,054,131,519,032. This condition illustrates that after year 5 the PGN company continues to operate, with the value of all cash flows after year 5 amounting to Rp. 94,054,131,519,032. The value of the cash flow projection results is then carried out as a present value projection, with the same discount rate as before to determine the present value of the terminal value. The calculation of the projected present value of the terminal value with equation (5) is as follows:

$$PV_{TV} = \frac{94.054.131.519.032}{(1+8\%)^5}$$

$$PV_{TV} = 64.011.661.523.456$$

The projected present value of the expected terminal value after year 5 using a discount rate of 8% is Rp. 64,011,661,523,456. This condition states that the terminal value of Rp. 94,054,131,519,032 has a present value of Rp. 64,011,661,523,456.

f. Determination of intrinsic value of shares

The calculation of the intrinsic value of shares with this DCF analysis, used calculations with predetermined components. The intrinsic value calculation used equation (1), with the number of PGN outstanding shares of 24,241,508,196.

The intrinsic value calculation is done as follows:

$$I = \frac{PV - ND}{SO}$$

$$I = \frac{(3.344.400.207.286 + 3.468.266.881.630 + \cdots + 64.011.661.523.456) - 5.476.970.731.050}{24.241.508.196}$$

$$I = 3.149{,}18$$

The result of the intrinsic value of PGN shares with 64,011,661,523,456 outstanding shares is 3,149.18. The intrinsic value of the shares is compared with the current share price of 1,140. This condition shows that PGN's current stock performance is in an optimal position, with the intrinsic value of the shares greater than the current stock price (undervalued). From these conditions, the decision to invest in PGN shares can provide benefits for investors.

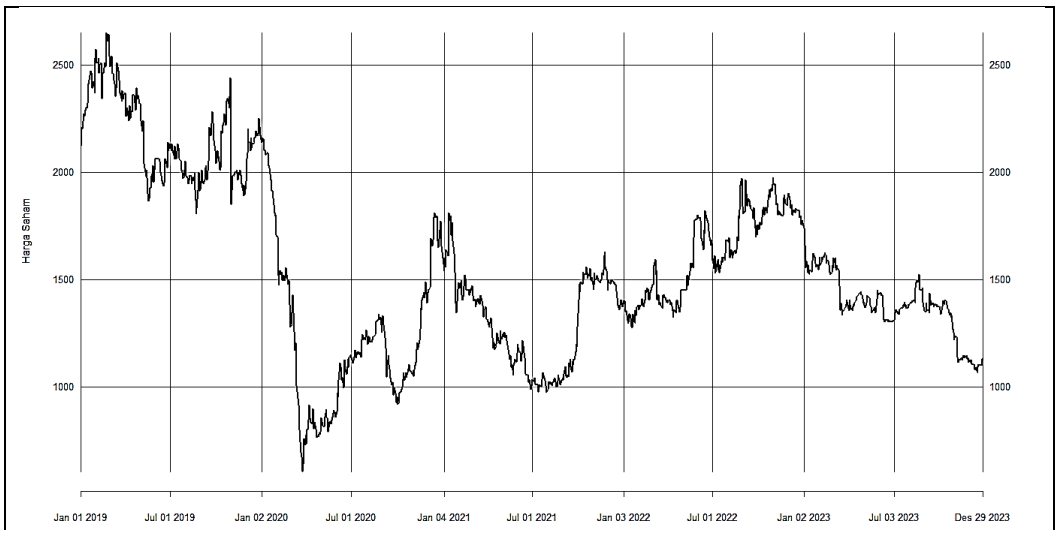
After obtaining the results of fundamental analysis with the results of PGN's undervalued stock performance, technical analysis is then carried out, namely stock price forecasting using the Holt-Winters method.

Optimal Stock Price Forecasting with the Holt-Winters Method

The role of technical analysis with the Holt-Winters method in analyzing the stock performance of PT Perusahaan Gas Negara Tbk is used for forecasting stock prices in the future, which serves to illustrate the optimality of PGN's stock performance. PGN stock price data for the period January 1, 2019 to December 31, 2023, obtained from the official Yahoo Finance website as many as 1,231. PGN stock price data is presented in Appendix 4. The stock price forecasting using Holt-Winters is carried out in the following stages:

1. Data Presentation

The data presentation process involves visualizing the time series data in a plot. This process aims to obtain a visual overview of the data. Data presentation with plots is shown in Figure 9.



Period

Figure 9. Time Series Data of PGN Stock Price

Figure 9 shows that the closing price data for PGN shares experienced significant fluctuations in 2020, which was the result of the Covid-19 pandemic. These fluctuations reflect the uncertainty faced by the market that affects economic conditions. Fluctuations in the closing price of PGN shares continued until the end of 2023.

2. Division of Training Data and Testing Data

In this study, stock price data totaling 1,231 data was divided into training and testing data. The training data used is 1,221 data with data from the period January 1, 2019 to December 13, 2023. The testing data used is 10 data with the period December 14 to December 31, 2023. Training data is used for the formation of forecasting models, while testing data is used for evaluating forecasting models.

3. Seasonal Effect Test

At this stage, a seasonal effect test is carried out on the daily PGN stock price data. This aims to determine whether there is a seasonal effect on the data, while the test used is the decomposition test. The decomposition test results are presented in Figure 10.

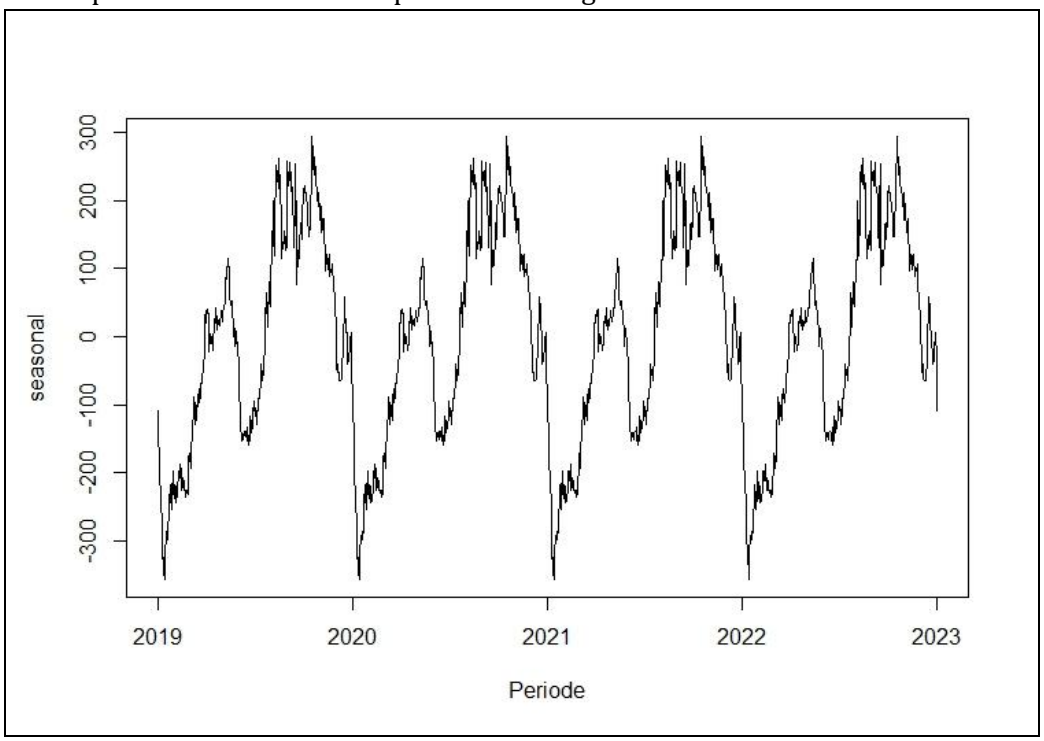


Figure 10. Seasonal Effect Test

Visually, Figure 10 shows that in the daily data of PGN stock prices there is a seasonal effect (seasonal pattern). The seasonal pattern in the data is additive type. This is due to the constant seasonal pattern in the same time period. This seasonal pattern tends to increase from January to June, then decreases until July and increases again until October. Furthermore, in October the pattern

decreases again until January. Apart from visually, a formal test can be used to test for seasonal effects. The stages of the seasonal effect test with the OCSB test are as follows:

1. Determination of significant level $\alpha = 0{,}05$
2. Hypothesis formation

H_0 : ρ = 1, No seasonal effect
H_1: ρ ≠ 1, There is seasonal effect

3. Calculation of t-statistic

$$t_{stat} = \frac{\hat{\rho}-1}{SE(\hat{\rho})}$$
$$t_{stat} = \frac{(-0{,}9569643878)-1}{0{,}053798}$$
$$t_{stat} = -36.3845$$

The calculation results obtained a t-statistic value of -36.3845.

4. Comparison with critical values

After the t-statistic calculation results are obtained, the next step is to compare the t-statistic value with the critical value (t-distribution) at the significance level. $\alpha = 0{,}05$. The degree of freedom (df) is $n - 2$ because it uses simple regression. Then obtained $df = 1221 - 2 = 1219$. The critical value from the t-distribution table for $df = 1219$ and 5% significance level is -1.6687.

5. Hypothesis decision

If the t-statistic < t-distribution at the significance level α, then the decision to reject H_0. At the previous stage, it is obtained that -36.3845 < -1.6687, so the decision is rejected. H_0. This shows that the PGN stock price data has a seasonal effect.

The results of the formal test of seasonal effects with the OCSB test are shown in Table 7.

Table 7. Results of the Formal Test for Seasonal Effects with the OCSB Test

Seasonal Effect Test	t-statistic	t-distribution	Description
OCSB Test	-36.3845	-1.6687	There is a seasonal effect

Table 7 shows the results of the seasonal effect test with the OCSB test. The test results show that there is a seasonal effect on PGN stock price data. The conclusion from the results of the seasonal effect test with the decomposition test and the formal test with the OCSB test concludes that the PGN stock price data has a seasonal effect. The type of seasonal effect on PGN stock price data shown in the decomposition test results is the additive seasonal type. The next stage after obtaining the additive seasonal pattern is the stage of forecasting PGN's stock performance in the coming period. The forecasting process begins with the formation of a forecasting model that is in accordance with the additive seasonal type.

4. Forecasting Model Building

At the modeling stage in this research, training data is used for model formation. The model building process begins with determining the exponential smoothing weights (α), trend smoothing weights (β), and seasonal smoothing weights (γ). The stages carried out are as follows:

1. Determination of exponential smoothing weights (α)

   Values α ranges from 0 to 1. α gives more weight to the most recent data. Also, a smaller α values give more weight to past data. Therefore, α larger values are required for a good model. The selection of the value α from 0 to 1 is done randomly with Rstudio. The value α that was selected was 0.8459903. Based on this, the α = 0,8459903 is used for the Holt-Winters model.
2. Determination of trend smoothing weights (β)

   Values β ranges from 0 to 1. β larger values give a fast response to trend changes, while smaller values give a slower response. β values give a slower response. Therefore, β smaller values are required for a good model. The selection of values β from 0 to 1 is done randomly with Rstudio. The value β The selected value is 0.0005911995. Based on this, the β = 0,0005911995 is used for the Holt-Winters model.
3. Determination of seasonal smoothing weights (γ)

   Just like the values of α and βvalue, the γ also ranges from 0 to 1. γ larger values adjust the seasonal pattern more quickly, while smaller values γ makes the seasonal pattern more stable. Therefore, γ larger values are required for a good model. The selection of values γ from 0 to 1 is done randomly with Rstudio. The value γ Based on this, the value selected is 1. γ = 1 is used for the Holt-Winters model.

Stages after obtaining the value α, β, and γ is the determination of the initial value of the exponential smoothing component (S_0), the initial value of the trend smoothing component (b_0), and the initial value of the seasonal smoothing component (l_k). The calculation of the initial value for the additive Holt-Winters model is as follows:

1. The initial value of the exponential smoothing component (S_0)

$$S_0 = \frac{1}{l}(x_1 + x_2 + \cdots + x_t)$$
$$S_0 = \frac{1}{305}(2120 + 2210 + \cdots + 1170)$$
$$S_0 = 1.353{,}4835785$$

2. The initial value of the trend smoothing component (b_0)

$$b_0 = \frac{1}{l}\left(\frac{x_{t+1}-x_1}{l} + \frac{x_{t+2}-x_2}{l} + \cdots + \frac{x_{t+l}-x_t}{l}\right)$$
$$b_0 = \frac{1}{305}\left(\frac{1205-2120}{305} + \frac{1125-2210}{305} + \cdots + \frac{1105-1170}{305}\right)$$
$$b_0 = -1{,}8490310$$

3. The initial value of the seasonal smoothing component (l_k)

$$l_k = x_t - S_0$$
$$l_k = x_t - 1.353{,}4835785$$

Based on the calculation of the weights and initial values of the smoothing components, the results of the calculation of the weights and initial values of the smoothing components of the Holt-Winters model are presented in Table 8.

Table 8. Holt-Winters Model Parameters

Parameters	Coefficient
α	0,8459903
β	0,0005911995
γ	1
S_0	1.353,4835785
b_0	-1,8490310
l_k	x_t −1.353,4835785

Table 8 shows the calculation results of the weights and initial values of the Holt-Winters smoothing model. After the weights and initial smoothing values are obtained, the model formation process is then carried out based on the calculation results as shown in Table 9.

Table 9. Holt-Winters Additive Method Forecasting Model

Component	Model
Exponential smoothing	$S_t = 0{,}8459903(x_t - 0{,}8459903l_{t-l}) + (1 - 0{,}8459903)(S_{t-1} + b_{t-1})$
Trend smoothing	$b_t = 0{,}0005911995(S_t - S_{t-1}) + (1 - 0{,}0005911995)b_{t-1}$
Seasonal smoothing	$l_t = 1(x_t - S_t) + (1 - 1)l_{t-l}$
Forecasting	$F_{t+m} = S_t + mb_t + l_{t-l+m}$

Table 9 shows the models that have been formed based on the calculation of weights and smoothing initial values obtained previously. These models are formed for forecasting with the Holt-Winters additive type. The stage after obtaining the additive Holt-Winters model presented in Table 8 is the process of evaluating the model formed.

5. Holt-Winters Model Evaluation

The Holt-Winters model evaluation process aims to evaluate the fitting power of the model. The evaluation stages are carried out by determining the comparison of model fitting power with actual data, then determining the MAPE value based on this comparison as an evaluation of the goodness of the model. The results of the model fitting power evaluation are presented in Figure 11.

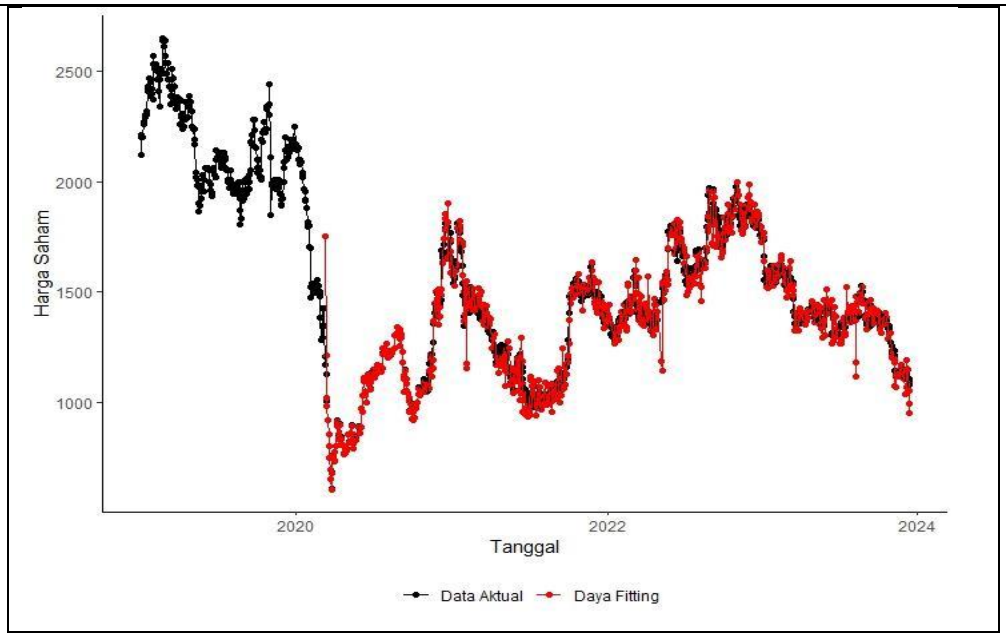


Figure 11. Model Fitting Power Plot

Figure 11 shows the model evaluation results in the form of a comparison of the model fitting power with the actual data. The evaluation results show that the model fitting power has followed the actual data pattern. This shows that the model has a good ability to capture the pattern of the actual data.

Evaluation after the pattern of the model fitting power is known is an evaluation based on the accuracy of the model formed. The accuracy measure is based on the mean absolute percentage error (MAPE). The calculation of the fitting power of the model obtained is as follows:

a. Calculation of fitting power of the 1st data

$$S_t = 0{,}8459903(x_t - 0{,}8459903l_{t-l}) + (1 - 0{,}8459903)(S_{t-1} + b_{t-1})$$

$$S_1 = 0{,}8459903(x_1 - 0{,}8459903(x_1 - 1.353{,}4835785)) + (1 - 0{,}8459903)(1.353{,}4835785 + (-1{,}8490310))$$

$$= 0{,}8459903\big(2.120 - 0{,}8459903(2.120 - 1.353{,}4835785)\big) + (1 - 0{,}8459903)(1.353{,}4835785 + (-1{,}8490310))$$

$$= 1976{,}0865 \approx 1976$$

$$b_1 = 0{,}0005911995(S_t - S_{t-1}) + (1 - 0{,}0005911995)b_{t-1}$$

$$= 0{,}0005911995(1454 - 1.353{,}4835785) + (1 - 0{,}0005911995)(-1{,}8490310)$$

$$= 0{,}0005911995(100{,}514215) + (0{,}9994088005)(-1{,}8490310)$$

$$= -2{,}800301$$

$$l_1 = 1(x_1 - S_t) + (1 - 1)l_{t-l}$$

$$= 1(2120 - 1976)$$

$$= 144$$

$$F_1 = S_t + mb_t + l_{t-l+m}$$

$$= 1976 + 1(-2{,}800301) + (144)$$

$$= 1.752{,}24847 \approx 1.752$$

b. Calculation of 2nd data fitting power

$$S_t = 0{,}8459903(x_t - 0{,}8459903l_{t-l}) + (1 - 0{,}8459903)(S_{t-1} + b_{t-1})$$
$$S_2 = 0{,}8459903(x_2 - 0{,}8459903(144)) + (1 - 0{,}8459903)(1975 + (-2{,}800301))$$
$$= 0{,}8459903\big(2.210 - 0{,}8459903(144)\big) + (1 - 0{,}8459903)(1976 + (-2{,}800301))$$
$$= 1510{,}3613 \approx 1510$$
$$b_2 = 0{,}0005911995(S_t - S_{t-1}) + (1 - 0{,}0005911995)b_{t-1}$$
$$= 0{,}0005911995(1510 - 1976) + (1 - 0{,}0005911995)(-2{,}800301)$$
$$= 0{,}0005911995(68) + (0{,}9994088005)(-1{,}75153)$$
$$= -3{,}073982$$
$$l_2 = 1(x_2 - S_2) + (1 - 1)l_{t-l}$$
$$= 1(2210 - 1510)$$
$$= 700$$

$$F_2 = S_t + mb_t + l_{t-l+m}$$
$$= 1510 + 1(-3{,}073982) + (700)$$
$$= 1.209{,}28971 \approx 1.209$$

The process of calculating the fitting power for the 3rd period until the 1221th period is carried out in the same process. The results of the calculation of the fitting power that has been obtained compared to the training data are presented in Table 10.

Table 10. Evaluation of Fitting Power to Training Data

t (Days)	Fitting Power (Rp)	Training Data (Rp)
1	1.752	2.120
2	1.209	2.210
3	1.018	2.200
4	982	2.200
5	915	2.270
6	855	2.260
7	800	2.260
8	745	2.290
9	694	2.300
	⋮	⋮
1219	1.185	1.105
1220	1.084	1.090
1221	953	1.080

Table 10 shows the evaluation results of the Holt-Winters model for forecasting training data. The evaluation results are calculated with MAPE accuracy to illustrate how much accuracy the fitting power is on the training data. The calculation of fitting accuracy with MAPE is as follows:

$$\text{MAPE} = \frac{1}{1221}\sum_{t=1}^{1221} \left|\frac{X_t - F_t}{X_t}\right| \times 100$$
$$\text{MAPE} = \frac{1}{1221}\left(\frac{2.120-1.752}{2.120} + \frac{2.210-1.209}{2.210} + \cdots + \frac{1.080-953}{1.080}\right) \times 100$$
$$\text{MAPE} = 29\%$$

After the evaluation process of the model fitting power is obtained, the next step is to use the model in the PGN stock price forecasting process.

6. Stock Price Forecasting

Stock price forecasting is done to provide an overview of stock price conditions in the next few periods. In this analysis, PGN stock price forecasting is carried out for the next 10 days with a predetermined model. The forecasting results show the prediction of PGN's stock price every day in the next 10 days. The forecasting results will be visualized in the form of a plot shown in Figure 12.

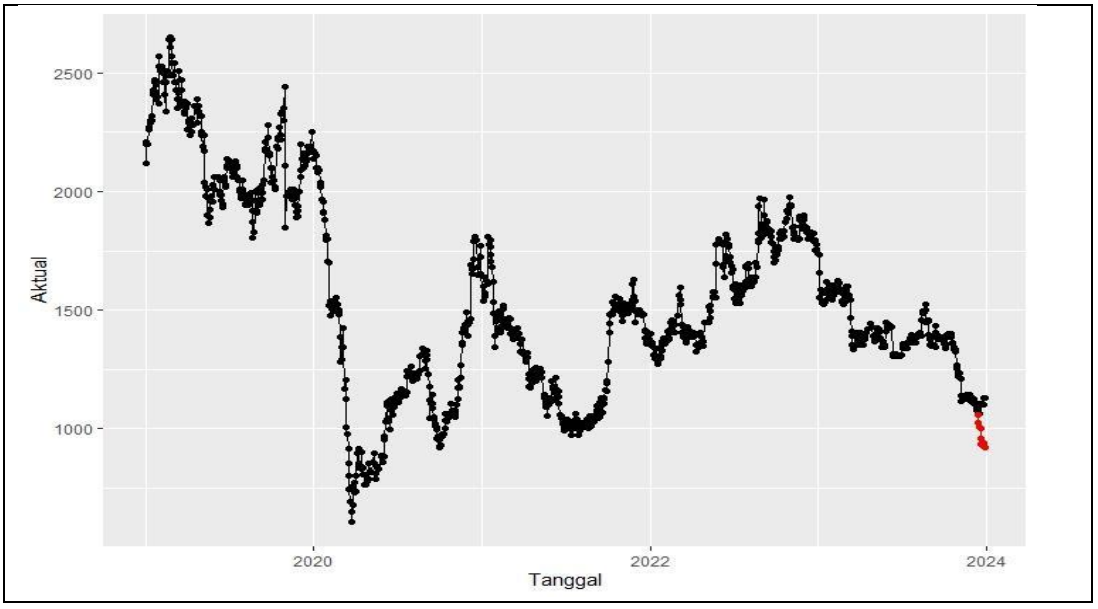


Figure 12. Plot of PGN Stock Price Forecasting Results

Figure 12 shows the results of PGN stock price forecasting for the next 10 days marked with a red pattern. The plot illustrates the condition of the stock price for the first 10 days of 2024, which is predicted to tend to decrease during the observation period. The results of PGN stock price forecasting are shown in Table 11.

Table 11. PGN Stock Price Forecasting Results

t (days)	Forecasting (Rp)
1	1059
2	1025
3	1007
4	1006
5	1001
6	961
7	934
8	940
9	925
10	921

Table 11 shows the results of PGN stock price forecasting in the first 10 days of 2024. Based on the forecasting results, it shows that PGN's stock price is predicted to decline over the next 10 periods. The results of this stock price forecasting when compared with the intrinsic value of the previously obtained stock price of 3,149.18, it will be decided that the prediction of stock performance in the next 10 periods is declared optimal.

7. Evaluation of Forecasting Results

The results of PGN stock price forecasting with the Holt-Winters additive model obtained previously, then evaluate the forecasting results. In this study, the mean absoluted percentage error (MAPE) is used to measure the level of forecasting accuracy. Comparison of stock price forecasting results with actual data is presented in Figure 13.

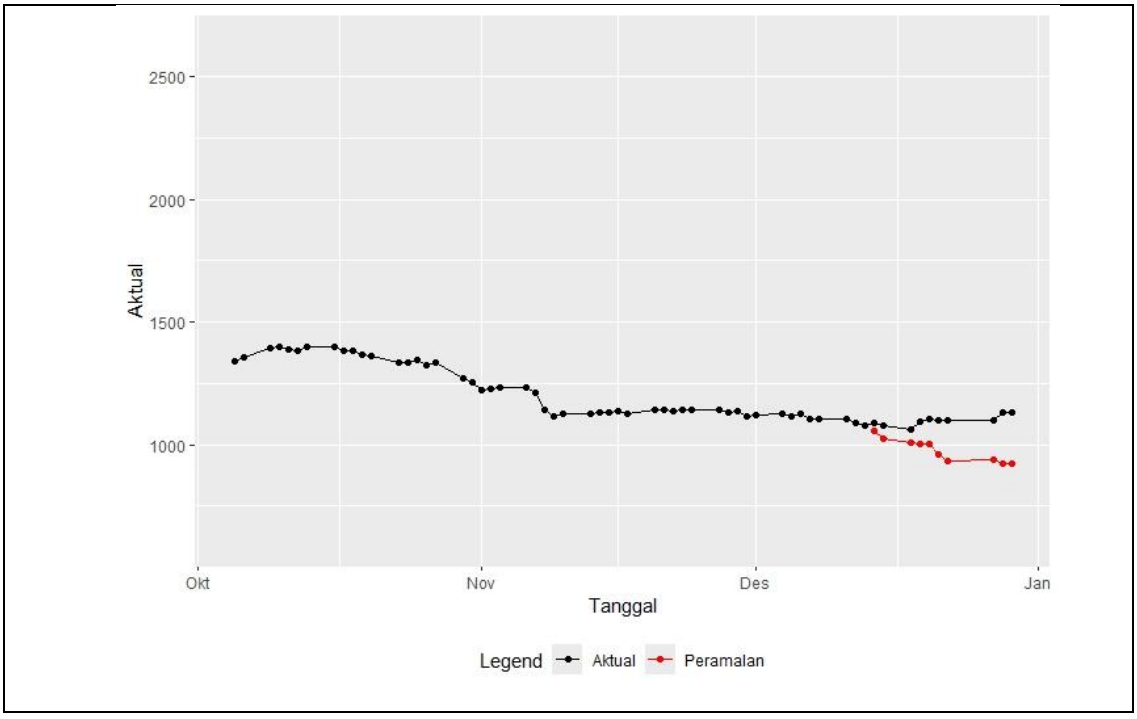


Figure 13. Comparison of Forecasting Results with Actual Data

Based on Figure 13, a comparison between the forecasting results marked in red and the actual data marked in black is shown. The results of the comparison with Figure 13 show that the forecasting results tend to follow the actual data pattern. The comparison results are presented in Table 12.

Table 12. Comparison of Forecasting Results with Actual Data

t (Days)	Forecasting Power (Rp)	Actual Data (Rp)
1	1059	1090
2	1025	1080
3	1007	1065
4	1006	1095

5	1001	1105
6	961	1100
7	934	1100
8	940	1100
9	925	1130
10	921	1130

Table 12 shows that the stock price forecasting results have a value that is relatively not much different from the actual data. Therefore, the forecasting results are calculated with MAPE to illustrate the forecasting accuracy. The calculation of forecasting power accuracy with MAPE is carried out as follows:

$$\text{MAPE} = \frac{1}{10}\sum_{t=1}^{10} \left|\frac{X_t - F_t}{X_t}\right| \times 100$$

$$\text{MAPE} = \frac{1}{10}\left(\frac{1090-1059}{1090} + \frac{1080-1025}{1080} + \cdots + \frac{1130-921}{1130}\right) \times 100$$

$$\text{MAPE} = 10{,}9\%$$

The evaluation results show that the forecasting results perform well. This is based on the results of obtaining a MAPE value of 10.9%. Therefore, the forecasting that has been done shows that the forecasting performance is performing well.

Conclusion

Based on the results of the previous explanation, this research can conclude that The results of the analysis of the optimal stock performance of PT Perusahaan Gas Negara Tbk using the discounted cash flow (DCF) method obtained that PGN shares have optimal performance. These results obtained by comparing the results of the intrinsic value of shares with the current share price show that the intrinsic value of shares is undervalued or the performance of PGN shares is categorized as optimal. The forecasting results of PGN stock prices, using the Holt-Winters method, show that the forecasting results have a pattern that follows the actual data. The forecasting results obtained indicate that the predicted stock price is in the optimal stock performance category for the first 10 days of 2024. Evaluation of stock price forecasting results with mean absoluted percentage error (MAPE) obtained 10.9%. This shows that the forecasting performance has performed well.

The suggestions that can be proposed based on the research results that have been obtained include: Future research can use deep learning methods for technical analysis in big data forecasting. In addition, future research can consider the use of external factors such as macroeconomic conditions, market news, and social media sentiment that can affect stock prices. Prospective investors are advised to conduct a more in-depth fundamental analysis by monitoring the latest developments about the PGN company and considering conducting technical analysis to complement the fundamental analysis conducted.

References

Anggraeni, A. S., Utama, R. C., & Wati, D. C. (2022). Penghalusan eksponensial dan dekomposisi saham Apple.inc. *Jurnal Sintak*, *1*(1), 24–30.

Anindya, V. (2023). Analisis Penilaian Harga Wajar Saham Dengan Metode Discounted Cash Flow (Studi Kasus Pada PT Kalbe Farma Tahun 2022). *Jurnal Pasar Modal Bisnis*, *5*(2).

Ardesfira, G., Zedha, H. F., Fazana, I., Rahmadhiyanti, J., Rahima, S., & Anwar, S. (2022). Peramalan nilai tukar rupiah terhadap dollar amerika dengan menggunakan metode Autoregressive Integrated Moving Average (ARIMA). *Jambura Journal of Probability and Statistics*, *3*(2), 71–84. https://doi.org/10.34312/jjps.v3i2.15469

Asriawan, Permata, S. U., & Fausan, M. I. (2022). Pendekatan univariate time series modeling untuk prediksi kuartalan pertumbuhan ekonomi Indonesia pasca vaksinasi COVID-19. *JAMBURA: Journal of Mathematics, 4(1),* 86-103. https://doi.org/10.34312/jjom.v4i1.11717

Hartono, J. (2016). *Teori portofolio dan analisis investasi* (Edisi ke-10). BPFE Yogyakarta.

Hassyddiqy, H., & Hasdiana, H. (2023). Analisis Peramalan (Forecasting) Penjualan Dengan Metode ARIMA (Autoregressive Integrated Moving Average) Pada Huebee Indonesia. *Data Sciences Indonesia (DSI)*, *2*(2), 92–100. https://doi.org/10.47709/dsi.v2i2.2022

Hyndman, R. J., & Athanasopoulos, G. (2018). *Forecasting: Principles and practice* (3rd ed.).

Krisma, A., Azhari, M., & Widagdo, P. P. (2019). Perbandingan metode double exponential smoothing dan triple eksponensial smoothing dalam parameter tingkat error mean absolute percentage error (MAPE) dan mean absolute deviation (MAD). *Jurnal Ilmu Komputer dan Teknologi Informasi, 4(2),* 81-87. http://download.garuda.kemdikbud.go.id/

Martia, D. Y., Setyawati, W., & Hastuti, Y. (2018). Analisis Valuasi Saham PT. Semen Indonesia (Persero) Tbk Dengan Metode Discounted Cash Flow (DCF). *Jurnal Aktual Akuntansi Keuangan Bisnis Terapan (AKUNBISNIS)*.

OJK. (2024). Saham. *Otoritas Jasa Keuangan*. https://sikapiuangmu.ojk.go.id/FrontEnd/CMS/Category/64

PT Perusahaan Gas Negara Tbk. (2024). Laporan Tahunan 2023. *PT Perusahaan Gas Negara Tbk*. https://ir.pgn.co.id/AssetFiles/Financial/AnnualReport/laporan_tahunan_2023.pdf

Putri, R. D., & Sihombing, P. (2020). The effect of stock split announcement on the trading volume activity, abnormal return, and bid ask spread (Study On Companies Listed On The IDX For The Period Of 2015-2019). *Dinasti International Journal of Economics, Finance & Accounting*, *1*(4), 696–709. https://doi.org/10.38035/dijefa.v1i4.546

Sutjipto, E., Setiawan, W., & Ghozali, I. (2020). Determination of Intrinsic Value: Dividend Discount Model and Discounted Cash Flow Methods in Indonesia Stock Exchange. *International Journal of Management*, *11*(1), 1842–1852.

Yahoo Finance. (2024). PT. Perusahaan Gas Negara Tbk (PGAS.JK). *Yahoo Finance*. https://finance.yahoo.com/quote/PGAS.JK/history/?period1=1546300800&period2=1703980800&guccounter=1

Yohana, Gaol, R. M. L., Dewi, G. K., Kalbuana, N., & Abdusshomad, A. (2021). Pengaruh free cash flow, probabilitas, kualitas audit, laverage, kebijakan dividen terhadap liabilitas pada perusahaan terdaftar di Jakarta Islamic Index. *Jurnal Ilmiah Ekonomi Islam, 7(3).* http://jurnal.stie-aas.ac.id/index.php/jie