VOLUME 1
Issue 2, December 2024

GOLD STOCK PRICE PREDICTION: ARIMA TIME SERIES ANALYSIS OF PT ANTAM TBK

Azril Rabbani Hawa[1]
Dian Nur Safitri[2]
Eka Prasetianingsih[3]
Augistri Putri Pradani[4*]

[1,2,3,4]*Universitas Putra Bangsa Kebumen, Indonesia*

Article || Published: 30/12/2024
10.58989/symmerge.v1i2.25
augistri@fst.universitasputrabangsa.ac.id

How to cite || Hawa, Azril Rabbani., Safitri, Dian Nur., Prasetianingsih, Eka., & Pradani, Augistri Putri. (2024). Gold Stock Price Prediction: Arima Time Series Analysis of PT Antam Tbk. *Symmetry & Sigma: Journal of Mathematical Structures and Statistical Patterns*, 1(2), 116–131. https://doi.org/10.58989/symmerge.v1i2.25

YNIMGM
YAYASAN NURUL IMAN | MUARA GADING MAS
e-ISSN: 3047-6380

SYMMETRY & SIGMA
Journal of Mathematical Structures and Statistical Patterns

Abstract || Stock investment is a popular choice for securing future financial stability due to its long-term income potential. Shares of PT Antam Tbk (Antam), commonly referred to as gold stocks, exhibit a strong correlation with gold prices, particularly during periods of global economic and geopolitical uncertainty. This study aims to forecast stock prices using the ARIMA (Auto Regressive Integrated Moving Average) time-series model, considering the role of gold as a global currency. The data utilized in this study includes stock prices and relevant influencing factors, such as gold prices and global socio-economic conditions. The analysis results indicate that the ARIMA (5, 2, 0) model is the most suitable for forecasting stock prices, as it yields the lowest Akaike Information Criterion (AIC) value of 0.151031. This model effectively captures significant patterns and trends in the data, making it a reliable tool for predicting future stock prices. The forecast suggests that stock prices are expected to increase over the next 12 months, with an estimated value reaching approximately 1,880.554 by the end of the period.

Keywords || Antam Stock; Gold Prices; ARIMA (Time Series); Stock Price Forecasting

Abstrak || Investasi saham menjadi pilihan populer untuk mempersiapkan dana masa depan dengan potensi penghasilan jangka panjang. Saham PT Antam Tbk (Antam), yang dikenal sebagai saham emas, menunjukkan hubungan erat dengan harga emas, terutama di tengah ketidakpastian ekonomi dan geopolitik global. Penelitian ini bertujuan meramalkan harga saham), menggunakan model Arima (Time Series), dengan mempertimbangkan prospek emas sebagai mata uang dunia. Data yang digunakan mencakup harga saham), dan faktor terkait, seperti harga emas dan kondisi sosial ekonomi global. Hasil analisis menunjukkan bahwa model Arima (5,2,0) merupakan model terbaik untuk peramalan harga saham), dengan nilai Akaike Information Criterion (AIC) terkecil sebesar 0,151031. Model ini mampu menangkap pola dan tren signifikan dalam data, sehingga akurat untuk prediksi harga saham di masa depan. Prediksi menunjukkan harga saham), diperkirakan meningkat dalam 12 bulan ke depan, dengan estimasi mencapai 1880,554 pada akhir periode.

Katakunci || Saham Antam; Harga emas; Arima (Time Series); Prediksi Harga Saham

Introduction

Investment is a form of activity undertaken to develop assets, with the goal of achieving various outcomes, including a prosperous and financially secure life (Surya et al., 2021). One popular type of long-term investment is stock investment. Stock investment involves the allocation of capital into a company, whereby investors gain partial ownership through shares (Yeni et al., 2024). By holding shares, investors are entitled to a portion of the company's assets and may participate in shareholder meetings, offering them the opportunity to influence decision-making that impacts the company's direction.

The primary purpose of stock investment is to secure funds for the future. With a well-devised strategy, this type of investment can generate stable, long-term returns (Demirel et al., 2023). These returns stem from both the appreciation of stock prices and dividends distributed by the company to its shareholders. Furthermore, stock investment can serve as capital for future needs, whether for business expansion, education, or other purposes. The returns from such investments can become a valuable source of funds. Therefore, understanding the risks and strategies associated with investment is crucial to maximizing the potential benefits from stock investments.

Antam shares, commonly referred to as gold stocks, represent a company that produces Antam-certified gold bars. This certification assures investors of the quality and reliability of the product, making Antam shares an attractive investment choice for those interested in the gold industry (PT Aneka Tambang Tbk, 2023). As a result, Antam shares are a preferred investment option for individuals looking to invest in the precious metals sector, which has promising prospects.

In addition to investing in Antam shares, physical gold investment remains highly appealing. Gold has long been regarded as a safe-haven asset capable of withstanding economic volatility. Its value tends to remain stable, making it a preferred option for investors seeking low-risk investment instruments.

Although the return on gold investment may not be as high as that of other investment vehicles, its stability is an inherent advantage. In comparison to stocks or other higher-risk assets, gold offers a safer means of value preservation over the long term. Consequently, both Antam shares and physical gold represent viable investment options, depending on the investor's risk profile and financial objectives (Widuhung, 2014).

The prices of gold and Antam shares are influenced by similar or interconnected factors. Both are closely linked to global economic conditions, monetary policies, and market supply and demand. As gold prices increase, the value of Antam shares typically rises as well, given the company's operations in the gold and precious metals mining sector.

Socio-economic conditions play a significant role in determining fluctuations in gold prices. Factors such as inflation, interest rates, currency exchange rates, and political instability can trigger substantial changes in the price of gold (Hasanudin et al., 2022). Therefore, it is crucial for investors to understand market dynamics in order to make informed decisions when investing in gold or related stocks.

To anticipate unforeseen price changes, forecasting gold prices is an essential step for investors. By analyzing historical trends, global economic factors, and government policies, investors can predict potential gold price movements in the future (Maryati et al., 2023). A comprehensive understanding of these factors aids in developing a more informed investment strategy, thereby reducing the risk of financial loss (Amri et al., 2024).

During periods of global economic and geopolitical uncertainty, such as the Covid-19 pandemic and the Middle East conflict, gold prices tend to rise, and Antam shares also experience increases, as investors seek safer assets. Previous research conducted by Dewi et al (2022) found that during the Covid-19 pandemic, gold prices rose within 30 days, with a daily percentage increase of 1-3%. Similarly, when prospects for global economic recovery led to declines in gold prices, Antam shares also tend to decrease as investors shift their investments to riskier assets.

In recent years, fluctuations in fiat currency values and global economic uncertainty have led to discussions about replacing conventional currencies with gold. Some argue that gold, as an asset with intrinsic value and long-term stability, can serve as a safer alternative to fiat currencies, which are vulnerable to inflation and monetary policy changes.

Moreover, the price of precious metals, particularly gold, is expected to increase significantly in the future. This projection is based on various global economic factors, including growing demand for gold as a hedge against economic and geopolitical uncertainty. Gold is often the primary choice for investors during periods of financial market pressure, which further drives price increases.

A key factor expected to accelerate the increase in gold prices is the interest rate cut policy by the United States Federal Reserve (Crafts & Fearon, 2010). As interest rates decrease, dollar-based investment yields tend to weaken, prompting investors to shift their investments toward more stable assets, such as gold. This shift may reinforce the upward trend in gold prices over the long term.

This optimism followed the rise in U.S. inflation in October, which is likely to have a significant impact on the future increase in Antam shares. Previous research has demonstrated that the price of gold and the exchange rate of the dollar against the rupiah influence the share price of PT. Antam Tbk (Sinay et al., 2018). The increase in gold prices positively impacts Antam's stock returns (Faraga et al., 2017). The purpose of this study is to conduct a predictive analysis of Antam's share price in the future, considering the anticipated increase in gold prices and the potential shift toward gold as the world's currency.

Methodology

The data used in this study are secondary data. This study covers the stock price data of PT. Antam Tbk for the period from January 2010 to December 2024. The data is collected on a monthly basis, and data processing is carried out using EViews software. The methodology employed in this study involves the collection, examination, and analysis of scientific data obtained from research materials. Data analysis is conducted using the Arima method. Before applying the Arima method to the data, several preliminary tests are performed, including stationarity tests, differencing processes, and correlograms, to determine the autoregression coefficient. The following are the stages of Arima analysis that are conducted for forecasting:

Data Stationarity

Stationarity testing of the data is performed using the autocorrelation function correlogram (ACF and PACF) to identify time patterns. If the data is non-stationary, a log transformation or differencing process is applied until the data becomes sufficiently stationary (Greunen et al., 2014).

Determining the Values of p, d, and q in Arima

Once the time-series data is sufficiently stationary, the next step is to determine the Arima model (*p*, *d*, *q*). The values of *p* and *q* are

determined by observing the ACF and PACF function patterns of the stationary data, while the value of d is determined by the number of differencing operations required to achieve stationarity (Rahmawati et al., 2021).

Arima Model Parameter Estimation

Parameter significance testing is conducted on the Arima model to assess whether the model is statistically significant. If the model is sufficiently significant, the analysis proceeds to the next stage; otherwise, further tests are conducted using alternative Arima models (Muis & Setiyadi, 2020).

Forecasting

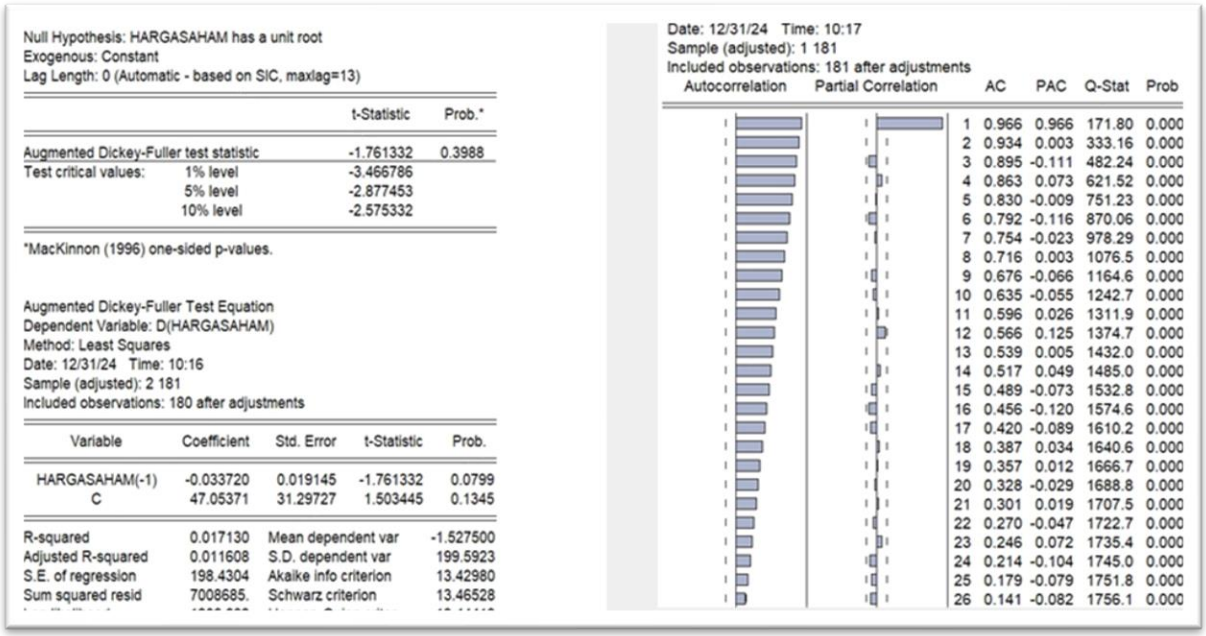
During the forecasting stage, the best model is selected based on the previous analysis. This model is chosen by evaluating its accuracy, relevance to the data used, and its ability to describe the patterns and trends in the data. The results of the forecast serve as the foundation for decision-making or recommendations in the study. By understanding the patterns that emerge, researchers can identify potential changes and provide a clearer insight into the phenomenon being investigated.

Analysis and Discussion

Based on the plot below, it is evident that the data still exhibits a trend, indicating that the data is not yet stationary. This trend suggests a change in pattern over time, both in terms of the mean and variance. Non-stationarity can compromise the accuracy of subsequent analyses, necessitating steps to stabilize the data.

Figure 1. Stock Price Trend Plot

Moreover, the results of statistical tests confirm that the data is not stationary. This is evident from the probability value (p-value), which is greater than the significance level of $\alpha = 0.05$. In the stationarity test, when the p-value exceeds the significance threshold, the null hypothesis (H_0), which asserts that the data is non-stationary, cannot be rejected.



Null Hypothesis: HARGASAHAM has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=13)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.761332	0.3988
Test critical values:	1% level	-3.466786	
	5% level	-2.877453	
	10% level	-2.575332	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(HARGASAHAM)
Method: Least Squares
Date: 12/31/24 Time: 10:16
Sample (adjusted): 2 181
Included observations: 180 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
HARGASAHAM(-1)	-0.033720	0.019145	-1.761332	0.0799
C	47.05371	31.29727	1.503445	0.1345

R-squared	0.017130	Mean dependent var	-1.527500
Adjusted R-squared	0.011608	S.D. dependent var	199.5923
S.E. of regression	198.4304	Akaike info criterion	13.42980
Sum squared resid	7008685.	Schwarz criterion	13.46528

Date: 12/31/24 Time: 10:17
Sample (adjusted): 1 181
Included observations: 181 after adjustments

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
		1	0.966	0.966	171.80	0.000
		2	0.934	0.003	333.16	0.000
		3	0.895	-0.111	482.24	0.000
		4	0.863	0.073	621.52	0.000
		5	0.830	-0.009	751.23	0.000
		6	0.792	-0.116	870.06	0.000
		7	0.754	-0.023	978.29	0.000
		8	0.716	0.003	1076.5	0.000
		9	0.676	-0.066	1164.6	0.000
		10	0.635	-0.055	1242.7	0.000
		11	0.596	0.026	1311.9	0.000
		12	0.566	0.125	1374.7	0.000
		13	0.539	0.005	1432.0	0.000
		14	0.517	0.049	1485.0	0.000
		15	0.489	-0.073	1532.8	0.000
		16	0.456	-0.120	1574.6	0.000
		17	0.420	-0.089	1610.2	0.000
		18	0.387	0.034	1640.6	0.000
		19	0.357	0.012	1666.7	0.000
		20	0.328	-0.029	1688.8	0.000
		21	0.301	0.019	1707.5	0.000
		22	0.270	-0.047	1722.7	0.000
		23	0.246	0.072	1735.4	0.000
		24	0.214	-0.104	1745.0	0.000
		25	0.179	-0.079	1751.8	0.000
		26	0.141	-0.082	1756.1	0.000

Figure 2. Stationarity Test and Autocorrelation Analysis of Stock Price Time Series Data

Therefore, data transformation or differencing is required to achieve stationarity. This step is crucial to ensure that the data can be

analyzed with greater accuracy and that the forecasting results are more reliable. Once the data is confirmed to be stationary, the appropriate model can be applied for further analysis. To address non-stationarity in variance, data transformation is performed using the logarithmic method, specifically by applying Log(data). This transformation aims to stabilize the variance and reduce extreme fluctuations in the data, allowing for clearer patterns to emerge. As a result, the data analysis can be conducted with greater accuracy and validity.

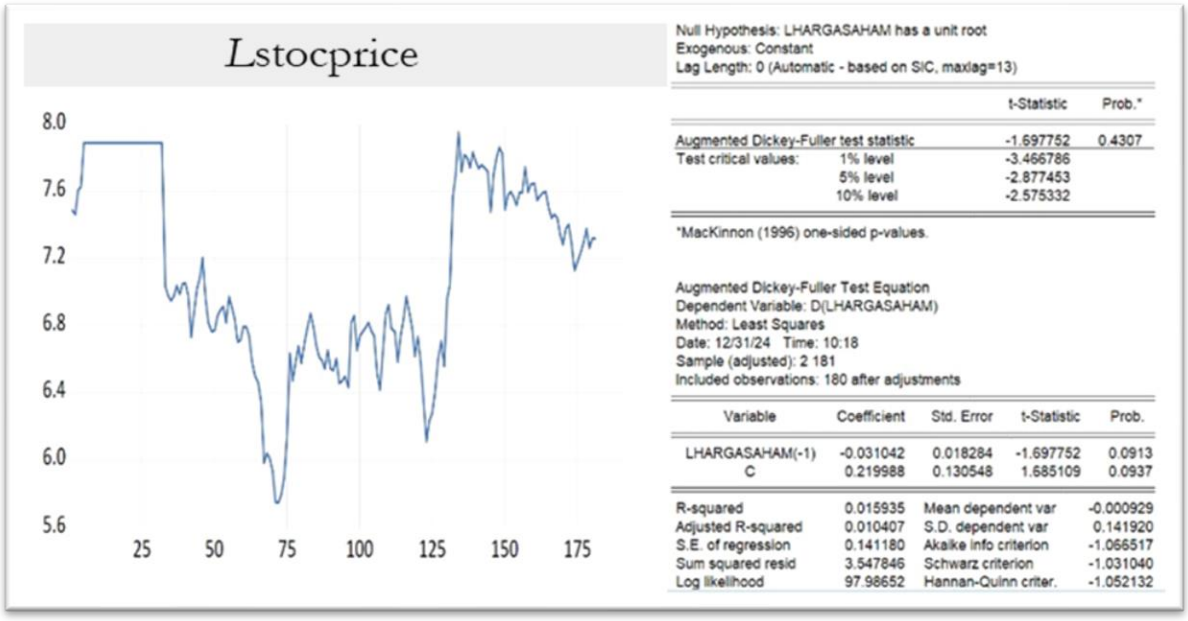
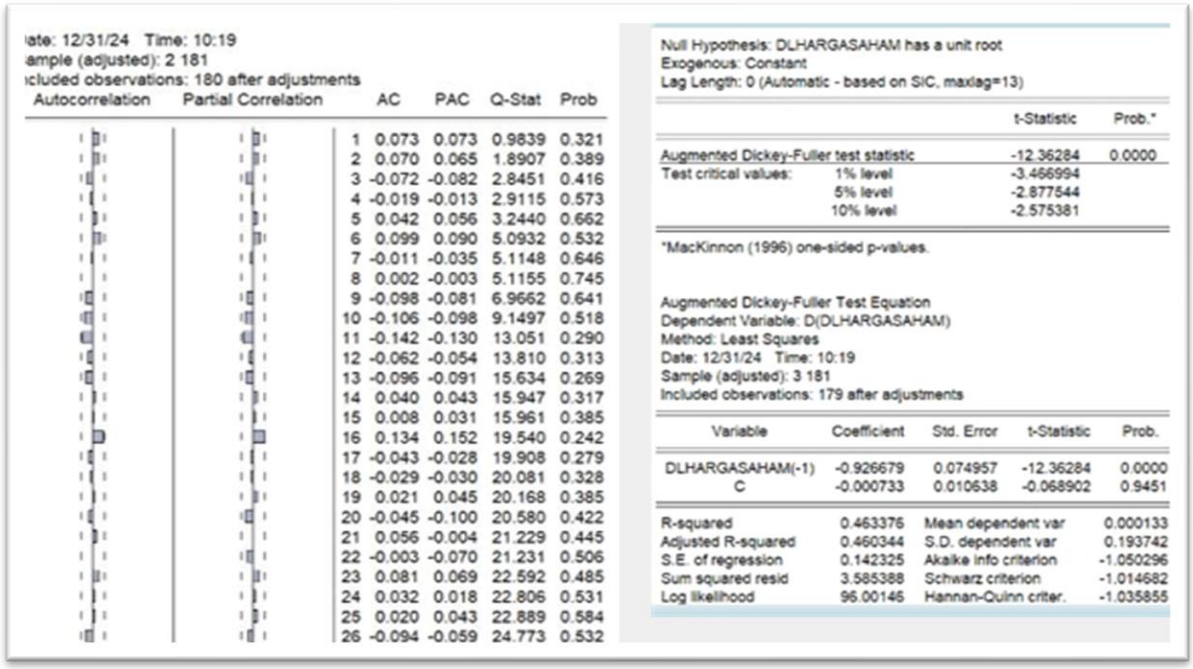


Figure 3. Time Series Analysis of *L*stockprice

However, based on the *L*hargasaham (*L*stockproce) data plot above, the logarithmic transformation has not fully rendered the data stationary in terms of the mean. This is apparent from the data pattern, which still displays a trend, indicating that the mean continues to change over time. This trend suggests that the data still contains a pattern that must be removed in order to satisfy the stationarity assumption.



ate: 12/31/24 Time: 10:19
ample (adjusted): 2 181
ncluded observations: 180 after adjustments

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
		1	0.073	0.073	0.9839	0.321
		2	0.070	0.065	1.8907	0.389
		3	-0.072	-0.082	2.8451	0.416
		4	-0.019	-0.013	2.9115	0.573
		5	0.042	0.056	3.2440	0.662
		6	0.099	0.090	5.0932	0.532
		7	-0.011	-0.035	5.1148	0.646
		8	0.002	-0.003	5.1155	0.745
		9	-0.098	-0.081	6.9662	0.641
		10	-0.106	-0.098	9.1497	0.518
		11	-0.142	-0.130	13.051	0.290
		12	-0.062	-0.054	13.810	0.313
		13	-0.096	-0.091	15.634	0.269
		14	0.040	0.043	15.947	0.317
		15	0.008	0.031	15.961	0.385
		16	0.134	0.152	19.540	0.242
		17	-0.043	-0.028	19.908	0.279
		18	-0.029	-0.030	20.081	0.328
		19	0.021	0.045	20.168	0.385
		20	-0.045	-0.100	20.580	0.422
		21	0.056	-0.004	21.229	0.445
		22	-0.003	-0.070	21.231	0.506
		23	0.081	0.069	22.592	0.485
		24	0.032	0.018	22.806	0.531
		25	0.020	0.043	22.889	0.584
		26	-0.094	-0.059	24.773	0.532

Null Hypothesis: DLHARGASAHAM has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=13)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-12.36284	0.0000
Test critical values:	1% level	-3.466994	
	5% level	-2.877544	
	10% level	-2.575381	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(DLHARGASAHAM)
Method: Least Squares
Date: 12/31/24 Time: 10:19
Sample (adjusted): 3 181
Included observations: 179 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
DLHARGASAHAM(-1)	-0.926679	0.074957	-12.36284	0.0000
C	-0.000733	0.010638	-0.068902	0.9451

R-squared	0.463376	Mean dependent var	0.000133
Adjusted R-squared	0.460344	S.D. dependent var	0.193742
S.E. of regression	0.142325	Akaike info criterion	-1.050296
Sum squared resid	3.585388	Schwarz criterion	-1.014682
Log likelihood	96.00146	Hannan-Quinn criter.	-1.035855

Figure 4. Stationarity Test of *DL*stockprice

Additionally, the results of the statistical test indicate that the probability value (Prob) remains greater than $\alpha = 0.05$. Consequently, the null hypothesis (H0), which states that the data is not stationary, cannot be rejected. Therefore, to achieve stationarity in the mean, further steps, such as data differencing, are necessary to ensure more accurate forecasting analysis. To address the issue of non-stationarity, even after applying the logarithmic transformation, the next step is to implement the first differencing process on the *DL*stockprice data. Differencing is used to remove any remaining trends by calculating the difference between the current observation and the previous one. This process helps stabilize the mean, making the data more suitable for further analysis.

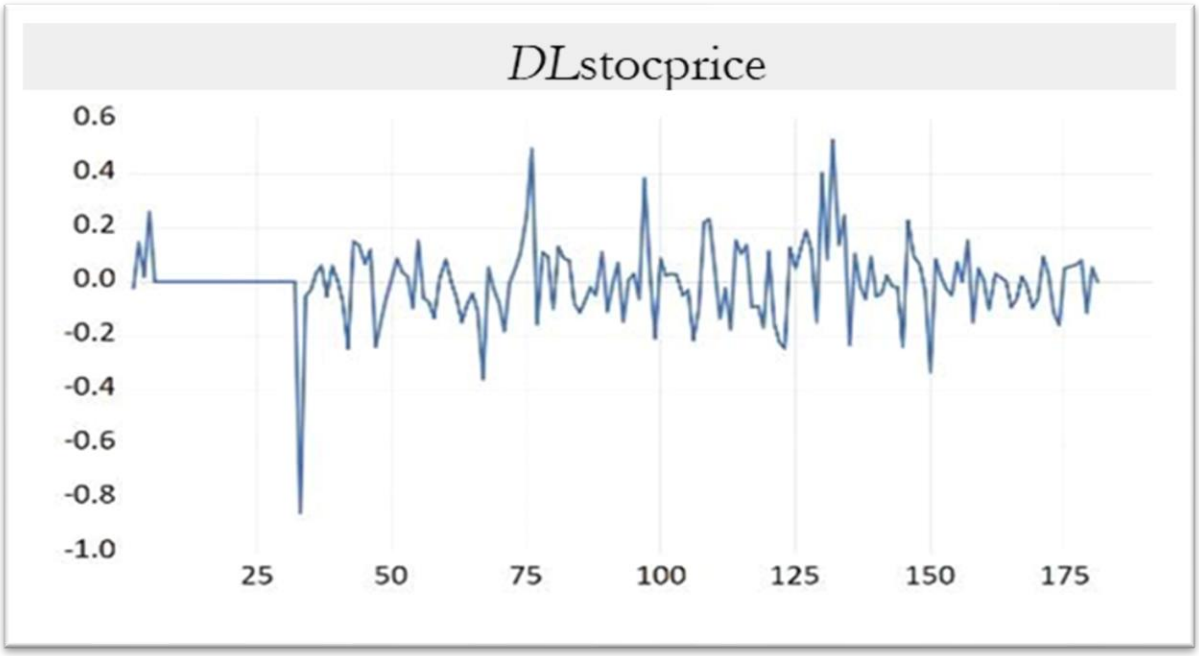
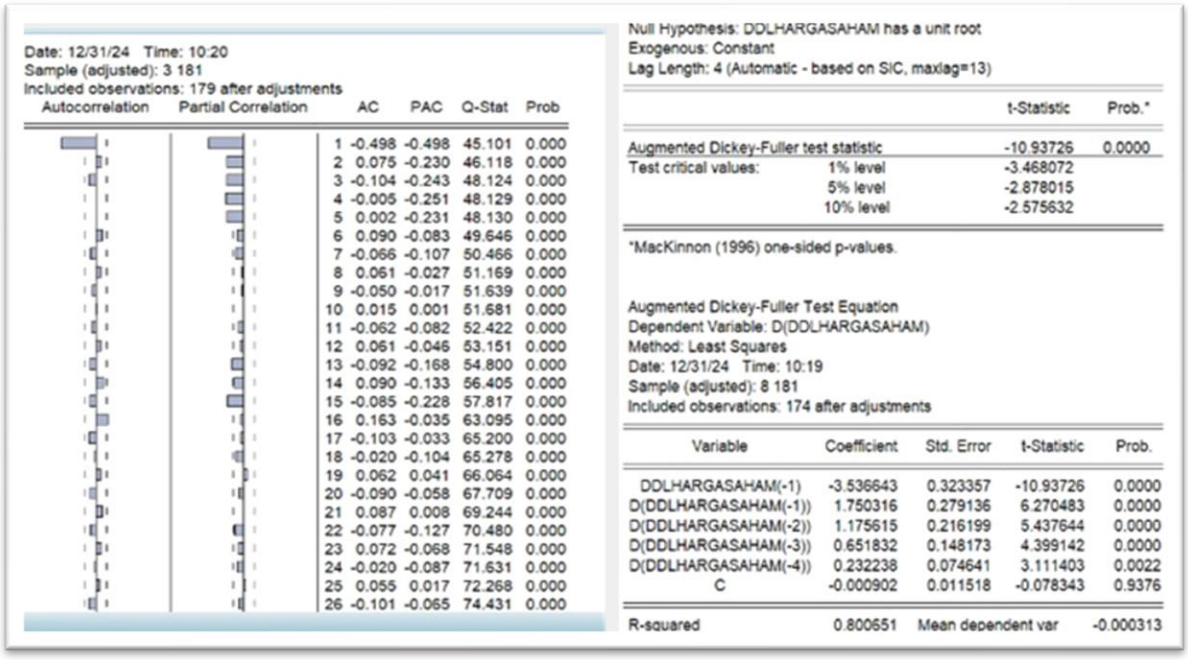


Figure 5. Price Volatility Time Series

Following the first differencing, the graphical results suggest that the data appears more stationary, and the probability value (Prob) is now smaller than $\alpha = 0.05$. This indicates that the null hypothesis (H0) can be rejected, suggesting that the data is approaching stationarity. However, despite the improved stability, no significant lag is observed in the statistical test, implying that the process is not yet optimal. Therefore, a second differencing step is required to ensure that the data achieves full stationarity in both mean and variance. By applying an additional differencing process, any remaining trend patterns in the data can be completely eliminated, resulting in more accurate analysis and forecasting outcomes. Once this process is complete, the appropriate model can be applied for further analysis.



Date: 12/31/24 Time: 10:20
Sample (adjusted): 3 181
Included observations: 179 after adjustments

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
		1	-0.498	-0.498	45.101	0.000
		2	0.075	-0.230	46.118	0.000
		3	-0.104	-0.243	48.124	0.000
		4	-0.005	-0.251	48.129	0.000
		5	0.002	-0.231	48.130	0.000
		6	0.090	-0.083	49.646	0.000
		7	-0.066	-0.107	50.466	0.000
		8	0.061	-0.027	51.169	0.000
		9	-0.050	-0.017	51.639	0.000
		10	0.015	0.001	51.681	0.000
		11	-0.062	-0.082	52.422	0.000
		12	0.061	-0.046	53.151	0.000
		13	-0.092	-0.168	54.800	0.000
		14	0.090	-0.133	56.405	0.000
		15	-0.085	-0.228	57.817	0.000
		16	0.163	-0.035	63.095	0.000
		17	-0.103	-0.033	65.200	0.000
		18	-0.020	-0.104	65.278	0.000
		19	0.062	0.041	66.064	0.000
		20	-0.090	-0.058	67.709	0.000
		21	0.087	0.008	69.244	0.000
		22	-0.077	-0.127	70.480	0.000
		23	0.072	-0.068	71.548	0.000
		24	-0.020	-0.087	71.631	0.000
		25	0.055	0.017	72.268	0.000
		26	-0.101	-0.065	74.431	0.000

Null Hypothesis: DDLHARGASAHAM has a unit root
Exogenous: Constant
Lag Length: 4 (Automatic - based on SIC, maxlag=13)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-10.93726	0.0000
Test critical values:	1% level	-3.468072	
	5% level	-2.878015	
	10% level	-2.575632	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(DDLHARGASAHAM)
Method: Least Squares
Date: 12/31/24 Time: 10:19
Sample (adjusted): 8 181
Included observations: 174 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
DDLHARGASAHAM(-1)	-3.536643	0.323357	-10.93726	0.0000
D(DDLHARGASAHAM(-1))	1.750316	0.279136	6.270483	0.0000
D(DDLHARGASAHAM(-2))	1.175615	0.216199	5.437644	0.0000
D(DDLHARGASAHAM(-3))	0.651832	0.148173	4.399142	0.0000
D(DDLHARGASAHAM(-4))	0.232238	0.074641	3.111403	0.0022
C	-0.000902	0.011518	-0.078343	0.9376

R-squared	0.800651	Mean dependent var	-0.000313

Figure 6. Augmented Dickey-Fuller Test Results

The data above confirms that stationarity has been achieved, as the probability value (Prob) is less than $\alpha = 0.05$, and a significant lag is present. In the given dataset, the significant ACF value corresponds to the first lag, while the significant PACF values range from lag -1 to lag 5.

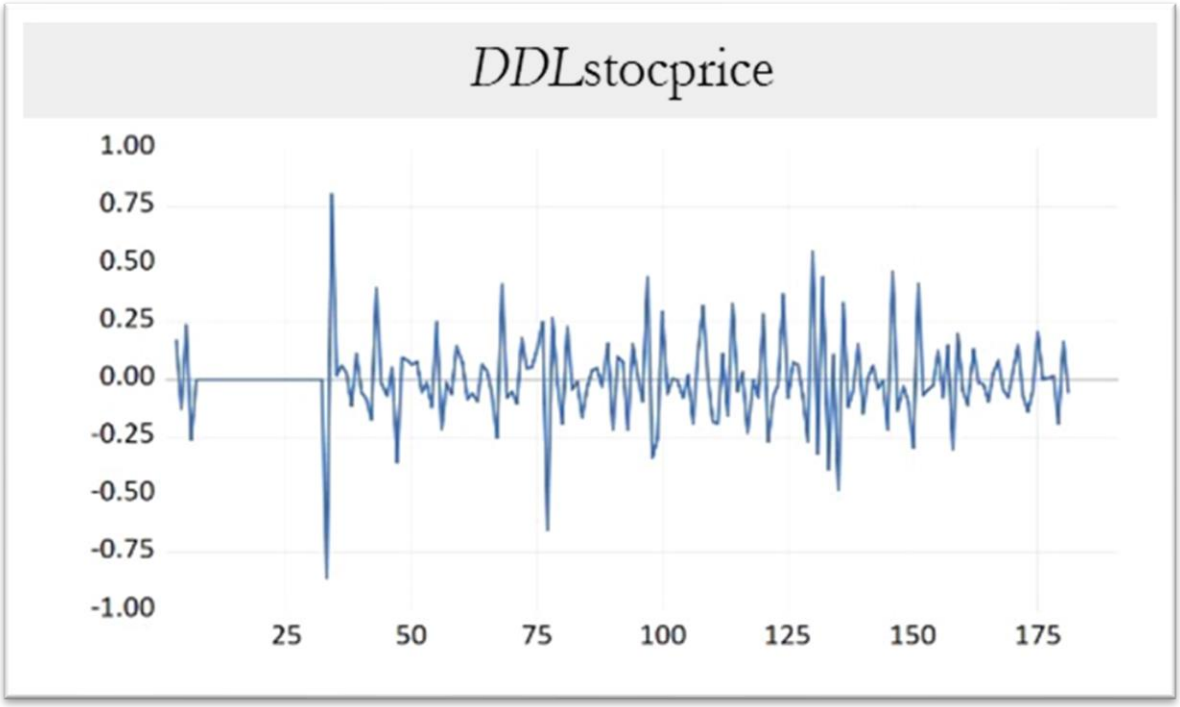


Figure 7. Second-Order Price Differences

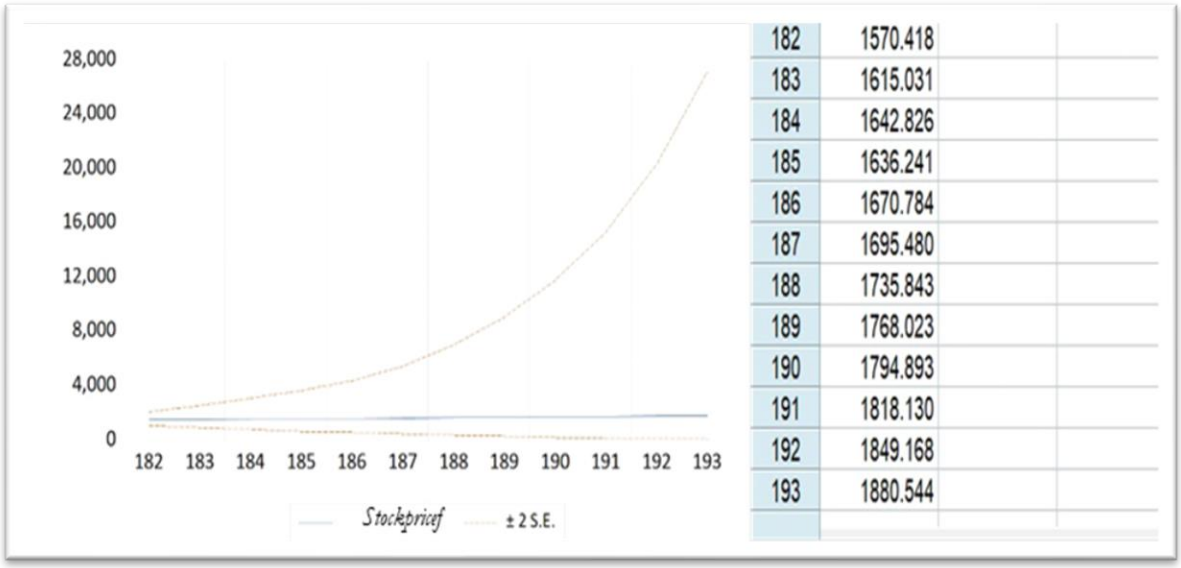
The ARIMA (p, d, q) models considered, with parameters p = 1, 2, 3, 4, 5; q = 1; and d = 2, are as follows:

- Model 1: ARIMA (1, 2, 0) or AR(1)
- Model 2: ARIMA (2, 2, 0) or AR(2)
- Model 3: ARIMA (3, 2, 0) or AR(3)
- Model 4: ARIMA (4, 2, 0) or AR(4)
- Model 5: ARIMA (5, 2, 0) or AR(5)
- Model 6: ARIMA (0, 2, 1) or MA(1)
- Model 7: ARIMA (1, 2, 1)
- Model 8: ARIMA (2, 2, 1)
- Model 9: ARIMA (3, 2, 1)
- Model 10: ARIMA (4, 2, 1)
- Model 11: ARIMA (5, 2, 1)

This structured approach ensures clarity and precision in the selection of the appropriate ARIMA model for forecasting.

Table 1. ARIMA Model Comparison Results

Model	Significant Parameter	SSE	AIC	SIC
AR (1)	< 0.05	0.168376	-0.712540	-0.675927
AR (2)	< 0.05	0.164316	-0.755245	-0.701825
AR (3)	< 0.05	0.159603	-0.806902	-0.735675
AR (4)	< 0.05	0.154872	-0.860211	-0.771178
AR (5)	< 0.05	0.151031	-0.903503	-0.796663
ARIMA (0,2,1)	>0.05	0.142720	-1.015747	-0.980134
ARIMA (1,2,1)	>0.05	0.142741	-1.010812	-0.957393
ARIMA (2,2,1)	>0.05	0.142845	-1.004648	-0.933421
ARIMA (3,2,1)	>0.05	0.142766	-0.999393	-0.910360
ARIMA (4,2,1)	>0.05	0.143170	-0.988259	-0.881419
ARIMA (5,2,1)	>0.05	0.143360	-0.980855	-0.856209



182	1570.418
183	1615.031
184	1642.826
185	1636.241
186	1670.784
187	1695.480
188	1735.843
189	1768.023
190	1794.893
191	1818.130
192	1849.168
193	1880.544

Figure 8. Stock Price Forecast with Confidence Intervals

Based on the data, the results of stock price forecasting for the next 12 months using the Arima (5, 2, 0) model have been obtained. This model was selected because it effectively captures historical data patterns and addresses non-stationarity through the differencing process. With this approach, stock price predictions can be made more accurately, providing valuable insights for investors in their decision-making process.

The forecast results indicate that Antam's stock price is expected to experience an upward trend over the next 12 months. This increase suggests potential growth in stock value, influenced by factors such as market conditions, commodity prices, and relevant economic policies. This upward trend can serve as a positive signal for investors interested in investing in Antam shares.

Although the trend is upward, it is essential for investors to continue considering external factors that may influence stock price movements. Market fluctuations, interest rate policies, and global economic dynamics can all affect the accuracy of the forecasts. Therefore, continuous monitoring and a well-developed investment strategy remain critical to minimizing risks and maximizing potential returns.

Conclusion

Antam's stock price is influenced by factors closely associated with gold prices, particularly during periods of global economic and geopolitical

uncertainty. When gold prices rise due to a crisis or inflation, Antam's stock tends to increase as well, given that the company operates within the precious metals mining sector. To predict the movement of this stock price, the Arima (5, 2, 0) model was selected as the most suitable model, based on its optimal Akaike Information Criterion (AIC) value of 0.151031. This indicates a high level of accuracy and efficiency in capturing historical data patterns.

Using the Arima (5, 2, 0) model, it is estimated that Antam's stock price will continue to rise over the next 12 months. The forecast suggests that by the end of the period, Antam's stock price may reach approximately 1,880,554. This model has demonstrated its ability to capture significant patterns and trends in stock price movements, making it a reliable tool for forecasting and assisting investors in making informed investment decisions based on accurate data analysis.

Future research should consider additional factors that could influence Antam's stock price, such as government policies and global economic conditions. Simulations using the Arima (5, 2, 0) model could be conducted across various scenarios to assess the potential fluctuations in Antam's stock price. A more comprehensive analysis is needed to explore the impact of fiat currency fluctuations and global economic uncertainty on Antam's stock price.

References

Journals

Amri, I. F., Astuti, S. A., Sulistiya, I., Suherdi, A., & Haris, M. Al. (2024). Peramalan Harga Emas Antam Menggunakan Metode Generalized Autoregressive Conditional Heterokedasticity (GARCH). *Unisda Journal of Mathematics and Computer Science*, *10*(1), 26–35. https://doi.org/10.52166/ujmc.v10i1.4679

Crafts, N., & Fearon, P. (2010). Lessons from the 1930s Great Depression. *Oxford Review of Economic Policy*, *26*(3), 285–317. https://doi.org/10.1093/oxrep/grq030

Demirel, H. C., Leendertse, W., & Volker, L. (2023). Mechanisms for Protecting Returns on Private Investments in Public Infrastructure Projects. *International Journal of Project Management*, *40*(3), 155–166. https://doi.org/10.1016/j.ijproman.2021.11.008

Dewi, D. M., Nafi', M. Z., & Nasrudin, N. (2022). Analisis Peramalan Harga Emas di Indonesia pada Masa Pandemi Covid-19 untuk Investasi. *Jurnal Litbang Sukowati: Media Penelitian Dan*

Pengembangan, *5*(2), 38–50. https://doi.org/10.32630/sukowati.v5i2.235

Faraga, F., Chabachib, M., & Muharam, H. (2017). Analisis Pengaruh Harga Minyak dan Harga Emas terhadap Hubungan Timbal-Balik Kurs dan Indeks Harga Saham Gabungan (IHSG) di Bursa Efek Indonesia (BEI) 2000 -2013. *Jurnal Bisnis Strategi*, *21*(1), 72–94. https://doi.org/10.14710/jbs.21.1.72-94

Greunen, J. Van, Heymans, A., University, N.-W., Heerden, C. Van, & Vuuren, G. van. (2014). The Prominence of Stationarity in Time Series Forecasting. *Studies in Economics and Econometrics*, *38*(1), 1–16. https://doi.org/10.1080/10800379.2014.12097260

Hasanudin, H., Suradi, R., Supriyanto, E., & Permadi, A. (2022). Dynamics of Gold Prices in Indonesia: A Short-Term and Long-Term Estimation Approach. *Economics Social and Development Studies*, *9*(1), 21–41. https://doi.org/10.24252/ecc.v9i1.29325

Maryati, I., Christian, C., & Paramita, A. S. (2023). Gold Prices Time-Series Forecasting: Comparison of Statistical Techniques. *Journal of Applied Data Sciences*, *4*(4), 372–381. https://doi.org/10.47738/jads.v4i4.135

Muis, S., & Setiyadi, D. (2020). Model Statistik Arima Dalam Meramal Pergerakan Harga Saham. *Information System for Educators and Professionals: Journal of Information System*, *4*(2), 154–167. https://ejournal-binainsani.ac.id/index.php/ISBI/article/view/1295

Rahmawati, Y. F., Zukhronah, E., & Pratiwi, H. (2021). Penerapan Model ARIMA-ARCH untuk Meramalkan Harga Saham PT. Indofood Sukses Makmur Tbk. *Business Innovation & Entrepreneurship Journal*, *3*(3), 171–177. https://doi.org/10.35899/biej.v3i3.307

Sinay, L. J., Tihurua, F. R. N., & Rahakbauw, D. L. (2018). Analisis Harga Saham PT. Antam Tbk Berdasarkan Harga Emas Dan Nilai Tukar Rupiah Terhadap Dolar Menggunakan Model Autoregressive Distributed Lag. *Barekeng: Jurnal Ilmu Matematika Dan Terapan*, *12*(1), 53–62. https://doi.org/10.30598/vol12iss1pp53-62ar364

Surya, B., Menne, F., Sabhan, H., Suriani, S., Abubakar, H., & Idris, M. (2021). Economic Growth, Increasing Productivity of SMEs, and Open Innovation. *Journal of Open Innovation: Technology, Market, and Complexity*, *7*(1), 1–37. https://doi.org/10.3390/joitmc7010020

Widuhung, S. D. (2014). Perbandingan Return dan Risiko Investasi pada Saham Syariah dan Emas. *Jurnal Al-Azhar Indonesia Seri Pranata Sosial*, *2*(3), 144–150. https://jurnal.uai.ac.id/index.php/SPS/article/view/166

Yeni, F., Pitoyo, R., & Afriany, A. (2024). What Are the Differentiating Factors between Investor and Shareholder Investment? *Jurnal Riset Akuntansi Dan Keuangan*, *12*(2), 1050–1064. https://doi.org/10.17509/jrak.v12i2.70575

Report

PT Aneka Tambang Tbk. (2023). *Memperkuat Fundamental Bisnis Menuju Perusahaan Global Terkemuka*. https://www.antam.com/uploads/antam-ar2023.pdf