Indonesia Stock Price Behavior in Banking and Energy Sectors: A Machine Learning Approach to Dividend Analysis

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***Abstract*—This research conducts an analysis on the dividend period, focusing on banking and energy sectors in the Indonesian stock market. Utilizing Random Forest and XGBoost, Ex Date and Cum Date were found the most influential factors, Ex Date is the first day a stock trades without the right to a dividend and Cum Date is the last day investors can buy a stock to be eligible for a dividend. Based on the results from the machine learning models. The analysis indicates that the banking sector shows a more stable price pattern compared to energy sector. These results suggesting that targeting companies that distribute dividends may serve as a long-term investment strategy, or could present attractive opportunities.**

Keywords—Machine Learning, Dividend Analysis, Stock Price, Financial Market

I. Introduction

The stock market serves as a platform where buyers and sellers meet to trade company shares. It all began with companies raising capital through initial Public Offerings or IPOs, allowing investors, traders, and institutions to buy and sell shares[1]. Among various corporate actions, dividends have consistently presented opportunities for investors and traders to earn return through both volatility and dividend payouts. It is known that stock prices often fluctuate around key dividend dates, where external factors such as liquidity, a company's fundamentals, and market sentiments also act as a significant role in affecting stock prices and volume[2].

Indonesian stocks, particularly in the banking and energy sectors are known for their highly impact on the composite index (IHSG) due to their large market capitalization and their consistency in paying out dividends. The banking sector represented by BBCA, BBRI, BMRI, BBNI, and BRIS are known for stability, with stock performance influenced by interest rates. Meanwhile, the energy sector consists of ADRO, BYAN, AKRA, GEMS, and PGAS tends to be high in volatility due to external factors such as fluctuations in global commodity prices [3]. These sectoral differences make them suitable for comparative analysis regarding dividend-related stock price behavior.

Traditional stock analysis always relies on manual financial analysis and basic statistical models, which have limitations in speed, scalability, and identifying hidden patterns within large datasets. In contrast, Machine Learning (ML) can process enormous data quickly, detect complex patterns, and improve its accuracy over time [4]. Research also shows that these combination approaches, combining human expertise with ML models, consistently outperform either method alone [5].

Machine Learning ability to highlight feature importance is particularly valuable for understanding price movements around dividend dates or even hidden patterns. Algorithms such as Random Forest and XGBoost can identify which factors such as dividend size, historical dividend consistency, market sentiment, sector performance, and macroeconomic indicators most influence stock price fluctuations during cum-dividend and ex-dividend periods [6][7]. This study uses the historical stock data obtained from TradingView and StockBit, both serves as a trusted platform offering real-time and historical financial data, including stock prices, dividends, and financial ratios [8]. By applying these techniques to banking and energy sector data, this research aims to compare price volatility, dividend payout ratios, and external influences (interest rates and commodity prices) around key dividend dates. This ultimate goal is to

provide investors with deeper insights and support more data driven trading strategies in the Indonesian capital market.

II. Related Works

This section provides a detailed review of international journals related to dividend related stock price behavior in Indonesia and the application of Machine Learning in stock price forecasting. This literature review serves to establish a research foundation, identify existing challenges, and determine suitable methodologies for the current study.

2.1 Traditional Stock Analysis vs. Machine Learning Analysis

Traditional stock has always depended on financial ratios, fundamental analysis, and statistical methods. Even though these tools have proven valuable over time, they often fail or struggle in capturing the complex, non-linear, and dynamic patterns inherent in modern financial markets. The presence of Machine Learning (ML) has significantly improved stock price prediction by allowing the processing of large, complex datasets and as well as identifying hidden patterns that are often missed by traditional techniques.

Among the most widely used ML algorithms in finance is XGBoost, a powerful gradient-boosted decision tree algorithm well known for its highly valued for its exceptional speed, efficiency, and robust feature selection capabilities, making it particularly effective in various financial forecasting tasks [11]. Similarly, Random Forest, which operates through the bagging technique, improves model stability by reducing overfitting and refining the understanding of complex relationships within financial data [12]. Many studies show that by combining or selectively applying these advanced models significantly improves predictive accuracy, with Random Forest often excelling in feature selection and XGBoost proves highly capable of modeling subtle and finding patterns in price behavior.[11-13].

2.2 Related Works to Dividends and Stock Price Behavior in Indonesia

Various studies have analyzed the relationship between dividends and stock price behavior, especially in the Indonesian market. M. Mahirun et al. [2] using historical stock price data and statistical methods to determine how dividend policy affects stock price movements on ex-dividend in the Indonesian stock market. Produced a strong opinion on dividend signaling theory, and can show that dividend announcements have a significant impact on stock prices on ex-dividend days. In the next research, we explore the research of L. Yin, B. Li, and R. Zhang [12] which gives us insight that the use of machine learning models to predict future dividend yields is reliable because it provides a very small error value when compared to predictions issued by several institutions. The insights from these two studies reinforce our goal that machine learning can provide more accurate dividend yield predictions compared to traditional statistical methods that were used in the past.

2.3 Related Works to Machine Learning Applications in Stock Price Forecasting

After that, we did a deep dive into several studies that focused on the application of machine learning in forecasting stock prices, in the research of Ratih Hurriyati et al. [1] conducted experiments on several machine learning models, namely Random Forest, Support Vector Machine, and Artificial Neural Network in analyzing trends that occur in the stock market and predicting price movements. In the study, with the help of historical stock price data and the help of supporting indicators, and it can be concluded from the study, complex machine learning models have better performance in capturing every pattern in the data. However, the study also said that there is no machine learning model that is fully reliable in all situations, and it can be concluded again that the hybrid approach, namely traditional statistics and machine learning when combined will provide better results. After that, mentioned in the research of Abdul Syukur and Deden Ishawan [10], comparing machine learning models such as SVM, Random Forest, and Neural networks focusing on the LQ45 index in the Indonesian capital market. In this study, it is said that the neural network model provides better prediction accuracy, then emphasized that data preprocessing is very important to get good results. In this study, it is said that there is an advancing trend in the use of machine learning in analyzing and predicting stock movements, the results obtained are also better than previous traditional methods. However, there are challenges in getting perfect scores in evaluation metrics, especially accuracy scores. Therefore, our research aims to deepen our previous understanding and analyze how stock price movements, especially in the Indonesian banking and energy sectors ahead of dividend events, using a machine learning approach.

III. Methodology

3.1 Research Scope

This study examines stock price behavior in response to dividend distributions in the Indonesian banking and energy sectors. We focus on five major stocks from each sector: BBCA, BBRI, BMRI, BBNI, and MEGA (banking); ADRO, BYAN, GEMS, AKRA, and PGAS (energy). The primary objective is to analyze stock price fluctuations around cum-dividend and ex-dividend dates using machine learning techniques. Unlike traditional approaches that incorporate macroeconomic variables (e.g., interest rates, inflation), this study isolates the effect of dividends on stock prices.

3.2 Data Collection

The dataset is obtained from Tradingview platform, where it covers historical stock prices and dividend information from 2015 to 2024. It includes the following features:

- Open, High, Low, and Close Prices: Capturing daily stock price movements

- Trading Volume: Reflecting liquidity changes around dividend dates
- Dividend Amount and Yield: Measuring the impact of dividends relative to stock prices
- Event-Based Features: Including percentage changes in stock prices before and after dividend events

3.3 Data Preprocessing

Data preprocessing is one of the most crucial step to ensure data quality and also enhance model performance. Data preprocessing is essential before any kind of model training, because a model requires clean and high quality data to produce good and accurate results. The following steps are applied:

1. Handling Missing Data: In this step, missing values in stock price or dividend records are imputed using historical averages or removed if data is insufficient.
2. Feature Engineering: We construct key features such as:
    - Price Change (%) Before and After Dividend: To quantify stock reaction to dividend events.
    - Dividend Yield: Calculated as (Dividend per share / stock prices)
    - Trading Volume Changes: To seize investor's responses towards dividend payouts.
3. Normalization and Scaling: In this step, standardization techniques are applied to prevent model bias towards large-valued features.

3.4 Machine Learning Methodology

There are several machine learning models that can be applied to predict stock price movements before and after dividend distributions. XGBoost and Random Forest Regression are the models that we have chosen, as both models are effective at handling structured financial data, capturing complex and nonlinear relationships.

A. XGBoost

We utilize XGBoost to analyze stock price behavior before and after dividend payouts in the Indonesian banking and energy sectors. XGBoost is the ideal algorithm for this task, because it offers the ability to model large datasets, detect complex patterns, and mitigate overfitting. Historical stock data from 2019 to 2024, which covers 5 major banking stocks and 5 major energy stocks, is processed using XGBoost. In this task, feature engineering was essential, where variables such as stock price before cum-dividend date, stock price after ex-dividend date, dividend payout ratios, stock price after dividend payouts and trading volume are collected as input features.

The dataset is then divided into training and testing sets using a 70/30 split to effectively evaluate model performance. The training set covers data from 2019 to 2022, while the testing set covers data from 2023 to 2024. The model is then trained using the training set, and its accuracy is assessed using the test set. This study will evaluate the model using standard forecasting metrics including MSE (Mean Squared Error), MAE (Mean Absolute Error), and R-Squared. This approach will help identify consistent patterns in stock price reactions to dividend payouts and assess the effectiveness of XGBoost in identifying the trends

B. Random Forest Regression

The Random Forest machine learning model is very often used because of its ability to perform both regression and classification tasks. Random Forest has the ability to identify complex relationships and can reduce overfitting. In this research, Random Forest is used for regression. Random Forest is classified as ensemble learning, it builds many decision trees, and combines each prediction result to get a high evaluation result. This model performs training with several decision trees on random data and then gets the average prediction result in regression. The final prediction is obtained from the final calculation of the average output of all trees:

$$\widehat{Y} = \frac{1}{n} \sum_{i=1}^{n} \mathrm{T}i \ (\mathrm{X})$$

Y = Predicted Stock Price
X = Input features (dividend yield, trading volume, etc)
Ti = Decision tree predictions
n = Number of trees

The algorithm's ability to capture non-linear relationships in financial data without requiring explicit formulation will be highly beneficial for this study. On a daily basis, stock price movements often show complex interactions, and Random Forest can effectively model these dynamics. Additionally, The algorithm provides features importance evaluation, assigning important scores to different variables. These features will help identify the most influential factors affecting stock prices before and after dividend payouts. Random Forest also known for its robustness to overfitting. It helps the model to generalize well when the model encounters unseen stock price data by averaging the predictions of multiple decision trees. Furthermore, Random Forest is well-suited for handling missing data which is particularly useful when working with historical stock market records that may contain gaps. These strengths make Random Forest a powerful tool for analyzing stock behavior around dividend events in this study

3.5 Evaluation Metric

We evaluated the machine learning model performance using R2 Score, RMSE, MAE, and CV RMSE metrics to measure accuracy and generalization capability.

- RMSE (Root Mean Squared Error)

$$RMSE = \sqrt{\frac{1}{n}\Sigma_{i=1}^{n}(y_i - \hat{y}_i)^2}$$

y_i = the actual value
$\hat{y}_i$ = the predicted value
n = total number of observation

- MAE (Mean Absolute Error)

$$MAE = \frac{1}{n}\Sigma_{i=1}^{n}|P_i - O_i|$$

P_i = the predicted value
O_i = the actual value
n = total number of observation

- R-Square (The Coefficient of Determination)

$$R^2 = 1 - \frac{SSR}{SST}$$

SSR = the residual sum
SST = total sum of squares

- CV RMSE (Cross Validation Root Mean Squared Error)

Measures model performance on unseen data using cross-validation. The formula is the same as RMSE, but applies the validation folds and averages them. Lower values mean better model capability and less overfitting.

IV. Results and Discussion

4.1 Model & Metric Evaluation

This section compares the performance of two models used to analyze stock price behavior with machine learning, specifically Random Forest and XGBoost. The models were applied to predict stock price movements in the banking and energy sectors, focusing on dividend impact analysis.

TABLE I. Model Performance Table

Model	R^2 Score	RMSE	MAE	CV RMSE
Random Forest	0.937691	0.027611	0.009632	0.04236
XGBoost	0.753679	0.054898	0.013442	0.02246

Based on TABLE 1, Random Forest and XGBoost performance to analyze stock price behavior with machine learning. Random Forest better in R^2 Score, RMSE, and MAE, indicating better performance. But, XGBoost has a slightly better in generalization based on CV RMSE, meaning it might be better at predicting new data. The conclusion is Random Forest is the better choice for accuracy, but XGBoost can be considered if generalization is a primary concern.

4.2 Comparison of Volatility Between the Banking and Energy Sectors Around the Cum-Dividend and Ex-Dividend Dates

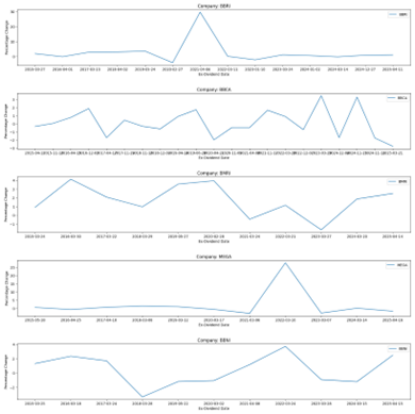

Fig 1. Banking Sector Plot Around the Cum-Dividend and Ex-Dividend Dates

Fig 2. Energy Sectors Plot Around the Cum-Dividend and Ex-Dividend Dates

Stock price movements in the banking and energy sectors show significant differences around the cum-dividend and ex-dividend dates. The banking sector seems to be on a steady trend, with stocks from companies we've picked like BBRI, BBCA, and BBNI not fluctuating much. The supportive factors in the banking sector are stable dividend policies and maintained interest rates, which help keep things steady. Unlike the energy sector, which exhibits significantly higher volatility, companies such as ADRO, BYAN, and PGAS demonstrate high volatility. Commodity prices influenced by government policies greatly affect stock movements in the

energy sector. Additionally, investors react swiftly to dividend announcements, resulting in substantial price changes. This disparity provides insight into how market reactions to internal and external factors vary between the two sectors. Furthermore, there are supporting factors for this difference in volatility for the banking sector; price stability is bolstered by consistent dividend policies, as major banks in Indonesia typically have a predictable dividend schedule. Moreover, stable macroeconomic conditions also support the stability of the banking sector. In contrast, the energy sector is influenced by global commodity price fluctuations, where volatility in oil and natural gas prices triggers changes in stock prices. Government policy changes and external factors such as geopolitics contribute to increased volatility. The differences between these two sectors provide valuable insights into how internal factors, such as dividend policies and interest rates, as well as external factors, such as commodity prices and government policies, affect stock price volatility in both sectors.

4.3 Feature Importance Analysis

In this study, the importance of various features in predicting stock price changes around the ex-dividend date was assessed using the Random Forest and XGBoost models. The analysis of feature importance provides insights into which variables most significantly impact the predicted change in stock price (Pct_Change). The following features were evaluated: Ex Date, Cum Date, and sector classifications (Banking Sector and Energy Sector).

The Ex Date emerged as the most influential feature in the model, with an importance score of 50.96%. This result underscores the critical role that the ex-dividend date plays in the movement of stock prices. Typically, on the ex-dividend date, stock prices experience a drop due to the dividend being subtracted from the stock's price. The model clearly indicates that this date is a pivotal factor in determining stock price behavior, highlighting the market's sensitivity to this event. Therefore, the Ex Date is a key determinant for investor strategies, as prices tend to adjust around this time.

1. Cum Date

The Cum Date showed the with an importance score of 44.77%. This feature refers to the date prior to the ex-dividend date, when investors who purchase the stock are still entitled to receive the upcoming dividend. The fact that the Cum Date also holds substantial weight in the model reflects the anticipation and expectation of dividends by the market, which can influence price movements. While its importance is secondary to the ex-dividend date, the Cum Date still plays a critical role in understanding the behavior of stock prices leading up to the dividend announcement.

2. Banking Sector and Energy Sector

Both the Banking Sector and Energy Sector features had relatively low importance, with importance scores of 2.16% and 2.12%, respectively. These results suggest that the sector classification of the company (whether in the banking or energy sector) does not significantly influence the price change during the dividend event. Despite the potential for sector-specific factors—such as interest rates in banking or commodity prices in energy—the model shows that these factors are less impactful in predicting price movements during the dividend period. This finding highlights the stronger influence of dividend timing (Ex Date and Cum Date) on stock price behavior, rather than sector-specific dynamics.

The feature importance analysis reveals that Ex Date and Cum Date are the most significant factors affecting stock price movement around dividend announcements, accounting for nearly 95% of the importance in the model. The sector classification, while useful in broader financial analysis, plays a minimal role in predicting price changes specifically around dividend events. This suggests that dividend timing is a primary driver of stock price fluctuations, and investors may benefit from focusing on the calendar dates related to dividends rather than the sectoral affiliation of the company.

TABLE II. Feature Importance Percentage

Feature	Importance Percentage
Ex Date	0.509566
Cum Date	0.447660
Banking Sector	0.021568
Energy Sector	0.021207

4.4 Practical benefits for investor and investment strategies

After analyzing feature importance, volatility, and several other factors, it becomes clear that for long-term investment horizons (over one year), investing in the Indonesian stock market can be profitable. While each investment decision should be backed by thorough analysis, both the energy and banking sectors stand out as reliable dividend-paying sectors. Even if investors do not withdraw their funds during the investment period, they can still benefit from dividends as a form of appreciation from the companies they've entrusted with their capital. These dividends serve as a steady income stream, enhancing the overall returns on investment.

However, for short-term investments, caution is required, especially during periods close to or on the ex-dividend date, as volatility tends to increase significantly. However, for short-term investments, caution is needed, especially close to or on the ex-dividend date, because volatility tends to increase significantly. Sharp price movements and high trading volumes during the dividend period can expose investors to significant risks. That said, price fluctuations—while often causing stock prices to drop—also present opportunities for investors to buy shares at lower and more attractive prices. This allows them to increase their positions in stocks at a 'discount,' taking advantage of the temporary price drops. The main point for investors is that even though

long-term investments in these sectors can provide reliable returns thanks to consistent dividend payments, short-term strategies need to be approached carefully, especially during periods of high volatility. For investors who can manage risk and have a strategy to take advantage of lower prices during this period, it might be a really good move, especially if they want to increase their investment in the Indonesian stock market

V. Conclusion

This research analyzes stock price movements focusing on two sectors that regularly distribute dividends compared to other sectors, namely the energy and banking sectors, specifically in the Indonesian stock market. This study also applies the use of machine learning models, specifically random forest and xgboost, both models are used to understand the factors that create hidden patterns and to discover how stock prices can be influenced during dividend distribution periods, and it is expected to provide useful recommendations or assist in decision-making while investing. After conducting the work on this research, we obtained the evaluation metrics results of the model performance we used, it can be explained that Random Forest outperforms the XGBoost model in the case of predicting dividend outcomes or amounts. This confirms the evaluation metrics table in the previous chapter, however, XGBoost has a slight advantage in the cross validation RMSE value, it can be concluded that Random Forest shows that it is a better fit for this case. At the same time, it indicates that the application of traditional analysis with machine learning methods, especially in the stock market, can be said to be very promising.

In addition, we analyze the factors that play a very significant role in the movement of stock prices during the announcement of dividend distribution, namely Ex Date and Cum Date, both of which almost have an important role valued at 95%. This concludes that the price tends to decrease on Ex Date and investors anticipate Cum Date, causing prices to move sensitively on both of these dates. Meanwhile, based on the results of our feature importance analysis, sector differences play a small role in price movements during the dividend period, indicating that the two dates mentioned earlier are more influential than the sector.

In the next analysis, we conducted an analysis using traditional statistics on the price movement chart or volatility that occurred during the dividend period, specifically for the companies we have selected. The banking sector shows a stable price pattern consistently over the years we used, which is also supported by favorable factors for the banking sector, namely predictable dividend policies and a stable interest rate environment. In contrast, the energy sector exhibits stock movements with high volatility, influenced by global commodity prices, company factors, and the size of dividends distributed. This difference provides valuable insights for investors as it affects the risk profile already determined at the outset for stock investors and demonstrates different price sensitivities between these two sectors. Thus, this research can provide insights for investors, particularly regarding the influence of dividends, and our focus on sectors that regularly distribute dividends. For investors with long-term investment goals, dividends can be interpreted as appreciation for companies and provide income for investors, while short-term investors need to analyze and understand how the supporting factors of stock price movements during this dividend period work to avoid the so-called dividend trap, which has very high volatility. Machine learning assists us in this research for predictive analysis, and this research helps investors make more informed decisions and achieve the desired results.

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