COMPARATIVE ANALYSIS OF INVESTMENT RETURN CALCULATIONS BETWEEN SINGLE INDEX MODEL (SIM), CAPITAL ASSET PRICING MODEL (CAPM), AND ARBITRAGE PRICING THEORY (APT) IN 8 MINING COMPANY SECTORS

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ABSTRACT

Investment is an activity related to the economic and business world. Investment actions can meet future financial needs where the invested funds gain returns after a certain period. Investors with broad insights significantly influence investment decisions. This study aims to analyze the comparative calculation of investment return rates between three models, namely Single Index Model (SIM), Capital Asset Pricing Model (CAPM), and Arbitrage Pricing Theory (APT), in eight mining company sectors listed on the Indonesia Stock Exchange (IDX 30). This study uses historical data from the mining company sectors to calculate and compare the investment return rates based on these three models. The research method used is statistical analysis to evaluate and compare the predicted investment return rates from the Single Index Model (SIM), Capital Asset Pricing Model (CAPM), and Arbitrage Pricing Theory (APT). The data used includes historical stock prices, company financial data, and relevant market data. The results of this study are expected to provide a better understanding of the effectiveness and advantages of each model in the context of mining companies listed on IDX 30. The results of this study show that the Single Index Model (SIM) indicates a moderate financial potential with an average value of 7,58, which is lower compared to CAPM. A high risk (beta) of 2,20 indicates that this investment has a higher risk than the market. On the other hand, the Capital Asset Pricing Model (CAPM) has a higher average return value of 19,15, indicating greater profit potential but also commensurate risk. The Arbitrage Pricing Theory calculation of 6,46, the lowest, reflects a more cautious calculation of return estimates. The inflation beta risk value of 100.924,50 and the deposit interest beta risk of 9.320,14 are very high.

INTRODUCTION

The stock market is often a primary indicator for predicting recessions and crises. When a country faces a potential recession or crisis, economic growth declines, impacting company sales and profits, resulting in stock prices being corrected due to high price-earnings ratios (PER) (Hans Kwee 2023).

Stocks are a financial instrument with a central role in the investment and financial market world. Stock ownership is not just a document but also encompasses deep rights and obligations within the company's structure. Stocks create opportunities for their owners to participate in the company's growth and success. Stock investment has become a popular choice among market players, both individuals and financial institutions (Tony Hartawan 2024).

Stock price prediction is one step an investor can take to reduce losses and increase future profit opportunities. Therefore, predicting stock prices requires methods and approaches with good accuracy. The higher the accuracy of a prediction method, the greater the profit opportunities from purchased stocks (Sumarga et al., 2023).

Investing in stocks can be profitable for an investor but also carries the risk of loss. This occurs because stock prices fluctuate, leading investors to create portfolios to reduce risk. One index measuring the performance of highly liquid and large-cap stocks supported by good company fundamentals is the IDX30 index (Nadia Inka aulia, 2022).

With fluctuating stock movements influenced by various factors, from internal company factors to domestic and global conditions, mining companies, which perform outstandingly compared to others, can see significant stock price increases when commodity prices rise. Mining company stocks can provide diversification to an investment portfolio, especially when balanced with other different sectors. With the increasing global demand for commodities, particularly those related to renewable energy and new technologies, mining companies have strong growth prospects. Investors need to consider risks associated with commodity price fluctuations, environmental issues, and regulatory changes. Proper analysis and diversification strategies in mining company investments can be an essential part of a balanced portfolio. It is crucial to prepare the right strategies to face potential stock increases or decreases. Several methods can be used to calculate expected returns from stock investments, such as the Single Index Model (SIM), Capital Asset Model (CAPM), Arbitrage Pricing Theory (APT), and other calculation models (Andita, 2019).

Theoretical Review

Management

According to Stephen P. Robbins and Mary Coulter (2018), "Management involves coordinating and overseeing the work activities of others so their activities are completed efficiently and effectively." This definition can be interpreted as management involving the coordination and supervision of other people's activities so that their activities are completed efficiently and effectively.

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Financial Management
According to Rini Astuti (2022), financial management is a field that focuses on the efficient and effective use of capital, borrowed funds, and other business resources, as well as the decision-making processes necessary to maximize profits and add value to an entity.

Signaling Theory
According to Ghozali (2020) in his book, signaling theory was first developed by Spence in 1973. This theory explains how two parties behave when they obtain different types of information. A signal is an indication given by the company (management) to communicate with external parties (investors). This signal can take various forms, whether it can be directly observed or requires deeper analysis to be understood. Regardless of the form or type of signal issued, all are intended to indicate something with the expectation that the market or external parties will change their assessment of the company. This means that the chosen signal must have information content strong enough to change the external party's assessment of the company.

Financial Performance
According to Hutabarat (2021), financial performance is an analysis conducted to assess the extent to which a company has implemented financial execution rules correctly and appropriately.

Stock Valuation
According to K.R. Subramanyam (2014), the basis for intrinsic stock valuation is the present value of future returns discounted at an appropriate rate. These returns include dividends, free cash flows, and residual earnings. Future returns are obtained from financial information with adjustments through financial statement analysis. Therefore, the analysis of a stock's intrinsic value aims to eliminate distortions in financial statements.

Book Value and Market Value
According to Richard A. Brealey et al. (2014), **Book Value** is the value of a company's assets as listed on the balance sheet. It is calculated as total assets minus total liabilities. Book value is often used to assess a company's financial health, determine liquidation value, and serve as a basis for several financial ratios, such as the Price to Book (P/B) ratio.

Market Value, is the value placed by the market on a company's stock or assets. It is determined by the current stock price multiplied by the number of outstanding shares. Market value is used by investors to determine the company's value based on market perception and expectations of future performance. It is also used in measurements such as market capitalization

Risk

According to Richard A. Brealey et al. (2019), risk in a financial context is the variation of possible outcomes from an investment. Risk is often measured using the standard deviation of expected returns. The formula is as follows:

$$\sigma = \sqrt{\frac{\sum(Ri-R)^2}{n-1}}$$

Explanation:
σ = the standard deviation (risk),
Ri = represents each individual return,
μ = the mean (average) return,
N = the number of observations.

Return

According to Richard A. Brealey et al. (2019), return is the total gain received from an investment over a specific period, which consists of income from the asset (dividends, interest) and changes in the asset's value. The formula is as follows:

$$Return = \frac{(P1-P0)}{P0} + D$$

Explanation:
P_t = the price of the asset at the end of the period,
P_{t-1} = is the price of the asset at the beginning of the period,
D = represents the income received from the asset during the period (e.g., dividends or interest).

Beta

According to Richard A. Brealey et al. (2019), Beta is a statistical measure indicating the extent to which the return of an asset, such as stocks, fluctuates relative to the market return. The market is represented by market indices such as the S&P 500 or IHSG. Beta is used in the Capital Asset Pricing Model (CAPM) to measure the risk that cannot be eliminated through portfolio diversification. The formula is as follows;

$$\beta = \frac{Cov(Ri-Rm)}{\sigma_m^2}$$

Explanation:
Cov (Ri-Rm) = Covariance of the return of stock i and the market return.
σ_3^2 = Variance of the market return.

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Beta helps investors understand systematic risk that cannot be eliminated through diversification. This risk originates from macroeconomic factors that affect the entire market.

Single Index Model (SIM)

According to Dayan Hakim et al. (2022), the Single Index Model (SIM) is a simple asset pricing model used to measure the rate of return of stocks. This model was developed by William Sharpe in 1963 and is now widely used in the financial industry. The Single Index Model, or SIM, is a simplified form of the Capital Asset Pricing Model (CAPM) that does not include the risk-free asset in its calculations. The basic assumption used in SIM calculations is that stocks tend to move with the overall market if the stock market index rises (common response), and this is depicted in the following equation.

$$Ri = \alpha i + (\beta i \times Rm) + ei$$

Explanation:
R   : Return of security i.
α   : Expected value of the security's independent return against market return.
β   : Coefficient of sensitivity of the security's return to the market.
Rm: Market return.
e   : Residual error of the asset

Capital Asset Pricing Model (CAPM)

According to Dayan Hakim et al. (2022), the Capital Asset Pricing Model (CAPM) is an estimation model for securities returns applied by investment managers in portfolio construction. CAPM is also known as a useful tool in portfolio preparation because portfolios formed based on risk management design can provide good returns. The results of CAPM calculations are generally used by investors to manage portfolios. An optimal portfolio is formed by balancing risk with the rate of return of securities. Verification of CAPM calculations can be done through two potential tests:
1. Beta stability test
2. Security Market Line (SML) slope test

Security Market Line (SML) is a part of CAPM that depicts the relationship between risk and the expected rate of return on each stock within a portfolio. The risk measure used on the SML is the company's Beta coefficient (βi). When formulated systematically, it appears as follows:

$$Ri = rRf + (rM) \beta i$$

Explanation:
ri   = Rate of return of the security.
rRF   = Rate of return of the risk-free asset.

rM = Rate of return of the market.
βi = Beta or risk of the security.

Arbitrage Pricing Theory (APT)

According to Dayan Hakim et al. (2022), the Arbitrage Pricing Theory (APT) is a theory of asset valuation that states expected financial asset returns can be modeled as a linear function of various macroeconomic factors or theoretical market indices. APT calculations predict the relationship between portfolio returns and the return of an asset through a linear combination of many independent macroeconomic variables. The rate of return on each traded security consists of two components:

1. Normal or expected rate of return, and
2. Uncertain or risky rate of return

Stephen Ross developed this theory in 1976, formulating the APT formula as follows:

$$E(rj) = rf + bj1\ RP1 + bj2\ RP2 + bj3\ RP3 + bj4\ RP4 + \ldots + bjn\ RPn$$

Explanation:
E (rj) = Expected rate of return of the asset.
rf = Risk-free rate.
bj = Sensitivity of the asset return to a specific factor.
RP = Risk premium associated with a specific factor.

This formula serves as the foundational model for incorporating risk variables into each security.

Mean Absolute Deviation (MAD)

According to Ken Black (2019), the Mean Absolute Deviation (MAD) is the average of the absolute deviations from the mean, providing a measure of how close data points are to the mean without disregarding the signs of the deviations

Multiple Linear Regression Analysis

According to Sugiyono (2019), multiple linear regression analysis is used when researchers intend to predict the condition (increase or decrease) of the dependent variable (criterion), with two or more independent variables as predictor factors being manipulated (increased or decreased in value). Therefore, multiple regression analysis is conducted when there are at least two independent variables. The equation for multiple linear regression is as follows:

$$Y = \alpha + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + e$$

Explanation:
Y = Dependent variable (Investment Yield Rate)
α = Constant
β = Regression coefficient
X1 = Independent variable (Single Index Model)

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X2 = Independent variable (Capital Asset Pricing Model)
X3 = Independent variable (Arbitrage Pricing Theory)
e = Standar eror

Hypothesis Testing

According to Andy Field (2013), hypothesis testing examines whether the difference in means between two or more groups is statistically significant. The formula for the Paired Samples t-Test is:

$$t = \frac{D}{sd/\sqrt{n}}$$

Explanation:
D = mean of paired differences
sD = standard deviation of paired differences
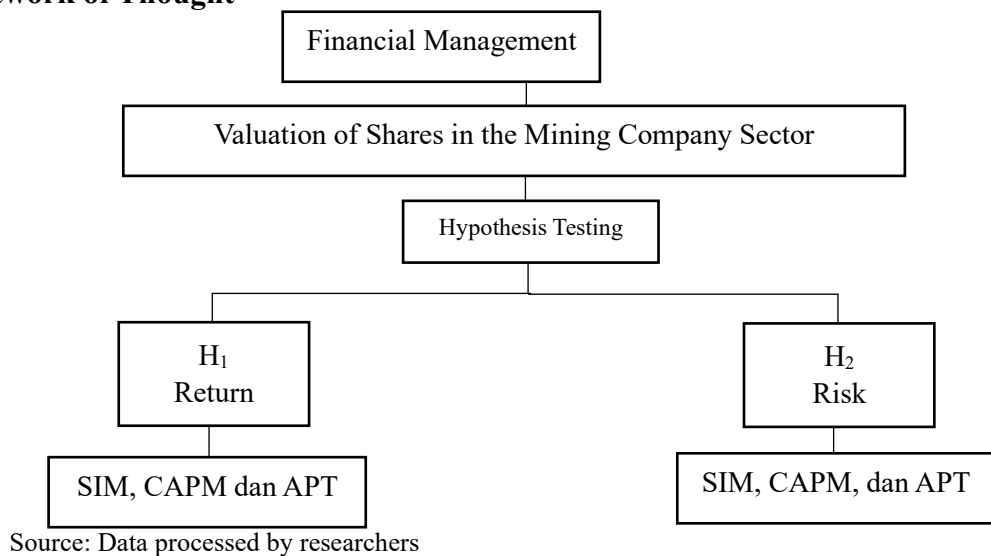n = number of pairs

Previous Research

Research by Dr. Dayan Hakim NS, S.E., Ak., M.M.CA, and Qisthi Andira Putri, S.E., M.M., (2017) analyzed the Comparison of Investment Yield Calculation between Single Index Model, Capital Asset Pricing Model, and Arbitrage Pricing Theory on 17 LQ30 and 2 Non-LQ30 listed companies during the 2017 period. The research findings indicate that CAPM cannot predict stocks with significant potential for increase but can assess significant declines in stock performance. SIM, without including the Risk-Free Asset, cannot demonstrate accurate results. SIM also fails to indicate significant declines, assuming all outcomes will be positive. APT illustrates how stocks with good returns compare to those with poor returns and can still show reasonably good results despite significant downturns. All three methods of calculation complement each other and are mutually supportive. There is no superior calculation method among them.

Another study by Muhammad Wafa Aunillah and Wahyudi (2022) analyzed the optimal portfolio of CAPM and SIM. The results showed: (1) CAPM method, obtained 2 stocks, namely: BBCA and ICBP. With a portfolio return rate of 0.26%, and a portfolio risk level of 5.32%. (2) SIM method, only one share is obtained, namely: BBCA. With a portfolio return rate of 1.38%, and a portfolio risk level of 0.57%. (3) the performance of the CAPM portfolio is worth 0.0485 Sharpeindex, 0.0034 Treynor, and 0.00515 Jensen. (4) SIM portfolio performance has an index of Sharpe 2.4280, Treynor 0.0154, and Jensen 0.01690.(5) stock performance in CAPM, namely BBCA and ICBP with Sharpe indexes 1.09286 and 0.17500, Treynor 0.00342 and 0.00319, and Jensen 0.00615 and 0.00116. (6) stock performance on SIM, namely BBCA with Sharpe index of 0.07857, Treynor 0.00025, and Jensen 0.00331.

Hypotheses:
1. There is an influence of the Single Index Model (SIM) on Investment Yield Calculation.
2. There is an influence of the Capital Asset Pricing Model (CAPM) on Investment Yield Calculation.
3. There is an influence of the Arbitrage Pricing Theory (APT) on Investment Yield Calculation.
4. There is a simultaneous influence of the Single Index Model (SIM), Capital Asset Pricing Model (CAPM), and Arbitrage Pricing Theory (APT) on Investment Yield Calculation.

Framework of Thought

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            Financial Management

    Valuation of Shares in the Mining Company Sector

              Hypothesis Testing

        H₁                          H₂
      Return                       Risk

   SIM, CAPM dan APT         SIM, CAPM, dan APT
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Source: Data processed by researchers

RESEARCH METHOD

Research Time and Location

The research analysis was conducted over approximately 3 months, from March 2024 to July 2024. Data analysis took place at the Master of Management program, Faculty of Economics, Department of Financial Management.

Population and Sample

The population used consists of all stocks listed in the IDX30 on the Indonesia Stock Exchange, specifically stocks from the 8 sectors of Mining during the period 2018-2023.

Table 1 Details of Stock Names Listed in IDX 30

No	Nama Saham	Kode Saham
1	Adaro Energy Indonesia Tbk.	ADRO
2	Aneka Tambang Tbk.	ANTM
3	Harum Energy Tbk.	HRUM
4	Vale Indonesia Tbk.	INCO
5	Indo Tambangraya Megah Tbk.	ITMG

6	Merdeka Copper Gold Tbk.	MDKA
7	Bukit Asam Tbk.	PTBA
8	Timah Tbk.	TINS

Source: Data processed by researchers

Operationalization of Variables

According to Sugiyono (2018), operationalization of variables refers to an attribute or characteristic or value of a person, object, or activity that has certain variations determined by the researcher to be studied and then drawn conclusions from.

1. **Independent Variables (X):**
   According to Sugiyono (2022:39), independent variables are variables that influence or cause changes in the dependent variable. In this study, the independent variables are the Single Index Model (SIM) (X1), Capital Asset Pricing Model (CAPM) (X2), and Arbitrage Pricing Theory (APT) (X3).

2. **Dependent Variable (Y):**
   According to Sugiyono (2022:39), the dependent variable is a variable that is influenced or caused by the independent variables.

Analysis Method

The analysis employed in this research is confirmatory analysis. According to Sugiyono (2022:149), confirmatory analysis is conducted on a specific population or sample with the aim of testing predefined hypotheses. In this study, the confirmatory approach is used to test hypotheses regarding the extent of the influence of comparing investment yield calculations between the Single Index Model (SIM), Capital Asset Pricing Model (CAPM), and Arbitrage Pricing Theory (APT) on the 8 sectors of mining companies in the IDX30 listed on the Indonesia Stock Exchange during the period 2018-2023.

In this study, the type of data used is secondary data, obtained from observations of annual reports released online and in real-time by mining sector companies listed on the Indonesia Stock Exchange during the period 2018-2023, which can be accessed at (www.idx.co.id).

The prices analyzed are the last trading prices (closing prices) from monthly periods ranging between January 31, 2018, to December 31, 2023. There are a total of 73 data points per company, amounting to 584 data points across 8 sectors of mining companies. The macroeconomic data utilized in this study include the IHSG (Indonesia Stock Exchange Composite Index) data, monthly inflation rates published by the Central Statistics Bureau, Indonesian bond yields, and the BI rate (Bank Indonesia interest rate).

The selected sample criteria include stocks listed on the Indonesia Stock Exchange, specifically those consistently included in the IDX30 list from 2018 to 2023. These stocks have complete monthly stock data history and positive raw returns.

Calculations and comparisons of returns and risks are conducted using the Single Index Model, Capital Asset Pricing Model, and Arbitrage Pricing Theory, employing geometric mean averages.

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RESULT AND DISCUSSION

Description in this study includes average returns, systematic risks of company stocks, and macroeconomic factors.

Research Object

No	Code	Stock Names	Rasio Free Float	Number of Stocks for the Index (units)		Exp
				Currently	Evaluation Results (15,0% Cap)	
1	ADRO	Adaro Energy Indonesia Tbk.	40,58%	13.981.063.990	12.979.903.380	Berubah
2	ANTM	Aneka Tambang Tbk.	34,83%	8.369.915.354	8.369.915.354	Tetap
3	ARTO	Bank Jago Tbk.	27,90%	-	3.827.234.813	Baru
4	ASII	Astra International Tbk.	45,08%	18.249.985.756	18.249.985.756	Tetap

No	Code	Stock Names	Rasio Free Float	Number of Stocks for the Index (units) Exp		Exp
				Currently	Evaluation Results (15,0% Cap)	
5	BBCA	Bank Central Asia Tbk.	42,41%	31.145.152.814	37.726.390.303	Berubah
6	BBNI	Bank Negara Indonesia (Persero) Tbk.	39,96%	7.353.482.268	7.377.483.089	Berubah
7	BBRI	Bank Rakyat Indonesia (Persero) Tbk.	46,74%	49.125.859.593	64.773.848.781	Berubah
8	BMRI	Bank Mandiri (Persero) Tbk.	39,97%	18.429.179.999	18.466.139.999	Berubah
9	BRPT	Barito Pacific Tbk.	28,54%	26.183.598.000	26.755.456.030	Berubah
10	BUKA	Bukalapak.com Tbk.	50,32%	52.437.955.447	51.860.808.139	Berubah
11	CPIN	Charoen Pokphand Indonesia Tbk	40,12%	6.578.877.600	6.578.877.600	Tetap
12	EMTK	Elang Mahkota Teknologi Tbk.	30,16%	15.292.065.345	18.470.512.247	Berubah
13	GOTO	GoTo Gojek Tokopedia Tbk.	66,39%	786.369.721.837	786.299.212.796	Berubah
14	HRUM	Harum Energy Tbk.	18,60%	-	2.514.366.600	Baru
15	ICBP	Indofood CBP Sukses Makmur Tbk.	20,00%	2.332.381.600	2.332.381.600	Tetap
16	INCO	Vale Indonesia Tbk.	20,29%	2.016.083.126	2.016.083.126	Tetap
17	INDF	Indofood Sukses Makmur Tbk.	49,57%	4.352.457.416	4.352.457.416	Tetap
18	INKP	Indah Kiat Pulp & Paper Tbk.	34,21%	1.871.623.264	1.871.623.264	Tetap
19	ITMG	Indo Tambangraya Megah Tbk.	34,74%	-	392.535.945	Baru
20	KLBF	Kalbe Farma Tbk.	41,75%	19.823.489.140	19.570.363.481	Berubah
21	MDKA	Merdeka Copper Gold Tbk.	46,96%	11.243.991.265	11.322.455.522	Berubah
22	PGAS	Perusahaan Gas Negara Tbk.	43,04%	10.433.545.128	10.433.545.128	Tetap
23	PTBA	Bukit Asam Tbk.	33,43%	3.851.356.387	3.851.356.387	Tetap
24	SMGR	Semen Indonesia (Persero) Tbk.	48,97%	2.904.665.344	2.904.665.344	Tetap
25	TBIG	Tower Bersama Infrastructure Tbk.	27,69%	7.977.529.505	6.273.723.146	Berubah
26	TINS	Timah Tbk.	34,96%	2.603.734.608	2.603.734.608	Tetap
27	TLKM	Telkom Indonesia (Persero) Tbk.	47,85%	47.401.270.643	47.401.270.643	Tetap
28	TOWR	Sarana Menara Nusantara Tbk.	46,87%	23.885.047.425	23.910.554.738	Berubah
29	UNTR	United Tractors Tbk.	40,43%	1.508.093.635	1.508.093.635	Tetap
30	UNVR	Unilever Indonesia Tbk.	14,44%	5.508.860.000	5.508.860.000	Tetap

Source: **www.idx.co.id**

Based on the criteria of stocks listed on the Indonesia Stock Exchange above, the research object consists of the 8 sectors of mining companies with consistent historical data from the period 2018-2023

Calculation of Company Stock Returns

This data comprises monthly closing prices of stocks. The return (Ri) is calculated by subtracting last month's closing price from the current month's closing price, then dividing by last month's closing price. From the calculation, the average return is 0.0372, indicating that the average return of stocks in the 8 mining sectors

of IDX30 during the period 2018-2023 shows a positive result, reflecting favorable investor response to these mining stocks. The highest stock return is held by Harum Energy Tbk. at 0.0675, while the lowest is held by Bukit Asam Tbk. at 0.0112.

Table 2
Stock Returns of 8 Mining Sectors

No	Stock Names	Stock Kode	Stock Return
1	Adaro Energy Indonesia Tbk.	ADRO	0,0229
2	Aneka Tambang Tbk.	ANTM	0,0519
3	Harum Energy Tbk.	HRUM	0,0675
4	Vale Indonesia Tbk.	INCO	0,0273
5	Indo Tambangraya Megah Tbk.	ITMG	0,0280
6	Merdeka Copper Gold Tbk.	MDKA	0,0697
7	Bukit Asam Tbk.	PTBA	0,0112
8	Timah Tbk.	TINS	0,0193
	Rata - Rata		0,0372

Source: Data processed by researchers

Calculation of Average IHSG (Market Return) Rm

The calculation for Rm uses the composite stock price index, which measures the performance of all stocks listed on the Indonesia Stock Exchange (IDX).

Table 3
Mean IHSG during the period from 2018 to 2023

Periode	2018	2019	2020	2021	2022	2023
Jan	6.605,63	6.532,97	5.940,05	5.862,35	6.631,15	6.839,34
Feb	6.597,22	6.443,35	5.452,70	6.241,80	6.888,17	6.843,24
Mar	6.188,99	6.468,75	4.538,93	5.985,52	7.071,44	6.805,28
Apr	5.994,60	6.455,35	4.716,40	5.995,62	7.228,91	6.915,72
Mei	5.983,59	6.209,12	4.753,61	5.947,46	7.148,97	6.633,26
Jun	5.799,24	6.358,63	4.905,39	5.985,49	6.911,58	6.661,88
Jul	5.936,44	6.390,50	5.149,63	6.070,04	6.951,12	6.931,36
Agust	6.018,46	6.328,47	5.238,49	6.150,30	7.178,59	6.953,26
Sep	5.976,55	6.169,10	4.870,04	6.286,94	7.040,80	6.939,89
Okt	5.831,65	6.228,32	5.128,23	6.591,35	7.098,89	6.752,21
Nov	6.056,12	6.011,83	5.612,42	6.533,93	7.081,31	7.080,74
Des	6.194,50	6.299,54	5.979,07	6.581,48	6.850,62	7.272,80
Annual Average	**6.098,58**	**6.324,66**	**5.190,41**	**6.186,02**	**7.006,80**	**6.885,75**
					The total average	**6.282,04**

Source: Data processed by researchers

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The average annual results are as follows: (2018) 6,0194.58, (2019) 6,324.66, (2020) 5,190.41, (2021) 6,1826.02, (2022) 7,006.80. The IHSG showed significant volatility, especially in 2020 due to the pandemic. After a steep decline in 2020, the IHSG demonstrated strong recovery in 2021 and 2022. The increases in IHSG in 2021 and 2022 reflect investor optimism regarding Indonesia's economic prospects post-pandemic.

Calculation using Single Index Model (SIM) Method

According to the formula of the Single Index Model (SIM) as explained earlier, the results of the calculation are as follows:

Table 4:
Expected Return and Risk of Stocks Using Single Index Model (SIM) Method for the Period 2018-2023

No	Stock Names	Stock Kode		α	β i	Ri SIM	LN
1	Adaro Energy Indonesia Tbk.	ADRO	-	4.375,16	1,01	1.939,95	7,57
2	Aneka Tambang Tbk.	ANTM	-	2.478,01	0,63	1.479,64	7,30
3	Harum Energy Tbk.	HRUM	-	3.743,34	0,75	976,80	6,88
4	Vale Indonesia Tbk.	INCO	-	5.156,98	1,55	4.591,59	8,43
5	Indo Tambangraya Megah Tbk.	ITMG	-	53.445,12	12,01	21.981,04	10,00
6	Merdeka Copper Gold Tbk.	MDKA	-	5.977,15	1,30	2.213,01	7,70
7	Bukit Asam Tbk.	PTBA	-	95,88	0,06	305,92	5,72
8	Timah Tbk.	TINS	-	642,28	0,28	1.116,06	7,02

Source: Data processed by researchers

Calculations using the Single Index Model provide the Expected Return for each stock. The risk of stocks relative to the market is also a key consideration in investment decision-making. In the results above, each company shows positive stock returns, indicating that market returns align with their beta (risk) levels. For example, ITMG/Indo Tambangraya Megah has an Expected Return calculation of 10.00, with a beta of 12.01, suggesting that higher return levels correspond to higher market risks. The LN value mentioned represents the natural logarithm (base e), simplified from a return figure of 21,981.04

Calculation using the CAPM Method

According to the Capital Asset Pricing Model (CAPM) calculation formula explained earlier, the results of the calculation are as follows:

Table 5:
Expected Return and Risk of Stocks Using the Capital Asset Pricing Model (CAPM) Method for the Period 2018-2023

No	Stock Names	Stock Kode	β i	LN	Rf	Ri CAPM
1	Adaro Energy Indonesia Tbk.	ADRO	1,01	7,57	6,99	8,79
2	Aneka Tambang Tbk.	ANTM	0,63	7,30	6,99	5,54
3	Harum Energy Tbk.	HRUM	0,75	6,88	6,99	6,59
4	Vale Indonesia Tbk.	INCO	1,55	8,43	6,99	13,53
5	Indo Tambangraya Megah Tbk.	ITMG	12,01	10,00	6,99	104,23
6	Merdeka Copper Gold Tbk.	MDKA	1,30	7,70	6,99	11,38
7	Bukit Asam Tbk.	PTBA	0,06	5,72	6,99	0,62
8	Timah Tbk.	TINS	0,28	7,02	6,99	2,50

Source: Data processed by researchers

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From the calculation results above, it can be concluded that the risk-free asset, represented by the average deposit interest rate of mining companies, indicates the minimum threshold that can be used as a basis for making investment decisions in the form of stocks. From the table above, it can be seen that ITMG/Indo Tambangraya Megah Tbk consistently had the highest return during the period 2018-2023, with a value of 104.23, while PTBA/Bukit Asam Tbk had the lowest return during the period 2018-2023, with a value of 0.63. The risk-free asset rate of 6.99% serves as a threshold for investors in making investment decisions.

Calculation using the APT Method

According to the Arbitrage Pricing Theory (APT) calculation formula explained earlier, the results of the calculation are as follows:

Table 6
Expected Return and Risk of Stocks Using the Arbitrage Pricing Theory (APT) Method for the Period 2018-2023

No	Stock Names	Stock Kode	β inflasi	β BI rate	Ri APT
1	Adaro Energy Indonesia Tbk.	ADRO	52.652,57	4.667,54	3,39
2	Aneka Tambang Tbk.	ANTM	629,61	- 29.344,66	- 1,31
3	Harum Energy Tbk.	HRUM	14.653,01	- 20.857,55	- 0,08
4	Vale Indonesia Tbk.	INCO	51.396,15	- 21.166,18	2,07
5	Indo Tambangraya Megah Tbk.	ITMG	649.949,49	207.892,66	48,35
6	Merdeka Copper Gold Tbk.	MDKA	37.122,36	- 46.301,82	0,01
7	Bukit Asam Tbk.	PTBA	4.159,54	2.649,64	0,44
8	Timah Tbk.	TINS	- 3.166,76	- 22.978,49	- 1,23

Source: Data processed by researchers

In the above calculation, the expected stock returns are determined by incorporating the inflation risk premium and the average deposit interest rate risk premium. By comparing these two risk premiums, the Expected Return for each company's stock yields the best possible outcomes.

The calculation results from the table above show that the highest risk is attributed to ITMG/Indo Tambangraya Megah Tbk, with an inflation risk value of 649,949.49 and an average deposit interest rate risk value of 207,892.66, resulting in an Expected Return of 48.35. This indicates that ITMG/Indo Tambangraya Megah Tbk is sensitive to both inflation risk and the average deposit interest rate risk, while also having the highest return.

On the other hand, the lowest risk is attributed to TINS/Timah Tbk, with a negative inflation risk value of -3,166.76 and a negative deposit interest rate risk value of -22,978.49, resulting in a negative Expected Return of -1.23. This result suggests that even though TINS/Timah Tbk experiences an increase in inflation and average deposit interest rate, it does not necessarily lead to an increase in stock returns; instead, the returns decrease.

Comparison of Investment Return Calculations

Based on the calculation results obtained from the Expected Return calculations using the Single Index Model (SIM), Capital Asset Pricing Theory (CAPM), and Arbitrage Pricing Theory (APT), the comparisons are as follows:

Table 7
Comparison of Calculations Using SIM, CAPM, and APT Methods for the Period 2018-2023

No	Stock Names	Stock Kode	SIM		CAPM		APT		
			Ri	β i	Ri	β i	Ri	β inflasi	β BI rate
1	Adaro Energy Indonesia Tbk.	ADRO	7,57	1,01	8,79	1,01	3,39	52.652,57	4.667,54
2	Aneka Tambang Tbk.	ANTM	7,30	0,63	5,54	0,63	- 1,31	629,61	- 29.344,66
3	Harum Energy Tbk.	HRUM	6,88	0,75	6,59	0,75	- 0,08	14.653,01	- 20.857,55
4	Vale Indonesia Tbk.	INCO	8,43	1,55	13,53	1,55	2,07	51.396,15	- 21.166,18
5	Indo Tambangraya Megah Tbk.	ITMG	10,00	12,01	104,23	12,01	48,35	649.949,49	207.892,66
6	Merdeka Copper Gold Tbk.	MDKA	7,70	1,30	11,38	1,30	0,01	37.122,36	- 46.301,82
7	Bukit Asam Tbk.	PTBA	5,72	0,06	0,62	0,06	0,44	4.159,54	2.649,64
8	Timah Tbk.	TINS	7,02	0,28	2,50	0,28	- 1,23	- 3.166,76	- 22.978,49
	Average		**7,58**	**2,20**	**19,15**	**2,20**	**6,46**	**100.924,50**	**9.320,14**

Source: Data processed by researchers

Based on the average comparison results above, it is known that the Single Index Model (SIM) has a return value indicating moderate financial potential, often referred to as medium, at 7.58. This value is lower compared to CAPM. The high risk (beta) of 2.20 indicates that this investment has a higher risk than the overall market (beta = 1). This means the investment is more volatile and has a greater potential return, but with a higher risk as well.

On the other hand, the Capital Asset Pricing Model (CAPM) has the highest average return value among the three models at 19.15. This indicates a greater profit potential but also corresponds to higher risk. Its beta, which is the same as that of the Single Index Model (SIM), indicates the same level of volatility and significance.

Meanwhile, the average return from the Arbitrage Pricing Theory calculation is 6.46, the lowest among the three models, reflecting a more cautious approach to estimating returns. The inflation beta risk value of 100,924.50 and the deposit interest rate beta risk value of 9,320.14 are very high. This indicates that the investment is highly sensitive to changes in inflation and deposit interest rates. The very high beta may be due to extreme macroeconomic conditions.

CONCLUSION

Based on the comparative analysis of the calculations above, the conclusions drawn are as follows: 1) Single Index Model (SIM) produces good returns or profits with high risk, without including a risk-free asset. 2) Capital Asset Pricing Model (CAPM) provides returns that offer high profit potential but with similarly high risk. 3) Arbitrage Pricing Theory (APT) yields lower returns with very high risks, both from inflation and deposit interest rate perspectives. This model is more conservative in return estimation but highly sensitive to macroeconomic factors. 4) From the continuous comparison of these calculation methods, they complement and support each other. Ultimately, the choice of method depends on investors' considerations in making investment decisions in future stock investments. These conclusions highlight the trade-offs between return potential and risk sensitivity across different models, emphasizing the importance of choosing an approach that aligns with investors' risk tolerance and investment goals.

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Based on the comparative analysis of the calculations above, here are the recommendations: 1) Single Index Model (SIM): Suitable for investors seeking moderate returns and willing to take on significant risks. 2) Capital Asset Pricing Model (CAPM): Recommended for investors aiming for higher returns, acknowledging the higher market risks associated with it. 3) Arbitrage Pricing Theory (APT): Suitable for in-depth analysis, particularly for investors considering various macroeconomic factors. Caution is advised due to the very high risks associated with inflation and deposit interest rate calculations in this model. These recommendations highlight the alignment of each model with different investor preferences and risk appetites. Investors should carefully consider these factors when making investment decisions in the Indonesian mining sector.

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