

Establishment of an Optimal Portfolio with The Markowitz Model and Single Index Model

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Abstract

This study aims to find out how much expected return and optimal portfolio risk and the best model between the Markowitz model and the single index model in forming optimal portfolios in banking sub-sector companies for the 2018-2022 period. This type of research includes applied quantitative descriptive. The research data uses secondary data in the form of stock closing prices, JCI and monthly BIC interest rates. The survey population is 29 companies. Data analysis uses the Markowitz model and single index model. The results showed that the stocks that make up the optimal portfolio with the Markowitz model are 12 company stocks that provide an expected return of 1.41%, an absolute risk of 4.48%, and a relative risk of 318.96%. While the single index model consists of 10 company stocks that provide an expected return of 4.65%, an absolute risk of 10.21%, and a relative risk of 219.68%. The research results are expected to contribute to investors, that the single index model is better than the Markowitz model.

Keywords: Optimal Portfolio, Efficient Portfolio Set, Portfolio Opportunity Set, Composite Stock Price Index, Risk Free Assets.

1. Introduction

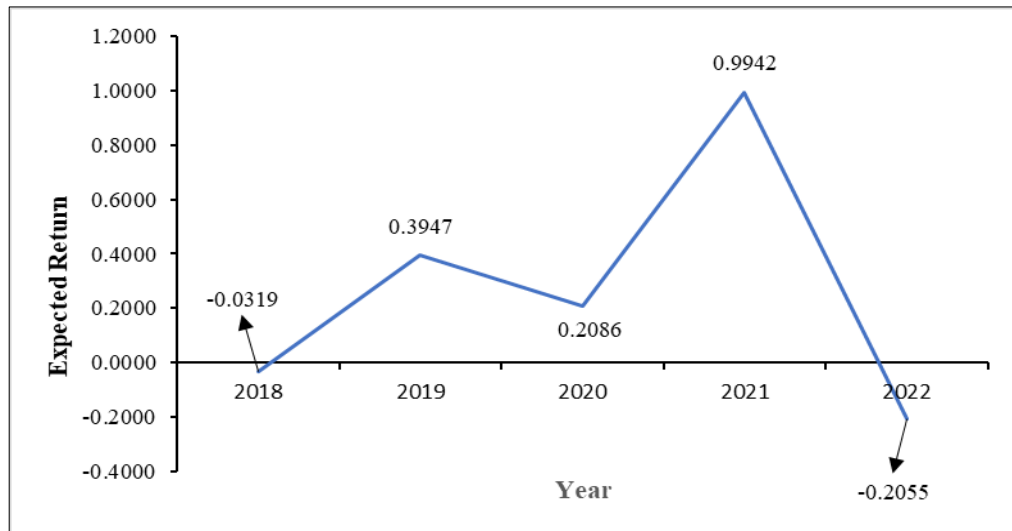
In the last five years, research on optimal portfolio formation has attracted the attention of experts, especially in the field of financial management. In general, research regarding the formation of an optimal portfolio is analyzed using the Markowitz Mahayani & Suarjaya, (2019), Hasbiah et al, (2022) and using the single index model (Fitriyani & Yunianingsih, 2020) (Rae et al., 2021), Fitriyani, N. & Yuniningsih, Y., 2020, Putra *et al*, 2021, Ismawati *et al*, 2022). Some even compare the two models (Putra & Dana, 2020, Nurdianingsih & Suryadi, 2021, Agustin *et al*, 2022, Arifin & Mutasowifin, 2022).

The optimal portfolio was initially developed by H. Markowitz (1952), then simplified by W. Sharpe (1963) due to limitations in real world application. The formation of an optimal portfolio requires a set of opportunities and an efficient portfolio set (Hartono, 2017). An opportunity set is a collection of all asset or investment combinations available to an investor with different expected returns and risks. However, the set of efficient portfolios is a collection of efficient portfolios. Efficient portfolios are not the best choice. The best portfolio is the optimal portfolio. Investors tend to look for optimal portfolios from a set of efficient portfolios that match their goals and risk tolerance. Selection of this optimal portfolio is an important step in achieving financial goals and optimizing investment returns (Hartono, 2017).

As time goes by, the number of companies listed on the Indonesia Stock Exchange (IDX) is increasing, so that it is difficult for investors to get stocks that will be optimal candidate portfolios, so IDX classifies the number of companies into eleven sectors, including the financial sector. There are five financial sub-sectors and based on these five sub-sectors, it is the banking sub-sector that has a higher contribution in terms of stock

investment because the operation of this sub-sector is closely related to the macroeconomic sector in Indonesia (Nur et al., 2016). In addition, Frankie revealed that the performance of the banking sub-sector companies in 2020 decreased along with the spread of Covid-19. However, it has a huge opportunity to wake up faster when the economy enters a recovery period (Sudarwan, 2020). Therefore, the banking sub-sector makes a good choice among sub-sectors in other industrial sectors that have large capitalization values. This condition is shown in Figure 1.

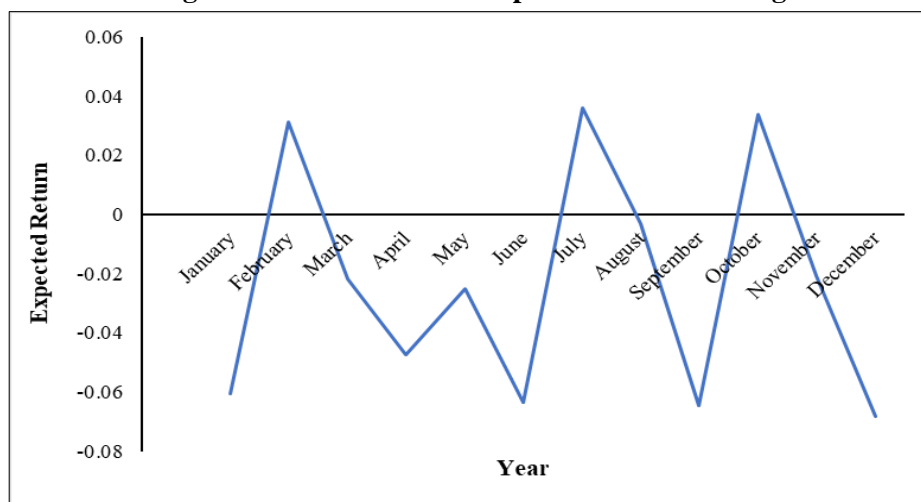
Figure 1. The expected return on shares of issuers



Source: Yahoo finance.com 2018 -2022 processed data.

Figure 1 above shows that the expected return on shares of issuers in the banking sub-sector in 2022 has decreased significantly. In 2018 it had an expected return of -0.0456, then in 2019 it experienced an increase in expected return to 0.4113, then in 2020 it decreased to 0.1540. In 2021 there was the highest increase to 0.8107 and in 2022 there was a very sharp decline to -0.1968. Meanwhile, the movement of monthly expected returns from shares of issuers in the banking sub-sector in 2022 is shown in Figure 2.

Figure 2 the movement of expected returns during 2022



Source: Yahoo finance.com 2018 -2022 processed data.

Figure 2 shows a graph of the movement of expected returns during 2022. In January, expected returns were at -0.0557, then in February they rose to 0.0245, then in March they

fell to -0.0206 and in April they fell again to -0.0470. In May it rose to -0.0245 then in June it fell again to -0.0616 and in July there was the highest increase to 0.0340. In August it fell again to -0.0064 then in September the decline increased to -0.0504 and in October it rose to 0.0320. In November there was a decrease to -0.0098 and in December there was a decrease again to -0.0757. So the monthly expected return of banking sub-sector companies will fluctuate throughout 2022. The steepest decline will occur in December 2022. This indicates that there is an element of investment risk, so investors must be more preventive in making investment decisions.

The magnitude of the risk of investing in individual stocks, possibly because investors fully allocate their funds to certain stocks only, so that unsystematic risk cannot be eliminated. Therefore, it is necessary to diversify with the aim of covering the capital losses of one share with the capital gains of another share. The basic concept of diversification is "Don't put several eggs in one basket". This statement is in accordance with the opinion of Latulanit et al, (2018) which explains that diversification aims to eliminate unsystematic risk.

This research is also motivated by the contradiction of previous research findings. The research results of Putra & Dana, (2020) regarding the optimal portfolio comparison between the Markowitz model and the single index model on the LQ-45 Index explain that the single index model has superior performance, because the expected return is greater with low risk. Arifin & Mutasowifin, (2022) also prove that the single index model is superior.

Meanwhile, the research results of Agustin et al, (2022) explain that the Markowitz model is superior to the single index model. In addition, the results of this research are supported by Nurdianingsih & Suryadi, (2021) who state that the Markowitz model is superior to the single index model.

Based on these two gaps, the problem statement of this research is indicated by the inconsistency of business phenomena in the form of realized returns received by investors, as well as the inconsistency of the results of previous research, so the purpose of this study is to determine the expected return and risk of the Markowitz model portfolio, and the single index model and compare which model is the best in between the Markowitz model and the single index model.

2. Literature Review

1) Investment Theory

Investment refers to actions or activities of investing capital or other resources that are expected to provide returns in the future (Tandelilin, 2001). Meanwhile, Suroto, (2019) gives the meaning that investment is the process of managing funds or allocating funds now to obtain results or benefits at a later time. Thus, investment is a process of managing funds or allocating funds now in the hope of obtaining greater benefits in the future.

According to Nuralfira & Onoy, (2021), there are various types of investments available to investors, namely:

- a. Investment in real assets, namely assets that have a physical form and have a value with their physical properties, such as land, buildings, gold and the like. The characteristics of investing in real assets are that information is obtained directly because the investment object can be seen clearly.

- b. Investment in financial assets, namely assets that have no form but still have a high value, such as bonds and stocks. One of the most popular financial asset investments is stocks. Shares can be interpreted as proof of participation or ownership of a person or entity in a company.

There are two categories of shares, namely:

- a. Ordinary shares. Ordinary shares are certificates or charters that serve as proof of ownership of the company and all-important aspects of the company. The company will provide income to shareholders in the form of dividends and shareholders must also participate in bearing the risks that the company may suffer in the future.
- b. Preference shares. Preference shares are shares that give their owners more rights than the rights held by common stockholders. Preferred stockholders have more rights than common stockholders.

The investment decision process includes five stages that must be carried out to make investment decisions, namely (Husnan, 2015): Determine the investment policy, Analyzing securities, Portfolio formation, Revise the portfolio, and Evaluation of portfolio performance.

2) Portfolio Theory

Portfolio theory is a basic concept in financial asset investment developed by Harry Markowitz in 1952. This concept states that investors can obtain optimal portfolios by aligning returns and risks (Husnan, 2015). Forming a portfolio aims to minimize risk without sacrificing the returns obtained through diversification. Portfolio diversification is an activity of spreading funds into several businesses. There is a saying "Don't put several eggs in one basket". Synonymous with not putting some of the funds you have in one business, put these funds in several businesses. However, investors will find it difficult to form a portfolio, because the number of existing assets causes many portfolios. Related to this problem, a rational investor will form an optimal portfolio. The optimal portfolio can be formed with the Markowitz model or the Sharpe model (single index model). Forming an optimal portfolio with these models requires a set of opportunities, an efficient portfolio set, and an efficient frontier (Hartono, 2017). The opportunity set is the set of possible combinations of various assets that can be invested in a portfolio. While an efficient portfolio is a portfolio that provides the highest expected return with a certain risk or a portfolio with the smallest risk provides a certain expected return. A set of efficient portfolios is referred to as a set of efficient portfolios.

The optimal portfolio is a portfolio in the set of opportunities that provides a combination of assets that produces the highest expected return with the least risk. This portfolio is in the set of efficient portfolios. In portfolio analysis, the main objective is to find the optimal portfolio according to the investor's risk profile and investment objectives. Determining the optimal portfolio can be done in several ways, namely (Hartono, 2017).

a. The optimal portfolio according to the Markowitz model

The Markowitz model explains that the optimal portfolio is a portfolio that provides a minimal variance portfolio (MVP).

The assumptions underlying the Markowitz model are:

1. Using shorter time periods.

Shorter time periods may be more responsive to changes in current market conditions. Even long time periods provide a broader picture of the behavior of historical asset data and help identify long-term trends.

2. Ignoring transaction fees and taxes.
The calculation of transaction costs and taxes will change the company's optimal capital structure, so these two costs are ignored.
3. Investors will consider the minimum level of risk and optimize the expected return of the portfolio they choose.
4. Without considering non-risk loans and deposit assets.
5. In reality, risk-free assets such as government bonds are often available to investors as investment options. However, by ignoring risk-free assets, Markowitz can simplify the analysis and focus on how to optimize the most efficient portfolio of risky assets.

b. Optimal portfolio according to the Single Index Model

The single index model is the model found by W. Sharpe (1963). The optimal portfolio according to this model is a set of portfolios that have a high excess return to beta ratio compared to the cut-off point (C^*). This model is based on the observation that securities prices fluctuate in the direction of the market index. Stock prices tend to increase, if the market index increases, and vice versa.

The single index model uses the following assumptions (Hartono, 2017):

1. The residual error of the i th security does not covariate or does not move together with the residual error of the j th security.
2. Return market index and residual error for each security (e_i) are random variables. Therefore, it is assumed that e_i does not move together with the market index return.

3) Composite Stock Price Index (JCI)

The JCI is a stock market index that is often used as a benchmark to analyze the performance of the Indonesian stock market and is a reference for many investors and analysts in making investment decisions and measuring the performance of their investment portfolios in the Indonesian stock market.

It should be remembered that the movement of the JCI can be influenced by a variety of complex and often difficult to predict factors, including economic and political conditions, global market conditions, investor sentiment, and the performance of companies listed on stock exchanges. As an investor, it is important to understand these various factors and carry out a comprehensive analysis before making investment decisions in the stock market.

Market return related to the JCI refers to the performance or value growth of the JCI stock index in a certain period. This market return gives an idea of how well or badly the overall performance of the Indonesian stock market was in that period. Market return can be calculated using the percentage change in the JCI value at the end of the period compared to the JCI value at the beginning of the period. This market return is a relevant indicator for assessing the performance of the stock market as a whole and a reference for investors in measuring the performance of their investments in the Indonesian stock market. High market returns indicate a strong and well-performing stock market, while negative market returns indicate a decline in the value of the JCI and more challenging market conditions.

4) Bank Indonesia Certificates

Basically, BIC is a financial instrument issued by Bank Indonesia to control money circulation in the market, regulate liquidity, and act as a monetary policy tool. BIC is considered a proxy for risk-free assets because it is considered an investment instrument with very low risk or almost no risk at all (Hartono, 2017). Risk-free assets in Indonesia are proxied as Bank Indonesia Certificate assets which provide interest rates according to the BI-7-day reverse repo rate, which is a new reference to replace the BI rate as of August 2016. In the United States, US government bonds are investment instruments that are considered risk-free because the federal government has never defaulted on its debts (Rafa, 2022).

3. Research Method

This research includes census research. The target population in this study is 46 companies that are members of the banking sub-sector on the Indonesia Stock Exchange (JCI) in 2018-2022 to predict the optimal portfolio of stocks. Meanwhile, the survey population consisted of 29 company shares. The population collection technique uses purposive sampling. This research data uses secondary data in the form of quantitative data. Quantitative data is in the form of monthly closing price data for the period December 2017-December 2022, JCI data for the period December 2017-December 2022, and BIC interest rate data. The data collection method used in this study is a documentary study.

This research data was collected through the official websites www.idx.co.id, www.finance.yahoo.com, and www.bi.go.id. Data analysis uses the Markowitz model and the single index model with the assumption that short sales are not permitted with the help of the Solver program.

4. Results and Discussion

1) Formation of the Markowitz Model Optimal Portfolio

The optimal portfolio of the Markowitz model assumes that investment is based on the expected return and the portfolio return variance of the total portfolio return. The Markowitz model provides portfolio values with small risks for certain expected returns. The following is the result of the calculation of the Markowitz model.

Figure 3 Graph of Efficient Portfolio Sets

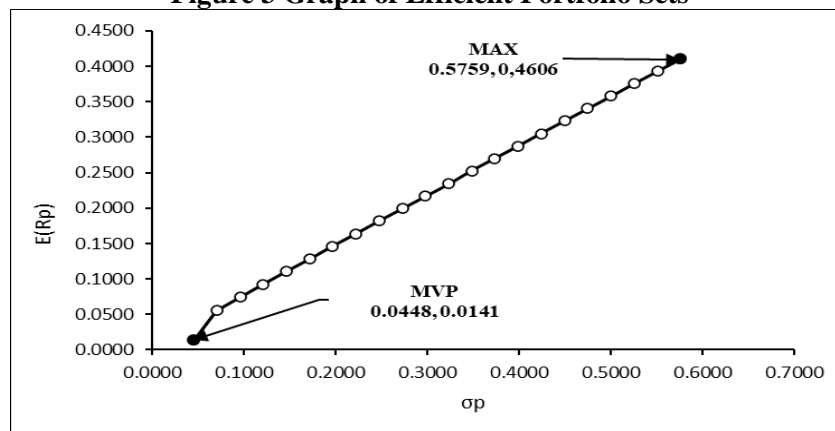


Figure 4 Optimal Portfolio Proportions Markowitz Model.

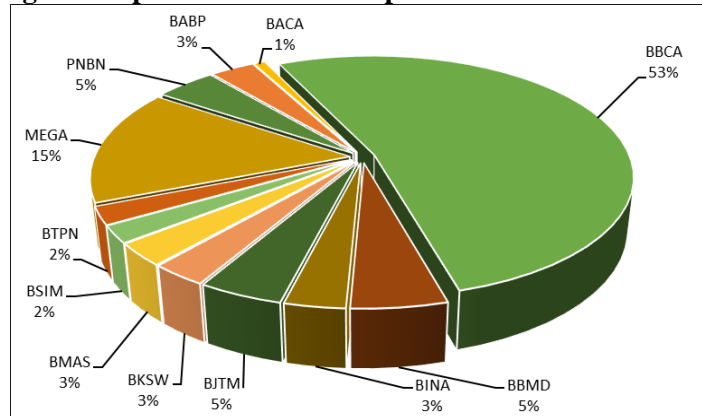


Table 1 Expected Return and Portfolio Risk

Portofolio Optimal	σ_p	$E(R_p)$	CV_p
	0.0448	0.0141	3.1896

Source: Processed yahoo finance 2022 data

2) Formation of the Optimal Portfolio Single Index Model

The single index model is based on the observation that if the stock price increases, then the stock price index also increases. Conversely, if the stock price decreases, then the stock price index decreases. The optimal portfolio contains stocks that have a high excess return to beta (ER_{Bi}), so a limiting point is needed that determines the threshold for the ER_{Bi} value to be said to be high. Following are the results of forming the optimal portfolio of the single index model.

Table 2 Value of Excess Return to Beta Ratio and Cut Off Rate (C_i)

Number	Stock	ER_{Bi}	C_i	Description
1.	BINA	0.1338	0.0003	Optimal
2.	BABP	0.0859	0.0006	Optimal
3.	MEGA	0.0614	0.0008	Optimal
4.	ARTO	0.0510	0.0025	Optimal
5.	BMAS	0.0276	0.0036	Optimal
6.	BNBA	0.0263	0.0047	Optimal
7.	BBYB	0.0243	0.0054	Optimal
8.	BBHI	0.0241	0.0085	Optimal
9.	BGTG	0.0112	0.0087	Optimal
10.	BBCA	0.0098	0.0091	Optimal

Source: Processed yahoo finance 2022 data

Figure 5 Optimal Portfolio Proportions Single Index Model.

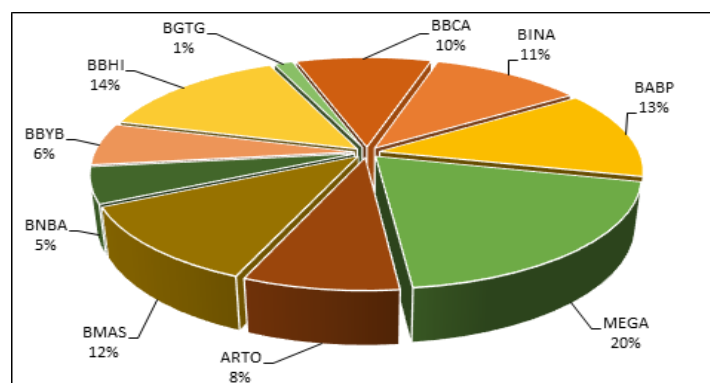


Table 3 Return Expectations and Portfolio Risk single index model

Portofolio Optimal	σ_p	$E(R_p)$	CV_p
	0.1021	0.0465	2.1968

3) Comparison of Optimal Portfolio Performance of the Markowitz Model with the Single Index Model

Comparison of optimal portfolio performance with the Markowitz model and the single index model in the Banking Sub Sector for the 2018-2022 period is presented in Table 4.

Table 4. Comparison of Optimal Portfolio Performance with the Markowitz Model and the Single Index Model

Number	Description	Markowitz model	Single index model		
1	Optimal Portfolio Proportions	BABP	3.29%	BINA	11.03%
		BACA	0.84%	BABP	12.87%
		BBCA	52.66%	MEGA	19.61%
		BBMD	5.05%	ARTO	8.05%
		BINA	3.21%	BMAS	11.60%
		BJMT	4.47%	BNBA	5.24%
		BKSW	2.98%	BBYB	6.16%
		BMAS	2.97%	BBHI	14.18%
		BSIM	2.24%	BGTG	1.36%
		BTPN	2.37%	BBCA	9.90%
		MEGA	15.43%		
		PNBN	4.49%		
2	Expected Return Portfolio $E(R_p)$	1.41%	4.65%		
3	Portfolio Risk (σ_p)	4.48%	10.21%		
4	Portfolio Coefficient of Variance (CV_p)	318.96%	219.68%		

Source: Processed yahoo finance 2022 data.

Table 4 shows that the optimal portfolio formation using the Markowitz model in the Banking Sub Sector for the 2018-2022 period consists of 12 stocks with the proportion of BBCA of 52.66%, BJTM of 4.47%, BABP of 3.29%, BACA of 0.84 %, BTPN 2.37%, PNBN 4.49%, BKSW 2.98%, MEGA 15.43%, BSIM 2.24%, BINA 3.21%, BMAS 2.97% and BBMD of 5.05%. In addition, it has an expected return of 0.0141 or 1.41%, a risk of 0.0448 or 4.48% and a portfolio variation coefficient of 3.1896 or 318.96%.

Formation of an optimal portfolio with the Single Index Model in the Banking Sub Sector for the 2018-2022 period as many as 10 shares with a portion of BINA of 11.03%, BABP of 12.87%, MEGA of 19.61%, ARTO of 8.05%, BMAS of 11.60%, BNBA 5.24%, BBYB 6.16%, BBHI 14.18%, BGTG 1.36%, BBCA 9.80%. For portfolio expected return of 0.0465 or 4.65%, portfolio risk of 0.1021 or 10.21% and portfolio variation coefficient of 2.1968 or 219.68%.

Comparison of the calculation results above, as a whole, when viewed from the ratio, namely the coefficient of variation, the Markowitz model is worse than the single index model. This is because the single index model has a smaller coefficient of variation than the Markowitz model.

4) Discussion

The results of the study show that the optimal portfolio is formed as a form of investment diversification and is proven to reduce investment risk, because the optimal portfolio provides the smallest risk when compared to the risk of each individual stock. In addition, it proves that the optimal portfolio performance of the index model is better than the Markowitz model. The results of this study are in line with Hartono's opinion (Hartono, 2017) that the optimal portfolio of the Markowitz model is not really an optimal portfolio, but only optimal for the smallest portfolio risk. The truly optimal portfolio is generally the portfolio that should perform the best.

The portfolio with the best performance can be measured by the portfolio that has the largest angle at the point of risk-free assets. The portfolio with the largest angle according to the single index model is measured by the excess return to beta of each asset which is the performance of individual assets. The results of this study are also supported by the findings of Putra & Dana, (2020) and Nurdianingsih & Suryadi, (2021) which state that the single index model is better than the Markowitz model.

The proportion of stocks that make up the optimal portfolio in this study are all positive, meaning that short sales are not permitted (Husnan, 2015). Investors think that making a portfolio with short sales is less flexible, because some shares must be borrowed by the broker and must be returned to the broker in due time. The investor must return the borrowed shares according to the agreement. Usually, the loan term is short term (Hartono, 2014).

If the shares must be returned, then the proportion of shares will be zero, so that changes in this proportion will no longer cause an optimal portfolio. In addition, returning these shares to the broker causes investors to bear transaction costs in the form of interest costs and fees to the broker. With the inflexibility of short sales, investors often create optimal portfolios that do not allow short sales (Suroto, 2019).

5. Conclusion

The conclusions drawn from the results of this research are as follows.

1. The Markowitz model provides a portfolio expectation return of 1.41 percent and a risk of 4.48 percent which is formed from 12 stocks with different proportions.
2. The single index model provides a portfolio expectation return of 4.65 percent, and a risk of 10.21 percent which is formed from 10 stocks with unequal proportions.
3. The single index model is better than the Markowitz model, because the coefficient of variation of the single index model is 219.68 percent smaller than the coefficient of variation of the Markowitz model of 318.96 percent.

6. Research Limitations

This research has limitations arising from the following:

1. The study only uses two models, namely the Markowitz model and the single index model without regard to short sales.
2. The object of research only focuses on stocks that are included in the Banking Sub-Sector only.

7. Future Research Agenda

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

1. Adding other models such as the Sharpe Model or continuing 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 a different perspective from other models.
2. Using a different research object, namely in addition to the Banking sub-sector for the 2018-2022 period because it is to find out the optimal portfolio formation in other instruments, such as mutual funds.

References

- Agustin et al. (2022). Analisis Pembentukan Portofolio Saham Optimal Menggunakan Model Markowitz dan Model Indeks Tunggal Sebagai Dasar Pengambilan Keputusan. *JURNAL EMAS*, 3(September).
- Arifin, N. P. U., & Mutasowifin, A. (2022). Analisis Penerapan Risiko Dalam Penyusunan Portofolio Optimal. *Jurnal Ilmiah Akuntansi Kesatuan*, 10(3), 575–584. <https://doi.org/10.37641/jiakes.v10i3.1509>
- Fitriyani, N., & Yunianingsih, Y. (2020). Penilaian Portofolio Optimal Pada Sektor Perbankan Indeks LQ45. *Cakrawala Management Business Journal*.
- Hartono, J. (2014). *Teori dan Praktik Portofolio dengan Excel*. Salemba Empat.
- Hartono, J. (2017). *Teori Portofolio dan Analisis Investasi* (Kesebelas). BPFE.
- Hasbiah et al. (2022). Model Markowitz Dalam Keputusan Investasi Saham Pada Index Lq45 di Bursa Efek Indonesia. *Jurnal Ekonomi Dan Pendidikan*, 5, 69–78. <https://doi.org/10.26858/jekpend>.
- Husnan, S. (2015). *Dasar-Dasar Teori Portofolio dan Analisis Sekuritas* (Kelima). UPP STIM YKPN, Yogyakarta.
- Latulani et al. (2018). Analisis penentuan portofolio optimal dengan menggunakan model markowitz pada perusahaan sektor perbankan yang terdaftar dalam indeks lq45 di bursa efek indonesia. 07(06), 27–41.
- Mahayani, N. P. M., & Suarjaya, G. (2019). Penentuan Portofolio Optimal Berdasarkan Model Markowitz Pada Perusahaan Infrastruktur. *E-Jurnal Manajemen*, 8(5), 3057–3085.
- Nur, A. A., Dwiatmono, A. W., & Pratnya, P. O. (2016). Analisis Clustering Perusahaan Sub Sektor Perbankan berdasarkan Rasio Keuangan CAMELS Tahun 2014 menggunakan Metode Fuzzy C-Means dan Fuzzy Gustafson Kessel. *JURNAL SAINS DAN SENI ITS*, 5(2), 2337–3520.
- Nuralfira, P. H., & Onoy, R. (2021). Menentukan Portofolio Optimal Menggunakan Model Markowitz. *Jurnal Riset Matematika*, 1(1), 57–64.
- Nurdianingsih, R., & Suryadi, E. (2021). Analisis Perbandingan Portofolio Optimal Dengan Menggunakan Model Single Indeks dan Model Markowitz dalam Penetapan Investasi Saham (Studi Pada Perusahaan Manufaktur Sektor Industri Barang Konsumsi yang Terdaftar di Bursa Efek Indonesia Tahun 2019). *Jurnal Produktivitas*, 8, 46–55.
- Putra, I. K. A. A. S., & Dana, I. M. (2020). Open Access Study of Optimal Portfolio Performance Comparison : Single Index Model and Markowitz Model on LQ45 Stocks in Indonesia Stock Exchange. *American Journal of Humanities and Social Sciences*

Research (AJHSSR), 4(12), 237–244.

- Rae, A. S., Putra, G. R., Aulia, N., & Soeroto, W. M. (2021). Pembentukan Portofolio Optimal Pada Saham Perbankan Dalam Indeks LQ 45 Di Masa Vaksinasi Covid -19 Menggunakan Model Indeks Tunggal. *Sebatik*, 25(2), 484–492. <https://doi.org/10.46984/sebatik.v25i2.1356>
- Sudarwan, I. A. (2020). *Emiten Perbankan Dinilai Punya Prospek Paling Menarik, Kenapa Ya?* Bisnis.Com.
- Suroto. (2019). *Manajemen Investasi* (Pertama). Pustaka Magister Semarang.
- Tandelilin, E. (2001). *Analisis Investasi dan Manajemen Portofolio*. (Pertama). BPFE.