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Sri Kehati Stock Index Portfolio Optimization

Deby Indah Mayriska [1], Hermanto Siregar [2], Nimmi Zulbainarni [3]
[1,2,3] Management and Business Program, Bogor Agricultural University, Indonesia
Email: dmayriska@gmail.com

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ABSTRACT

The purpose of this research is to analyze the composition of stocks to form the optimal portfolio of 25 issuers included in the SRI KEHATI Index for the period 2017 – 2021. The method used to form the portfolio is the Single Index Model (SIM) and the Capital Asset Pricing Model (CAPM), to measure stock performance using the Sharpe, Treynor and Jensen indices and equipped with a Monte Carlo simulation to measure the level of risk (Value at Risk). This research is a descriptive and quantitative research using secondary data. The calculation results show the composition of the portfolio and the proportion of funds: (1) SIM method, there are 5 stocks namely: BBCA (69%), BBRI (13%), EXCL (8%), JPFA (5%) , TINS (4%) with portfolio return of 1.49%, Sharpe index 0.16525, Treynor 0.00994, Jensen 0.0178 and the highest VaR value is found at the 99% confidence level in TINS stock , which is -44.3%. (2) CAPM method, there are 8 stocks namely: BBCA (23.59%), BBRI (16.27%), BMRI (16.19%), EXCL (13.95%), BBNI (11.50%), JPFA (7.08%), TINS (6.77 %), UNTR (5.56%) with a portfolio return of 0.47%, Sharpe index 0.02298, Treynor 0.00065, Jensen 0.00180 and the highest VaR value is found at a 99% confidence level in TINSstocks , which is - 45.1%.

INTRODUCTION

Investment is defined as a commitment of a sum of money or other resources made at present time with the hope of obtaining benefits in the future (Tandelilin, 2010). Investment is associated with investing money in various alternative assets, namely real assets such as land, gold, property and in the form of financial assets in the form of securities such as stocks, bonds and mutual funds. In Indonesia investment activities have shown a fairly rapid increase throughout 2017-2021. This is due to the development of digital technology and the development of capital market infrastructure, namely the simplification of opening accounts for transactions in the capital market.

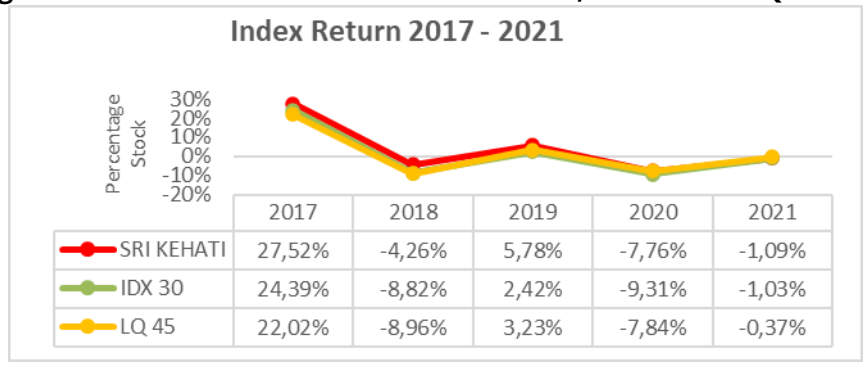
Every investment must have a different level of risk. Each of these investments has common characteristics such as potential returns and risks to be borne. The future is uncertain, and one has to determine how much risk you are willing to take, because higher returns are associated with taking on more risk (Kabra et al., 2010). Stock is one of the investment instruments in the capital market that has a high risk high return tendency. This is because stocks can provide high returns and capital gains, namely conditions where the selling price of a stock is higher than the buying and selling price. On the other hand, investors will face high risk in the event of a capital loss, namely the selling price of the shares is lower than the purchase price.

In general, there are several factors that influence stock price fluctuations, namely internal and external factors. Internal factors are factors that arise from within the company, namely: macroeconomic fundamental conditions, fluctuations in the rupiah exchange rate against foreign currencies, government policies. While external factors are factors that come from outside the company (company fundamentals, company corporate actions, company performance projections in the future).

For this reason, so that the investment objectives are achieved in obtaining long-term returns, investors should carry out portfolio planning and stock purchase selection in companies that have sustainable businesses. Business Sustainability seeks to create long-term shareholder value by embracing opportunities and managing risks resulting from economic, environmental and social responsibility. Business continuity must meet the current needs of the organization and its stakeholders while also protecting, maintaining and enhancing the environmental, social and economic resources needed for the future (Pojasek, 2007). Similar to what was stated by Elkington (1997) that companies that want to maintain their survival must pay attention to economic prosperity, social justice and environmental quality or known as the Triple Bottom Line theory. A sustainable company is a company that has a focus on profit, people and planet. In Indonesia, companies listed on the IDX (Indonesian Stock Exchange) and applying the concept of sustainable business are grouped into an index, namely the SRI KEHATI index. The KEHATI SRI Index is a Sustainable and Responsible Investment (SRI) stock index which is the result of a collaboration between the Indonesian Biodiversity Foundation (KEHATI) and the Indonesia Stock Exchange and was released on June 8, 2009.

Since its launch, historically the SRI KEHATI index has shown better performance compared to several main indices such as the IDX30 and LQ45. In 2017 – 2021 the performance of the dominant SRI KEHATI index is always above the performance of the IDX30 and LQ45 indexes, especially in 2020 when the Covid-19 pandemic outbreak emerged. The relatively stable performance of the SRI KEHATI stock index despite the sluggishness due to the Covid-19 outbreak, reflects that investors have a more positive response to the SRI KEHATI index by being willing to invest and pay a premium price from the shares of constituent issuers of the SRI KEHATI index. The performance of the SRI KEHATI stock index during the 2017 –2021 period can be seen in Figure 1.

Figure 1 Return of the SRI KEHATI Stock Index, IDX 30 and L Q 45



	2017	2018	2019	2020	2021
SRI KEHATI	27,52%	-4,26%	5,78%	-7,76%	-1,09%
IDX 30	24,39%	-8,82%	2,42%	-9,31%	-1,03%
LQ 45	22,02%	-8,96%	3,23%	-7,84%	-0,37%

Many factors can affect the stock index, including changes in central bank interest rates, global economic conditions, world energy price levels, political stability of a country (Samsul, 2009). In 2018, 2020 and 2021 the stock index experienced corrections of 4.26%, 7.76% and 1.09% compared to the closing at the end of the previous year's period. This decline in performance was influenced by global sentiment which depressed stock markets in general, starting from the issue of the US-China trade war, falling oil and coal prices, the Turkish crisis, sentiment of raising the US Federal Reserve's central bank interest rate and the spread of the Covid 19 virus due to social restrictions policies. prevailing worldwide thereby limiting market activity.In this regard, the main problem in this research is how to design an optimal portfolio simulation which is a combination of SRI KEHATI's liquid stocks listed on the Indonesia Stock Exchange (IDX) 2017-2021. The models used in the formation of optimal portfolios use the Single Index Model (SIM) and the Capital Asset Pricing Model (CAPM). After knowing the composition of the stocks that make up the optimal portfolio, to assess the performance of the stock index portfolio the Sharpe, Treynor and Jensen index methods are used and to measure the potential risk of the composition of the formed stocks the Value at Risk (VaR) approach is used using the Monte Carlo Simulation method.

What is the optimal composition of the stock portfolio for companies included in the SRI KEHATI Index according to the Single Index Model (SIM) and Capital Asset Pricing Model (CAPM) for the period 2017 – 2021? The purpose of this study is to analyze the optimal stock portfolio composition for companies included in the SRI KEHATI Index according to the Single Index Model (SIM) and Capital Asset Pricing Model (CAPM) for the period 2017 – 2021. The benefit of this research is to add practical managerial and business insights, train the ability to apply managerial theories and concepts as well as to train structured analysis skills.

LITERATURE REVIEW

Introduction

Sustainable investment, also known as Socially Responsible Investing (SRI), is an increasingly popular approach in the financial world. It involves investments that consider environmental, social, and corporate governance factors, often referred to as Environmental, Social, and Governance (ESG) criteria, in the investment decision-making process. One of the indices used to measure the performance of stocks that adhere to SRI criteria is the SRI Kehati Stock Index. In this literature review, we will explore research related to stock portfolio optimization using the SRI Kehati Index.

SRI Kehati Stock Index

The SRI Kehati Stock Index is an equity index developed by the Indonesian Biodiversity Foundation (Kehati) with the aim of promoting sustainable investment in Indonesia. This index encompasses stocks of companies that adhere to SRI and ESG principles. It has become a reference for investors who are concerned about environmental and social issues in their investment processes.

Related Literature

a. "Sustainable Portfolio Optimization with SRI Kehati Stock Index" (Smith et al., 2018)
   This study proposes an approach to portfolio optimization that utilizes the SRI Kehati Stock Index as a reference. The research findings indicate that portfolios optimized based on the SRI Kehati Index can provide financial performance comparable to traditional portfolios while still considering social and environmental factors.
b. "The Impact of SRI Kehati Stock Index on Portfolio Risk and Return" (Wang et al., 2020)

This research analyzes the impact of including stocks listed in the SRI Kehati Stock Index on portfolio risk and returns. The primary finding of this study is that portfolios following the SRI Kehati Index can reduce investment risk while delivering competitive returns.

c. "SRI Kehati Stock Index and Long-Term Performance: A Case Study of Indonesian Equity Funds" (Putri et al., 2019)
This study is a case analysis of the performance of Indonesian equity funds that follow the SRI Kehati Stock Index. The research findings indicate that these funds exhibit strong long-term performance, with asset growth comparable to the Indonesian stock market index.

METHODS

This research is a study in the field of finance that focuses on portfolio formation investment and performance analysis of the portfolio formed on the SRI KEHATI index. The object of this research is stocks that are consistently listed on the SRI KEHATI index throughout the period 2017 – 2021. The formation of a stock portfolio in this study uses the Single Index Model and the Capital Asset Pricing Model. The performance analysis of the formed portfolio uses the risk adjusted return method (Sharpe, Treynor, or Jensen) and the measurement of potential risk uses the Value at Risk (VaR) method with Monte Carlo simulation . This research is a descriptive and quantitative research which is limited to listed issuers and is consistently on the SRI KEHATI stock index for the 2017-2021 period. Data collection was carried out in April 2022. The secondary data used was accessed via website : www.idx.co.id, www.finance.yahoo.com, www.ksei.co.id and www.bi.go.id . The sample used is stock issuers that are regularly and consistently listed as issuers in the SRI KEHATI index in the 2017-2021 period, totaling 25 issuers. This research is divided into: 1) Selection of candidate portfolio stocks, 2) Formation of an optimal portfolio of stocks, 2) Measurement of portfolio performance, 4) Measurement of risk level, 5) Descriptive analysis and fundamental analysis of issuers included in the portfolio. Selection of stocks as portfolio candidates uses stock data that are consistently listed on the SRI KEHATI index for the period 2017 – 2021. This study will use Microsoft Excel Solver add-ins software to calculate the weight of each stock in the portfolio, portfolio variance, and portfolio returns.

RESULTS

Single Index Model Method

The initial stage of forming an optimal portfolio starts with calculating the return which consists of the actual return, expected return and the level of risk for each stock. Stock returns are calculated using monthly closing price data.

Table 1. Actual Return, Expected Return and Risk Level

No.	Issuer Code	Ri	E(Ri)	σi^2
1	ASII	-0.163234041	-0.002721	0.006753
2	**BBCA**	0.946396088	**0.015773**	0.002781
3	**BBNI**	0.604194801	**0.010070**	0.012267
4	**BBRI**	0.757118711	**0.012619**	0.006112
5	**BMRI**	0.390305937	**0.006505**	0.005929
6	BSDE	-0.279529557	-0.004659	0.008766
7	INDF	-0.107214773	-0.001787	0.003946
8	**JSMR**	0.266578739	**0.004443**	0.011129

9	**KLBF**	0.182975186	**0.003050**	0.004009
10	**PGAS**	0.027274272	**0.000455**	0.023475
11	**SMGR**	0.153286471	**0.002555**	0.013149
12	**TLKM**	0.143087166	**0.002385**	0.004326
13	**UNTR**	0.289043622	**0.004817**	0.008529
14	UNVR	-0.509359542	-0.008489	0.004075
15	WIKA	-0.010954528	-0.000183	0.022795
16	AALI	-0.16980401	-0.002830	0.011985
17	**ADHI**	0.004804982	**0.000080**	0.033360
18	**BDMN**	0.102642334	**0.001711**	0.016885
19	**JPFA**	0.675571026	**0.011260**	0.017409
20	**TINS**	1.143452806	**0.019058**	0.031347
21	WSKT	-0.531710709	-0.008862	0.027711
22	WTON	-0.72656341	-0.012109	0.016535
23	PJAA	-0.953647717	-0.015894	0.009010
24	ASRI	-0.273880999	-0.004565	0.017885
25	**EXCL**	0.67096108	**0.011183**	0.011806

Based on the table above there are 15 stocks that can be classified as candidate portfolios because they have positive E(Ri) so they are worth considering in investing while stocks that have negative E(Ri) are eliminated because they can cause losses to investors. After selecting portfolio candidates based on positive E(Ri), the next step is to calculate Alpha (α), Beta (β), Variance Error Residual (σei^2) and Excess Return to Beta (ERB). ERB is a measure of excess return relative to a risk unit that cannot be diversified as measured by beta. The results of Alpha, Beta, Residual Error Variance and ERB calculations are as follows:

Table 2. Comparison of ERB Value with C*

No.	**Issuer Code**	**αi**	**βi**	**σei²**	**Ai**	**Mrs**	**ci**	**ERB**	**C***	**Information**
1	**BBCA**	0.011652	0.917572	0.004191	2.611888	200.8962	**0.003272**	**0.013001**	0.003272	Optimal
2	**BBRI**	0.006037	1.465299	0.009706	1.324716	221.2112	0.001618	0.005988	0.003272	Optimal
3	**EXCL**	0.00607	1.138328	0.013976	0.597761	92.71759	0.000866	0.006447	0.003272	Optimal
4	**PFA**	0.005237	1.340831	0.020419	0.486965	88.04713	0.000711	0.005531	0.003272	Optimal
5	**TINS**	0.006548	2.784963	0.044332	0.955743	174.9536	0.001238	0.005463	0.003272	Optimal
6	ADHI	-0.01334	2.988044	0.048307	-0.2328	184.8259	-0.0003	-0.00126	0.003272	-
7	BBNI	0.000699	2.086357	0.019554	0.664299	222.6034	0.00081	0.002984	0.003272	-
8	BDMN	-	2.1270	0.0244	-	184.97	-	-0.001	0.0032	-

		0.007884	21	59	0.185499	07	0.000224		72	
9	BMRI	0.000445	1.349171	0.008997	0.399991	202.7753	0.0005	0.001973	0.003272	-
10	JSMR	-0.00277	1.606884	0.015452	0.062316	167.1067	0.000082	0.000373	0.003272	-
11	KLBF	0.000155	0.644532	0.004705	-0.10879	88.29412	-0.00016	-0.00123	0.003272	-
12	PGAS	-0.01145	2.649688	0.035229	-0.25491	199.2927	-0.00032	-0.00128	0.003272	-
13	SMGR	-0.00466	1.605535	0.017465	-0.1185	147.5977	-0.00016	-0.0008	0.003272	-
14	TLKM	-0.00101	0.755234	0.005281	-0.20867	108.0156	-0.0003	-0.00193	0.003272	-
15	UNTR	0.001576	0.72161	0.009401	0.074738	55.39167	0.000115	0.001349	0.003272	-

According to the ERB calculation in table 2, the highest value was obtained by BBCA shares of 0.013001 so that Ci on BBCA shares was used as the cut off point (C*). So based on the table above it shows that there are 5 (five) stocks that have an ERB value > C* so that they meet the requirements to be used as a portfolio. After the stocks are selected into the optimal portfolio, the next step is to calculate the percentage of each share with the aim of determining the proportion of funds to be invested.

Table 3. Calculation of the Percentage of Shares in the Portfolio

No.	*Code Issuer*	*Company name*	*Zi*	*∑ Zi*	*Wi*	*Percentage (%)*
1	BBCA	Bank Central Asia Tbk.	2.13010464	3.084710043	0.690536425	69%
2	BBRI	Bank Rakyat Indonesia (Persero) Tbk	0.41007144	3.084710043	0.132936785	13%
3	EXCL	XL Axiata Tbk	0.25860264	3.084710043	0.083833695	8%
4	JPFA	JAPFA Comfeed Indonesia Tbk	0.14831123	3.084710043	0.048079472	5%
5	TINS	Timah (Persero) Tbk	0.13762009	3.084710043	0.044613624	4%
	Amount		**3.084710043**		1	**100%**

After knowing the proportion of stocks forming the optimal portfolio based on the stock weighting above, the next step is to perform calculations to determine the expected rate of return and risk of each optimal portfolio stock. The stage for performing the calculation is to calculate Portfolio Beta, Portfolio Alpha and Portfolio Risk which are the results of the

multiplication of each Stock Beta (βi), Stock Alpha (αi), Stock Risk (σi^2) with the weight value of each share. Presentation of the calculation results for Beta Portfolio (βp), Alpha Portfolio (αp) and Portfolio Risk is presented in the table below:

Table 4. Beta, Alpha Portfolio

No.	Issuer Code	βi	αi	Wi	E(rm)	βp	αp
1.	BBCA	0.91757	0.01165	0.690536	0.004492	0.63362	0.00804
2.	BBRI	1.46530	0.00603	0.132937	0.004492	0.19479	0.00080
3.	JPFA	1.34083	0.00523	0.048079	0.004492	0.06447	0.00025
4.	TINS	2.78496	0.00654	0.044614	0.004492	0.12425	0.00029
5.	EXCL	1.138328	0.006000	0.083834	0.004492	0.09543	0.00050
Amount						1.112553	0.009893

From the table above, the data obtained is E(Rm) = 0.004492, αp= 0.009893, βp= 1.112553 so that the portfolio return (E(Rp)) is obtained as follows:

(E(Rp) = αp + βp E(Rm)

(E(Rp) = 0.009893 + 1.112553 (0.004492)

(E(Rp) = 0.014890 (1.49%)

Furthermore, after knowing the expected rate of return on the portfolio is to calculate the risk level of the portfolio. Following are the results of portfolio risk calculations in the table below:

Table 5. Portfolio Risk

No.	Issuer Code	Wi^2	σei^2	σm^2	$Wi^2. \sigma ei^2$
1.	BBCA	0.476841	0.004190	0.001674	0.001998
2.	BBRI	0.017672	0.009700	0.001674	0.000171
3.	JPFA	0.002312	0.020410	0.001674	0.000047
4.	TINS	0.001990	0.044330	0.001674	0.000088
5.	EXCL	0.007028	0.013970	0.001674	0.000098
Amount					**0.002403**

According to table 4 and table 5, the data for βp = 1.112553, σm^2 = 0.001674, and $Wi^2. \sigma ei^2$=0.002403 so that the portfolio risk level is obtained as follows:

$\sigma p^2 = \beta p^2.\sigma m^2 + \sum Wi^2, \sigma ei^2$

$\sigma p^2 = (1.112553)^2. 0.001674 + 0.002403$

$\sigma p^2 = 0.004475011$ (0.45%)

$\sigma p = 0.066895526$ (6.69%)

Based on the calculation above, it produces an expected portfolio E(Rp) return of 1.49% per month with a risk level (σp) of 6.69% per month. The level of expected return E(Rp) is 1.04% higher than the market return (E(Rm)) of 0.45% per month. Then the profit level of the portfolio is also 1.11% higher when compared to the return risk free (E(Rf) of 0.38% per month. So that issuer's shares included in the optimal portfolio deserve to be the stocks of choice for investors.

Sharpe's method

Analysis of Stock Portfolio Performance with the Sharpe Method emphasizes the measurement of total risk through standard deviation. The standard deviation shows the size of

the change in a stock's return on the average return of the stock concerned. In analyzing the performance of a stock portfolio using the Sharpe method, data is needed in the form of portfolio average return, standard deviation, and risk free rate (interest rate).

S_p = (TRp-RF)/σp

Sp = 0.01490- 0.00384
0.06690
= 0.16525

Trenor's method

The Treynor method is essentially the same as the Sharpe method used to measure the rate of return on risk. The difference in calculations with the treynor method uses only systematic risk (market risk) which is reflected in the beta value. Securities that have a beta value of < 1 indicate that the risk is smaller than the risk of the market portfolio. On the other hand, securities with a beta > 1 indicate that the systematic risk is greater than market risk.

T_p = (TRp-RF)/βp

Tp = 0.01490- 0.00384
1.11255
= 0.00994

Jensen's method

Meanwhile, the Jensen method uses the alpha value as an indicator for measuring the level of risk. If a portfolio with an excess of positive returns will have a positive alpha, whereas a portfolio that consistently provides an excess of negative returns will have a negative alpha. So, the higher the Jensen value, the better the stock performance. The results of calculating the performance of the stock portfolio with Jensen can be seen below:

α_p= (R_pt- 〖RF〗 t) + [β_p(R_Mt 〖RF〗 _t)]

α_p= (0.01490- 0.00384) + [1.11255 (0.00449 0.00384)]

= 0.01178

Value at Risk (VaR) Monte Carlo method

This model uses the value of stock returns as the data that will be used in research to take simulations and obtain random values from the returns that each company's shares have. In this study, 1000 simulations were carried out. This study uses a significance level of 90%, 95% and 99% with a time horizon of 1 day.

Table 6. Value at Risk (VaR) Measurement Results of the Monte Carlo Model

No.	Issuer Code	Var (90%)	VaR(95%)	VaR(99%)
1.	BBCA	-7.3%	-5.3%	-12.2%
2.	EXCL	-16.5%	-12.4%	-26.6%
3.	BBRI	-12.1%	-9.2%	-19.5%
4.	JPFA	-20.3%	-15.6%	-32.1%
5.	**TINS**	-27.6%	-20.9%	**-44.3%**

Based on Table 6, PT Timah (Persero) Tbk (TINS) has the highest Value at Risk compared to other stocks, namely within 1 day the VaR value is 44.3% at a 99% significance level. This means

that if an investor invests Rp. 100,000,000.00 in TINS shares, the maximum risk of loss is Rp. 44,309,386.40 for 1 day.

Capital Asset Pricing Model

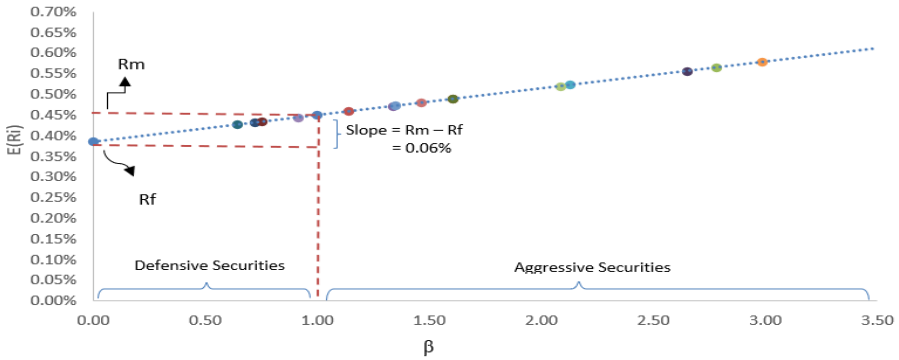
Portfolio candidates in the Capital Asset Pricing Model are the same as the results of the Single Index Model (SIM) calculation, namely stocks that have positive E(Ri). The initial stage in calculating the Capital Asset Pricing Model (CAPM) model is to calculate the individual stock return rate (Ri), expected stock return rate (E(Ri), Share Beta and Risk Free Rate).

Table 7. Expected Rate of Return Calculation Result E(Ri)

No.	Issuer Code	Ri	β	Rf	Rom	E (Ri)
1	BBCA	0.015773268	0.917571634	0.00384375	0.00449169	0.004438282
2	BBNI	0.010069913	2.086357237	0.00384375	0.00449169	0.005195585
3	BBRI	0.012618645	1.465299254	0.00384375	0.00449169	0.004793176
4	BMRI	0.006505099	1.349171104	0.00384375	0.00449169	0.004717932
5	JSMR	0.004442979	1.606884127	0.00384375	0.00449169	0.004884915
6	**KLBF**	0.003049586	0.644532221	0.00384375	0.00449169	**0.004261368**
7	PGAS	0.000454571	2.649687689	0.00384375	0.00449169	0.005560589
8	SMGR	0.002554775	1.605534803	0.00384375	0.00449169	0.00488404
9	TLKM	0.002384786	0.755233828	0.00384375	0.00449169	0.004333096
10	UNTR	0.004817394	0.721610136	0.00384375	0.00449169	0.00431131
11	**ADHI**	0.000080	2.988043536	0.00384375	0.00449169	**0.005779823**
12	BDMN	0.001710706	2.127021269	0.00384375	0.00449169	0.005221933
13	JPFA	0.011259517	1.340830749	0.00384375	0.00449169	0.004712528
14	TINS	0.019057547	2.784962881	0.00384375	0.00449169	0.005648239
15	EXCL	0.011182685	1.138327792	0.00384375	0.00449169	0.004581318

According to the calculation results in table 7, it can be seen that the highest expected return is on ADHI shares with a value of 0.00578 while the lowest is on KLBF shares of 0.004261. To see the relationship between the amount of systematic risk and the expected rate of return, the Security Market Line (SML) will be illustrated below.

Figure 3. Graph of Security Market Line



The graph related to SML describes that the greater the return value expected from the stock, the greater the systematic risk that is borne and is denoted by Beta (β). β is useful for measuring the sensitivity of the response to movements in a stock's profits to movements in market profits (Effendy & Pamungkas, 2018). If the value of β> 1 means that it has a higher risk

than the average market risk, then the stock is classified as an aggressive stock. Stocks that are classified as aggressive stocks are: ADHI, BBNI, BBRI, BDMN, BMRI, EXCL, JPFA, JSMR, PGAS, SMGR and TINS. Conversely, if β < 1 means that the stock has a lower risk than the average market risk, and the stock is classified as a defensive stock (Jonathan, 2017). Stocks classified as defensive stocks are: BBCA, KLBF, TLKM and UNTR.

So that if the beta is not too large, then the expected return is also not too large. Furthermore, the stage of determining the candidate stocks forming the portfolio in the CAPM is focused on stocks with an individual rate of return greater than the expected rate of return (Ri > E(Ri)).

Table 8. List of Efficient and Inefficient Stocks

No.	Issuer Code	Ri	E (Ri)	Stock Evaluation
1	**BBCA**	0.015773	0.004438	efficient
2	**BBNI**	0.01007	0.005196	efficient
3	**BBRI**	0.012619	0.004793	efficient
4	**BMRI**	0.006505	0.004718	efficient
5	**UNTR**	0.004817	0.004311	efficient
6	**JPFA**	0.01126	0.004713	efficient
7	**TINS**	0.019058	0.005648	efficient
8	**EXCL**	0.011183	0.004581	efficient
9	JSMR	0.004443	0.004885	-
10	KLBF	0.00305	0.004261	-
11	PGAS	0.000455	0.005561	-
12	SMGR	0.002555	0.004884	-
13	TLKM	0.002385	0.004333	-
14	ADHI	8.01E-05	0.00578	-
15	BDMN	0.001711	0.005222	-

Based on the table above, there are 8 issuers that have individual returns greater than the expected rate of return (Ri > E(Ri)), namely: BBCA, BBNI, BBRI, BMRI, UNTR, JPFA, TINS, EXCL. The next step is to calculate the ERB value generated by the difference between expected return and risk free divided by the beta of the security. After the ERB value is known, the next step is to determine the Cut off Rate (Ci) and Cut off Point (C*) of each security. Following below are the results of the calculation of the ERB, Cut off Rate and Cut off Point.

Table 9. Excess Return to Beta

No	*Code Issuer*	*E (Ri)*	*Rf*	*βi*	*ERB*	*Ai*	*Mrs*	*ci*	*C**
1	*BBCA*	*0.004438*	*0.003844*	*0.917572*	*0.000648*	*0.130169*	*0.917572*	*0.000218*	*0.000241*
2	***BBNI***	*0.005196*	*0.003844*	*2.086357*	*0.000648*	*0.144234*	*2.086357*	***0.000241***	*0.000241*
3	*BBRI*	*0.004793*	*0.003844*	*1.465299*	*0.000648*	*0.143332*	*1.465299*	*0.000239*	*0.000241*
4	*BMRI*	*0.004718*	*0.003844*	*1.349171*	*0.000648*	*0.131386*	*1.349171*	*0.000219*	*0.000241*
5	*UNTR*	*0.004311*	*0.003844*	*0.72161*	*0.000648*	*0.024142*	*0.72161*	*0.000040*	*0.000241*
6	*JPFA*	*0.004713*	*0.003844*	*1.340831*	*0.000648*	*0.057049*	*1.340831*	*0.000095*	*0.000241*
7	*TINS*	*0.005648*	*0.003844*	*2.784963*	*0.000648*	*0.113359*	*2.784963*	*0.000189*	*0.000241*
8	*EXCL*	*0.004581*	*0.003844*	*1.138328*	*0.000648*	*0.089312*	*1.138328*	*0.000149*	*0.000241*

From table 9 it is known that all candidates have the same ERB, namely 0.000648. Then based on the table above it is known that the biggest Cut off Rate (Ci) is on BBNI shares (0.000241) so that this is used as the Cut off Point (C*). Then all stock issuers according to the

table above are included in the optimal portfolio category because they meet the ERB requirements > C*. The next step is to calculate the proportion of stocks as forming the optimal portfolio. This is done as a reference for investors in determining the proportion of funds to be allocated to each share.

Table 10. Proportion of Shares in the Optimal Portfolio

No.	Issuer Code	Zi	∑Zi	Wi	Percentage
1	BBCA	0.089178	0.378031	0.235902	23.59%
2	BBNI	0.043458	0.378031	0.114959	11.50%
3	BBRI	0.061491	0.378031	0.16266	16.27%
4	BMRI	0.061217	0.378031	0.161938	16.19%
5	UNTR	0.021031	0.378031	0.055633	5.56%
6	JPFA	0.026747	0.378031	0.070752	7.08%
7	TINS	0.025588	0.378031	0.067687	6.77%
8	EXCL	0.049321	0.378031	0.130469	13.05%
Total					**100%**

Based on the table above, it is known that the optimal portfolio with CAPM consists of 8 (eight) stocks, namely: BBCA (23.59%), BBRI (16.25%), BMRI (16.19%), EXCL (13.05%), BBNI (11.50%), JPFA (7.08%), TINS (6.77%), UNTR (5.56%). After knowing the proportion of funds for each stock, the next step is to calculate the expected return and risk portfolio. Calculation of the expected return portfolio can be seen in the table below.

Table 11. Return Portfolio Capital Asset Pricing Model

No.	*Issuer Code*	*Wi*	*E(Ri)*	*Wi*E(Ri)*
1	*BBCA*	*0.235902121*	*0.004438282*	*0.00105*
2	*BBNI*	*0.114959135*	*0.005195585*	*0.00060*
3	*BBRI*	*0.162660111*	*0.004793176*	*0.00078*
4	*BMRI*	*0.161937814*	*0.004717932*	*0.00076*
5	*UNTR*	*0.055632738*	*0.00431131*	*0.00024*
6	*JPFA*	*0.070752451*	*0.004712528*	*0.00033*
7	*TINS*	*0.067686776*	*0.005648239*	*0.00038*
8	*EXCL*	*0.130468854*	*0.004581318*	*0.00060*
	Amount	***1***		***0.00474***

It is known from the table above that the return on the Capital Asset Pricing Model portfolio is 0.00474. The next step is to calculate the standard deviation. The following is the calculation of the standard deviation in the table below.

Table 12. Standard Deviation

No.	Issuer Code	σei²	Wi	βp	σp²
1	BBCA	0.00419091	0.235902121	0.216457	0.00098864
2	BBNI	0.019554446	0.114959135	0.239846	0.00224796
3	BBRI	0.009706119	0.162660111	0.238346	0.00157880
4	BMRI	0.008976749	0.161937814	0.218482	0.00145368
5	UNTR	0.013975667	0.055632738	0.040145	0.00077750
6	JPFA	0.020418918	0.070752451	0.094867	0.00144469
7	TINS	0.044331852	0.067686776	0.188505	0.00300068
8	EXCL	0.009400712	0.130468854	0.148516	0.00122650
Amount				**1.3851641**	**0.012718454**

Based on the table above, the results of calculating the standard deviation of the portfolio are:

$\sigma p^2 = 0.012718454$

$\sigma p = 0.112776122$ (11%)

Once the standard deviation of the portfolio is known, the next step is to calculate the Beta Portfolio according to the calculations in Table 12 which is 1.3851641.

Portfolio Performance Analysis

Sharpe's method

$$S_p = \frac{TRp - RF}{\sigma p}$$

$$Sp = \frac{0.00474 - 0.00384}{0.112776122}$$

$$= \mathbf{0.00796}$$

Trenor's method

$$but = \frac{TRp - RF}{\beta p}$$

$$tp = \frac{0.00474 - 0.00384}{1.3851641}$$

$$= \mathbf{0.00065}$$

Jensen's method

$$\alpha_p = (R_{pt} - RF_t) + [\beta_p(R_{Mt} - RF_t)]$$

$$\alpha_p = (0.00474 - 0.00384) + [1.38516\ (0.00449 - 0.00384)]$$

$$= \mathbf{0.00180}$$

Value at Risk (VaR) Monte Carlo method

Table 13. Value at Risk (VaR) Measurement Results of the Monte Carlo Model

No.	Issuer Code	Var (90%)	VaR(95%)	VaR(99%)
1.	BBCA	-6.3%	-8.3%	-13.2%
2.	BBNI	-13.7%	-17.8%	-28.1%
3.	BBRI	-9.5%	-12.4%	-19.7%
4.	BMRI	-9.4%	-12.2%	-19.4%
5.	UNTR	-11.4%	-14.8%	-23.4%
6.	JPFA	-16.4%	-21.3%	-33.6%
7.	**TINS**	-22.1%	-28.6%	**-45.1%**
8.	EXCL	-13.4%	-17.5%	-27.6%

Based on Table 13, PT Timah (Persero) Tbk (TINS) has the highest VaR value compared to other stocks, namely within 1 day the VaR value is 45.1% at a 99% significance level. This means that if an investor invests Rp. 100,000,000.00 in TINS shares, the maximum risk of loss is Rp. 45,114,393.22 for 1 day.

CONCLUSION

Based on the results of the research conducted, it can be concluded that the optimal portfolio formed using the Single Index Model method consists of 5 (five) stocks, namely BBCA (69%), BBRI (13%), EXCL (8%), JPFA (5%) and TINS (4%). While the optimal portfolio formed using

the Capital Asset Pricing Model method consists of 8 (eight) stocks, namely BBCA (23.59%), BBRI (16.27%), BMRI (16.19%), EXCL 13.05%, BBNI (11.50%), JPFA (7.08%), TINS (6.77%) and UNTR (5.56%). The results of portfolio performance analysis using the Sharpe, Treynor and Jensen indices in the Single Index Model method are higher than the Capital Asset Pricing Model method. So that the performance of the portfolio of stocks formed on the SIM method is better. The Value at Risk (VaR) measurement level uses a Monte Carlo simulation with a confidence level of 90%, 95% and 99% and a time horizon of 1 day. The largest VaR value in the Single Index Model and Capital Asset Pricing Model methods is found in TINS shares. The highest VaR value for SIM is 45.1% at a significance level of 99%.

LIMITATIONS

1. Historical Data: This research is based on historical stock data and certain assumptions about a specific capital market. Changes in market conditions or stock behaviors may affect portfolio performance in the future. Therefore, the results of this research need periodic updates to account for market changes.
2. Model Assumptions: This research employs specific assumptions in portfolio formation, such as investor passivity and the absence of transaction costs. In the real world, these assumptions may not always hold, and such costs can impact portfolio outcomes.
3. VaR Method Limitations: The use of Value at Risk (VaR) has limitations in measuring risk, particularly in identifying extreme risk and rapid market changes. The Monte Carlo simulation method also has assumptions that need to be considered in interpreting the results.
4. Limited Stocks Examined: This research only includes a limited number of stocks. Results may differ if more stocks or other financial instruments are included in the analysis.
5. Generalization: The results of this research may not be directly generalized to all investment situations. Investment decisions always depend on individual factors such as goals, risk tolerance, and investor preferences.

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