Universitas Warmadewa
Editorial Office: Program Studi Magister Manajemen | Program Pascasarjana | Universitas Warmadewa
Jl. Terompong No.24, Sumerta Kelod, Kec. Denpasar Timur, Kota Denpasar, Bali 80239

Jurnal Ekonomi dan Bisnis Jagaditha

Volume 11, Number 1, 2024

ISSN: 2355-4150 (Print) | 2579-8162 (Online)
Publication details, Including author guidelines
visit URL: https://www.ejournal.warmadewa.ac.id/index.php/jagaditha/authorguideline

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Article History
Received: January 27, 2024
Revised: March 21, 2024
Accepted: March 22, 2024

How to cite this article (APA)
Suarjana, I. W., & Surasmi, I. A. (2024). Forming an Optimal Portfolio with a Single Index Model: Empirical study on banking stocks in the LQ45 Index. Jurnal Ekonomi dan Bisnis Jagaditha. 11(1), 88-95. https://doi.org/10.22225/jj.11.1.2024.88-95

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ISSN 2355-4150 (Print)
ISSN 2579-8162 (Electronic)

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Abstract: The aim of forming an optimal portfolio in this research is to determine the composition of the shares that form the portfolio. Apart from that, this research also aims to determine the expected return and risk of the portfolio being formed. The research sample is 5 banks included in the LQ45 Index. The data used is monthly stock prices. Data analysis uses a single index model, where the reference index is the Composite Stock Price Index on the Indonesian Stock Exchange. The results of the analysis found that there were shares of 4 banks that were included in the optimal portfolio. The proportion of each stock in the portfolio is as follows: Bank Mandiri 60.13%, Bank BRI 26.71%, Bank BCA 8.91%, and Bank BNI 4.25%. The portfolio formed is able to minimize risk compared to the shares that form the portfolio.

Keywords: LQ45 index; optimal portfolio; single index model

Introduction

The banking sector is one of the sectors experiencing the fastest recovery in performance after the Covid-19 pandemic. Based on data from the Financial Services Authority (OJK), up to semester I-2023, bank credit distribution in Indonesia has reached IDR 6,723 trillion or grew 7.8 from semester I-2022. The Covid-19 pandemic had an impact on the Indonesian capital market (Widnyana & Warmana, 2022). Banking is one of the state financial institutions that has a role in collecting and distributing funds to the community. Apart from that, of course it aims to meet the capital and investment needs of capital owners. The banking sector is the face of a country's economy. Even in the stock market, banking issuers attract the most attention. If the movement is promising, it is believed that capital market conditions will be better in the future.

When conditions start to improve, blue chip stocks are the first to be targeted by investors. This research takes a sample of banking shares that are included in the LQ 45 index. The LQ 45 index is an index that measures the price performance of 45 shares that have high liquidity and large market capitalization and are supported by good company fundamentals. Previous research found that a portfolio formed from LQ45 shares can reduce investment risk (Suroto, 2015). Determining the optimal portfolio using the Single Index Model can provide higher returns compared to a Random portfolio (Hariasih & Wirama, 2016). However, several previous studies on LQ45 Index shares found that banking shares were not included in the optimal portfolio of the single index model (Darmawan & Purnawati, 2015; Graha et al., 2016; Nadir & Dewi, 2020; Oktaviani & Wijayanto, 2016).

Previous research on the formation of banking stock portfolios used the Markowitz model (Wijaya, 2021). Meanwhile, this research uses a single index model. Based on empirical

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testing, there is no difference in the composition of shares formed using the Markowitz model and the single index model (Yuwono & Ramdhani, 2017). The advantages of the Single Index Model analysis are that it simplifies calculations and takes into account market changes, whereas the Markowitz Model only focuses on unsystematic risk or securities and does not pay attention to the relationship between securities and market changes (Supriyanthi & Rahyuda, 2017).

The aim of this research is to form a portfolio of banking shares with the LQ 45 index based on a single index model. From the formation of the portfolio, it can be seen which bank shares are included in the portfolio and their proportions. Next, based on the shares and the proportion of each share, the expected return and risk of the portfolio formed can be calculated.

Method

The research sample is all banking sector companies that have always been included in the LQ45 index from August 2021 to August 2023. Based on these criteria, there are five banks that are included in the research sample.

Table 1. Research sample

No	Bank	IDX Stock code
1	PT Bank BCA, Tbk	BBCA
2	PT Bank BNI, Tbk	BBNI
3	PT Bank BRI, Tbk	BBRI
4	PT Bank Tabungan Negara, Tbk	BBTN
5	PT Bank Mandiri, Tbk	BMRI

Data and data sources are as follows

Stock prices of all samples on a monthly basis from August 2021 to August 2023. Source of this data is from Yahoo Finance

Composite Stock Price Index (IHSG) on a monthly basis from August 2021 to August 2023. In this research, IHSG is a proxy for the market portfolio. The source of this data is from Yahoo Finance

Bank Indonesia's reference interest rate, namely the BI-7 Day Reverse Repo Rate (BI7DRR) from August 2021 to August 2023. In this research BI7DRR is a proxy for risk-free interest rates. The source of this data is Bank Indonesia. The average BI interest rate during the observation period was 4.41 percent per year or 0.37 percent per month

The data analysis procedure is as follows:

Calculate the actual stock return for each bank every month (R_{it})

$$R_{it} = \frac{P_{it} - P_{it-1}}{P_{it-1}} \quad \text{.....(1)}$$

Where

R_{it} : Return of bank i stock in month t

P_{it} : Bank i's stock price in month t

P_{it-1} : Bank i's stock price in month t-1

Calculate the Expected Return on shares of each bank (ER_i). In this research Expected return is the average return during the observation period.

$$ER_i = \frac{\sum R_i}{n} \quad \text{.....(2)}$$

ER_i : Expected Return on bank shares i

ΣR_i : total stock return of bank i during the observation period

n : number of observation periods, in this case n = 24 months (September 2021-August 2023)

Calculate the stock return variance for each bank (σR_i^2) based on return data during the observation period

$$\sigma_{Ri}^2 = \frac{\sum(R_i - ER_i)^2}{n} \quad \text{.....(3)}$$

Calculating monthly market returns (R_{mt})

$$RM_t = \frac{PIHSG_t - PIHSG_{t-1}}{PIHSG_{t-1}} \quad \text{.....(4)}$$

RM_t : Market return in month t

$PIHSG_t$: IHSG price in month t

$PIHSG_{t-1}$: IHSG price in month t-1

Calculating Expected Return Market (ERM). In this research Expected return is the average market return during the observation period. months (R_{mt})

$$ERM = \frac{\sum RM}{n} \quad \text{.....(5)}$$

ERM : Expected Return Market

ΣRM : total market return during the observation period

Calculate the market return variance (σRM^2) based on market return data during the observation period.

$$\sigma_{RM}^2 = \frac{\sum(RM - ERM)^2}{n} \quad \text{.....(6)}$$

Estimating parameters α, β, and e in a single index model. The single index model is expressed in the following equation:

$R_i = \alpha_i + \beta_i RM_t$ (7)

So that

$ER_i = \alpha_i + \beta_i ERM + e_i$ (8)

α_i : intercept regression of market returns on bank i stock returns

β_i : regression coefficient of market returns on bank i's stock returns

ER_i : Estimated stock return of bank i based on a single index model

E_i : estimation error

ERM : expected market return, namely the average market return during the observation period

$$ERM = \frac{\sum RM}{n} \quad \text{..... (9)}$$

$$\alpha_i = ER_i - \beta_i ERM \quad \text{.....(10)}$$

$$\beta_i = \frac{\sum(RM_t - ERM)(R_i - ER_i)}{\sum(RM_t - ERM)^2} \quad \text{.....(11)}$$

$e_i = R_i - ER_i$ ..... (12)

Calculating the Excess Return to Beta of each bank's stock (ERB_i)

$$ERB_i = \frac{ER_i - RF}{\beta_i} \quad \text{.....(13)}$$

RF: average BI Interest Rate during the observation period, divided by 12 months

Sort banks based on ERBi value from highest to lowest, j = 1 for the highest ERB_i and so on.

Calculate the cut off value (ci) to determine the cut off point for which banks are included in the portfolio.

$$c_i = \frac{\sigma_{RM}^2 \left[\sum_{j=1}^{i} \frac{(ER_i - RF)\beta_i}{\sigma_{ei}^2}\right]}{1 + \left[\sum_{j=1}^{i} \frac{\beta_i}{\sigma_{ei}^2}\right]\sigma_{RM}^2} \quad \text{.....(14)}$$

where

$\left[\sum_{j=1}^{i} \frac{(ER_i - RF)\beta_i}{\sigma_{ei}^2}\right]$ is the total sum $\frac{(ER_i - RF)\beta_i}{\sigma_{ei}^2}$ of stock order j=1 to order i

$\left[\sum_{j=1}^{i} \frac{\beta_i}{\sigma_{ei}^2}\right]$ is the sum of $\frac{\beta_i}{\sigma_{ei}^2}$ from stock of order j=1 to order i

The cut off point (c_i^*) is the value (c_i) at the point where ERBi is still above c_i. Stocks in the sequence below that have an ERB below c_i are excluded from the portfolio.

Calculating the weight of each stock in the portfolio (Wi)

$$W_i = \frac{z_i}{\sum z_i} \quad \text{.....(15)}$$

where

$$Z_i = \frac{\beta_i}{\sigma_{ei}^2}(ERB_i - c_i^*) \quad \text{.....(16)}$$

Calculate expected portfolio return (ERP)

$$ERP = \sum W_i ER_i \quad \text{.....(17)}$$

Calculate portfolio risk. Portfolio risk is measured by betas (β_p) and variance (σP^2)

$$\beta_P = \sum W_i \beta_i \quad \text{.....(18)}$$

$$\sigma_p^2 = \beta_p^2 \sigma_M^2 + W_i^2 \sigma_{ei}^2 \quad \text{.....(19)}$$

$\beta_p^2 \sigma_M^2$: market-related risks

$W_i^2 \sigma_{ei}^2$: the weighted average of each bank's unsystematic risk

Result and Discussion

Calculation of return, expected return, variance, Beta, and Excess Return to Beta (steps 1 – 8) using Ms. Excel, the results are shown in the Appendix. A summary of the calculation results is shown in Table 2. The poor performance of Bank BTN shares during the observation period resulted in a negative expected return. Based on share price data in Appendix 1, Bank BTN's share price has decreased from IDR 1,405 in August 2021 to IDR 1,255 in August 2023. Other banks, on the other hand, have actually experienced appreciation. In general, the average stock return of banks other than Bank BTN is higher than the average market return, where Bank Mandiri has the highest average return (expected return).

In terms of risk, Bank BCA has the lowest total risk (σR_i^2 = 0.002), while the lowest systematic risk is Bank BRI (β_i = 1.084). In general, all banks have a stock return variance that is higher than the market return variance.

Table 2. Expected return, return variance, alpha, beta, and excess return to beta

Stock	$E(R_i)$	σ_{Ri}^2	αi	βi	ERB_i
BBCA	0.015	0.002	0.009	1.181	0.010
BBNI	0.025	0.007	0.013	2.287	0.009
BBRI	0.020	0.003	0.014	1.084	0.015
BBTN	-0.002	0.005	-0.013	2.092	-0.003
BMRI	0.030	0.003	0.021	1.762	0.015
Market	0.005	0.001			

The ERB of each stock is sorted from highest to lowest value. Sequencing results in Table 3.

Table 3. Sorted ERB

Stock	ERB_i
BMRI	0.015
BBRI	0.015
BBCA	0.010
BBNI	0.009
BBTN	-0.003

Next, calculate c_i using equation 14, the results are in Table 4. The cut off point is BBNI shares where the ERB value is still higher than c_i, so the c_i^* value is 0.009. BBTN shares were excluded from the portfolio because ERB was lower than c_i. This result is different from the findings of (Wijaya, 2021) who found that BBTN shares were included in the optimal portfolio. This difference in results is due to differences in sampling techniques.

Table 4. C_i value and cut off

Stock	$\frac{(ER_i - RF)\beta_i}{\sigma_{ei}^2}$	$\frac{\beta_i}{\sigma_{ei}^2}$	$\sum_{j=1}^{i} \frac{(ER_i - RF)\beta_i}{\sigma_{ei}^2}$
BMRI	26,909	1774,989	26,909
BBRI	7,420	492,445	34,329
BBCA	11,773	1220,147	46,102
BBNI	12,849	1353,461	58,951
BBTN	-3,821	1386,546	55,130

Stock	$\sum_{j=1}^{i} \frac{\beta_i}{\sigma_{ei}^2}$	c_i
BMRI	1774,989	0,007
BBRI	2267,434	0,008
BBCA	3487,581	0,009
BBNI	4841,042	**0,009**
BBTN	6227,588	0,007

Note: ci calculation using equation 14 and $\sigma RM^2 = 0.001$ (see Appendix)

Calculate the proportion of each stock in the portfolio. Calculations use the formula in equation 15. Calculation results are in Table 5.

Table 5. Results of calculating stock proportions

Stock	ERB_i	c_i	Z_i	W_i
BMRI	0,015	0,007	6,490	60,13%
BBRI	0,015	0,008	2,883	26,71%
BBCA	0,010	0,009	0,961	8,91%
BBNI	0,009	**0,009**	0,459	4,25%
			10,793	100,00%

The proportion of each bank share in the portfolio formed is shown in Figure 1. The largest share is BMRI while the smallest is BBNI.

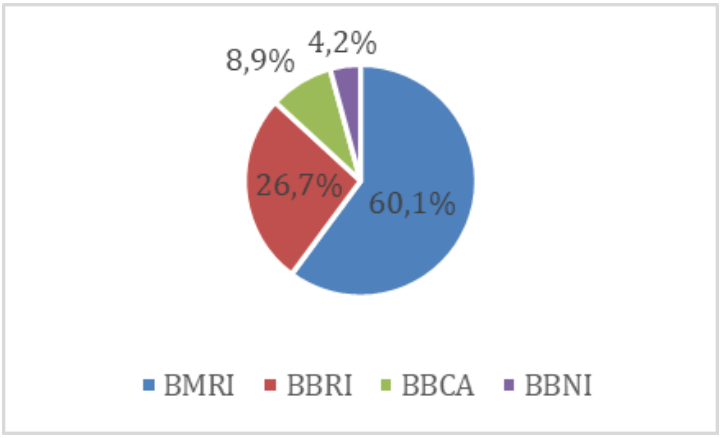

Figure 1. Proportion of shares in the portfolio

Calculation of portfolio expected return using equation 17. The results are shown in

Table 6. The expected return of the portfolio formed is 2.6 percent, much higher than the expected return of the market portfolio which is only 0.5 percent.

Table 6. Calculation of portfolio expected return

Stock	W_i	ER_i	W_iR_i
BMRI	60.13%	0.030	0.018
BBRI	26.71%	0.020	0.005
BBCA	8.91%	0.015	0.001
BBNI	4.25%	0.025	0.001
	ERP =		0.026

Portfolio beta calculation using equation 18. The results are shown in Table 7. The beta of the portfolio formed is 1.551. Beta: ß > 1: Above-average risk stocks (Jones & Jensen, 2023).

Table 7. Calculation of portfolio betas

Stock	W_i	β_i	$W_i\ \beta_i$
BMRI	60.13%	1.762	1.059
BBRI	26.71%	1.084	0.290
BBCA	8.91%	1.181	0.105
BBNI	4.25%	2.287	0.097
	β_i =		1.551

Market-related portfolio risk is $\beta_P^2\sigma_M^2$ = 1.551 * 0.001 = 0.001. Meanwhile, the weighted average of unsystematic risk for each stock is shown in Table 8

Table 8. Calculation of portfolio unsystematic risk

Stock	W_i^2	e_i^2	$W_i^2\ e_i^2$
BMRI	0.362	0.002	0.00063
BBRI	0.071	0.002	0.00017
BBCA	0.008	0.001	0.00001
BBNI	0.002	0.004	0.00001
	$\Sigma W_i^2\ e_i^2$ =		0.00082

Thus, the total portfolio risk (calculated by equation 19) is 0.001 + 0.0008 = 0.002. Portfolio risk is relatively lower than the risk of Bank Mandiri, BNI and BRI shares, although almost the same as the risk of Bank BCA shares.

Conclusion

This research aims to form an optimal portfolio with a single index model from banking shares included in the LQ45 index for the period August 2021-August 2023 . There are 5 bank shares as candidates for forming the portfolio, four of which are state-owned banks, namely Bank BNI, BRI, BTN and Mandiri, as well as one nonstate-owned bank, namely Bank BCA. The optimal portfolio is formed using a single index model consisting of four banks, namely Bank Mandiri, BRI, BCA and BNI. Bank BTN shares are not included in the optimal portfolio. Bank BTN share price data during the observation period did show a decline in stock performance as indicated by negative returns, while the shares of the other four banks showed positive stock performance, even above market portfolio performance.

Calculation of the optimal portfolio proportion found that the proportion of Bank Mandiri shares was far above the proportion of the other three bank shares, while the proportion of Bank BCA and BNI shares in the optimal portfolio was relatively small.

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