Optimal Portfolio Formation Analysis vs. Single Index Model: 2018–2019 Before Crisis and 2020–21 During Crisis

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A B S T R A C T

This paper focuses on a portfolio comparison analysis between 30 leading board stocks and 30 development board stocks selected from the Indonesia Stock Exchange (IDX). The analysis used in this study is the single index model. The periods used in this study are 2018-2019 (before the crisis) and 2020-2021 (during the crisis). The research results concluded that the Development Board stock group generated a higher portfolio return compared to the Main Board stock group, both in the 2018-2019 period (before the crisis) and in the 2020-2021 period (during the crisis). However, even though it produces a higher portfolio return, the Development Board stock group also has a higher level of portfolio risk compared to the Main Board stock group.

A B S T R A K

Penelitian ini berfokus pada analisis perbandingan portofolio antara 30 saham papan utama dan 30 saham papan pengembangan yang dipilih dari Bursa Efek Indonesia (BEI). Analisis yang digunakan dalam penelitian ini adalah model indeks tunggal. Periode yang digunakan dalam penelitian ini adalah tahun 2018-2019 (sebelum krisis) dan tahun 2020-2021 (selama krisis). Hasil penelitian menyimpulkan bahwa kelompok saham Papan Pengembangan menghasilkan return portofolio yang lebih tinggi dibandingkan dengan kelompok saham Papan Utama, baik pada periode 2018-2019 (sebelum krisis) maupun pada periode 2020-2021 (saat krisis). Namun, meskipun menghasilkan return portofolio yang lebih tinggi, kelompok saham Papan Pengembangan juga memiliki tingkat risiko portofolio yang lebih tinggi dibandingkan dengan kelompok saham Papan Utama.

INTRODUCTION

According to Ahmad and Kamaruddin in 2004, investment refers to goods or assets owned to gain profit or increase value. The concept of investment in the economic field is defined as the purchase of goods that are not used at this time but are used in the future to enrich oneself. In finance, investment is used to obtain financial benefits in the future, either from income or from the sale of assets with a higher value. Thus, investment can be referred to as a form of goods or assets acquired or purchased to obtain profits in the future.

Stocks are one of the most popular investment alternatives because stocks can provide benefits in the form of dividends and capital gains. According to (Jabar & Cahyadi, 2020), Shares are a unit of ownership in a company or financial asset. Shares are a part of the exchangeable value of a company that can fluctuate up or down depending on several different market factors. The company divides the capital into shares as a means of raising capital. In stock investment, the profit

investors receive, called the return, is divided into expected and realized returns. However, apart from providing returns, stocks also contain risks that investors must bear.

Based on information from Bank Indonesia (bi.go.id) economic growth in Indonesia in 2018 was 5.17%. This is the highest growth rate since 2013. Indonesia's increased economic growth in 2018 was largely supported by domestic demand. Consumption and investment growth increased on the back of improved incomes, continued development of infrastructure projects, and maintained purchasing power in line with low inflationary pressures.
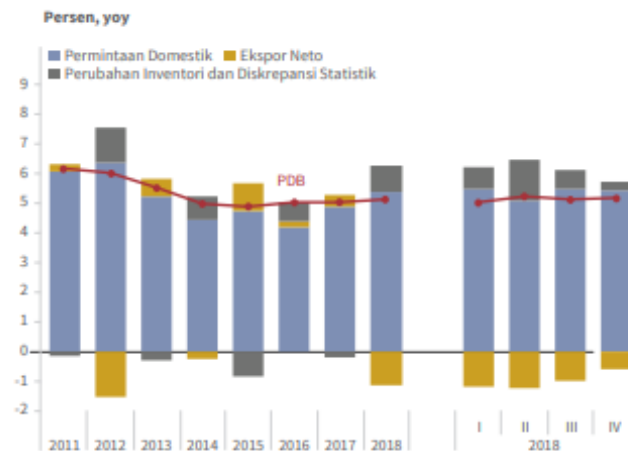
Picture of Indonesia's Economic Growth
Source: Bank Indonesia

According to data from the Central Statistics Agency (BPS), Indonesia's economic growth rate will slow to -2.07% in 2020, which means that the Indonesian economy will experience deflation or a sharp decline in 2020 due to developments in the Indonesian economy. The COVID-19 pandemic has contributed to this change. This also affects the stock prices of companies. Based on data from IDX.co.id at the end of 2020, the JCI fell -5.09% compared to 30 December 2019. Specifically, this weakening was caused by a decrease in the LQ45 index of 7.85%, the JCI 30 of 9.31%, and IDX 80 of 5.70%.

As the above, return and risk have a unidirectional relationship, but this risk can be minimized by diversifying. Portfolio risk diversification can result in a portfolio risk that is lower than the risk of each stock. Diversification can be done by forming an optimal portfolio. One method that can be used in compiling an investment portfolio is the single index model method. The calculation of the Single index model is based on observing market prices that fluctuate in the direction of the market index. The Single index model was chosen because the calculation is more straightforward; besides that, the Single index model can also be used to calculate expected return and portfolio risk.

Based on data from IDX.co.id, a list of listed companies listed on the IDX Main Board of 355 (three hundred fifty-five) listed companies and 374 (three hundred seventy-four) listed on the Development Board. After compiling the population, there are a total of the top 30 trading stocks listed on the Main Board and the top 30 on the Development Board.

Based on the description above, the researcher is interested in researching investments, especially investments made in the form of shares. The Single Index Model is the method chosen to determine the optimal portfolio, formed from stocks listed on the IDX and included in the comparison of the Main Board and Development Board stock groups for the period 2018-2019 (before the crisis) and 2020-2021 (during the crisis).

Investment is the act of investing funds to obtain positive results in the future, as defined by several economists. (Matiin, 2020) explains that investment involves the commitment of funds in a certain period with the aim of obtaining expected income in the future. In this context, (Meidiawati & Mildawati, 2016) also points out that investment involves the use of funds to increase the wealth of the company. Investment can also mean buying goods with the aim of increasing capital. However, every investment is inseparable from risk. (Jogiyanto, 2003) defines risk as fluctuations that affect expected earnings. There are two types of risk described by Jogiyanto: systematic risk and unsystematic risk. This risk arises due to the uncertainty of the expected returns. Therefore, the amount of risk can affect the rate of return on investment, which is divided into realised return and expected return.

In the context of investment, portfolio formation plays an important role. A portfolio is a combination of various types of investments that aim to optimise returns and reduce overall risk. Tandelilin (Tandelilin, 2010) mentions that diversification in a portfolio helps achieve this goal. Through diversification, investors can minimise risk by allocating funds to different types of assets.

The Single Index Model is one approach in investment analysis that states that changes in security prices are related to changes in the market price index. This model was first developed by William Sharpe in 1963 and helps in calculating the expected return and risk of a portfolio, as explained by Burgess and Bey in 1988. Overall, an understanding of investment, risk, return, portfolio formation, and analytical models such as the Single Index Model are interrelated and important in making smart and effective investment decisions.

RESEARCH METHODS

This research is located in Indonesia and uses secondary company data that is quantitative, such as stock prices (Ri), market index prices (Rm), and risk-free interest rates (Rf) obtained from the internet and various other capital market reference centers for 2018-2019 (before the crisis) and 2020-2021 (during the crisis). Secondary data is obtained from the second party and usually has undergone processing (Timotius, 2017). At the same time, quantitative research collects data using many numbers along with tables, graphs, pictures, and others whose size can be determined (Amaratunga et al., 2002). The population in this study are all companies that are consistently listed on the Main Board and Development Board of the Indonesian Stock Exchange (IDX) during the 2018-2019 period (before the crisis) and 2020-2021 (during the crisis).

Stock Returns and Market Parameters Calculation:

In this study, various formulas are employed to compute market and stock variables to determine the optimal portfolio. The chosen method is the single index model. To calculate individual stock returns, the formula used is (Nugroho, 2018):

$$R_{i=}\frac{P_t-P_{t-1}}{P_{t-1}}$$

Here, R_i represents the rate of return on stock i at observation t, Pt is the stock price at observation t, and P_{t-1} is the stock price at the previous observation. It's important to note that this return calculation excludes dividends and adjusted closing prices due to their assumed insignificance.

Market parameters, namely returns and risks from the Indonesia Stock Exchange, are calculated using the formula (Nugroho, 2018):

$$R_{mt=}\frac{IHSG_t-IHSG_{t-1}}{IHSG_{t-1}}$$

Where R_{mt} represents the market return, $IHSG_t$ is the current IHSG, and $IHSG_{t-1}$ is the IHSG from the previous period.

Risk-Free Rate Calculation:

The risk-free rate R_f is calculated involving the one-month time deposit interest rate at a government-managed bank (Weil, 1989). This specific deposit type is chosen due to its minimal risk compared to other forms of deposits. The study uses interest rate data from January 2018 to December 2021. The average one-month time deposit interest rates per year are computed as follows:

$$R_f/year = \frac{\sum_{t=1}^{N} R_f}{N}$$

Subsequently, the yearly average is converted into monthly interest rates: $R_f/month=R_f/24$.

Return and Risk of Shares Calculation:

The average return and risk of shares are calculated using the formulas:

$$\overline{R_i} = \frac{\sum_{t=1}^{N} R_t}{n}$$

$$\sigma_1^2 = \frac{\sum_{I=1}^{N}(R_I - \overline{R_i})}{n-1}$$

Results from this regression analysis include constants (ai), standard error estimates for Y or X, R-squared (R2) values, and other relevant coefficients.

The covariance of stocks with the market, reflecting the relationship between stock and market returns, is calculated as:

$$R_t = \alpha_t - \beta_i R_{nt}$$

The results of the calculation of the regression during the observation period are:

Constanta (ai), which is a constant value, The standard error at Y estimate is the standard error at estimate Y or X, R Squared (R2) or coefficient determination, The amount of observation in this case is 24 observations, Degree of freedom is a degree of freedom whose magnitude is (N-2) or 22 observations, X coefficient (s) is the magnitude of the coefficient Bi, The standard error at coefficient is the standard deviation of Bi, and What is used for further data processing are

constants and X coefficients.

Calculating the covariance of stocks with the market which reflects the relationship between stock returns and market returns.

$$\sigma im = \frac{\sum_t^n (R_I - \overline{R_i})(R_m - \overline{R_m})}{n - 1}$$

To calculate the systematic risk of stocks, the beta coefficient (β) formula is used, which is defined as follows:

$$\beta_i = \frac{\sum_{t=1}^n (R_I - \overline{R_i})(R_m - \overline{R_m})}{\sum (R_m - \overline{R_m})}$$

Where R_i is the stock return, R_m is the market return, and $\overline{R_i}$ and $\overline{R_m}$ are the average returns respectively. The denominator in the formula is the sum of the covariances between the market return and its average. The result β reflects the extent to which stock returns respond to overall market movements.

Then, the stock return variance σ_i^2 is obtained by combining the square of β, the market return variance σ_m^2, and the unsystematic risk, σ_{ei}^2 as per the following formula

$$\sigma_i^2 = \beta_i^2 \sigma_m^2 + \sigma_{ei}^2$$

Calculating the amount of unsystematic risk with the following formula:

$$\sigma_{ei}^2 = \sigma_t^2 + \beta_t^2 \sigma_m^2$$

The next step is to calculate the Excess Return to Beta (ERB) to assess the relationship between returns and systematic risk on stocks. The ERB value is calculated with the following formula (Faisol et al., 2023):

$$ERB_{i=} \frac{E(R_i) - R_f}{\beta_i}$$

These ERB results are used to rank the stocks from those with the highest positive ERB to the lowest, reflecting stocks with favorable returns relative to their risk.

The stock cut-off point (Ci) used in optimal portfolio selection is determined by the formula (Silalahi et al., 2022):

$$C_{i=} \frac{\sigma_m^2 . \sum_{j=1}^1 Aj}{1 + \sigma_m^2 . \sum_{j=1}^1 Bj}$$

Finally, to calculate the scale share (Zi), the following formula is used:
If ERB > Ci, then it is included in the optimal portfolio
If ERB < Ci, then it is not included in the optimal portfolio
Determines the proportion of unique Cut-Off Point (Ci*), ie optimal Ci.
Calculating the stock scale scale (Zi) with the following formula:

$$Z_t = \frac{\beta_t}{\sigma_{ei}^2}\left[\frac{\overline{R_1} - R_f}{\beta_t}\right] - C^*$$

Where β_t is the stock's beta coefficient, σ_{ei}^2 is unsystematic risk, $\overline{R_1}$ is the first average return, R_f is the risk-free interest rate, and C* is a constant.

Determine the proportion of funds for the optimal portfolio (Xi) with the following formula:

$$X_{i=} \frac{Z_i}{\sum_{j=1}^{N} Zj}$$

In order to compare the sample groups, the portfolio return (IDR) was used as a comparison parameter. The meaning of the symbols or symbols used in the formulas are as follows:

$\overline{R_m}$	: Expected Return Market
R_m	: Market Returns
N	: Period
σ_1^2	: Market Variance
$\overline{R_i}$	: Market Mean Return
R_i	: Stock returns
σ_i^2	: Stock Variance
σim	: Covariance of Stock Return with Stock Return
β_i	: Systematic Risk
σ_{ei}^2	: Unsystematic risk
ERB	: Excess Return to Beta
Rf	: Risk Free Rate
Ci	: Cut-off Point
C*	: Unique Cut-off Point
Zi	: Scale of Stock Scales
Zj	: Total Scale of Stock Scales
Xi	: Proportion of Funds

RESULTS AND DISCUSSION

Results

The following is a calculation of the optimal return and risk level of the Main Board stock portfolio for 2018-2019.

Table 1 Main Board Stock Optimal Portfolio Return and Risk Rate Period 2018-2019

No.	STOCK	X_i	R_i	β_i	X_iR_i	$X_i\beta_i$
1	BPTS	48.67%	0.0585	0.2680	0.0285	0.1304
2	BRPT	12.16%	0.0599	0.7298	0.0073	0.0887
3	CPIN	12.13%	0.0374	0.8365	0.0045	0.1015
4	MAPA	2.10%	0.0226	0.5462	0.0005	0.0115
5	CMNP	2.70%	0.0114	0.3560	0.0003	0.0096
6	CEKA	2.41%	0.0186	0.9386	0.0004	0.0226
7	BBCA	15.65%	0.0186	1.0209	0.0029	0.1598
8	BNLI	2.35%	0.0437	3.3726	0.0010	0.0794
9	BTPN	1.83%	0.0172	1.3569	0.0003	0.0249
				Total	0.0458	0.6284

From Table 1, the higher the return generated from a stock, the greater the level of risk it faces. Conversely, the lower the risk a stock faces, the smaller the return it will generate. In forming a portfolio of nine Main Board group stocks for 2018-2019, a portfolio return of 0.0458 was obtained

with a beta level of 0.6284.

The following is a calculation of the optimal level of return and risk for the Main Board stock portfolio for the 2020-2021 period.

Table 2 Main Board Stock Optimal Portfolio Return and Risk RatePeriod 2020-2021

No.	STOCK	X_i	$\overline{R_i}$	β_i	$X\overline{R_i}$	$X_i\beta_i$
1	CILO	11.75%	0.0195	0.0823	0.0023	0.1304
2	CYTY	10.57%	0.0627	0.3765	0.0066	0.0388
3	BUDI	23.27%	0.0314	0.5775	0.0073	0.1344
4	MDKA	40.43%	0.0645	1.3809	0.0061	0.5582
5	BVIC	8.62%	0.0729	2.0764	0.0063	0.1789
6	CMNP	4.37%	0.0188	0.7948	0.0008	0.0347
7	BNLI	1.00%	0.0227	1.6293	0.0002	0.0163
				Total	0.0496	0.970

From the results of Table 2 above, the higher the return generated from a stock, the greater the level of risk and vice versa. Forming a portfolio of the 7 (seven) shares of the Main Board group for the 2020-2021 period resulted in a portfolio return of 0.0496 with a beta level of 0.9720.

As for the results of calculating the optimal portfolio return and risk levels for the development board stock group, it can be seen in the table below:

Table 3 Optimal Portfolio of Return and Risk of Development Board Stocks Period 2018-2019

No.	STOCK	X_i	$\overline{R_i}$	β_i	$X\overline{R_i}$	$X_i\beta_i$
1	ARTO	10.09%	0.2506	1.5959	0.0253	0.1611
2	POLL	16.68%	0.1961	1.4712	0.0372	0.2453
3	ETWA	7.78%	0.0088	0.0665	0.0007	0.0052
4	TPIA	46.82%	0.0293	0.3762	0.0137	0.1761
5	MPRO	8.24%	0.1532	5.9562	0.0126	0.4906
6	TCPI	10.39%	0.0802	3.7914	0.0083	0.3939
				Total	0.0933	1.4722

From result 3, it is shown that forming a portfolio of the six stocks in the development board group produces a portfolio return of 0.0933 with a beta level of 1.4722. Among the six stocks, the highest return is ARTO, which is 0.2506, with a significant level of risk. Compared to other stocks.

The following is a calculation of the optimal level of return and risk for the Development Board stock portfolio for the 2020-2021 period.

Table 4 Optimal Portfolio of Return and Risk of Development Board Stocks Period 2020-2021

No.	STOCK	X_i	$\overline{R_i}$	β_i	$X\overline{R_i}$	$X_i\beta_i$
1	RANC	9.38%	0.1099	0.8516	0.0103	0.0799
2	CASA	19.68%	0.0124	0.0844	0.0024	0.0165
3	BULL	13.53%	0.0236	0.2195	0.0032	0.0297
4	MDKA	23.34%	0.0645	1.3809	0.0151	0.3223
5	ARTO	8.59%	0.1345	3.0993	0.0116	0.2663
6	ASSO	11.58%	0.0869	2.3391	0.0101	0.2709

7	TCPI	10.39%	0.0260	0.7182	0.0026	0.0724
8	ABMM	0.89%	0.0060	0.1140	0.0010	0.0010
9	AISA	2.99%	0.0201	0.8576	0.0006	0.0256
				Total	0.0559	1.0848

Table 4 shows that forming a portfolio of nine stocks in the Development Board group for 2020-2021 resulted in a portfolio return of 0.0559 with a beta level of 1.0848.

Discussion

Forming an optimal portfolio is expected to provide optimal investment returns for investors. The portfolio can provide higher returns with risks that remain controlled or with the same level of returns but lower risks.

Based on calculations for the 2018-2019 period, it can be concluded that the stock groups that fall into the Main Board category have a portfolio return rate of 0.0458 with a risk level of 0.6284. Meanwhile, for the Development Board stock group for the same period, the resulting portfolio return rate was higher, namely 0.0933, but with a higher risk, namely 1.4722. Based on the calculation results for the 2020-2021 period, it can be revealed that the group of stocks included in the Main Board category shows a portfolio return rate of 0.0496 with a risk of 0.9720. The Development Board stock group's portfolio return rate is 0.0559, with a higher risk of 1.0848.

After calculating the portfolio return rate for each group of stocks, information was obtained that the Development Board stock group produced a higher portfolio return rate compared to the Main Board stock group, both in the pre-crisis period, namely 2018-2019, and during the crisis period in 2020 -2021. In addition, in the pre-crisis period in 2018-2019, the Development Board stock group showed higher portfolio returns than during the crisis in 2019-2020.

Thus, the Development Board stock group generated a higher portfolio return than the Papan Main stock group. In contrast, in the pre-crisis period in 2018-2019, the Development Board stock group showed a higher portfolio return rate than during the crisis in 2020-2021. However, even though it produces a higher portfolio return, the Development Board stock group also has a higher portfolio risk than the Main Board stock group.

CONCLUSION

Investing in the optimal portfolio from the Development Board stock group is more profitable than investing in the optimal portfolio from the Main Board stock group because the optimal portfolio from the Development Board stock group provides a higher return. This happened because the share prices of the Development Board group companies were more volatile due to investors' profit-taking practices.

For further research, in the criteria for selecting stocks to be taken as the formation of a stock portfolio, other criteria can be used, for example, by combining the most active stocks with the performance of each of these stocks.

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