

APPLYING THE MARKOWITZ MODEL FOR OPTIMAL STOCK PORTFOLIO CONSTRUCTION TO MAXIMIZE INVESTOR RETURNS IN THE STOCK MARKET

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Abstract: Increased investor interest in stocks that have sustainability principles (ESG), but price fluctuations that tend to be more stable in the IDX ESG Leaders index often make investors face challenges in obtaining optimal returns. Index IDX ESG Leaders itself consists of 30 stocks that have good Environmental, Social, and Governance (ESG) assessments, solid financial performance, and high liquidity. The results showed that the resulting optimal portfolio provided an expected return of 0.06% with a risk of 0.68%. This portfolio consists of 9 stocks, namely ASII (17.66%), BMRI (12.85%), BRPT (1.68%), CTRA (7.14%), ICBP (20.77%), POWR (29.39%), PRDA (3.76%), RAJA (3.17%), and SMSM (3.58%).

Keywords: Risk, Optimal Portfolio, Markowitz Model

INTRODUCTION

Introduction

Investment is a delay in current consumption to be put into productive assets during a certain period which is expected to increase satisfaction (Hartono, 2013). Investment is an activity of allocating funds or investing capital today in the hope of getting benefits in the future. Investment in the capital market has the aim of obtaining maximum profit from the investment made either by investing in stocks, bonds or other securities.

According to (Bodie Zvi et al., 2006) said that the main problem faced by investors is how to choose between various types of stocks to get the best stock portfolio. In deciding to invest in stocks, investors pay attention to two things, namely return and risk, which are important concepts in investment. The main principle in investment is low risk low return, high risk high return, namely if the risk of an investment is low, the resulting return tends to be low and vice versa, high risk, the resulting return will also be high. Markowitz (1950) introduced the concept of portfolio risk where he showed that in general risk may be reduced by combining several single securities into a portfolio.

A portfolio is a combination of physical assets or financial assets owned by investors. According to (Tatang Ary Gumanti, 2011), a portfolio is a combination of several assets owned by investors that have different levels of risk and balance. In portfolio theory, there are concepts of efficient portfolios and optimal portfolios. An efficient investment portfolio is defined as an investment portfolio that provides the maximum expected return with a certain

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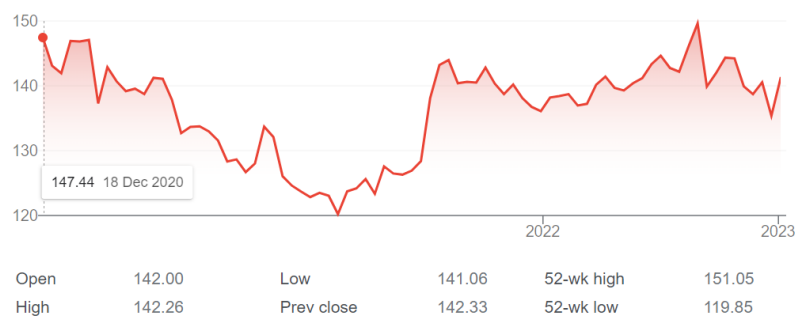
risk or minimum risk with a certain expected return. An optimal investment portfolio is to select various securities from an efficient investment portfolio.

In forming a portfolio, the problem will arise that there are many possible portfolios formed from a combination of risky assets available in the market. So if investors are rational, then they will choose the optimal portfolio (Hartono, 2013). The optimal portfolio is in efficient portfolios, so the determination of efficient portfolios is the most important thing that investors should pay attention to in determining the optimal portfolio.

The number of stocks listed on the stock exchange often makes investors confused in choosing good stocks to include in their portfolios. Therefore, the Indonesia Stock Exchange (IDX) created an index containing stocks of companies that have certain criteria to overcome the difficulties experienced by investors, namely the IDX ESG leaders index.

The IDX ESG Leaders index is an index containing 30 stocks with good ESG assessments. Where the focus of this index is to measure the price performance of a number of stocks that meet good Environmental, Social, and Governance (ESG) assessments, have never been involved in significant controversy, and have good transaction liquidity and financial performance.

Although it is filled with stocks of companies that have many advantages when compared to stocks of other companies, IDX ESG does not escape the ups and downs of returns. Price fluctuations in the IDX ESG stock group tend to be smooth, making the return from capital gains not as high as in the group of stocks that experience significant price fluctuations. This characteristic of IDX ESG stocks can represent the performance of a stock portfolio, where the assessment of portfolio performance is seen from two sides, namely yield and risk. Even so, there is still uncertainty about the returns received by investors, which can be seen from the fluctuations in the return of the IDX ESG Leaders Index shown in Figure 1.



Picture 1

IDX ESG Leaders Index Return Movement

Source: Processed secondary data (2024)

Portfolio formation using the Markowitz model is one of the most widely used approaches in portfolio selection (Harry Markowitz, 1959). An important contribution of Markowitz's teaching is that portfolio risk should not be calculated from the sum of all the risks of the assets in the portfolio, but should be calculated from the contribution of that asset's risk to portfolio risk (covariance). Covariance is an absolute measure that indicates the extent to which the returns of two securities in a portfolio tend to move together (Tandelilin, 2010). This model can help to calculate return and risk but requires calculations using covariance that are too complex especially when faced with a large number of securities.

Research Purposes

The general objective of this research is to obtain the results of the formation of an optimal portfolio of stocks in IDX ESG Leaders index companies listed on the Indonesia Stock Exchange using the Markowitz model.

Based on the research question above, the specific objectives of this study are as follows:

1. To find out what stocks can be candidates in the formation of the Optimal Portfolio on the IDX ESG Leaders index stocks on the Indonesia Stock Exchange using the Markowitz Model.
2. To analyze the formation of the optimal portfolio of stocks using the Markowitz Model on the ESG Leaders index.

LITERATURE REVIEW

1. Signaling Theory

Signal theory was first coined by Michael Spence in his research entitled Job Market Signalling in 1973. This theory involves two parties, namely the first party has a role as a party that provides signals such as management and the second or outside party has a role as receiving signals from the inside, namely investors. The urge to convey or provide information related to financial reports to external parties is based on the existence of information asymmetry between company management and external parties (Bergh D. D. et al., 2014).

Signal theory emphasizes the importance of information released by the company on investment decisions of parties outside the company. Information is an important element for investors and business people because information presents information, records or descriptions both for past, current and future circumstances for the survival of a company. Signal theory has a relationship with the research variables, namely if the stock market provides a good signal in the form of a good stock price or market price, then investors will also receive this good signal and will invest their funds in the capital market.

2. Investor Preference for Risk

The preference in question is the investor's attitude towards the risks faced when investing. According to (Tandelilin, 2010), investor preferences have 3 types, including;

1. Risk Seekers are investors who tend to dare to face risks. These investors tend to be aggressive, daring to take big risks to get big profits too.
2. Risk Neutral is an investor who is neutral to risk. Neutral means that investors do not take big or small risks, are not so afraid of big risks but want a safe investment.
3. Risk Aversion is an investor who tends not to dare to face risks. Investors who tend to be conservative, like safe and low-risk investment instruments.

3. Optimal Portfolio

The meaning of a portfolio is a combination or combination or a collection of assets, both in the form of real assets and financial assets owned by investors (Hartono, 2015). To avoid risk in an investment, among others, is done through stock diversification, which is managing a number of funds on various alternative investments that are negatively correlated by forming a portfolio. A stock portfolio is an investment consisting of various shares of

different companies with the hope that if the price of one of the shares decreases, while the others increase, the investment will not suffer losses (Zubir, 2011).

4. Markowitz Model Optimal Portfolio

The portfolio theory initiated by Markowitz explains about investing in different paths by splitting the funds owned by investors, so as not to focus on just one investment path. The separation of funds is done to reduce the level of risk that investors will bear in the future. In the evaluation stage, investors assess the performance of the portfolio, both in terms of the level of profit earned and the risk borne.

According to (Suad Husnan, 2009), it is not true that a portfolio that provides higher returns must be better than other portfolios. (Irham Fahmi, 2015) explains that “the Markowitz Model portfolio theory is based on the assumption that the investment period is single, there are no transaction costs, and the frequency of investors is only based on the expected returns and risks of the portfolio”. If an investor wishes to maximize the expected return of a portfolio, he will put his funds in securities that have maximum return expectations. Therefore, there is a recommendation that investors diversify and need to maximize the expected return.

Markowitz Portfolio Theory is based on the mean and variance approach, where the mean is a measurement of the level of return and variance is a measurement of the level of risk. Therefore, Markowitz portfolio theory is also known as the mean-variance model, which focuses on maximizing return and minimizing risk in forming the optimal portfolio. the calculation of portfolio expected returns using the Markowitz Model can use the following equation:

$$E(R_p) = \sum_{i=1}^n W_i \cdot E(R_i)$$

Description:

$E(R_p)$ = portfolio expected return

W_i = proportion of funds invested in stock i

$E(R_i)$ = expected return of stock i

RESEARCH METHODOLOGY

The objects in this study are companies listed on the IDX ESG Leaders index during the period 2017 to 2021, with the following criteria: (1) Companies in the IDX ESG Leaders that are listed on the Indonesia Stock Exchange during the 2017-2021 research period. (2) Companies in IDX ESG Leaders that publish annual financial reports during the 2017-2021 research period. (3) Companies in the IDX ESG Leaders were consistently included during the research period. (4) The data needed for research is available during the 2017-2021 period.

Determining the efficacy of stock-based portfolio management in the SRI-KEHATI index is the aim of this study. Using the Single Index Model and the Markowitz technique, this study will examine stock selection and the optimal approach for assembling a portfolio of SRI-KEHATI index equities between 2020 and 2023. The study will evaluate the portfolio risk and expected optimal returns of both methods in addition to determining the proportion of

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money invested in each stock. The secondary data utilized in this study came from <https://www.idx.co.id>, <https://id.investing.com>, and <https://www.bi.go.id>.

The variables used in forming the optimal portfolio are as follows:

1. Using the formula to determine each stock's return (Hartono, 2014).

$$R_i = \frac{P_t - (P_{t-1})}{(P_{t-1})} \dots \dots \dots (1)$$

Description:

R_i : i^{th} stock return
 P_t : current investment price
 P_{t-1} : last period investment price

2. Use the formula to get each stock's monthly projected return (Hartono, 2014)

$$E(R_i) = \frac{\sum_{t=1}^n R_{it}}{n} \dots \dots \dots (2)$$

Description:

$E(R_i)$: expected return value
 R_{it} : the i^{th} asset in the i^{th} period
 n : number of historical data observations for a sample of- n

3. Use the formula to determine each stock's variance and standard deviation (Hartono, 2014).

$$SD = \frac{\sum_{t=1}^n [R_{it} - E(R_i)]^2}{n} \dots \dots \dots (3)$$

Description:

SD : standard deviation
 R_{it} : the i^{th} asset in the i^{th} period
 $E(R_i)$: expected return value
 n : number of historical data observations for a sample of- n

$$\sigma_i^2 = SD_i^2 = \frac{\sum_{t=1}^n [R_{it} - E(R_i)]^2}{n} \dots \dots \dots (4)$$

Variance is the square of the standard deviation.

4. Figuring out the variation coefficient. Because expected return and asset risk are the two investing elements that need to be taken into account. Both elements may be taken into account using this correlation coefficient. Utilizing the formula for calculation:

$$CV_i = \frac{Risiko}{Return Ekspektasian} \dots \dots \dots (5)$$

Description:

CV_i : coefficient of variation for asset- i
 Risk : generally used standard deviation

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5. Use the formula to get the covariance between the shares of the sample firms (Hartono, 2014).

$$\sigma_{ij} = \frac{\sum_{t=1}^n [(R_{it} - E(R_i))(R_{jt} - E(R_j))]}{n} \dots\dots\dots(6)$$

Description:

σ_{ij} : return covariance between stock i and stock j
 R_{it} : return on stock i period t
 R_{jt} : return on stock j period t
 $E(R_i)$: expected return of stock i
 $E(R_j)$: expected return of stock j
n : number of observations from historical data for a sample of-n

6. Utilizing the method to determine the correlation between the shares of the sample firms (Hartono, 2014). The degree of movement association between each stock's two realized returns and each of its deviations is displayed by the correlation coefficient.

$$r_{AB} = \frac{Cov(R_A, R_B)}{\sigma_A \cdot \sigma_B} \dots\dots\dots(7)$$

7. Calculate the percentage of money that come from the stocks in the candidate portfolio. The Markowitz model-based portfolio risk function serves as the goal function. The optimization solution model is expressed as follows. The formula's objective function (Hartono, 2014).

$$\sigma_p^2 = \sum_{i=1}^n \sum_{j=1}^n W_i \cdot W_j \cdot \sigma_{ij} \dots\dots\dots(8)$$

8. Use Microsoft Excel's Excel Solver to calculate the return and risk. This program may be used to determine sample weights that will create an ideal portfolio.
9. Determine the ideal portfolio's risk and projected return. The same procedure used in the sixth-stage computation is used to calculate anticipated return and variance.

RESULTS AND ANALYSIS

The population of this research is go public companies listed on the IDX ESG Leaders, which are listed on the Indonesia Stock Exchange from 2017 to 2021. To form an optimal portfolio based on the Markowitz Model, the IDX ESG Leaders stock index uses secondary data consisting of stock prices, BI ratios, and the Composite Stock Price Index (CSPI) from daily time series data. There are 10 companies as the basis for the formation of the Markowitz Model optimal portfolio. The samples in this study are as follows:

Table 1

Research Sample

N o	Stock Name	Code
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1	PT. Astra International Tbk	ASII
2	PT. Bank Mandiri (Persero) Tbk	BMRI
3	PT. Barito Pasific Tbk	BRPT
4	PT. Ciputra Development Tbk	CTRA
5	PT. Dharma Polimetal Tbk	DRMA
6	PT. Indofood CBP Sukses Makmur Tbk	ICBP
7	PT. Cikarang Listrindo Tbk	POWR
8	PT. Prodia Widyahusada Tbk	PRDA
9	PT. Rukun Raharja Tbk	RAJA
10	PT. Selamat Sempurna Tbk	SMSM

Source: Processed secondary data (2024)

Based on table 2, the expected return on IDX ESG Leaders index stocks for the 2017-2021 period. Table 2 shows that there are 10 stocks that have a positive expected return value. There is a possibility that the issuer's shares can provide benefits for investors in the future. PT Dharma Polimetal Tbk (DRMA) is the stock with the largest expected return of 0.00440 or 0.440% and PT Astra International Tbk (ASII) is the stock with the lowest expected return of 0.00007 or 0.007%. The value of 0.440% to 0.007% indicates the level of return that investors will get per day.

Table 2

Rate of Return and Risk of Single Securities

No	Code	E(Ri)	σ_i
1	ASII	0,00007	0,01497
2	BMRI	0,00094	0,01501
3	BRPT	0,00313	0,03991
4	CTRA	0,00110	0,01925
5	DRMA	0,00440	0,03736
6	ICBP	0,00036	0,01563
7	POWR	0,00037	0,01112
8	PRDA	0,00020	0,02660
9	RAJA	0,00208	0,04074
10	SMSM	0,00138	0,02396

Source: Processed secondary data (2024)

Based on the 10 stocks included in the portfolio formation candidate, there are 90 combinations of stocks that have a positive covariance value, meaning that the two variables move in the same direction. Based on the calculation results of the IDX ESG Leaders index sample, it shows that all of its securities produce positive covariance numbers, which means they tend to move in the same direction.

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The correlation coefficient will show the extent of the return relationship between one security and another. Based on the calculation of the correlation coefficient of the IDX ESG Leaders Index sample, the entire sample is positively correlated, which means that it will not provide risk reduction benefits. The risk resulting from this merger is only a weighted average of the individual risks of the securities in the portfolio.

4.1. Markowitz Model Optimal Portfolio

The focus of this research is the smallest optimal risk portfolio in the Markowitz Model, known as the minimum variance portfolio, or MVP (Hartono, 2010). Investors with this behavior are known as risk averse, or investors who prefer to avoid risk. After knowing the expected value of covariance, correlation coefficient, and stock returns respectively shown in table 3, and the calculation of the proportion of funds is done using the Markowitz model. This calculation is done using the Microsoft Excel solver feature.

Based on table 3, the Markowitz model at the smallest risk preference forms 9 stock combinations and the largest proportion of funds in PT Cikarang Listrindo Tbk (POWR) of 29.39%. This number is identified as providing greater profit potential than other stocks. In addition, the smallest proportion of funds is in the shares of PT Barito Pacific Tbk (BRPT) of 1.68%. The mix of stocks that make up the optimal portfolio in table 5 produces the best return and risk based on the portfolio with the lowest level of risk with a certain return.

The expected return on the portfolio obtained by investors based on the combination of stocks in table 3 is 0.06%, with a portfolio risk level of 0.68%. The portfolio risk level is smaller than the risk of each stock in the research sample. Overall, the Markowitz Model's optimal portfolio assumption of least risk preference has been shown to provide the smallest level of risk with a given return.

Table 3

Fund Proportion, Expected Return, and Portfolio Risk using Markowitz Model based on Least Risk Preference

N o	Assets	Proportion	Return	Risk
1	ASII	17,66%	0,007%	1,497%
2	BMRI	12,85%	0,094%	1,501%
3	BRPT	1,68%	0,313%	3,991%
4	CTRA	7,14%	0,110%	1,925%
5	ICBP	20,77%	0,036%	1,563%
6	POWR	29,39%	0,037%	1,112%
7	PRDA	3,76%	0,020%	2,660%
8	RAJA	3,17%	0,208%	4,074%
9	SMSM	3,58%	0,138%	2,396%
Expected Return of Portfolio			0,06%	
Risk of Portfolio			0,68%	

Source: Processed secondary data (2024)

CONCLUSION

Based on the results of the optimal portfolio formation of the Markowitz model on the IDX ESG Leaders Index stocks that have been carried out, the following conclusions can be obtained:

1. The Markowitz model provides a portfolio expectation return of 0.06% and a risk of 0.68% formed from 9 stocks, namely ASII with a proportion of 17.66%, BMRI with a proportion of 12.85%, BRPT with a proportion of 1.68%, CTRA with a proportion of 7.14%, ICBP with a proportion of 20.77%, POWR with a proportion of 29.39%, PRDA with a proportion of 3.76%, RAJA with a proportion of 3.17% and SMSM with a proportion of 3.58%.
2. The optimal portfolio results with the Markowitz Model are not to forecast future returns and risks, but can be used for basic investor views in decision making and consideration of future portfolio formation. The optimal portfolio formation of the Markowitz Model has a different proportion.

This study has limitations arising from several things, namely research using only the model, namely the Markowitz Model without considering the existence of short sales, and the object of research only focuses on stocks included in companies that prioritize sustainability or ESG (Environmental, Social, and Governance) only.

Researchers believe that this research is not free from shortcomings, therefore future research is expected:

1. Add other models such as the Sharpe Model or continue to use the Markowitz Model and the Single Index Model by taking into account short sales, so that the portfolio formed is more varied and investors can have another point of view from other models.
2. Using different research objects, namely other than companies that prioritize sustainability or ESG (Environmental, Social, and Governance) for the period 2017-2021 because to find out the optimal portfolio formation in other instruments, such as mutual funds.

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