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Implementation of Capital Asset Pricing Model in Optimal Portfolio Formation on IDX High Dividend 20

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ABSTRACT

The IDX High Dividend 20 (IDX HIDIV20) is an Indonesian stock index known for its high dividend payouts, appealing to passive income investors. However, annual changes and fluctuating stock prices present challenges, necessitating diversification strategies. This study aims to create an optimal portfolio to balance returns and risks amidst market volatility on the IDX High Dividend 20 stock index. This research uses the Capital Asset Pricing Model (CAPM) method. The CAPM determines the relationship between risk and an asset's expected rate of return, especially shares. This model helps in evaluating whether an asset or investment provides sufficient returns commensurate with its risk. In this study. We used weekly stock price data and composite stock prices from Yahoo Finance and BI interest rates taken from Bank Indonesia from January 2020 to December 2023. The research findings found that there were 6 out of 12 samples forming the optimal portfolio, namely ITMG (28.0%), ADRO (16.6%), BMRI (29.2%), BBNI (13.7%), BBCA (11.8%), and BBRI (0.6%) with a portfolio return of 0.41% and a portfolio risk level of 0.16%. The study emphasizes the importance of diversification for investors, particularly in volatile markets, to manage risks and enhance returns. It also highlights the strategic value of investing in high-dividend stocks for consistent income and portfolio stability, offering practical insights for optimizing investment strategies.

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A. INTRODUCTION

In today's era of globalization, technology has reached an incredible level of advancement. The development of sophisticated technology provides much convenience in obtaining information (Audi et al., 2022). In addition, technological advances can also offer new opportunities to generate income, one of which is through investment activities. Investing in the capital market is one of the alternatives to develop the assets you own to earn profits in the future (Astuti et al., 2024). Investments can be made by buying stocks, bonds, and other financial instruments (Atmaningrum et al., 2021). Investors widely choose stocks as capital market instruments because they can provide attractive profits despite the risks (Farida et al., 2022). As financial markets become more complicated, the significance of investing in education and analysis has increased. To make wise choices, an investment must go through a multitude of information and different investment opportunities (Shahzad et al., 2024)(Subagio et al., 2020). As benchmarks for assessing market performance and spotting investment possibilities, stock market indices are essential in directing these choices (Dwitayanti et al., 2023).

One of Indonesia's stock indices is the IDX High Dividend 20 (IDX HIDIV20). IDX HIDIV20 includes the stocks of 20 companies with the largest market capitalization on the IDX and significant dividend levels. The index is specifically designed to prioritize the stocks of companies that regularly distribute dividends to their owners. This makes the IDX index HIDIV20 an option for investors looking for passive income from stock investments (Natasya & Yusbardini, 2022). The composition of this index often changes every year. If the company is inconsistent in managing its shares, it will be replaced by shares of other companies (Ardiansyah & Kohardinata, 2024). However, research on the IDX HIDIV20 index remains limited, with few studies exploring its implications for investment strategies and performance metrics. This gap highlights the need for more comprehensive research that examines how investors can leverage the IDX HIDIV20 to optimize their portfolios and manage risks effectively.

The composition of stocks that change can affect the risks and potential profits from the investment (Afego, 2017). The composition of stocks that change can affect the risks and potential profits from the investment (Huy et al., 2020). Therefore, investors must conduct in-depth analysis and develop appropriate risk management strategies. The changing composition and volatile movements of the IDX HIDIV20 price index show the importance of diversification by forming a portfolio (Almeida & Neves, 2022). A portfolio is a variety of assets owned by individuals, institutions, or other organizations in the financial field. Including various assets in a portfolio can reduce vulnerability to the potential for significant losses within a single asset class (Koumou, 2020). Furthermore, it is essential for investors to comprehend the industry and economic aspects affecting the firms in the IDX HIDIV20 index (Yusbardini & W Andani, 2022). Changes in government policies, market dynamics, or global economic conditions can significantly impact the performance of the constituent stocks. By staying informed about these macroeconomic trends and their implications, investors can make more informed decisions and enhance their ability to anticipate potential risks and opportunities within the high-dividend stock segment (Arilyn, 2022).

Various models can be used to form optimal portfolios, such as the Capital Asset Pricing Model (CAPM), Arbitrage Pricing Theory (APT), Single Index Model (SIM), Liquidity Adjusted Capital Asset Pricing Model (LCAPM), and others. Some studies on optimal portfolio formation include research by Pasaribu et al. (2018), forming an optimal portfolio on LQ45 Index stocks with the CAPM method, which obtained a portfolio return of 0.0447 and portfolio performance of 0.0184. If using the APT method, the portfolio return is 0.0371, and the portfolio performance is -0.0590. Research by Sholehah et al. (2020), forming an optimal portfolio of LQ45 Index stocks with the CAPM method obtained a portfolio return of 0.0246 and a portfolio risk of 0.0023. If using the SIM method, the portfolio return is 0.0229, and the portfolio risk is 0.0032. Furthermore, research by Apriyanti & Supandi (2019) forming an optimal portfolio on Sharia stocks using the CAPM method obtained a portfolio return of 0.006403 and a portfolio risk of 0.001793. If using the LCAPM method, the portfolio return is -0.044311, and the portfolio risk is 0.023850.

Based on previous studies, it was obtained that the CAPM method performs well in building optimal portfolios. This is indicated by the portfolio return obtained using CAPM, which is greater than other methods. In addition, the portfolio risk obtained is also smaller than that of

different methods, so CAPM is used in this study to determine the potential for optimal investment in IDX HIDIV20 stocks. The findings will contribute to the growing body of knowledge on portfolio optimization and offer practical insights for investors navigating the IDX HIDIV20 index.

B. METHODS

This quantitative study applies the CAPM method to identify stocks that can be categorized as optimal portfolios. The steps of analysis that will be carried out in this study can be illustrated in the following flowchart.

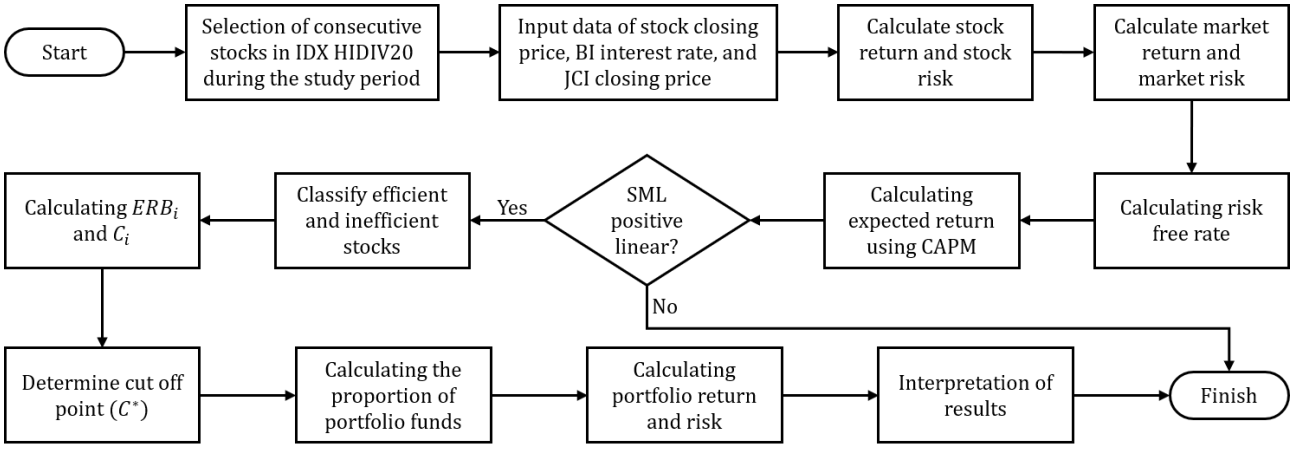

Figure 1. Research Flowchart

The following is a detailed explanation of the optimal portfolio formation steps using the CAPM method.

1. Data

This study data is taken from the shares of companies on the Indonesia Stock Exchange that are consistently included in the IDX High Dividend 20. There are 12 selected companies to be researched: ADRO, ASII, BBCA, BBNI, BBRI, BMRI, HMSP, INDF, ITMG, PTBA, TLKM, and UNTR (Bursa Efek Indonesia, 2024). The observed stock prices are weekly closing stock prices from January 2020 to December 2023 (Yahoo Finance, 2024). The BI rate (Bank Indonesia, 2024) was applied to calculate the optimal portfolio. The following is a sample of closing price data for IDX High Dividend 20 stocks and JCI:

Table 1. Sample Data of Stock Price and JCI

Stock / Date	ADRO	ASII	BBCA	BBNI	⋯	ITMG	PTBA	TLKM	UNTR	JCI
2019-12-31	1540	6775	6740	3775	⋯	11900	2710	3940	21250	6279.346
2020-01-07	1560	7175	6870	3925	⋯	13300	2790	3950	22700	6325.406
2020-01-14	1415	7025	6830	3787.5	⋯	12150	2560	3890	21075	6238.153
2020-01-21	1325	6825	6790	3737.5	⋯	11175	2330	3830	19875	6111.184
⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮
2023-12-05	2550	5575	8700	5275	⋯	24000	2350	3910	21850	7125.307
2023-12-12	2600	5625	9250	5200	⋯	24525	2370	3970	21825	7187.846
2023-12-19	2590	5550	9325	5250	⋯	25350	2400	3960	22025	7237.519
2023-12-26	2380	5650	9400	5375	⋯	25650	2440	3950	22625	7272.797

2. Stock Return

Stock return refers to the financial gain or loss earned by a company, individual, or institution. Stock returns can be given in cash or additional stock (Chou et al., 2021). Actual stock return (R_{it}) can be calculated using the following equation (Rutkowska-Ziarko et al., 2022):

$$R_{it} = \frac{P_t - P_{(t-1)}}{P_{(t-1)}} \tag{1}$$

where, P_t is the current stock price, $P_{(t-1)}$ is the previous stock price. Stock return (R_i) can be calculated using the following equation:

$$R_i = \frac{\sum_{i=1}^{n} R_{it}}{n} \tag{2}$$

where, R_{it} is the actual return of stock i in period t, n is the amount of data.

3. Stock Risk

Stock risk is used to identify the difference between actual and expected stock returns. To calculate stock risk, you can use the stock variance as follows (Setyo & Kurniasih, 2020):

$$\sigma_i^2 = \frac{\sum_{t=1}^{n}(R_{it} - R_i)^2}{n} \tag{3}$$

where, R_{it} is the actual return of stock i in period t, R_i is the return of stock i, n is the amount of data.

4. Market Return

Market return results from changes in a stock price index (Prasad et al., 2021). For example, if the choice of market index for actively traded stocks in Indonesia is the Composite Stock Price Index. Market return (R_m) can be calculated using the following equation (Sembiring, 2022):

$$R_{mt} = \frac{JCI_t - JCI_{(t-1)}}{JCI_{(t-1)}} \tag{4}$$

where, JCI_t is a current market index, $JCI_{(t-1)}$ is a previous market index. Expected market return can be calculated using the following equation:

$$E(R_m) = \frac{\sum_{t=1}^{n} R_{mt}}{n} \tag{5}$$

where, R_{mt} is the market return of period t.

5. Market Risk

Market risk is used to identify the difference between actual and expected market results. To calculate market risk, one can use the market variance as follows (Hundal et al., 2019):

$$\sigma_m^2 = \frac{\sum_{t=1}^{n}\left(R_{mt} - E(R_m)\right)^2}{n} \tag{6}$$

where, R_{mt} is market return period t, $E(R_m)$ is expected market return, n is the amount of data.

6. Risk-Free Rate

The risk-free rate (R_f) is the compensation received from an investment to obtain future profits without considering the risk associated with the investment. The risk-free rate is measured using government-issued Bank Indonesia Certificates (Mumu, 2020). In simple terms, risk free rate (R_f) is written as below:

$$R_f = \frac{\frac{\sum_{t=1}^{n} SBI_t}{n}}{52} \tag{7}$$

where, SBI_t is BI rate t period, n is the amount of data.

7. Systematic Risk and Non-systematic Risk

The risk included in the CAPM calculation is called systematic risk, known as beta value (Markowski, 2020). Beta is a value that reflects the tendency of a stock to market fluctuations, which the following equation can obtain (Vergara-Fernández et al., 2023):

$$\beta_i = \frac{\sigma_{im}}{\sigma_m^2} = \frac{\sum_{t=1}^{n}(R_{it} - R_i)\left(R_{mt} - E(R_m)\right)}{\sum_{t=1}^{n}\left(R_{mt} - E(R_m)\right)^2} \tag{8}$$

where, R_{it} is the actual return of stock i in period t, R_i is the return of stock i, R_{mt} is the market return of period t., $E(R_m)$ is expected market return. Non-systematic risk appears as a result of internal factors of the company and can be mitigated through the diversification process. Non-systematic risk can be done by calculating the residual error variance as follows (Chattopadhyay et al., 2022):

$$\sigma_{ei}^2 = \sigma_i^2 - \beta_i^2 . \sigma_m^2 \tag{9}$$

where, σ_i^2 is a risk of stock i, β_i a beta of stock i, σ_m^2 is market risk.

8. CAPM

The Capital Asset Pricing Model (CAPM) is an equilibrium model often used in the investment decision process. By using CAPM, investors can reduce the risk attached to stock investments. The model relies on assessing systematic risk through beta to forecast expected returns (Agouram et al., 2020). In mathematical terms, CAPM can be represented as follows (Latunde et al., 2020):

$$E(R_i) = R_f + \beta_i\big(E(R_m) - R_f\big) \tag{10}$$

where, R_f is Risk-free rate, β_i is beta of stock i, $E(R_m)$ is expected market return.

9. SML

Return refers to the financial gain obtained from an investment, while risk relates to the potential divergence from anticipated returns. The expected return and risk relationship is visualized through the Security Market Line (SML) chart. This graph serves as a tool to determine the appropriate level of return an investor should receive to compensate for the risk(Han et al., 2018).

10. Optimal Portfolio

An optimal portfolio is a collection of investment opportunities in various securities combined to achieve the best results with minimal risk. The steps for forming an optimal portfolio are as follows (Nurhayati et al., 2021):

a. Calculating Excess Return to Beta (ERB_i)
   ERB_i is used to assess the extra return generated based on measured risk using beta obtained with the following equation:

$$ERB_i = \frac{\big(R_i - R_f\big)}{\beta_i} \tag{11}$$

   where, R_i is the return of stock i, R_f risk free rate, β_i is beta of stock i.

b. Determining cut off point (C^*)
   A cut-of-point value is required to determine the limit point that can be accepted as an optimal portfolio candidate.

$$C_i = \frac{\sigma_m^2 \times \left(\frac{\big(R_i - R_f\big)\beta_i}{\sigma_{ei}^2}\right)}{1 + \left(\sigma_m^2 \times \frac{\beta_i^2}{\sigma_{ei}^2}\right)} \tag{12}$$

   Where, σ_m^2 is market risk, R_i is the return of stock i, R_f is Risk-free rate, β_i = Beta of stock i, σ_{ei}^2 is a non-systematic risk.

c. Determining Optimal Portfolio
   Optimal portfolio determination is based on the following conditions: (1) Stock is an optimal portfolio candidate if $ERB_i > C^*$; and (2) Stock is not an optimal portfolio candidate if $ERB_i < C^*$.
d. Calculating Z_i and W_i.
   Determine the proportion of fund allocation for each stock (W_i) by determining the weighted scale of each stock (Z_i):

$$Z_i = \frac{\beta_i}{\sigma_{ei}^2}(ERB_i - C^*) \tag{13}$$

$$W_i = \frac{Z_i}{\sum_{i=1}^{j} Z_i} \tag{14}$$

where, β_i is beta of stock i, σ_{ei}^2 is non-systematic risk, C^* is cut off point, W_i is the proportion of stock funds i, j is several optimal portfolio compositions.

11. Return Portfolio

Portfolio return can be defined as the calculated value obtained by summing the proportion of funds with individual stock returns that become portfolio candidates, such as the following equation(Chattopadhyay et al., 2022):

$$R_p = \sum_{i=1}^{j} W_i R_i \tag{15}$$

where, W_i is the proportion of stock fund i, R_i is a return of stock i.

12. Risk Portfolio

For calculating portfolio risk, one can use the variance of portfolio formers, such as the following equation(Sarva Jayana & Pardomuan Sihombing, 2020):

$$\sigma_p^2 = \beta_p^2 . \sigma_m^2 + \sum_{i=1}^{j} W_i^2 \sigma_{ei}^2 \tag{16}$$

where, $\beta_p = \sum_{i=1}^{j} W_i \times \beta_i$, σ_m^2 is market risk, W_i is the proportion of stock funds i, σ_{ei}^2 = non-systematic risk.

C. RESULT AND DISCUSSION

1. Stock Return and Stock Risk

Calculating stock return and risk is the initial stage in forming the optimal portfolio using the CAPM method. Stock return and risk are calculated with weekly stock price data from 12 IDX High Dividend 20 stocks from 1 January 2020 to 31 December 2023. To calculate the stock return, we can apply equation (1), which is used to calculate the actual stock return (R_{it}). For example, the calculation using ADRO stock data, where ADRO stock returns on 7 January 2020 are:

$$R_{it} = \frac{P_t - P_{(t-1)}}{P_{(t-1)}} = \frac{1560 - 1540}{1540} = 0.012987$$

Based on the calculation of the actual return of ADRO stock above, the profit earned by ADRO stock investors on 7 January 2020 is around 0.012987. The results of the actual stock return can be seen in the following Table 2.

Table 2. Stock Actual Return

Date \ Stock	ADRO	ASII	BBCA	⋯	PTBA	TLKM	UNTR
2020-01-07	0.012987	0.059041	0.019288	⋯	0.029520	0.002538	0.068235
2020-01-14	-0.092949	-0.020906	-0.005822	⋯	-0.082437	-0.015190	-0.071586
2020-01-21	-0.063604	-0.028470	-0.005857	⋯	-0.089844	-0.015424	-0.056940
⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮
2023-12-12	0.019608	0.008969	0.063218	⋯	0.008511	0.015345	-0.001144
2023-12-19	-0.003846	-0.013333	0.008108	⋯	0.012658	-0.002519	0.009164
2023-12-26	-0.081081	0.018018	0.008043	⋯	0.016667	-0.002525	0.027242

After obtaining the return value of each stock, the next step is to calculate the return of each stock (R_i) by applying equation (2):

$$R_i = \frac{\sum_{i=1}^{n} R_{it}}{n} = \frac{0.012987 + (-0.092949) + \cdots + (-0.081081)}{207} = 0.004240$$

Based on the ADRO stock return calculation results above, the profit earned by ADRO stock investors during the research period is around 0.004240. In addition, the calculation of stock risk is applying equation (3):

$$\sigma_i^2 = \frac{\sum_{i=1}^{n}(R_{it} - R_i)^2}{n}$$
$$= \frac{(0.010791 - 0.004240)^2 + \cdots + (-0.081081 - 0.004240)^2}{207} = 0.004282$$

Based on the calculation of ADRO stock risk above, it means that if a loss occurs, the risk obtained by stock investors is around 0.004282. Below is a table that displays the results of calculating stock return and stock risk.

Table 3. Stock Return and Stock Risk

No.	Company Code	R_i	σ_i^2	No.	Company Code	R_i	σ_i^2
1.	ADRO	0.004240	0.004282	7.	HMSP	-0.003389	0.002113
2.	ASII	0.000115	0.001945	8.	INDF	-0.000549	0.001241
3.	BBCA	0.002251	0.001303	9.	ITMG	0.005965	0.004541
4.	BBNI	0.003186	0.002882	10.	PTBA	0.001183	0.003238
5.	BBRI	0.002443	0.002366	11.	TLKM	0.000624	0.001238
6.	BMRI	0.003479	0.002356	12.	UNTR	0.001616	0.002671

Based on the information listed in Table 3, it is found that stocks with positive individual return values include ADRO (0.004240), ASII (0.000115), BBCA (0.002251), BBNI (0.003186), BBRI (0.002443), BMRI (0.003479), ITMG (0.005965), PTBA (0.001183), TLKM (0.000624), and UNTR (0.001616). Meanwhile, stocks with negative individual returns include HSMP (-0.003389) and INDF (-0.000549). Stocks with positive individual returns have the potential to generate profit for investors, while stocks with negative individual returns may result in profit loss. In terms of variance, it can be seen that ITMG stock has the largest variance (0.004541), while TLKM stock has the smallest variance (0.001238). The larger variance value indicates a larger deviation between actual and individual returns.

2. Market Return and Market Risk

After calculating stock return and stock risk, the next step is calculating market return and market risk. Market return and risk are calculated using the JCI weekly closing price data from 1 January 2020 to 31 December 2023. The calculation of market return is based on equation (4):

$$R_{mt} = \frac{JCI_t - JCI_{(t-1)}}{JCI_{(t-1)}} = \frac{6325.406 - 6279.346}{6279.346} = 0.007335$$

The result of the next period's market return calculation can be seen in Table 4.

Table 4. Return Market

Date	JCI
2020-01-07	0.007335
2020-01-14	-0.013794
2020-01-21	-0.020354
⋮	⋮
2023-12-12	0.008777
2023-12-19	0.006911
2023-12-26	0.004874

The next step is to use equation (5) to find the expected market return value. An example of calculating the market expected return can be seen as follows.

$$E(R_m) = \frac{\sum_{t=1}^{n} R_{mt}}{n} = \frac{0.007335 + (-0.013794) + \cdots + 0.004874}{207} = 0.001009$$

Meanwhile, calculating the market risk is based on equation (6):

$$\sigma_m^2 = \frac{\sum_{t=1}^{n}\left(R_{mt} - E(R_m)\right)^2}{n}$$
$$\sigma_m^2 = \frac{(0.007335 - 0.001009)^2 + \cdots + (0.004874 - 0.001009)^2}{207} = 0.000592$$

Based on the calculation, the expected market return is 0.001009 per week with a risk level 0.000592. The market expected return value is positive, so it can be concluded that JCI benefits investors.

3. Risk-Free Rate

The next step is to calculate risk-free rate value. Risk-free rate is obtained by calculating the average BI rate from January 2020 to December 2023. The following is BI rate data, as shown in Table 5.

Table 5. BI Rate Data for the Period January 2020-December 2023

Month	2020	2021	2022	2023
January	5.00%	3.75%	3.50%	5.75%
February	4.75%	3.50%	3.50%	5.75%
March	4.50%	3.50%	3.50%	5.75%
⋮	⋮	⋮	⋮	⋮
October	4.00%	3.50%	4.75%	6.00%
November	3.75%	3.50%	5.25%	6.00%
December	3.75%	3.5%	5.5%	6.00%

The calculation risk-free rate is based on equation (7):

$$R_f = \frac{\frac{\sum SBI_t}{n}}{52} = \frac{\frac{0{,}05 + 0{,}0475 + \cdots + 0{,}06}{48}}{52} = 0.000845$$

Based on the calculation, the risk-free rate value is 0.000845.

4. Systematic Risk and Non-systematic Risk

In this step, the systematic risk value (β_i) are calculated using equation (8) and the non-systematic risk (σ_{ei}^2) using equation (9). The following are the results of calculating systematic risk and non-systematic risk for ADRO stock.

$$\beta_i = \frac{\sum_{t=1}^{n}(R_{it} - R_i)\left(R_{mt} - E(R_m)\right)}{\sum_{t=1}^{n}\left(R_{mt} - E(R_m)\right)^2}$$
$$= \frac{(0.012987 - 0.004240)(0.007335 - 0.000592) + \cdots + (-0.081081 - 0.004240)(0.004874 - 0.000592)}{(0.007335 - 0.000592)^2 + \cdots + (0.004874 - 0.000592)^2}$$
$$\beta_i = 1.139333$$
$$\sigma_{ei}^2 = \sigma_i^2 - \beta_i^2.\sigma_m^2 = 0.004282 - (1.139333^2 \times 0.000592) = 0.003514$$

The following is a table of the calculation results of systematic risk (β_i) and nonsystematic risk (σ_{ei}^2), as shown in Table 6.

Table 6. Systematic Risk and Nonsystematic Risk

No.	Company Code	β_i	σ_{ei}^2	No.	Company Code	β_i	σ_{ei}^2
1.	ADRO	1,139333	0,003514	7.	HMSP	0,852665	0,001683
2.	ASII	1,300560	0,000944	8.	INDF	0,774850	0,000886
3.	BBCA	1,155081	0,000514	9.	ITMG	1,297941	0,003544
4.	BBNI	1,732968	0,001104	10.	PTBA	1,088343	0,002537
5.	BBRI	1,549421	0,000945	11.	TLKM	0,889828	0,000769
6.	BMRI	1,535689	0,000960	12.	UNTR	0,967395	0,002117

Based on Table 6, it can be seen that 9 stocks have $\beta > 1$, namely ADRO (1.139333), ASII (1.300560), BBCA (1.155081), BBNI (1.732968), BBRI (1.549421), BMRI (1.535689), ITMG (1.297941), and PTBA (1.088343). While stocks with $\beta < 1$ are HMSP (0.852665), INDF (0.774850), TLKM (0.889828), and UNTR (0.967395). The highest beta value is in BBNI stock (1.610789). Stocks with beta $\beta < 1$ are categorized as defensive (low) stocks that tend to respond passively to market price fluctuations. The highest residual error variance is in ITMG stock (0.003544), and the lowest is in BBCA stock (0.000514).

5. Expected Return Using Capital Asset Pricing Model (CAPM)

Calculating the value of $E(R_i)$ involves several variables, including the values of R_i, $E(R_m)$, R_f, and β_i. Investors usually favor assets with lower risk, especially when two investments have the same return but different risks. $E(R_i)$ is calculated by equation (10). An example of calculating $E(R_i)$ using CAPM for ADRO stock is as follows.

$$E(R_i) = R_f + \beta_i\big(E(R_m) - R_f\big) = 0{,}000845 + 1{,}139333(0{,}001009 - 0{,}000845) = \ 0{,}001032$$

Below is a table that displays the results of the expected return calculation for 12 stocks:

Table 7. Expected Return Stock

No.	Company Code	$E(R_i)$	No.	Company Code	$E(R_i)$
1.	ADRO	0.001032	7.	HMSP	0.000985
2.	ASII	0.001058	8.	INDF	0.000972
3.	BBCA	0.001034	9.	ITMG	0.001058
4.	BBNI	0.001129	10.	PTBA	0.001024
5.	BBRI	0.001099	11.	TLKM	0.000991
6.	BMRI	0.001097	12.	UNTR	0.001004

Based on Table 7, the largest $E(R_i)$ Among the other 11 companies is BBNI with a value 0.001129. BBNI also has the largest beta value, 1.732968. Meanwhile, the company with the lowest $E(R_i)$ is INDF, with a value of 0.000972, and INDF also has the smallest beta value of 0.774850.

6. Security Market Line (SML) Graph

Relationship between β_i and $E(R_i)$ is shown visually by the Security Market Line (SML), which is a representation of the CAPM model. β_i Values can be seen in Table 4 and $E(R_i)$ Values in Table 5. Below is the SML chart representing the 12 companies included in the research sample.

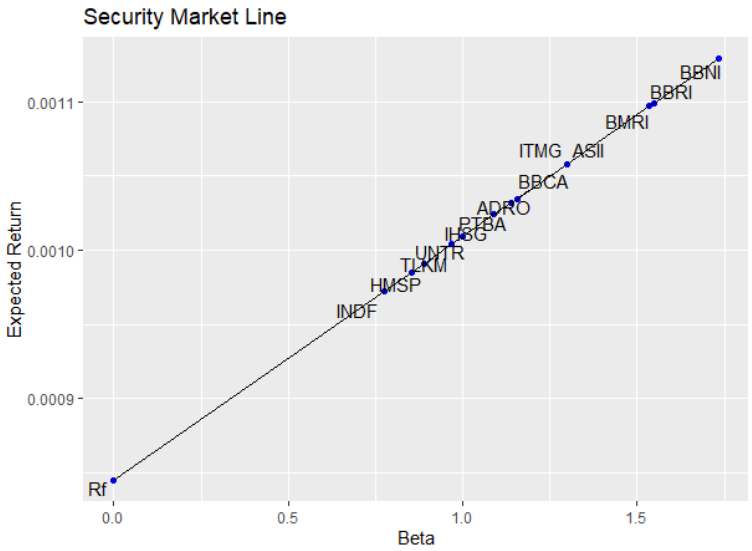

Figure 2. Security Market Line Saham IDX HIDIV20

Based on Figure 2, it was obtained that there is a positive linear relationship between β_i and $E(R_i)$. This shows that higher expected return, higher beta value of the stock. In other words, if the expected return is greater, investors must deal with greater risk, and vice versa.

7. Classify Efficient Stock

Stocks that investors favor are considered efficient, stocks that have individual returns that exceed the expected return $(R_i > E(R_i))$. Stock are considered profitable due to their lower price and greater potential return. The following is a classification of stocks for the 12 companies in the research sample.

Table 8. Classify Efficient Stock

No.	Company Code	R_i		$E(R_i)$	Decision
1.	ADRO	0.004240	>	0.001032	Efficient stock
2.	ASII	0.000115	<	0.001058	Inefficient stock
3.	BBCA	0.002251	>	0.001034	Efficient stock
4.	BBNI	0.003186	>	0.001129	Efficient stock
5.	BBRI	0.002443	>	0.001099	Efficient stock
6.	BMRI	0.003479	>	0.001097	Efficient stock
7.	HMSP	-0.003389	<	0.000985	Inefficient stock
8.	INDF	-0.000549	<	0.000972	Inefficient stock
9.	ITMG	0.005965	>	0.001058	Efficient stock
10.	PTBA	0.001183	>	0.001024	Efficient stock
11.	TLKM	0.000624	<	0.000991	Inefficient stock
12.	UNTR	0.001616	>	0.001004	Efficient stock

Based on Table 8, there are 8 stocks, including efficient stocks, while the other 4 are inefficient stocks. The Stocks classified as efficient stocks are ADRO, BBCA, BBNI, BBRI, BMRI, ITMG, PTBA, and UNTR. The decision made on efficient stocks is to consider buying these stocks or holding these stocks until the stock price increases. Inefficient stocks are ASII, HMSP, INDF, and TLKM. The decision taken on inefficient stocks is to consider selling these stocks before the stock price drops.

8. Optimal Portfolio Composition

Efficient stocks will be considered included in the optimal portfolio determined by the ERB_i value obtained using equation (11), which is more than C^*. The C^* value is the largest value of C_i obtained using equation (12). The example of calculating ERB_i and C_i for ADRO stock is as follows.

$$ERB_i = \frac{(R_i - R_f)}{\beta_i} = \frac{(0.004240 - 0.000845)}{1.139333} = 0.002979$$

$$C_i = \frac{\sigma_m^2 \times \left(\frac{(R_i - R_f)\beta_i}{\sigma_{ei}^2}\right)}{1 + \sigma_m^2 \times \left(\frac{\beta_i^2}{\sigma_{ei}^2}\right)} = \frac{\left(0.000592 \times \left(\frac{(0.005119)1.297941}{0.003544}\right)\right)}{1 + \left(0.000592 \times \left(\frac{1.297941^2}{0.003544}\right)\right)} = 0.000866$$

After obtaining the values of ERB_i, C_i, and C^*, then the stock with $ERB_i > C^*$ are selected as the optimal portfolio composition. Below is a Table 9 displaying the optimal portfolio composition.

Table 9. Optimal Portfolio Composition

No	Company Code	ERB_i		C_i	C^*	Decision
1.	ITMG	0.003944	>	0.000866	0.001016	Composition
2.	ADRO	0.002979	>	0.000534	0.001016	Composition
3.	BMRI	0.001715	>	**0.001016**	0.001016	Composition
4.	BBNI	0.001351	>	0.000833	0.001016	Composition
5.	BBCA	0.001217	>	0.000737	0.001016	Composition
6.	BBRI	0.001031	>	0.000619	0.001016	Composition
7.	UNTR	0.000797	<	0.000165	0.001016	Non-composition
8.	PTBA	0.000311	<	0.000067	0.001016	Non-composition

Based on Table 9, it was obtained that 6 stocks became the optimal portfolio composition, namely ITMG, ADRO, BMRI, BBNI, BBCA, and BBRI.

9. Optimal Portfolio Stock Proportion

Stocks forming the portfolio are then determined in proportion. The step to determine the proportion of portfolio stock is to calculate the value of Z_i with equation (13) and W_i with equation (14). The following is an example of calculating the proportion of ITMG stock.

$$Z_i = \frac{\beta_i}{\sigma_{ei}^2}(ERB_i - C^*) = \frac{1.297941}{0.003544}(0.003944 - 0.001016) = 1.072176$$

$$W_i = \frac{Z_i}{\sum_{i=1}^{j} Z_i} = \frac{1.072176}{1.072176 + \cdots + 0.024056} = 0.280215$$

Below is the result of the proportion of optimal portfolio funds, as shown in Figure 3.

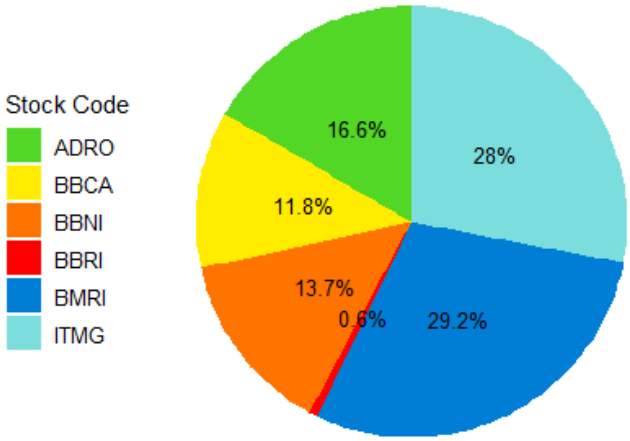

Figure 3. Proportion Dana Portfolio Optimal

Based on Figure 3, the proportion of funds for six stocks included in the optimal portfolio, namely ITMG (28.0%), ADRO (16.6%), BMRI (29.2%), BBNI (13.7%), BBCA (11.8%), and BBRI (0.6%). The most significant proportion of funds is in BMRI stock (29.2%), while the minor proportion is in BBRI stock (0.6%).

10. Optimal Portfolio Return and Risk

The next step is calculating portfolio return using equation (15) and portfolio risk using equation (16). The following is the calculation of portfolio return and portfolio risk.

$$R_p = \sum_{i=1}^{n} W_i R_i = (0.280215 \times 0.005965) + \cdots + (0.006287 \times 0.002443) = 0.004111$$

$$\beta_p = \sum_{i=1}^{j} W_i \times \beta_i = (0.280215 \times 1.297941) + \cdots + (0.006287 \times 1.549421) = 1.385500$$

$$\sum_{i=1}^{j} W_i^2 \sigma_{ei}^2 = ((0.280215)^2(0.003544)^2) + \cdots + ((0.006287)^2(0.000945)^2) = 0.000485$$

$$\sigma_p^2 = \beta_p^2 . \sigma_m^2 + \sum_{i=1}^{n} W_i^2 \sigma_{ei}^2 = (1.385500^2 \times 0.000592) + 0.000485 = 0.001621$$

Based on the calculation using the equation, the amount of portfolio return based on the calculation above is 0.004111 (0.41%). The amount of portfolio risk based on the above calculation is 0.001621 (0.16%). This represents the level of loss that may be encountered in investment activities. By forming an optimal portfolio through diversification, risk can be minimized. This study demonstrates that CAPM can lead to higher returns in various stock indices, indicating its reliability as a robust portfolio optimization method. Despite varying levels of return and risk in different indices, the methodology consistently yields favorable outcomes compared to existing risks. This study is in line with the research of Abdal et al. (2023) optimal portfolio formation on the LQ-45 stock index using CAPM from 45 LQ-45 stocks obtained 14 optimal portfolio forming stocks with a return of 0.52% with a risk of 0.26% and also research by Mumu (2020) optimal portfolio formation on the IDX-30 stock index using CAPM from 21 research samples obtained four optimal portfolio forming stocks with a return of 5.1% and a risk of 0.98%.

D. CONCLUSION AND SUGGESTIONS

Based on the results of implementing the Capital Asset Pricing Model (CAPM) in forming the optimal portfolio for the IDX High Dividend 20 stock index, the optimal portfolio composition includes six stocks from a sample of twelve, with fund proportions as follows: ITMG (28.0 %), ADRO (16.6%), BMRI (29.2%), BBNI (13.7%), BBCA (11.8%), and BBRI (0.6%). This composition yields a portfolio return of 0.004111 (0.41%) and a portfolio risk of 0.001621 (0.16%), calculated using weekly stock price data over four years from January 2020 to December 2023. These findings contribute to the existing literature by demonstrating the effectiveness of CAPM in optimizing portfolios, specifically within the context of high-dividend stocks (IDX HIDIV20).

For further research, as a comparison result of selecting the optimal portfolio, we can consider applying alternative techniques such as the Markowitz Mean-Variance Optimization, Black-Litterman Model, Multi-Factor Models, or Mean-Conditional Value at Risk (Mean-CVaR). Additionally, researchers could expand their analysis by using daily or monthly stock closing data over extended periods to enhance the robustness of their findings. Employing advanced statistical techniques, such as machine learning algorithms for predictive analytics or Monte Carlo simulations for risk assessment, can provide deeper insights into portfolio performance and risk management strategies tailored for high-dividend investing.

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