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Analysis of optimal portfolio formation using the single index model approach on Bisnis-27 index shares on the Indonesia Stock Exchange for the 2018-2022 period

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Abstract

Based on data from the Indonesian Central Securities Depository (KSEI), the number of investors in the Indonesian stock market is increasing, indicating the popularity of stocks as an investment instrument. This study aims to examine the returns and risks of stocks in the optimal portfolio, compared to those not under the optimal portfolio, using the Single Index Model. Secondary data from the Bisnis-27 index were used for the analysis. The results show that returns differ significantly between stocks in the optimal portfolio and those that are not. However, these risks were found to be insignificant. The determination of the optimal portfolio in this study can be used as a reference by investors when making investment decisions.

Keywords:
Optimal portfolio;
Single index model;
Difference test;
Return;
Risk.

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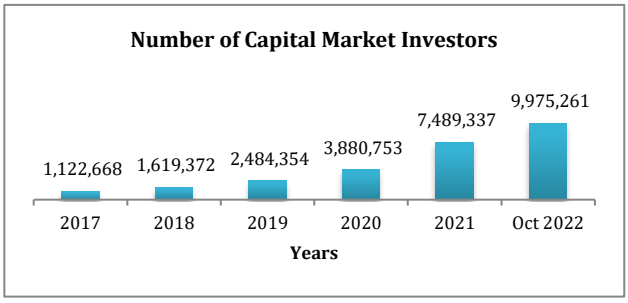
1. Introduction

The COVID-19 pandemic in Indonesia has brought about significant changes in people's lifestyles, notably creating heightened awareness of the imperative of investment. Prior to the pandemic, surplus funds were typically directed towards consumption. However, in the aftermath of the pandemic, individuals increasingly allocated excess funds to investment opportunities. Asriansyah (2022). One prominent investment avenue in Indonesia is the capital market. Capital markets play an important role in a country's economy. The capital market performs two functions: First, it serves as a means for companies to obtain funds from the public (investors). Second, the capital market provides individuals with opportunities to invest in financial instruments such as stocks, bonds, mutual funds, and others.



Source: www.ksei.co.id (data processed 2023)

Figure 1: Development of the number of capital market investors

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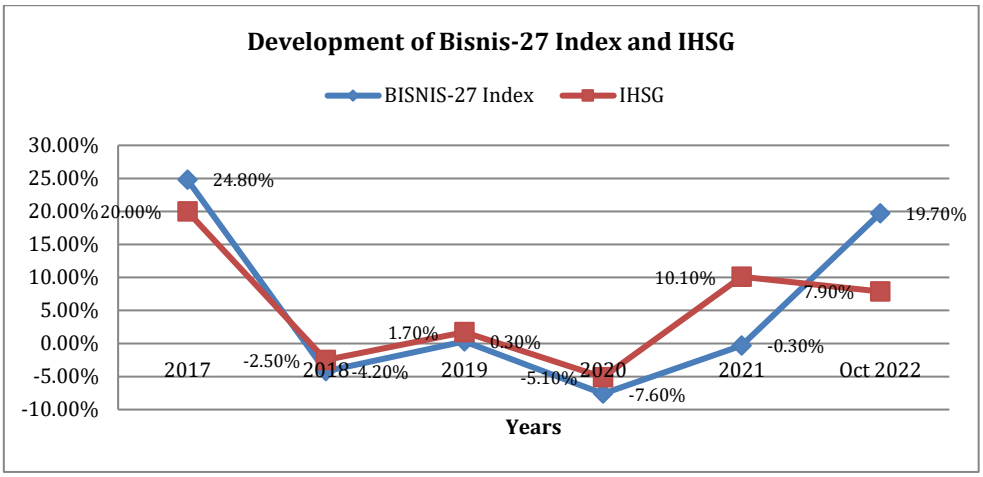
As shown in Figure 1, the number of capital market investors in Indonesia has consistently shown steady growth over the years, with a particularly remarkable surge observed following the onset of the pandemic, specifically from 2020 to October 2022. This upward trend suggests that investing in the capital market has become a preferred choice for individuals, especially compared to traditional business ventures that experienced a downturn during the pandemic.
Many types of investment instruments are available to investors in the capital market, but stocks are the most popular option because they potentially generate lucrative profits in both the short and long term. Otoritas Jasa Keuangan (2022). In the capital market, a variety of stock indices cater to investors' specific goals and requirements. These stock indices provide investors with an overview of stock prices on exchanges and can be used as a reference point to assess the performance of a stock portfolio.

Currently, the Indonesian Stock Exchange (IDX) provides investors with a wide selection of 42 stock index options. Among these indices is the Bisnis-27 Index, which reflects the stock prices of 27 issuers. Issuers are selected based on fundamental criteria, technical or transaction liquidity, accountability, and good corporate governance.



Source: www.idx.co.id (data processed 2023)

Figure 2: Development of Bisnis-27 Index and IHSG

Figure 2 shows the performance of the Bisnis-27 Index over the past six years, displaying fluctuations. The movement of the index serves as a valuable reference for assessing the potential level of return and associated risks involved in investing. This observation indicates that, despite comprising shares of carefully selected companies, the Bisnis-27 Index is not exempt from the inherent element of uncertainty in terms of return rates. Investors should acknowledge that investing in the Bisnis-27 Index, like any other investment, carries a certain level of risk that should be carefully considered and managed. In other words, every investment always has an element of uncertainty or risk.

Investing involves two interrelated factors: return and risk. The size of the returns received depends on the investor's willingness to bear the accepted risk. Behind the benefits obtained, there is a risk or element of uncertainty in an investment. This is in accordance with the characteristics of shares, namely, high risk-high returns. The levels of return and risk resulting from an investment will certainly differ from one another. Before investing, investors need to conduct an analysis to maximize the generated return and minimize risk as much as possible. One way to minimize the risk of stock investment is through diversification. Stock diversification can be achieved by combining optimal portfolio stocks. In this context, diversification means "spreading" risk across several assets in a portfolio. Although diversification cannot eliminate risk, it is expected to reduce portfolio risks.

Optimal portfolio formation can be achieved using various methods, including the Markowitz method and the single-index method (single-index model). In this study, we determined the optimal portfolio using a single-index model. The single-index method was developed by William Sharpe in 1963. This model can simplify calculations in the Markowitz model and is useful for calculating the expected returns and portfolio risk (Hartono, 2019; Setiawan, 2017). Rational investors naturally seek investments that offer high returns and low risks. The variation in the returns and risks in investing depends on the selected combination of shares. One way to mitigate the uncertainty associated with investments is to use a single index model.

Hence, this study was carried out to analyse and determine the stocks that make up the optimal portfolio in the Bisnis-27 Index for the 2018-2022 period, using the single index model. Once the optimal portfolio was formed, a Mann-Whitney Difference Test was carried out to examine the difference between the return and risk of stocks included in the optimal portfolio candidates and those that were not.

2. Literature review

2.1 Investment management

In investment, communities usually have assets in the form of real and financial assets. In managing investments at the community level, effective management is essential to ensure allocation to the needs of investors. . Investment management involves the activities of overseeing and analysing money, as well as selecting suitable assets for investment with the goal of achieving favourable returns (Bodie et al., 2018). Investment management is a specialised field within finance that deals with the management of funds, whether for individuals or institutions. Other commonly used terms to describe this area of finance include asset, portfolio, money, and wealth management. In industry parlance, an asset manager is responsible for "running money" (Fabozzi and Drake, 2009).

2.2 Common stock

Many types of financial market instruments can be used as a means to invest, but stocks are the most popular financial instruments because they can provide attractive returns. According to Smart et al., 2017), common stock represents ownership in a corporation. Each share of common stock represents a fractional ownership interest in the firm.

2.3 Return

Investors primarily base their decisions on anticipated returns and associated risks. The buying and selling prices of stock transactions are influenced by various factors. Return refers to the income generated from an investment, including any changes in the market price. It is typically expressed as a percentage of the initial market price of the investment (Horne & Wachowicz, 2009).

2.4 Risk

Investors must understand two aspects of investment: return and risk. In general, investors pay attention only to the returns that will be obtained without considering the potential losses and risks associated with their investments (Otoritas Jasa Keuangan, 2022). Risk can be defined as the degree of variability or uncertainty in the returns of an investment compared to what was initially anticipated. For instance, the cash dividend an investor expects to receive may differ from the actual return they receive. This discrepancy means that the actual return on investment can deviate significantly from the expected return (Horne & Wachowicz, 2009).

2.5 Optimal portfolio

Indeed, it is beneficial for investors, particularly when engaging in individual investment activities, to have a stock portfolio. To maximize profits, it is crucial to consider strategies when making investments. According to Brigham and Houston (2018), the optimal portfolio for each investor can be identified as the tangency point between the efficient set of portfolios and one of the investors' indifference curves. This tangency point represents the highest level of satisfaction or utility an investor can achieve.

2.5 Single index model

Hartono (2019) argues that the single-index model is based on the observation that the price of securities will fluctuate in the same direction as the market index; that is, if the stock price increases, the stock price index will increase, and vice versa. Returns from securities may be correlated because of the common response to changes in market value. The single-index model can also be used to calculate expected returns and portfolio risk.

Diversification helps investors develop optimal investment portfolios. One optimal portfolio formation strategy is to use a single-index model. Stocks included in the optimal portfolio candidates will inevitably exhibit different returns and risks compared with those that are not included. Returns and risk have a linear or unidirectional relationship. If the return is high, then the risk is high, and vice versa.

We have conducted a literature search using keywords such as "optimal portfolio formation," "single index model," and "differences in return and risk of candidate and non-candidate optimal portfolio stocks." The literature search returned twelve prior research papers relevant to the topic. Pratiwi and Hazmi (2022) demonstrated that there are differences in returns between stocks included in portfolio candidates and those that are not. Similarly, differences in stock risk were observed between candidate and non-candidate stocks. In contrast, Ekantari and Winandaputra (2015) reported no significant difference in stock returns between optimal portfolio candidate stocks and non-candidate stocks. The study also concluded that there was no difference in risk levels between optimal portfolio candidate stocks and non-candidate stocks. As both studies were conducted more than a decade apart, there could be changes in the economic conditions that have influenced the results.

The contrasting results of past studies prompted us to further investigate this matter and confirm the results, especially during the COVID-19 aftermath. Based on the above discussion, we propose the following hypotheses:

H1: There is a difference in returns between stocks included and not included in the optimal portfolio candidate.
H2: There is a difference in risk between stocks included and not included in the optimal portfolio candidate.

3. Research method

This study focuses on forming an optimal portfolio using the single index model and utilises a sample of companies listed on the Bisnis-27 index. Companies were selected for the sample using a purposive sampling method, which aligns with the criteria relevant to the research problem being investigated. The specific criteria for selecting companies for the sample were as follows:

(i) Companies that are consecutively entered and listed on the Indonesia Stock Exchange (IDX).
(ii) Companies are consistently included in the Bisnis-27 Index for the period November 2018 to October 2022.

(iii) Companies with complete monthly historical stock data for the research period were conducted from November 2018 to October 2022.

(iv) Companies that did not issue a stock split during the research period could have an impact on monthly returns to decrease and cause the ERB value to be negative.

Using the selection criteria, we selected 12 companies as the study sample, as shown in Table 1.

Table 1: Research Sample

No	Code	Companies	IPO
1	ADRO	Adaro Energy. Tbk	16 July 2008
2	ASII	Astra International Tbk.	04 October 1990
3	BBNI	Bank Negara Indonesia (Persero) Tbk.	25 November 1995
4	BBRI	Bank Rakyat Indonesia (Persero) Tbk.	10 November 2003
5	BMRI	Bank Mandiri (Persero) Tbk.	14 July 2003
6	CPIN	Charoen Pokphand Indonesia Tbk.	18 March 1991
7	INKP	Indah Kiat Pulp & Paper Tbk.	16 July 1990
8	KLBF	Kalbe Farma Tbk.	30 July 1990
9	PTBA	Bukit Asam Tbk.	23 December 2002
10	SMGR	Semen Indonesia (Persero) Tbk.	08 July 1991
11	TLKM	Telekomunikasi Indonesia (Persero) Tbk.	14 November 1995
12	UNTR	United Tractors Tbk.	19 September 1989

Source: www.idx.co.id (data processed 2023)

In the portfolio formation process, this study uses secondary data, specifically monthly stock prices at the closing price of the company's shares from the sampled companies during the research period. Several measurement components were used, including expected return (ER_i), expected market return (ER_M), and standard deviation (σ), which is an estimate of the risk that would be generated; systematic risk (β), which measures changes in securities against market prices; and alpha (α_i) or the expected return value that is independent of changes in market prices and beta and residual error (e_i). Table 2 presents the formulae used in the study.

Brown et al. (2014) stated that in determining the optimal portfolio using a single index, using a single index, involves four main steps. Step 1 ranks securities from those with the highest ERB (Excess Return to Beta) to those with the lowest ERB. Step 2 involves determining the cut-off point (C*) value of the highest share value in the group of securities included in the optimal portfolio. Step 3 determines the proportion of funds to be invested in the optimal portfolio using the scale of each share. Investors generally choose stocks with ERB that are higher than the cut-off point (ERB> C*) because these stocks show positive values and tend to be long-lasting. The last step is to select stocks that constitute the optimal portfolio. Based on this procedure, we identified stocks that are in the optimal portfolio category and those that are not.

Prior to conducting the difference test, the available data were subjected to data normality and homogeneity tests. These tests confirm the suitability of the data for the Mann-Whitney Difference test, which requires data to be normally distributed and the two groups within the data to have the same variance. The decision-making criteria were as follows.

- If the significance value> 0,05 then hypothesis accepted
- If the significance value< 0,05 then hypothesis rejected

Table 2: Measures

No	Measures	Description	Formula
1.	Monthly and market returns	This is a measure of returns	$Ri = \frac{P_t - P_{t-1}}{P_{t-1}}$
2.	Standard deviation	This is a measure of risks	$\sigma_i = \sqrt{\frac{\sum_{t=1}^{n}(Xi - (Xi))^2}{n-1}}$
3.	Beta (β_i)	A weighted average of the beta of each asset	$\beta_i = \frac{\alpha_i . m}{\alpha^2 m}$
4.	Alpha (α_i) for each asset	The portion of security i's return that is unaffected or independent of market performance.	$\alpha_i = R_i - \beta_i . R_m$
5.	The variance of a security calculated from the Single Index model	Variance of the security's residual error.	$\sigma_p^2 = \beta_i^2 . \alpha_M^2 + \sigma_{ei}^2$
6.	Excess return to beta	Measures the excess return relative to one unit of undiversifiable risk as measured by beta	$ERB_i = \frac{E(R_i) - R_f}{\beta_i}$
7.	C*	The quotient value of the market variance and return premium to the stock variance error with the market variance of the individual stock sensitivity to the stock variance error,	$C_i = \frac{\sigma_M^2 \sum_{j=1}^{1} \frac{[E(R_i - R_{BR}] . \beta_i}{\sigma_{ej}^2}}{1 + \sigma_M^2 \sum_{j=1}^{i} \frac{\beta_i^2}{\sigma_{ej}^2}}$
8.	The proportion of funds (Zi) is each stock in the optimal portfolio and the percentage of funds (Wi) each stock that makes up the optimal portfolio (This measure was calculated after knowing which stocks make up the optimal portfolio)	Proportion of funds	$Z_i = \frac{\beta_i^2}{\sigma_{ei}^2}(ERBi - C*)$ $W_i = \frac{Z_i}{\sum_{j=1}^{k} Z_i}$

4. Results

Table 3 summarises the measures calculated using the formula and ranked according to the ERBi values from the highest to the lowest value.

Table 3: Stock data, sorted according to *ERB$_i$*

Stock Code	*E(R$_i$)*	Standard Deviation	*Beta$_i$*	*Alpha$_i$*	*Variance e$_i$*	*ERB$_i$*
ADRO	0,030451	0,164571	1,574396	0,027734	0,020028	0,019341
KLBF	0,007161	0,070166	0,457923	0,006371	0,004326	0,015639
SMGR	0,003941	0,158498	0,274186	0,003468	0,024907	0,014373
BBRI	0,008888	0,094244	1,272073	0,006693	0,004276	0,006987
BMRI	0,009912	0,091652	1,439752	0,007427	0,002500	0,006884
BBNI	0,009413	0,116442	1,787638	0,006329	0,004462	0,005266
UNTR	0,002679	0,118338	1,033984	0,000895	0,010961	0,002591
TLKM	0,001505	0,070456	0,873933	-0,000002	0,002790	0,001723
PTBA	0,001621	0,116167	0,953702	-0,000025	0,010906	0,001700
INKP	0,001376	0,146580	1,239972	-0,000763	0,017109	0,001110
CPIN	0,000017	0,084433	0,286374	-0,000478	0,006896	0,000058
ASII	-0,001726	0,104080	1,273152	-0,003922	0,006219	-0,001355
RM	0,001725	0,053353				

Using the single-index model, we identified five candidates to be included in the optimal portfolio, and the remaining seven stocks were identified as non-candidates. Table 4 presents the details of candidate and non-candidate stocks.

Table 4: Determining C* in the Bisnis-27 Index

Stock Code	A_i	Accumulation A_i	B_i	Accumulation B_i	C_*	ERB_i	Result
ADRO	2,3937	2,3937	123,7634	123,7634	0,0050	0,0193	Candidate
KLBF	0,7580	3,1517	48,4683	172,2317	0,0060	0,0156	Candidate
SMGR	0,0434	3,1951	3,0183	175,2500	0,0061	0,0144	Candidate
BBRI	2,6442	5,8393	378,4476	553,6976	0,0065	0,0070	Candidate
BMRI	5,7089	11,5482	829,2681	1382,9657	0,0067	0,0069	Candidate
BBNI	3,7712	15,3193	716,1551	2099,1208	0,0063	0,0053	Non-Candidate
UNTR	0,2528	15,5721	97,5414	2196,6622	0,0061	0,0026	Non-Candidate
TLKM	0,4716	16,0437	273,7449	2470,4072	0,0057	0,0017	Non-Candidate
PTBA	0,1418	16,1854	83,4000	2553,8072	0,0056	0,0017	Non-Candidate
INKP	0,0997	16,2851	89,8661	2643,6732	0,0054	0,0011	Non-Candidate
CPIN	0,0007	16,2858	11,8932	2655,5664	0,0054	0,0001	Non-Candidate
ASII	-0,3533	15,9326	260,6507	2916,2171	0,0049	-0,0014	Non-Candidate

Once the candidates for the optimal portfolio have been determined, we calculate the optimal investment proportion for each candidate based on xxxxx (insert the method used to determine the proportion). The proportions are as follows: ADRO, 44.12%;, KLBF 42.06%; SMGR, 3.76%; BBRI, 4.32%; and BMRI, 5.75%. Table 5 shows the expected return portfolio ranked according to the investment proportion.

Table 5: Expected Return Portfolio

Stock Code	W_i	$Beta_i$	$Alpha_i$	$Alpha_p$	$Beta_p$
ADRO	0,441165	1,574396424	0,027734183	0,012235349	0,6945685
KLBF	0,420603	0,457923297	0,006371336	0,002679803	0,1926039
SMGR	0,037579	0,27418629	0,003467867	0,000130319	0,0103036
BBRI	0,0431962	1,272073435	0,006692984	0,000289112	0,0549487
BMRI	0,0574569	1,439752375	0,007427379	0,000426754	0,0827237
Total				0,015761337	1,0351485
E(RM)	0,0017254				

$E(R_p) = \alpha_p + \beta_p . E(R_M)$

$E(R_p) = 0.01580 + 1.03514\ (0{,}00172)$

$E(R_p) = 0{,}0175474\ or\ 1.755\%$

Based on these results, the expected return on the optimal portfolio is 1.75%. The expected return is considered promising because the expected return of the portfolio is above the market return E(RM) of 0.172%, as well as above the risk-free return of 0.36%. Table 6 presents the calculation results for portfolio risk. The calculated portfolio risk is 0.32%, indicating that the risk contained in this stock portfolio is lower than that of individual stocks.

Table 6: Risk portfolio

Stock Code	Wi	Variance i	Variance p
ADRO	0,441164952	0,02002793	0,008835622
KLBF	0,420602968	0,00432641	0,0018197
SMGR	0,037578996	0,02490747	0,000935998
BBRI	0,043196209	0,00427581	0,000184699
BMRI	0,057456875	0,00249966	0,000143623
Total			0,011919641
$\boldsymbol{\sigma_M^2}$	0,002846522		
$\boldsymbol{\beta_p^2}$	1,071532392		

$\sigma_p^2 = \beta_p^2 . \sigma_M^2 + \sigma_{ep}^2$

$\sigma_p^2 = (1.0715 \text{ x } 0.0028) + 0{,}0119$

$\sigma_p^2 = 0.003192218\ or\ 0.32\%$

4.1 Data normality and homogeneity

The results of the normality test showed that the return data were not normally distributed (Kolmogorov-Smirnov statistic = 0.252, p=0.034; Shapiro-Wilk statistic = 0.746, p=0.002), and the risk data were normally distributed (Kolmogorov-Smirnov statistic = 0.163, p=0.200; Shapiro-Wilk statistic = 0.931, p=0.338). The test of homogeneity of variance showed favorable results for the return data, with a p value of 0.122 (Levene's statistic = 2.858). The risk data were also found to be homogeneous, with a p value of 0.053 (Levene's statistic = 4.813).

4.2 Difference test

Due to the lack of normality in the return data, we tested the difference between the candidate and non-candidate stock returns using the Mann-Whitney Difference test instead of the t-test. The results show a significant difference in returns between the two stock groups. The test produced a significance value of 0.019 (2-tailed) with a Mann-Whitney U statistic of 3.000. This indicates that there is a difference in returns between candidates in the optimal portfolio and non-candidates with a confidence level of 95%. The results of the t-test show no significant difference in terms of risks between candidates of the optimal portfolio and non-candidates (t-value = 0.399; p=0.699, 2-tailed).

From the results of the t-test, the return data concludes that hypothesis H1 is accepted. The decision was made based on the significance value of 0.019 ($\alpha < 0.05$), indicating a difference in returns between stocks included in the optimal portfolio candidate and stocks not included in the optimal portfolio. From the results of the difference test, the return data indicate that hypothesis H2 is not supported. The decision was made based on a significance value of 0.699 ($\alpha > 0.05$), which implied no significant difference between the risk of stocks included in the optimal portfolio candidate and the risk of stocks that are not included in the optimal portfolio candidate.

5. Conclusion

The results indicate that out of the 12 stocks used in the research sample, five stocks formed the optimal portfolio with the following fund proportions: Adaro Energy Tbk (ADRO) with a proportion of 44.11%, Kalbe Farma Tbk (KLBF) with a proportion of 42.06%, Semen Indonesia (Persero) Tbk (SMGR) with a proportion of 3.75%, Bank Rakyat Indonesia (Persero) Tbk (BBRI) with a proportion of 4.32%, and Bank Mandiri (Persero) Tbk (BMRI) with a proportion of 5.74%. Furthermore, after conducting a comparison test between the stocks included in the optimal portfolio and those that are not, it is concluded that there is a difference in returns between the stocks included in the optimal portfolio candidates and non-candidate optimal portfolios. However, there is no significant difference in the risk levels between stocks included in the optimal portfolio candidates and those that are not.

This research can be used as reference material for investors and prospective investors regarding the proportion of investment funds calculated in this study. This research is expected to be a reference for further researchers, who are expected to increase the number of samples because the sample in this study only amounted to 12.

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