



Original Article

Optimal Portfolio Analysis Using The Markowitz Model

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Abstract:

The purpose of this study is to determine the optimal portfolio using the Markowitz model approach. Secondary data used in this study are in the form of a list of company stock prices on IDXBUMN20 and SRI-KEHATI on the Indonesia Stock Exchange. There are several research findings including the variance of stock returns between groups is not significantly different. There is no significant difference in variance between groups in stock risk data. There is no significant difference in the average stock return between the groups being compared. There was no significant difference in average stock risk between groups.

Keywords: Stock return variance, Stock risk

Introduction

One of the important foundations in a country's economy is the capital market. This is because the capital market has two important roles that can contribute, namely as a source of funding for businesses and as a means for companies to obtain additional business capital. After receiving an injection of funds, the capital funds can be used to support various business economic activities, expand businesses, and improve jobs. Furthermore, the capital market can also act as a liaison to introduce the importance of investing to the Indonesian people. There are several financial instruments that can be chosen for investing, such as bonds, mutual funds, and stocks (Felisiah & Natalia, 2023).

In recent years, the capital market in Indonesia has attracted the attention of many parties due to the increasing interest of investors in seeking alternative funding sources other than banking. A company can issue shares and sell them on the capital market to obtain funding sources without the obligation to pay fixed interest as in bank loans. The capital market can be an option for companies to obtain additional funds and also as an investment opportunity for investors. The capital market exists to unite the flow of funds from investors to companies that need funds to develop their business or improve their company's capital structure (Setyawan & Suwitho,



<https://jurnal.usk.ac.id/riwayat>

[2019](#)).

The capital market plays an important role in a country's economy because it fulfills two important functions, namely as a medium to support business activities and as a vehicle for companies to obtain funds from investors. Funds obtained from the capital market can be used to support business growth, expand reach, increase working capital, and other needs. The capital market provides opportunities for the public to invest in various financial instruments such as stocks, bonds, mutual funds, and so on. That way, people can allocate their funds according to the benefits and risks of each instrument ([Vinet & Zhedanov, 2019](#)). It is hoped that the existence of the capital market will encourage the growth of economic activity by providing additional funding options for companies. This allows companies to grow more widely, which will ultimately have a positive impact on the company's income and the welfare of society as a whole ([Rustiana & Ramadhani, 2022](#)).

Investments are made to get *returns* so they need to be calculated carefully. However, calculating *returns* alone is not enough because investments also involve risks that must be considered. In the world of investment, investors always try to reduce the risks that arise, both short-term and long-term risks. There are several factors that investors need to consider, such as stock prices, dividends, and economic situations that may change at any time. By applying the concept of optimal stock portfolio diversification, investors can reduce risk according to the desired level of profit or achieve the maximum level of profit according to the desired level of risk. ([Setyawan & Suwitho, 2019](#)).

As an investor, the main principle to remember in investing is that high *returns* will also provide a high level of risk and vice versa. Moreover, in stock investment which is one of the investments with a fairly high level of risk. The cause of the high risk of investing in stocks is when all the capital owned is invested in one stock so that the risk of loss cannot be avoided. For this reason, it is necessary to diversify (by forming an optimal stock portfolio) that in making investments, investors can invest their funds in many stocks so that if there is a loss in one stock, the profit from other stocks can cover it. The purpose of diversification is to minimize the level of unsystematic or non-eliminable risk ([Khudin Anam et al., 2021](#)).

A portfolio is a collection of investment opportunities in various stocks that are combined to obtain optimal *returns* with certain risks. With diversification, it is expected to reduce portfolio risk. The selection of stocks to form this portfolio with a combination and proportion of funds that can dominate if it is predicted to provide the same level of profit with lower risk or a higher level of profit with the same risk.

A portfolio is said to be efficient when it provides the greatest expected *return without increasing risk or offers the least risk without reducing the expected return*. An efficient portfolio is an important factor for investors when they make decisions about stock investments in the capital market. By having a good portfolio, investors can avoid the risk of buying stocks that have the potential to result in losses, both in the short and long term. An optimal portfolio is a portfolio choice chosen by an investor from the various choices available in a collection of efficient portfolios, in line with their preferences for the level of *return* and risk. The Markowitz model is a method of determining a portfolio that emphasizes the relationship between *return* and risk in stock investment. The Markowitz model is a superior choice compared to random diversification. The random diversification model believes that the more stocks are included in a portfolio, the greater the benefit in reducing risk. In contrast

to the Markowitz model which believes that adding many stocks to a portfolio will increase its risk level ([Setyawan & Suwitho, 2019](#)).

Several studies on optimal portfolios using the Markowitz Model as follows ([Khudin Anam et al., 2021](#)) revealed that the analysis of optimal portfolio formation using the Markowitz Model was able to produce 6 candidate stocks as components of the optimal portfolio. ([Dewi, 2021](#)) showed a balance between *return value* and risk level. ([Mahayani & Suarjaya, 2019](#)) said that the Markowitz Model was able to show which stocks were able to form an optimal portfolio.

Methods

The data sources obtained in this study are secondary data in the form of a list of company stock prices listed on IDXBUMN20 and SRI-KEHATI on the Indonesia Stock Exchange. The IDXBUMN20 index measures the price performance of 20 listed company stocks which are State-Owned Enterprises (BUMN), Regional-Owned Enterprises (BUMD), and their affiliates. And also the SRI-KEHATI index which consists of 25 stock indices, this is the result of cooperation between IDX and the KEHATI Foundation (Indonesian Biodiversity Foundation).

Determining the optimal portfolio using the steps of the Markowitz model with the help of the Solver program in Excel. The *Solver program* helps find the optimal stock weight for determining the optimal portfolio.

The homogeneity test is used to determine whether several variants of the data population are the same or not. This test is carried out as a prerequisite in the Independent Samples T Test analysis. Before the t test (independent t test) is carried out, a test of equality of variance (homogeneity) is carried out with the F test (*Levene's Test*), meaning that if the variants are the same, then the use of *Equal Variances Assumed* (assumed the same variants) and if the variants are different using *Equal Variances Not Assumed* (assumed different variants). The *Independent Sample T-Test* difference test in this study is to determine whether there is a difference between the optimal portfolio of IDXBUMN20 and SRI-KEHATI stocks.

Results

Homogeneity Test Results

The homogeneity test is used to determine whether several variants of the data population are the same or not. This test is carried out as a prerequisite in the Independent Samples T Test analysis. Before the t test (independent t test) is carried out, a test for equality of variance (homogeneity) is carried out with the F test (*Levene's Test*), meaning that if the variants are the same, then the use of *Equal Variances Assumed* (assumed the same variants) and if the variants are different using *Equal Variances Not Assumed* (assumed different variants).

Table 1

Test of Homogeneity of Variances

		Levene Statistic	df1	df2	Sig.
Return Saham	Based on Mean	4.025	1	18	0.060
	Based on Median	1.862	1	18	0.189
	Based on Median and with adjusted df	1.862	1	10.382	0.201
	Based on trimmed mean	3.568	1	18	0.075

The Levene test result for Stock Return shows Levene's statistical value based on the mean of 4.025 with degrees of freedom (df1=1, df2=18) and a significance value (p-value) of 0.060. Because this significance value is greater than 0.05, there is insufficient evidence to reject the null hypothesis stating that the variance between groups is the same or homogeneous.

In addition, tests based on median, median with adjusted df, and trimmed mean also produced p-values greater than 0.05 (0.189, 0.201, and 0.075 respectively), which strengthens the conclusion that the assumption of homogeneity of variance is met.

These results indicate that the variance of Stock Returns between groups is not significantly different, so that the assumption of homoscedasticity or equality of variance can be accepted and statistical analysis that requires homogeneity of variance, such as the t-test or ANOVA, can be performed with the validity of the assumption met. Meanwhile, the results of the stock risk homogeneity test between IDXBUMN20 and SRI-KEHATI can be seen in the following figure.

Table 2

Test of Homogeneity of Variances

		Levene Statistic	df1	df2	Sig.
Risiko Saham	Based on Mean	0.433	1	18	0.519
	Based on Median	0.351	1	18	0.561
	Based on Median and with adjusted df	0.351	1	17.519	0.561
	Based on trimmed mean	0.432	1	18	0.519

Based on the results of the homogeneity of variance test (Levene's Test) on the Stock Risk variable, a fairly high significance value (Sig.) was obtained in all testing methods, namely 0.519 based on the mean, 0.561 based on the median, 0.561 based on the median with degrees of freedom adjustment, and 0.519 based on the trimmed mean. All of these significance values are far above the threshold of 0.05. This indicates that there is no significant difference in variance between groups in the Stock Risk data tested. Thus, it can be concluded that the Stock Risk variance between groups is homogeneous or uniform.

Hypothesis Test Results

The purpose of hypothesis testing with *the Independent Sample T-Test* in this study is to determine whether there is a difference between the optimal portfolio of IDXBUMN20 and SRI-KEHATI shares.

The basis for making a decision to accept or reject the Ho test in *the Independent Sample T-Test* is as follows:

- If the P value (sig) < 0.05 then Ho is rejected and Ha is accepted.
- If the P value (sig) > 0.05 then Ho is accepted and Ha is rejected.

The following are the results of the hypothesis test between the 2 stock indexes IDXBUMN20 and SRI-KEHATI:

Table 3
Results of Hypothesis Test of IDXBUMN20 and SRI-KEHATI Stocks

Statistical Test	Statistical Values	Sig. (p-value)	Conclusion
Levene's Test Stock Return	F = 4.025	0.060	There is no significant difference
t-test (Equal variances assumed)	t = 1.765	0.094	Variance between homogeneous groups
t- test(Equal variances not assumed)	t = 1.765	0.102	There is no significant difference
Mean Difference Stock Return	0.006		The difference in average stock returns between groups
Confidence Interval (95%)	-0.001 to 0.014		The average difference is not significant

The Levene's Test result on Stock Returns shows a significance value of 0.060, which means that the variance between groups can be considered homogeneous or uniform. The t-test (Independent Samples t-test) for Stock Returns, both assuming equal and unequal variances, produces significance values of 0.094 and 0.102, both of which are greater than 0.05. This indicates that there is no significant difference in the average stock return between the groups being compared. The difference in the average stock return between groups is 0.006, with a 95% confidence interval between -0.001 to 0.014, which includes the value of zero, so the difference is not statistically significant.

Table 4
Results of Hypothesis Test of IDXBUMN20 and SRI-KEHATI Stocks

Statistical Test	Statistical Values	Sig. (p-value)	Conclusion
Levene's Test Stock Return	F = 0.433	0.519	There is no significant difference
t-test (Equal variances assumed)	t = 1.142	0.268	Variance between homogeneous groups
t- test (Equal variances not assumed)	t = 1.142	0.269	There is no significant difference
Mean Difference Stock Return	0.007		The average difference in stock risk between groups
Confidence Interval (95%)	-0.006 to 0.020		The average difference is not significant

Levene's Test results show a significance value of 0.519, indicating that the variance of stock risk between groups is homogeneous or uniform. The t-test (Independent Samples t-test) for Stock Risk, both assuming equal and unequal variances, produces significance values of 0.268 and 0.269, both of which are greater than 0.05. This indicates that there is no significant difference in the average stock risk between the groups being compared. The difference in the average stock risk between groups is 0.007, with a 95% confidence interval between -0.006 and 0.020, which includes the value of zero, so the difference is not statistically significant.

Conclusion

Based on the results of the analysis of optimal portfolio formation data using the Markowitz model on the IDXBUMN20 and SRI-KEHATI stock indices on the Indonesia Stock Exchange in the 2021-2023 annual period, it can be concluded:

1. The analysis of optimal portfolio formation using the Markowitz model only produces 1 candidate stock each from the IDXBUMN20 index, namely Aneka Tambang (Persero) Tbk (ANTM) and Bank Mandiri (Persero) Tbk (BMRI) from the SRI-KEHATI index. Both optimal portfolios have a weight of 100% because these stocks are considered the most efficient in terms of *risk-return* according to the data and parameters used.
2. The variance of stock *returns* between groups does not differ significantly, so the assumption of homoscedasticity or equality of variance can be accepted and statistical analysis that requires homogeneity of variance, such as the t-test or ANOVA, can be performed with the validity of the assumption met.
3. Based on the results of the homogeneity of variance test (Levene's Test) on the Stock Risk variable, a fairly high significance value (Sig.) was obtained in all testing methods. This indicates that there is no significant difference in variance between groups in the stock risk data tested.
4. The t-test (Independent Samples t-test) for stock *returns* showed no significant difference in average stock returns between the groups being compared.
5. The Independent Samples t-test (T-test) for stock risk showed no significant difference in average stock risk between the groups being compared.

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