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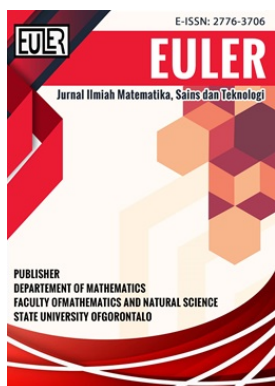
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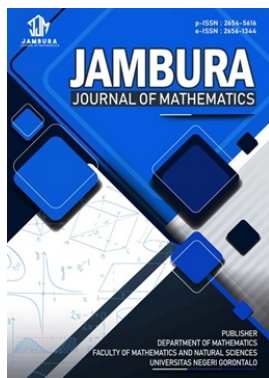


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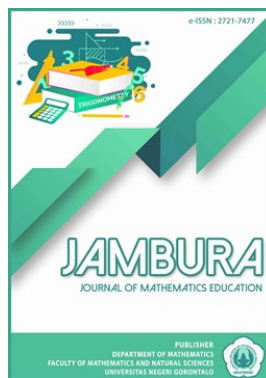
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Comparative Analysis of the Capital Asset Pricing Model and Arbitrage Pricing Theory in Estimating Expected Stock Returns in the IDX BUMN20 Index

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ABSTRACT. This study examines the comparative performance of the Capital Asset Pricing Model (CAPM) and Arbitrage Pricing Theory (APT) in estimating expected stock returns within the IDX BUMN20 Index. The study is motivated by the ongoing debate regarding the empirical validity of single-factor and multifactor asset pricing models, particularly in emerging markets such as Indonesia. While prior studies provide mixed evidence, limited research has focused specifically on state-owned enterprise indices, which exhibit distinct risk characteristics. Using monthly stock price data, this study estimates expected returns under both models and evaluates their performance using Mean Absolute Deviation (MAD), which measures the average deviation between estimated and realized returns. In the APT framework, factor sensitivities are estimated using a multifactor regression approach, incorporating macroeconomic variables as systematic risk factors. This allows a more detailed assessment of how multiple sources of risk influence return estimation. The results indicate that the CAPM demonstrates relatively better estimation performance, as reflected by lower MAD values compared to the APT. However, the APT provides additional insights into the role of multiple risk factors, suggesting its relevance in capturing more complex market dynamics. These findings highlight that while simpler models may perform more consistently in certain contexts, multifactor approaches remain valuable for understanding broader sources of systematic risk. The study contributes to the asset pricing literature by providing empirical evidence from the IDX BUMN20 Index and offering a more nuanced comparison between single-factor and multifactor models in an emerging market setting.



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1. Introduction

Investment plays a crucial role in fostering economic growth and maintaining macroeconomic stability. It contributes not only to increasing production capacity but also to enhancing resource allocation efficiency and strengthening financial system stability. In the modern economic framework, the capital market serves as a primary platform for investment activities by facilitating the interaction between surplus fund holders and deficit units through various financial instruments, particularly stocks [1]. Furthermore, capital markets function as price discovery mechanisms that reflect available economic information efficiently [2].

Stocks, as one of the most widely used investment instruments, offer potential returns in the form of capital gains and dividends, making them attractive to investors. Stock return is a key indicator in investment decision-making, as investors seek to achieve optimal returns with manageable risk levels [3]. The relationship between risk and return remains a fundamental principle in modern financial theory, where higher expected returns are associated with higher levels of risk [4]. Additionally, portfolio diversification continues to be an essential

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strategy for minimizing investment risk [5]. However, stock investment is inherently subject to uncertainty due to market dynamics and economic conditions. Limited information and insufficient analytical capabilities often lead to suboptimal investment decisions [6]. Therefore, quantitative asset pricing approaches, such as CAPM, are used to systematically estimate expected returns and portfolio risk in investment decision-making [7].

Among the most widely applied asset pricing models are the Capital Asset Pricing Model (CAPM) and the Arbitrage Pricing Theory (APT). CAPM explains that stock returns are determined by systematic risk, which is measured by the market beta coefficient [8]. This model remains a fundamental framework in financial research due to its simplicity and ease of application [9]. Recent studies indicate that CAPM continues to be widely used across various market contexts, despite ongoing modifications and extensions [10]. Moreover, CAPM has been shown to exhibit relatively stable performance under normal market conditions [11]. Nevertheless, CAPM has several limitations. The model relies on a single risk factor, which limits its ability to fully explain variations in stock returns, particularly in emerging markets [12]. In addition, the assumption of market efficiency underlying CAPM is often not satisfied in real-world conditions, thereby reducing its predictive accuracy [2]. In volatile market environments, the market beta may also fail to accurately capture actual risk exposure [13].

As an alternative, Arbitrage Pricing Theory (APT) adopts a multifactor approach, allowing the inclusion of macroeconomic variables in explaining stock returns [14]. APT is considered more flexible as it incorporates factors such as inflation, interest rates, and exchange rates, which have been empirically proven to influence stock returns [15]. This multifactor framework provides a more comprehensive explanation of return variations by capturing broader economic dynamics compared to single-factor models [16]. Despite its advantages, APT also has several drawbacks. The inclusion of multiple variables may lead to instability in coefficient estimation and increase model complexity [17]. Furthermore, inappropriate selection of factors can reduce model accuracy and introduce multicollinearity issues [18]. These limitations indicate that careful variable selection is essential to ensure reliable estimation results.

Empirical studies comparing CAPM and APT have produced inconsistent findings. Some studies suggest that CAPM provides more accurate estimates of expected returns than APT [19]. Conversely, other studies indicate that APT performs better in explaining return variations due to its incorporation of multiple risk factors [15]. These conflicting results imply that the performance of both models depends heavily on data characteristics, market conditions, and the observation period [20].

To evaluate the accuracy of CAPM and APT, one commonly used metric is the Mean Absolute Deviation (MAD). MAD measures the average absolute difference between actual returns and estimated returns. A lower MAD value indicates higher predictive accuracy of the model. This method is widely applied in empirical studies due to its simplicity and robustness, as it focuses on the magnitude of prediction errors regardless of their direction [19].

Based on the above discussion, several research gaps can be identified. First, there is still inconsistency in empirical findings regarding the comparative accuracy of CAPM and APT, leading to no definitive conclusion on which model is superior. Second, previous studies have predominantly focused on general market indices, with limited attention given to thematic indices such as IDXBUMN20. Third, macroeconomic variables have often been analyzed partially rather than simultaneously, limiting the comprehensiveness of the analysis. Fourth, differences in evaluation methods across studies make direct comparisons difficult. Fifth, there is a lack of research examining both models within the context of state-owned enterprise (SOE) stocks, which possess unique characteristics and are sensitive to government policies.

This study offers novelty by conducting a comparative analysis of CAPM and APT within the IDXBUMN20 index using a more comprehensive approach. It incorporates key macroeconomic variables—namely inflation, exchange rates, and interest rates simultaneously within the APT framework. In addition, this study employs a consistent evaluation method, namely Mean Absolute Deviation (MAD), to assess the accuracy of both models, ensuring a more objective and reliable comparison.

Based on this gap, this study aims to: (1) estimate expected returns using CAPM; (2) estimate expected returns using APT based on macroeconomic factors (inflation, exchange rate, and interest rate); and (3) compare the estimation performance of both models against realized returns. The findings are expected to provide practical insights for investors in developing investment strategies and risk management, as well as contribute to the asset pricing literature by strengthening empirical evidence on the application of CAPM and APT in the context of strategic indices in the Indonesian capital market.

2. Methods

This study employs a quantitative approach using secondary data from financial markets and macroeconomic sources. The data include monthly closing prices of stocks listed in the IDX BUMN20 Index and the Composite Stock Price Index (IHSG) for the period from March 1, 2023 to September 1, 2025, obtained from Investing.com. Macroeconomic variables, including inflation, the Bank Indonesia benchmark interest rate, and the Rupiah exchange rate against the United States Dollar, are sourced from official publications of the Central Bureau of Statistics and Bank Indonesia. These variables are selected because they represent key sources of systematic risk in asset pricing: inflation reflects changes in purchasing power, interest rates capture the cost of capital and monetary policy stance, and exchange rates indicate external economic exposure affecting firm performance. This observation period represents the most recent three-year market conditions. The sampling technique used is saturated sampling, where all 20 stocks included in the IDX BUMN20 Index are selected. Based on official Indonesia Stock Exchange reports, there were no changes in index constituents during the observation period, ensuring sample consistency.

The dataset consists of 31 monthly observations for each stock, which are used to estimate returns and fit the Capital Asset Pricing Model (CAPM) and Arbitrage Pricing Theory (APT). No data were excluded, as the dataset did not contain missing values. The data are used as reported without adjustments for dividends, stock splits, or other corporate actions, which is acknowledged as a limitation. The expected returns are estimated using CAPM and APT, and the performance of both models is evaluated by comparing the deviation between estimated and realized returns using Mean Absolute Deviation (MAD) [25–27].

2.1. Return

Return is the profit or result obtained from an investment or security, expressed as a percentage per period. In stock investment, return reflects the outcome obtained by investors from changes in stock prices, which can be positive as a capital gain or negative as a capital loss [29]. Return is divided into two types, namely realized return which is calculated based on historical data, and expected return which is anticipated in the future. Actual return is the level of profit that is actually received by investors as a result of investing in a stock. The formula used to calculate the actual stock return is as follows [26]:

$$R_{it} = \frac{P_{it} - P_{i(t-1)}}{P_{i(t-1)}}, \quad (1)$$

where R_{it} represents the return of stock i in period t , P_{it} represents the price of stock i in period t , and $P_{i(t-1)}$ represents the price of stock i in the previous period.

Market return is the rate of profit obtained based on changes in the stock price index. In this study, market return is calculated through changes in the IHSG. The formula used to calculate market return is as follows [26]:

$$R_m = \frac{IHSG_t - IHSG_{(t-1)}}{IHSG_{(t-1)}}, \quad (2)$$

where R_m is the market return value, $IHSG_t$ is the IHSG price in period t , and $IHSG_{(t-1)}$ is the IHSG price in the previous period.

Risk-free return is the rate of return from instruments considered to be free of risk. In this study, the risk-free rate refers to the Bank Indonesia benchmark interest rate and is converted into a monthly return. The formula for risk-free return is as follows [26]:

$$R_f = \frac{SBI_t}{n}, \quad (3)$$

where R_f is the monthly risk-free return, r_t is the benchmark interest rate in period t (in decimal form), and n is the number of months in a year.

2.2. Changes in Each Macroeconomic Variable Factor

Changes in each macroeconomic variable are measured based on the difference between the value of the factor in the current period and the previous period (first difference). This approach is used to analyze the effect of the relative change of a variable, rather than only its absolute level, on stock return movements. Thus, it can be identified how fluctuations in inflation, interest rates, and exchange rates contribute to systematic risk and stock returns within the multifactor APT framework [22, 23]. The formula for changes in each macroeconomic factor is expressed as follows [26]:

$$F_1 = Inflasi_t - Inflasi_{(t-1)}, \quad (4)$$

$$F_2 = SBI_t - SBI_{(t-1)}, \quad (5)$$

$$F_3 = Kurs_t - Kurs_{(t-1)}, \quad (6)$$

where F_{1t} represents the change in the inflation rate, F_{2t} represents the change in the BI benchmark interest rate, and F_{3t} represents the change in the Rupiah exchange rate against the US Dollar in period t .

2.3. Risk (Beta)

Systematic risk is risk that cannot be eliminated through portfolio diversification because it is influenced by macroeconomic factors and overall market conditions. Systematic risk is measured using beta (β), which indicates the sensitivity of stock returns to changes in market returns [28]. The CAPM beta is calculated using the covariance ratio between stock returns and market returns divided by the variance of market returns as follows [26]:

$$\beta_i = \frac{\text{Cov}(R_i, R_m)}{\text{Var}(R_m)}, \quad (7)$$

where β_i is the sensitivity of stock i to market return.

In the APT model, beta represents the sensitivity of a stock to each macroeconomic factor. The APT beta for factor k is calculated by dividing the covariance of stock returns with that

factor by the variance of the factor, as follows [26]:

$$\beta_{ik} = \frac{\text{Cov}(R_i, F_k)}{\text{Var}(F_k)}, \quad (8)$$

where β_{ik} is the sensitivity of stock i to factor F_k .

2.4. Capital Asset Pricing Model (CAPM)

The CAPM model is used to estimate expected return based on the linear relationship between stock returns and market returns. This model estimates the level of return expected by investors based on systematic risk (beta), so that the higher the beta value, the greater the risk and the potential return expected [25]:

$$E(R_i) = R_f + \beta_i [E(R_m) - R_f], \quad (9)$$

where $E(R_i)$ is the expected return of stock i , $E(R_m)$ is the expected market return, R_f is the risk-free return, and β_i is systematic risk.

2.5. Arbitrage Pricing Theory (APT)

APT is a developed model that assumes the return of a stock is influenced by several systematic risk factors, including macroeconomic factors, making it more flexible than CAPM which is based only on a single market factor [22, 23]. In this study, three macro factors are used, namely inflation, the BI benchmark interest rate, and the Rupiah exchange rate against the US Dollar. In general, the APT expected return can be calculated using the following formula [23, 25]:

$$E(R_i) = R_f + \beta_{i1}F_{1t} + \beta_{i2}F_{2t} + \beta_{i3}F_{3t}, \quad (10)$$

where $E(R_i)$ is the expected return of stock i , R_f is the risk-free return, $\beta_{i1}, \beta_{i2}, \beta_{i3}$ are the sensitivities of the stock to each factor, and F_{1t}, F_{2t}, F_{3t} are the changes in inflation, interest rates, and exchange rates in period t .

2.6. Mean Absolute Deviation (MAD)

MAD is used to assess estimation accuracy by calculating the average absolute error between actual return and expected return. A smaller MAD value indicates a lower deviation, meaning the model is considered more accurate [24]. The MAD formula is as follows [24]:

$$MAD = \frac{1}{N} \sum_{t=1}^N |R_{it} - E(R_i)|, \quad (11)$$

where R_{it} is the actual return of stock i in period t , $E(R_i)$ is the expected return of stock i , and N is the number of observations.

3. Results and Discussion

Descriptive statistical analysis was conducted using monthly stock returns rather than raw stock prices to provide a more meaningful comparison across firms with different nominal price levels. The use of return data allows for a standardized assessment of performance and risk, which is more relevant in the context of asset pricing models such as CAPM and APT. The results of the descriptive statistics are presented in Table 1.

Based on Table 1, it can be seen that the average closing price of stocks included in the IDX BUMN20 index during the period of March 1, 2023 to September 1, 2025 was Rp 2,151

Table 1. Descriptive Statistics of Stock Prices in the IDX BUMN20 Index

Statistic	Value
Mean	2,151
Standard Deviation	1,840
Minimum	170
Maximum	7,250
Count	20

per share. The standard deviation value is Rp 1,840, which indicates a relatively high level of price fluctuation, reflecting the volatility of state-owned enterprise stock price movements during the observation period. This relatively large standard deviation compared to the mean suggests substantial dispersion in stock prices across firms, indicating differences in firm size, market capitalization, and investor perception.

The lowest closing price was Rp170 per share, which occurred in ADHI stock on February 1, 2025, while the highest price occurred in BMRI stock on March 1, 2024, reaching Rp 7,250 per share. The wide range between the minimum and maximum values indicates significant heterogeneity in nominal stock prices within the IDX BUMN20 index, which limits the comparability of price levels across companies. This condition implies that stock prices in absolute terms may not fully reflect relative performance or risk, thereby reinforcing the need to use return-based measures in further analysis. The total number of observations used in this analysis was 20 data points, representing all IDX BUMN20 constituent stocks.

3.1. Calculating Stock Returns

In this study, the calculation of the actual return value of each stock can be performed using eq. (1). The following is the calculation of the actual return for all stocks.

Table 2. Summary of Actual Stock Returns

No.	Stock Code	$E(R_{it})$	Volatility
1	BBRI	-0.0019	0.0960
2	BBTN	0.0057	0.0926
3	BJBR	-0.0167	0.0670
4	BJTM	-0.0098	0.0670
5	BMRI	-0.0019	0.0816
6	BRIS	0.0198	0.1076
7	BBNI	-0.0014	0.0777
8	AGRO	-0.0085	0.1219
9	ANTM	0.0202	0.1219
10	ELSA	0.0177	0.0697
11	PGAS	0.0093	0.0743
12	PGEO	0.0354	0.1719
13	PTBA	-0.0134	0.0892
14	TINS	0.0256	0.1632
15	ADHI	-0.0005	0.1660
16	JSMR	0.0052	0.0742
17	PTPP	0.0029	0.1795
18	MTEL	-0.0044	0.0660
19	TLKM	0.0116	0.0633
20	SMGR	-0.0216	0.0945

The results of actual return calculations indicate that IDX BUMN20 stocks exhibit heterogeneous return and volatility profiles. Several stocks, such as PGEO and TINS, show relatively high average returns accompanied by high volatility, reflecting higher risk exposure, while

others such as BJBR and SMGR record negative average returns. This variation highlights that return distribution among state-owned enterprises is not uniform, implying differences in risk characteristics and market sensitivity. From an asset pricing perspective, this heterogeneity is important because it forms the basis for estimating systematic risk and expected return under both CAPM and APT frameworks.

Market return is calculated from the IHSG using eq. (2). The following is an example of the calculation of market return in the second period:

$$R_m = \frac{6,915.72 - 6,805.28}{6,805.28} = 0.01623.$$

This result shows that the IHSG increased by 1.62% compared to the previous period. Furthermore, the expected market return is calculated as the average market return during the observation period, resulting in

$$E(R_m) = 0.006466.$$

The average market return of 0.006466 indicates moderate positive market performance during the observation period, while the calculated risk-free rate reflects prevailing monetary conditions. These results provide the baseline for estimating expected returns and suggest that overall market movements remain an important determinant of stock performance, consistent with the theoretical foundation of CAPM.

The risk-free return is calculated using eq. (3). As an illustration, with an annual policy interest rate of 5.75%, then:

$$R_f = \frac{5.75\%}{12} = 0.00479.$$

Based on the calculation results, the risk-free interest rate in the first period is obtained as 0.00479. This value indicates the level of return that investors can obtain if they place their funds in risk-free instruments such as SBI.

3.2. Calculating Changes in Each Macroeconomic Variable Factor

In calculating APT, changes in macroeconomic factors are required to represent economic dynamics that can drive fluctuations in stock returns. The first difference approach is applied so that the analysis focuses on changes between periods rather than absolute levels. This approach is consistent with the multifactor APT framework, in which returns are modeled as a function of systematic factors [22, 23]. Using eq. (4) to eq. (6) [26], an example of factor changes in the second period is presented as follows:

a. Inflation

$$F_1 = 0.33 - 0.18 = 0.15.$$

A positive value of 0.15 indicates that the inflation rate increased compared to the previous period.

b. Bank Indonesia Interest Rate

$$F_2 = 5.75\% - 5.75\% = 0.00\%.$$

A value of 0.00% indicates that there was no change in the policy interest rate during that period.

c. Exchange Rate

$$F_3 = 14866.71 - 15300.71 = -434.$$

A negative value of -434 indicates that the Rupiah strengthened against the United States Dollar, which is reflected in the decline in the exchange rate value.

3.3. Calculating Systematic Risk

Systematic risk is calculated to measure the sensitivity of each stock to systematic market movements. Within the CAPM framework, systematic risk is summarized by a single beta coefficient (β_i) that reflects the sensitivity of a stock to market returns [28]. The CAPM beta value is calculated using eq. (7).

Table 3. Systematic Risk Estimation of CAPM

No.	Stock Code	β_i	No.	Stock Code	β_i
1	BBRI	1.5929	11	PGAS	0.3586
2	BBTN	1.4889	12	PGEO	0.4986
3	BJBR	0.9357	13	PTBA	0.8544
4	BJTM	1.2027	14	TINS	1.2196
5	BMRI	1.3010	15	ADHI	2.3065
6	BRIS	0.9871	16	JSMR	0.7901
7	BBNI	1.1226	17	PTPP	2.3157
8	AGRO	2.0165	18	MTEL	0.5063
9	ANTM	0.8021	19	TLKM	0.1652
10	ELSA	0.8503	20	SMGR	1.4111

For PTPP stock, the estimated beta value is 2.3157, which indicates a high level of sensitivity to market movements (an aggressive stock). This condition can also be associated with the characteristics of PTPP's business sector, which operates in construction and infrastructure, sectors that are generally highly influenced by economic cycles, government projects, and investment dynamics in development. As a result, the movement of its stock price tends to be more responsive to changes in market conditions. The CAPM beta values for all stocks included in the IDX BUMN20 index are presented in Table 3. The differences in these beta values reflect heterogeneous risk profiles among stocks, which directly affect the estimation of expected returns based on CAPM [25, 28].

In the APT model, the beta value represents sensitivity to various macroeconomic factors (inflation, interest rates, and exchange rates), rather than only to a single market factor [22, 23]. The APT beta values are calculated using eq. (8) and are presented in Table 4.

Table 4. Systematic Risk Estimation of APT

Stock Code	Inflation	SBI	Exchange Rate	Stock Code	Inflation	SBI	Exchange Rate
BBRI	0.0072	-23.546	-0.00015	PGAS	-0.0242	-1.815	0.00003
BBTN	-0.0278	-22.125	-0.00011	PGEO	-0.1306	-18.145	-0.00005
BJBR	0.0254	-10.018	-0.000002	PTBA	-0.0203	-13.7	-0.00005
BJTM	-0.0151	-14.257	0.000005	TINS	0.0254	-30.899	0.0000009
BMRI	-0.0019	-6.968	-0.00007	ADHI	0.0971	-14.974	-0.00002
BRIS	-0.0596	-15.633	-0.00002	JSMR	0.0402	13.039	0.00006
BBNI	0.0972	-14.974	-0.00008	PTPP	0.0539	-18.859	-0.0001
AGRO	-0.0037	-32.751	-0.00018	MTEL	-0.0249	-8.289	0.000016
ANTM	-0.0573	-21.843	-0.00011	TLKM	-0.0131	9.338	-0.000006
ELSA	-0.0104	3.672	0.00006	SMGR	0.0390	-15.257	-0.000062

Based on Table 4, IDX BUMN20 stocks show different levels of sensitivity to macroeconomic factors. However, the inflation beta values are generally relatively small (close to zero), indicating that the effect of inflation on return variation is relatively weak. Meanwhile, most interest rate beta values are negative and relatively large, indicating that increases in interest rates tend to reduce stock returns (although there are several stocks, such as JSMR and TLKM, that have positive interest rate betas). Furthermore, the exchange rate beta values are very

small and close to zero for most stocks, indicating that fluctuations in the Rupiah exchange rate against the US Dollar are not a major driver of stock returns in the sample of this study.

The CAPM beta estimates demonstrate substantial variation across stocks, indicating differing levels of sensitivity to market movements. Stocks such as PTPP and ADHI exhibit high beta values (> 2), classifying them as aggressive stocks that are highly responsive to market changes. This is consistent with their sectoral characteristics, as infrastructure and construction firms are generally more cyclical and dependent on economic conditions. In contrast, stocks such as TLKM and PGAS show low beta values, indicating more defensive characteristics. These findings align with prior studies that highlight sectoral differences in systematic risk.

In the APT model, the estimated factor sensitivities reveal that inflation and exchange rate coefficients are generally small, suggesting limited direct influence on stock returns. In contrast, most interest rate coefficients are negative and relatively large. While this is theoretically consistent with the inverse relationship between interest rates and stock prices, the magnitude of these coefficients requires careful interpretation. It may reflect model sensitivity to limited variation in interest rates, potential scaling issues, or multicollinearity among macroeconomic variables. Therefore, these results should not be interpreted as purely economic effects, but also as a consequence of model specification and data structure.

3.4. Calculating Expected Return CAPM and APT

The calculation of expected return aims to measure the level of return expected by investors based on asset pricing models [21]. The expected return using the CAPM model is calculated using eq. (9). For the stock with the code ADHI, the following result is obtained:

$$\begin{aligned} E(R_1) &= 0.00485 + 2.30655 [(0.006466) - (0.00485)] \\ &= 0.008574477. \end{aligned}$$

The expected return using the APT model is calculated using eq. (10). To maintain consistency of units, the changes in factors are expressed on the same scale as that used when estimating the APT beta. For ADHI stock, the following result is obtained:

$$\begin{aligned} E(R_1) &= 0.00485 + (0.0971 \times 0.001) + (-14.97436 \times -0.03\%) + (-2.80051 \times 38.6762) \\ &= 0.008857675. \end{aligned}$$

The values of expected return from CAPM and APT are presented in full in Table 5.

Table 5. CAPM and APT Expected Return Estimates

No.	Stock Code	CAPM	APT	No.	Stock Code	CAPM	APT
1	BBRI	0.0074	0.0066	11	PGAS	0.0054	0.0069
2	BBTN	0.0072	0.0079	12	PGEO	0.0056	0.0086
3	BJBR	0.0063	0.0081	13	PTBA	0.0062	0.0071
4	BJTM	0.0067	0.0097	14	TINS	0.0068	0.0155
5	BMRI	0.0069	0.0042	15	ADHI	0.0085	0.0088
6	BRIS	0.0064	0.0092	16	JSMR	0.0061	0.0030
7	BBNI	0.0066	0.0079	17	PTPP	0.0085	0.0064
8	AGRO	0.0081	0.0086	18	MTEL	0.0056	0.0082
9	ANTM	0.0061	0.0078	19	TLKM	0.0051	0.0014
10	ELSA	0.0062	0.0063	20	SMGR	0.0071	0.0075

Table 5 shows that expected returns differ across stocks and across models because CAPM depends only on market risk, whereas APT integrates macroeconomic factors. Based on CAPM,

the highest expected return is recorded for PTPP stock at 0.0085, and the lowest for PGAS stock at 0.0054. Meanwhile, based on APT, the highest expected return is found in TINS stock at 0.0155, and the lowest in TLKM stock at 0.0014. This indicates that the inclusion of macroeconomic factors in APT can produce a wider range of expected return estimates. The expected return estimates from CAPM and APT show variation across stocks and models. CAPM produces a relatively narrower range of expected returns, reflecting its reliance on a single market factor. In contrast, APT generates a wider dispersion of expected returns, as seen in stocks such as TINS and TLKM, indicating that the inclusion of macroeconomic variables increases sensitivity to different sources of risk. However, this wider dispersion does not necessarily imply better estimation accuracy, but rather reflects differences in model structure.

3.5. Calculating MAD

The Mean Absolute Deviation (MAD) method is used to assess the accuracy of forecasting results by calculating the total absolute error. This approach measures prediction accuracy through the average of the absolute value of each error. The results of the MAD calculation for both models using eq. (11) are presented in Table 6.

Table 6. MAD Estimates

No.	Stock Code	CAPM	APT
1	BBRI	0.0762	0.0761
2	BBTN	0.0702	0.0702
3	BJBR	0.0433	0.0440
4	BJTM	0.0475	0.0480
5	BMRI	0.0653	0.0653
6	BRIS	0.0781	0.0782
7	BBNI	0.0632	0.0632
8	AGRO	0.0942	0.0942
9	ANTM	0.0825	0.0824
10	ELSA	0.0539	0.0539
11	PGAS	0.0548	0.0547
12	PGEO	0.1107	0.1111
13	PTBA	0.0651	0.0652
14	TINS	0.1084	0.1106
15	ADHI	0.1328	0.1328
16	JSMR	0.0589	0.0589
17	PTPP	0.1432	0.1426
18	MTEL	0.0541	0.0550
19	TLKM	0.0506	0.0503
20	SMGR	0.0774	0.0775
Average		0.0765	0.0767

Based on Table 6, the evaluation using MAD shows that CAPM (0.0765) and APT (0.0767) have nearly identical levels of accuracy in estimating IDX BUMN20 stock returns. At the individual stock level, the highest MAD value in both models is observed in PTPP (0.1432 for CAPM and 0.1426 for APT), while the lowest values are found in BJBR (0.0433) for CAPM and ELSA (0.0539) for APT. Although CAPM exhibits a slightly lower average MAD, the difference is marginal and does not indicate a meaningful superiority, as APT provides comparable or even lower deviations for several stocks.

This finding suggests that the additional complexity of APT does not necessarily lead to significantly better predictive performance in this context, which is consistent with em-

empirical evidence in emerging markets where CAPM often performs comparably to multifactor models. One possible explanation is that the selected macroeconomic variables may not fully capture the relevant sources of systematic risk. In addition, the characteristics of state-owned enterprises such as government support, strategic roles, and relatively stable operations may reduce sensitivity to macroeconomic fluctuations. As a result, market-wide risk captured by CAPM may already explain a substantial portion of return variation, limiting the incremental benefit of APT.

4. Conclusion

This study shows that the Capital Asset Pricing Model (CAPM) and Arbitrage Pricing Theory (APT) provide comparable accuracy in estimating expected returns of IDX BUMN20 stocks. This finding suggests that, in the context of Indonesian state-owned enterprises, market risk remains the dominant factor, making CAPM sufficiently effective despite its simplicity. Although APT incorporates macroeconomic variables such as inflation, interest rates, and exchange rates, its additional complexity does not necessarily result in superior predictive performance. This indicates that the effectiveness of multifactor models depends not only on theoretical flexibility but also on the relevance and variability of the selected factors, as well as the characteristics of the firms being analyzed.

However, this study has several limitations, including the limited selection of macroeconomic variables, the relatively short observation period, and the use of unadjusted price data that does not account for dividends or corporate actions. These constraints may affect the robustness of the estimation results. Practically, the findings imply that CAPM can be used as a simple and efficient tool for estimating expected returns, while APT remains useful for providing additional insights into macroeconomic risk exposure. Therefore, future research is recommended to incorporate broader risk factors, longer observation periods, and more refined data adjustments to enhance the explanatory power of asset pricing models.

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Data availability. The data used in this study were obtained from several publicly available secondary data sources, namely Investing (<https://investing.com>), the Central Bureau of Statistics (<https://www.bps.go.id>), and Bank Indonesia (<https://www.bi.go.id>). All data used are publicly accessible and can be freely obtained through their respective official websites.

References

- [1] Y. Pratama, E. Sulistianingsih, N. N. Debatara, and N. Imro'ah, "K-Means Clustering dan Mean Variance Efficient Portfolio dalam Portofolio Saham," *J. Probab. Stat.*, vol. 5, no. 1, pp. 24–30, 2024.
- [2] E. F. Fama, "Efficient Capital Markets: II," *J. Finance*, vol. 46, no. 5, pp. 1575–1617, 1991, doi: [10.1111/j.1540-6261.1991.tb04636.x](https://doi.org/10.1111/j.1540-6261.1991.tb04636.x).
- [3] T. C. Yoda, T. Husni, E. Luthan, and R. Rahim, "Moderating Effects of Market Based Value on the Relationship Between Financial Performance and Stock Returns: Evidence from the Indonesian Banking Industry," *J. Manaj. Univ. Bung Hatta*, vol. 20, no. 1, pp. 84–95, 2025.
- [4] S. A. Safira and N. Satyahadewi, "Analisis Portofolio Optimal Dengan Metode Liquidity Adjusted Capital Asset Pricing Model Pada Indeks Saham LQ-45," *J. Math. Educ.*, pp. 129–135, 2024.
- [5] A. F. Aridwianto et al., "Optimasi Portofolio Capital Asset Pricing Model (CAPM) Pada Indeks Bisnis-27," *J. Gaussian*, vol. 14, no. 2, pp. 547–553, 2025, doi: [10.14710/j.gauss.14.2.547-553](https://doi.org/10.14710/j.gauss.14.2.547-553).
- [6] D. R. Amalia, E. Sulistianingsih, and N. Imro'ah, "Analisis Pembentukan Portofolio Optimal pada Indeks Saham LQ-45 dengan Metode Safety First Criterion," *Jambura J. Math.*, vol. 6, no. 2, pp. 140–146, 2024, doi: [10.37905/jjom.v6i2.24438](https://doi.org/10.37905/jjom.v6i2.24438).
- [7] E. V. Putri and W. Hariyanto, "Comparative analysis of expected return and portfolio risk in formation of optimal portfolios using the capital asset pricing model (CAPM) and single index methods," *Academia Open*, vol. 5, 2021, doi: [10.21070/acopen.5.2021.2371](https://doi.org/10.21070/acopen.5.2021.2371).
- [8] W. Chindrianti, S. W. Rizki, and N. Imro'ah, "Analisis Pembentukan Portofolio Optimal Saham JII Dengan Metode Capital Asset Pricing Model," *Bul. Ilm. Math. Stat dan Ter.*, vol. 11, no. 3, pp. 561–570, 2021.
- [9] M. Kurniawan, E. Sisdianto, and U. A. Mustofa, "Pengaruh Bid-Ask Spread, Market Value dan Dividend Payout Ratio Terhadap Holding Period," *J. Ilm. Ekon. Islam*, vol. 8, no. 1, p. 607, 2022, doi: [10.29040/jiei.v8i1.4059](https://doi.org/10.29040/jiei.v8i1.4059).
- [10] O. Paseda et al., "The capital asset pricing model (CAPM) after 60 years: Key insights, unresolved issues, and future directions," *Soc. Sci. Humanit. Open*, vol. 13, p. 102256, 2026, doi: [10.1016/j.ssaho.2025.102256](https://doi.org/10.1016/j.ssaho.2025.102256).
- [11] P. Hartono et al., "Analisis Komparasi Metode CAPM dan APT dalam Memprediksi Return Saham LQ45 2019-2021," *J. Ris. Manaj.*, vol. 11, no. 2, pp. 219–225, 2023, doi: [10.17509/image.2023.020](https://doi.org/10.17509/image.2023.020).
- [12] T. Wahyuni and T. Gunarsih, "Comparative Analysis of Accuracy Between CAPM and APT," *J. Appl. Econ. Dev. Ctries.*, vol. 5, no. 1, pp. 23–30, 2020.
- [13] W. Ichwanudin and R. Kambara, "Testing The Indonesian Stock Market Arbitrage Pricing Model," *J. Manaj.*, vol. 27, no. 1, pp. 86–102, 2023, doi: [10.24912/jm.v27i1.950](https://doi.org/10.24912/jm.v27i1.950).
- [14] E. F. Fama and K. R. French, "A five-factor asset pricing model," *J. Financ. Econ.*, vol. 116, no. 1, pp. 1–22, 2015.
- [15] N.-F. Chen, R. Roll, and S. A. Ross, "Economic forces and the stock market revisited," *J. Empir. Financ.*, vol. 13, no. 2, pp. 129–144, 2006, doi: [10.1016/j.jempfin.2005.09.001](https://doi.org/10.1016/j.jempfin.2005.09.001).
- [16] D. Noviani et al., "And Arbitrage Pricing Theory (APT) In Mining Company Sectors," *Eduvest*, vol. 4, no. 9, pp. 7560–7575, 2024.
- [17] S. Fratama and E. Kurniati, "Penerapan Model CAPM dan APT dalam Menghitung Return Indeks Saham IDX30," *J. Ris. Mat.*, pp. 37–44, 2023.
- [18] D. N. Gujarati, *Basic Econometrics*, 4th ed. New York: McGraw-Hill, 2012.
- [19] A. S. Wati and W. Hariyanto, "Comparison of CAPM and APT in predicting stock returns," *Indonesian Journal of Law and Economics Review*, vol. 1, no. 4, pp. 1–10, 2018.
- [20] S. J. Sindhuarta et al., "Comparison Analysis Between CAPM and APT Models in Predicting Return of IDX-30 Stocks," *Indikator*, vol. 7, no. 1, p. 48, 2023, doi: [10.22441/indikator.v7i1.15992](https://doi.org/10.22441/indikator.v7i1.15992).
- [21] C. R. Harvey, Y. Liu, and H. Zhu, "... and the Cross-Section of Expected Returns," *Rev. Financ. Stud.*, vol. 29, no. 1, pp. 5–68, 2016, doi: [10.1093/rfs/hhv059](https://doi.org/10.1093/rfs/hhv059).
- [22] K. R. French, "Macroeconomic Forces and Arbitrage Pricing Theory," *J. Portf. Manag.*, vol. 43, no. 5, 2017.
- [23] N. Arif, P. Harto, and S. Rahayu, "Arbitrage Pricing Theory: A Macro Variable Model Approach," *J. Account. Manag.*, vol. 14, no. 3, 2024.
- [24] D. B. Pasaribu et al., "Pengukuran Kinerja Portofolio Optimal CAPM dan APT," *J. Gaussian*, vol. 7, no. 4, pp. 419–430, 2018.
- [25] D. Kurniasari and I. A. Saputra, "Analisis Perbandingan Keakuratan Model CAPM dan APT," *JSER*, vol. 5, no. 2, pp. 22–30, 2023.
- [26] S. Fratama and E. Kurniati, "Penerapan Model CAPM dan APT dalam Menghitung Return Indeks Saham IDX30," *Jurnal Riset Matematika*, pp. 37–44, 2023.
- [27] D. T. Wibowo and F. T. Alfina, "CAPM dan APT dalam Membentuk Portofolio Optimal Saham," *J. Ilm.*

-
- Bisnis dan Ekon.*, vol. 3, no. 1, pp. 1–8, 2024.
- [28] I. Nugroho and S. Sukhemi, “Pengaruh Risiko Sistematis dan Likuiditas terhadap Return Saham,” *J. Akuntansi*, vol. 3, no. 2, 2016.
- [29] D. A. Oktaviani et al., “Pricing of Call Options Using the Quasi Monte Carlo Method,” *BAREKENG*, vol. 17, no. 4, pp. 1232–1242, 2023, doi: [10.30598/barekengvol17iss4pp1232-1242](https://doi.org/10.30598/barekengvol17iss4pp1232-1242).