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Optimal Portfolio Using Single Index Model (SIM) For Health Sector Stocks

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Abstract

Investment is one of the fund management activities with the aim of obtaining future profits. In addition to profits, investors also need to consider the risks that will be faced by diversifying. Diversification is done by forming an optimal portfolio. This research aims to determine the proportion of stocks in the optimal portfolio and calculate the expected return and risk value of the optimal portfolio. The object used to form the optimal portfolio is health sector stock group for the period January 2020 - December 2022. The method used to form the optimal portfolio is Single Index Model (SIM). The results showed that there were 6 combinations of health sector stock in the optimal portfolio, such as IRRA, PRDA, SAME, SILO, MERK, and HEAL stocks of 8.94%, 9.24%, 9.34%, 11.92%, 27.15%, and 33.41% respectively with expected return of 2.68% and a risk value of 1.85%.
Keywords: Optimal Portfolio; Health Sector Stock; Single Index Model

1. Introduction

Indonesia's economy after the Covid-19 pandemic has increased. One of the factors driving economic growth in Indonesia is investment. Investment is the commitment of a number of funds or other resources invested at this time to obtain a number of benefits in the future (Tandelilin, 2010). Stock is one of the most popular investments for investors. The Indonesia Stock Exchange (IDX) is one of the places where stock transactions in Indonesia. There are many sectoral indices available on the IDX. The performance of sectoral stocks for the 2018-2022 period based on stocks closing prices is shown in Table 1.

Based on Table 1, there is positive and negative growth from each sectoral stock on the IDX. Health sector is one of the sectors that has good index growth. In 2020, when other sector stock prices decreased due to the Covid-19 pandemic, health sector stocks increased compared to other stocks by 17.8%, indicating that companies in the health sector are always needed by the public in various circumstances. So that health sector stocks can be an option for investors in investing in stocks.

An investor who buys stocks has the main goal to obtain returns in the future. Investors must take into account not only the potential gains but also the potential risks that they may encounter. Return and risk have a strong relationship, the greater the expected return, the greater the risk faced (Hidayat et al., 2022). An investor can minimize the risk by diversifying. Diversification is the formation of a portfolio that contains a combination of several stocks. Diversification is done to minimize risk without reducing returns by forming an optimal portfolio.

This research aims to form an optimal portfolio of health sector stocks using single index model (SIM). The closing price of stocks of each month from January 2020 to December 2022 serves as the historical data employed in the process of portfolio formation. After that, calculate the expected return and risk value of the portfolio that has been formed.

Table 1: Stock Price Index Growth Data

Sectors	2018 (%)	2019 (%)	2020 (%)	2021 (%)	2022 (%)
Basic Materials	−2.7	21.8	4.0	0.1	−1.5
Consumer Cyclicals	−14.6	3.8	−16.1	21.2	−5.5
Consumer Non Cyclicals	7.9	−16.8	−11.9	−16.0	7.9
Energy	−0.4	−17.3	−5.0	45.6	100.0
Finance	13.2	14.0	−2.3	21.1	−7.3
Healthcare	6.3	4.7	17.8	8.4	10.2
Industrials	5.8	−16.0	4.6	11.6	13.3
Infrastructures	−8.7	5.5	−10.5	11.6	−9.4
Properties & Real Estate	2.8	22.9	−24.3	−19.1	−8.0
Technology	31.7	−3.1	−12.8	707.6	−42.6
Transportation & Logistic	6.8	7.7	−17.1	67.8	3.9

2. Literature Review

2.1 Portfolio

A portfolio is formed by combining assets that are anticipated to yield a return, but also entail multiple risks (Alkindi et al., 2023). However, these risks can be mitigated by distributing them among different assets. Portfolios are formed to reduce risk without reducing returns by diversifying. With diversification, an investor can form an optimal portfolio.

The first step to forming an optimal portfolio is form an efficient portfolio first. An efficient portfolio is characterized by having the highest anticipated yield relative to portfolios of equal risk, or alternatively, by maintaining a portfolio with low risk compared to portfolios that possess the same return. (Hidayat et al., 2022). From the group of efficient portfolios, the best one can be selected to become the optimal portfolio.

2.2 Stock

Stock return is the profit obtained in investing in stocks. Furthermore, the stock expected return is the value of profit expected by investors in the future. The return and expected return value are written as follows (Qin, 2023):

$$R_i = \frac{S_t - S_{t-1}}{S_{t-1}}, i = 1,2, \dots, t = 1,2, \dots, \tag{1}$$

$$E(R_i) = \frac{\sum_{i=1}^{n}(R_i)}{n}, i = 1,2, \dots, \tag{2}$$

R_i : Stock return,
S_t : Stock price of period t,
S_{t-1} : Stock price of period $(t-1)$,
$E(R_i)$: Stock expected return.

Standard deviation is a value to measure the level of risk that will be obtained when making an investment. The stock risk value are written as follows (Zhang, 2022):

$$\sigma_i = \sqrt{\frac{\sum_{i=1}^{n}(R_i - E(R_i))^2}{n-1}}, \qquad i = 1, 2, \dots, \tag{3}$$

σ_i : Stock risk.

2.3 Kolmogorov-Smirnov Normality Test

Stock return data is assumed to distribute normally with hypothesis (Awan and Wang, 2022):
H_0 : return data follows a normal distribution,
H_1 : return data is not follows normal distribution,

with significance level:

$$\alpha = 5\%$$

with test value:

$$D = \sup x \ |F(x) - F_0(x)|, \tag{4}$$

D : Supremum value,
$F(x)$: Cumulative distribution function of the sample data,
$F_0(x)$: Cumulative distribution function of the normal distribution,

with test criteria:
H_0 is rejected when $D > D^*(\alpha)$ or $p - value < \alpha$.

2.4 Single Index Model (SIM)

Single Index Model (SIM) assumes that the rate of return between two or more effects will be correlated (Alkindi et al., 2023). This shows that stock price movements have a strong relationship with market price movements.

Single Index Model (SIM) is a model that assumes that there is a correlation between stock returns and market returns (Yusup, 2022). The measure of the volatility of a stock's return to the market return is called beta. Beta is an indicator that assesses the level of systemic risk possessed by a particular stock in relation to the risks associated with the market. The beta value are written as follows (Yusup, 2022):

$$\beta_i = \frac{\sigma_{im}}{\sigma_m^2}, i = 1, 2, ..., \tag{5}$$

β_i : Volatility of the stock return,
σ_{im} : Covariance between stock return and market return.

There is a stock alpha value as a relative stock performance value. The alpha value are written as follows (Yusup, 2022)

$$\alpha_i = E(R_i) - \left(\beta_i . E(R_m)\right), i = 1, 2, ..., \tag{6}$$

α_i: Relative stock performance value.

Portfolio determination using Single Index Model (SIM) is based on comparing the Excess Return to Beta (ERB_i) and cut-off point value (C^*). The ERB_i value are written as follows (Yusup, 2022):

$$ERB_i = \frac{E(R_i) - R_f}{\beta_i}, i = 1, 2, ..., \tag{7}$$

ERB_i : Excess Return to Beta,
R_f : Risk-free asset return.

The determination of the optimal portfolio stock candidates can follow the criteria:

$$ERB_i \geq C^* \tag{8}$$

Furthermore, the calculation of the proportion of stocks and stock weights in the optimal portfolio are written as follows (Yusup, 2022):

$$Z_i = \frac{\beta_i}{\sigma_{ei}^2}(ERB_i - C^*), i = 1, 2, ..., \tag{9}$$

$$W_i = \frac{Z_i}{\sum Z_i}, i = 1, 2, ..., \tag{10}$$

$$\sum_{i=1}^{n} W_i = 1 , i = 1, 2, ..., \tag{11}$$

Z_i : Stock proportion,
W_i : Stock weight.

After forming the optimal portfolio, investor need to determine the expected return and risk value of the optimal portfolio. According to (Yusup, 2022), the expected return of the portfolio is a weighted average of individual stock returns. The expected return and risk value of the portfolio optimal using Single Index Model (SIM) are written as follows (Yusup, 2022):

$$E(R_p) = \alpha_p + \beta_p . E(R_m), \tag{12}$$

$$\sigma_p^2 = (\beta_p^2 . \sigma_M^2) + \sum_{i=1}^{n} W_i . \sigma_{ei}^2, \tag{13}$$

$E(R_p)$: Portfolio expected return,
σ_p^2 : Portfolio risk.

3. Materials and Methods

3.1. Materials

The object used for this research is the closing price of the health sector group stocks (IDXHEALTH) listed on the Indonesia Stock Exchange (IDX). The data used is secondary data and time series data. There are 18 stocks listed in the health sector group stocks during the period January 2020 - December 2022).

3.2. Methods

1. Stock Selection based on Expected Return
   The first step to form an optimal portfolio is select stocks that have a positive expected return value. The expected return of stocks is calculated using equation (2).
2. Kolmogorov-Smirnov Normality Test on Stock Return Data
   After the normality test of Kolmogorov-Smirnov, normally distributed stocks are added to the next calculation.
3. Determining Stocks for The Optimal Portfolio Using Single Index Model (SIM)
   Next, calculate the ERB_i using equation (7) to determine the optimal portfolio stocks. After that, calculate the proportion and weight of stocks in the optimal portfolio using equations (9) and (10).
4. Calculation of Expected Return and Risk Value of The Optimal Portfolio
   Last, calculate the expected return and risk value of the optimal portfolio using equations (12) and (13).

4. Results and Discussion

1. Stock Selection based on Expected Return

The first step to form an optimal portfolio using Single Index Model (SIM) is calculated the expected return of stocks using equation (2). Stocks added to the next calculation are stocks that have positive expected return values. Stocks that have negative expected return are assumed not to be profitable for the portfolio.

Table 2: Expected Return of Stocks Value

Stocks	Expected Return
DVLA	0.00317
HEAL	0.02953
IRRA	0.02547
KAEF	0.03699
KLBF	0.01279
MERK	0.02461
MIKA	0.00910
PEHA	−0.00409
PRDA	0.02374
PRIM	−0.01349
PYFA	0.06246
SAME	0.03582
SIDO	0.00962
SILO	0.02024
SRAJ	0.07405
TSPC	0.00484

2. Kolmogorov-Smirnov Normality Test on Stock Return Data

Based on the previous calculation, there are 14 stocks for the Kolmogorov-Smirnov normality test. Kolmogorov-Smirnov test value is calculated using equation (4) and the value is compared to the value in the Kolmogorov-Smirnov table with a significance level of 5%.

Table 3: Kolmogorov-Smirnov Normality Test Results

Stocks	D	$D^*(0.05)$
DVLA	0.09921	0.23
HEAL	0.12918	0.23
IRRA	0.16249	0.23
KAEF	0.23813	0.23
KLBF	0.16233	0.23
MERK	0.15395	0.23
MIKA	0.07029	0.23
PRDA	0.21284	0.23
PYFA	0.27543	0.23
SAME	0.12291	0.23
SIDO	0.13161	0.23
SILO	0.19997	0.23
SRAJ	0.23468	0.23
TSPC	0.23673	0.23

Based on Table 3, 10 stocks that are normally distributed are DVLA, HEAL, IRRA, KLBF, MERK, MIKA, PDRA, SAME, SIDO, and SILO.

3. Determining Stocks for The Optimal Portfolio Using Single Index Model (SIM)

Next, determine the candidate portfolio stocks from the 10 normally distributed stocks. ERB_i value is used to determine the relationship between return and risk in an investment. ERB value is calculated using equation (7).

Table 4: Determination of Candidate Portfolio Stocks

Stocks	ERB_i	C_i	C^*
DVLA	-0.00067	$-1.687\text{E}-05$	0.00519
HEAL	0.02988	0.00461	0.00519
IRRA	0.01817	0.00208	0.00519
KLBF	0.02764	0.00191	0.00519
MERK	0.01711	0.00519	0.00519
MIKA	0.01995	0.00058	0.00519
PRDA	0.03822	0.00086	0.00519
SAME	0.03060	0.00173	0.00519
SIDO	0.02937	0.00059	0.00519
SILO	0.27835	0.00011	0.00519

Based on Table 4, 9 stocks are selected as optimal portfolio candidates. Only 6 stocks were selected as the optimal portfolio, which are HEAL, IRRA, MERK, PRDA, SAME, and SILO. Proportion and weight of each stock in the optimal portfolio using the Single Index Model is calculated using equations (9) and (10).

Table 5: Proportions and Weights of Optimal Portfolio Stock

Stocks	Z_i	W_i
HEAL	2.27881	0.33411
IRRA	0.60989	0.08942
MERK	1.85188	0.27152
PRDA	0.63038	0.09242
SAME	0.63684	0.09337
SILO	0.81272	0.11916

Based on Table 5, the composition for the optimal portfolio are HEAL, IRRA, MERK, PRDA, SAME, and SILO with stock weights of 33.41%, 8.94%, 27.15%, 9.24%, 9.34%, and 11.92% respectively.

4. Calculation of Expected Return and Risk Value of The Optimal Portfolio

After forming the optimal portfolio, calculate the expected return and risk value of optimal portfolio using Single Index Model using equations (12) and (13).

Table 6: Expected Return and Risk Value of Optimal Portfolio

$E(R_p)$	σ_p^2
0.02677	0.01849

Based on Table 6, expected return value is 2.68% and risk value is 1.85% of optimal portfolio.

5. Conclusion

In this research, optimal portfolio in the health sector stock group formed with the Single Index Model (SIM) contains 6 stock combinations with the composition of IRRA, PRDA, SAME, SILO, MERK, and HEAL stocks respectively of 8.94%, 9.24%, 9.34%, 11.92%, 27.15%, and 33.41%. Expected return value of the optimal portfolio that has been formed with the Single Index Model (SIM) is 2.68% with a risk value of 1.85%.

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