



Application of The Single Index Model In The Establishment of A Portfolio Stock Optimization

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Article Info

Article history:

Keywords:

Optimal Stock Portfolio, Consumer Goods Industry Stock, Index Model Single.

ABSTRACT

Investing in stocks in the capital market is an investment that has big risks, so if you are not careful in choosing stocks, it can cause losses. In this case, investors need to form an optimal portfolio of shares to reduce risk in investment activities in the capital market. The purpose of this study was to determine the optimal portfolio value of stocks during the COVID-19 pandemic using a single index model. The data used are stock price data, the JCI and the BI Rate, which is from January to December 2020. Based on the research that has been done, 6 stocks are classified into the optimal stock portfolio during the 2020 pandemic. The proportion value of each share is COCO shares of 0.84%, GOOD shares are 59%, ROTI shares are 35%, SKBM shares are 0.78%, ULTJ shares are 1.4%, and UNVR shares are 3%, with an expected portfolio return value of 0.39% and a risk of 0.0066%.

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1. INTRODUCTION

Investment is the desire to invest funds at a certain time to get rewards in the future as income for investors as long as the funds are invested (Tambunan, 2020). Stock investment in the capital market is an investment that contains a high risk, so that if you are not careful in choosing stocks, it can result in bankruptcy (Mussafi, 2017). can be minimized without reducing the expected profit.

The optimal portfolio is a portfolio that has a combination of the expected return and optimal risk (Andayani, 2013). The conception contained in the optimal portfolio is how to distribute a certain amount of capital in various types of investments that will get the expected optimal results (Yunita, 2015).

The single index model is a simplification of the Markowitz model developed by William F. Sharpe which is one of the models in the formation of an optimal stock portfolio used by investors. The single index model provides an alternative way to determine variance in a portfolio, which is simpler than other models (Chasanah, 2020).

2. RESEARCH METHODE

Indonesian Sharia Stock Index (ISSI)

On May 12, 2011, the Indonesian Sharia Stock Index (ISSI) is a composite index of sharia shares listed on the Indonesia Stock Exchange (IDX). ISSI is one of the indicators of the performance of the Indonesian Islamic capital market. ISSI constituents are all sharia shares listed on the IDX and included in the Sharia Securities List (DES) issued by the Financial Services Authority (OJK) which are re-selected twice a year, every May and November, following the DES review schedule. Therefore, every selection period, there are always sharia shares that come out and become ISSI constituents. The ISSI calculation method follows another IDX stock index calculation method (idx.co.id).

MODEL INDEKS TUNGGALSINGLE INDEX MODEL

a. Calculating individual stock returns

Stock return is the result of the return obtained by a number of investments in each stock. In calculating stock returns, you can use the following equation:

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

b. Calculating the expected return of a stock

The expected return of a stock is the expected return on a stock which can be calculated by:

$$E(R_i) = \frac{\sum_{i=1}^n R_i}{n}$$

c. Calculating stock risk

Calculating the risk of an investment is intended to find out how far the possible value to be obtained deviates from the expected value. Calculations can be performed using the following equation:

$$\sigma_i = \sqrt{\frac{\sum_{i=1}^n (R_i - E(R_i))^2}{n-1}}$$

d. Calculating Market Returns

Market returns are returns that are earned through investments in all shares on the Indonesia Stock Exchange. To calculate the market price return using the following equation:

$$R_m = \frac{IHSG_t - IHSG_{t-1}}{IHSG_{t-1}}$$

e. Calculating Expected Market Return

The expected market return is the return that investors expect the market to generate. To calculate the market profit yield use the following equation:

$$E(R_m) = \frac{\sum_{i=1}^n R_m}{n}$$

f. Calculating Market Risik

Market risk is the difference between expected market return and market return. To calculate market risk using the following equation:

$$\sigma_m = \sqrt{\frac{\sum_{i=1}^n (R_m - E(R_m))^2}{n-1}}$$

g. Calculating the Covariance between stock returns and market returns

In calculating the covariance between the yield of each share and the market return that reflects the relationship between the return of each share and the market return. Covariance is the average deviation of each mutual fund, which is the ratio of the return of each stock and the market return which can be calculated by the following equation:

$$\sigma_{im} = \sum_{i=1}^m [R_i - E(R_i)][R_m - E(R_m)]$$

h. Calculating Alpha dan Beta

Beta is a coefficient that assesses the effect of market returns on changes that occur in stock returns. Beta is used to calculate Excess Return to Beta and beta is also needed to calculate Cut-off Point. While Alpha is a variable that is not influenced by market returns. Beta and Alpha are calculated using the following equation:

$$\beta_i = \frac{\sigma_{im}}{\sigma_m^2}$$

$$\alpha_i = E(R_i) - \beta_i \cdot E(R_m)$$

i. Calculating Total Risk

- Calculating systematic risk using the following equation:

$$e = \beta_i^2 \times \sigma_m^2$$

- Calculating unsystematic risk by using the following equation:

$$e_i^2 = \sigma_i^2 - (\beta_i^2 \times \sigma_m^2)$$

- Calculating total risk by using the following equation :

$$\sigma_{ei}^2 = (\beta_i^2 \times \sigma_m^2) + e_i^2$$

j. Calculating Excess Return to Beta (ERB)

The value of Excess Return to Beta is a requirement to determine which stocks are the optimal portfolio group. The value of excess return to beta is calculated using the equation:

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

k. Calculating Value Cut off point (Ci)

The cut off point is the limit point used to determine whether a stock is classified as an optimal portfolio or not. The value of Ci can be calculated using the following equation:

$$C_i = \frac{\sigma_m^2 \sum \frac{(E(R_i) - R_f) \beta_i}{\sigma_{ei}^2}}{1 + \sigma_m^2 \sum \frac{\beta_i}{\sigma_{ei}^2}}$$

l. Determine Optimal portfolio share proportion.

$$W_i = \frac{z_i}{\sum_{i=1}^n z_i}$$

Where :

$$z_i = \frac{\beta_i}{\sigma_{ei}^2} (ERB_i - C^*)$$

m. Calculating expected portfolio return and portfolio risk

- Expected Portfolio Return

Is a weighted average of the returns on each stock that makes up the portfolio. Portfolio return expectations can be calculated using the following equation:

$$E(R_p) = \alpha_p + \beta_p E(R_m)$$

Where,

$$\alpha_p = \sum_{i=1}^n W_i (\alpha_i)$$

$$\beta_p = \sum_{i=1}^n W_i (\beta_i)$$

- Portfolio Risk

Is the risk of investing a group of stocks in a portfolio or a group of financial instruments in a portfolio. The two components used as risk measurements are standard deviation and stock beta. Portfolio risk can be calculated using the following equation:

$$\sigma_p^2 = \beta_p^2 \cdot \sigma_m^2 + (\sum_{i=1}^n w_i^2 \cdot \sigma_{ei}^2)$$

3. RESULT AND ANALYSIS

Stock Price

Tabel 1: Stock Price Data

Month	Invest Name									
	ADES		BTEK		BUDI		CAMP		CEKA	
	OPE	CLO	OPE	CLO	OPE	CLO	OPE	CLO	OPE	CLO
	N	SE	N	SE	N	SE	N	SE	N	SE
JANUARI	970	970	50	50	99	98	336	322	1575	1550
FEBRUARI	895	825	50	50	95	93	262	214	1500	1470
MARET	700	700	50	50	82	83	153	157	1200	1200

APRIL	745	790	50	50	90	91	192	193	1510	1510
MEI	940	960	50	50	88	87	204	208	1695	1705
JUNI	845	865	50	50	86	86	208	206	1980	1995
JULI	1000	990	50	50	91	90	204	197	1900	1800
AGUSTU S	1300	1225	50	50	99	100	268	256	1990	2000
SEPTEMBER	1125	1125	50	50	92	93	276	270	1680	1675
OKTOBER	1165	1165	50	50	98	98	262	258	1720	1740
NOVEMBER	1310	1265	50	50	101	100	260	258	1810	1780
DESEMBER	1510	1460	50	50	103	99	306	302	1820	1785

Indeks Harga Saham Gabungan (IHSG)

Table2: IHSG Data

BULAN	IHSG	
	OPEN	CLOSE
JANUARI	6076.46	5940.05
FEBRUARI	5436.17	5452.70
MARET	4414.50	4538.93
APRIL	4567.32	4716.40
MEI	4716.19	4753.61
JUNI	4901.82	4905.39
JULI	5111.11	5149.63
AGUSTUS	5346.66	5238.49
SEPTEMBER	4896.43	4870.04
OKTOBER	5133.54	5128.23
NOVEMBER	5779.67	5612.42
DESEMBER	6052.12	5979.07

BI Rate

Table3: BI Rate Data

MONTH	BI RATE
JANUARI	5.00 %
FEBRUARI	4.75 %
MARET	4.50 %
APRIL	4.50 %
MEI	4.00 %
JUNI	4.25 %
JULI	4.00 %
AGUSTUS	4.00 %
SEPTEMBER	4.00 %
OKTOBER	4.00 %
NOVEMBER	3.75 %
DESEMBER	3.75 %

Data processing**Stock returns**

ADES Stocks:

For $i = 1$, then:

$$R_1 = \frac{970 - 970}{970} = 0$$

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For $i = 12$, then:

$$R_{12} = \frac{1460 - 1510}{1510} = -0.03425$$

$$\sum R_i \text{ ADES} = 0 + (-0.08485) + \dots + (-0.03425) = -0.12508$$

Table 4: Stock Return Calculation Results

MONTH	INVEST NAME								
	ADES	BTEK	BUDI	CAMP	CEKA	CINT	CLEO	COCO	DMND
JANUARI	0	0	- 0.01010	- 0.04167	- 0.01587	- 0.00758	- 0.02970	0	- 0.02105
FEBRUARI	- 0.08485	0	- 0.02105	- 0.18321	- 0.02000	0.00746	- 0.00922	0.24306	0
MARET	0	0	0.01220	0.02614	0	0.02190	0.04494	0	0
APRIL	0.05696	0	0.01111	0.00521	0	0.03053	0.00913	0	- 0.01058
MEI	0.02083	0	- 0.01136	0.01961	0.00590	- 0.06667	0.00431	0.00606	0.00524
JUNI	0.02312	0	0	- 0.00962	0.00758	- 0.00781	- 0.00427	0	0
JULI	- 0.01010	0	- 0.01099	- 0.03431	- 0.05263	0	- 0.01905	0	- 0.02105
AGUSTUS	- 0.06122	0	0.01010	- 0.04478	0.00503	- 0.03200	- 0.04717	0	0
SEPTEMBER	0	0	0.01087	- 0.02174	- 0.00298	0	0.00450	0.00552	0
OKTOBER	0	0	0	- 0.01527	0.01163	0	- 0.01245	0	- 0.00552
NOVEMBER	- 0.03557	0	- 0.00990	- 0.00769	- 0.01657	0	- 0.04158	- 0.00538	- 0.01667
DESEMBER	- 0.03425	0	- 0.03883	- 0.01307	- 0.01923	- 0.00826	- 0.02913	- 0.06667	0.00546
$\sum_{i=1}^n R_i$	- 0.12508	0	- 0.05797	- 0.32039	- 0.09716	- 0.06242	- 0.12968	0.18260	- 0.06418

Based on the table above, it can be seen that the largest share return value is found in COCO shares of **0.18260** and the smallest share return is found in CAMP shares of **-0.32039**.

Stock Return Expectations

$$\text{ADES Stocks: } E(R_1) = \frac{-0.12508}{12} = 0.01042$$

Table 5: Calculation Results of Stock Return Expectations

INVEST NAME	STOCK RETURN EXPECTATIONS
ADES	-0.01042
BTEK	0
BUDI	-0.00483
CAMP	-0.02670
CEKA	-0.00810
CINT	-0.00520
CLEO	-0.01081
COCO	0.01522
DMND	-0.00535
DVLA	0.00980
FOOD	-0.01745
GOOD	0.00106
HOKI	-0.02080
HRTA	-0.00681
ICBP	-0.00708
IKP	0
INAF	-0.01872
INDF	-0.00960
KAEF	-0.01909
KEJU	0.00516
KICI	0.01100
KINO	-0.00033
KLBF	0.01144
KPAS	-0.00668
LMPI	-0.00033
MBTO	-0.01167
MREK	-0.01222
MRAT	-0.02022
MYOR	-0.00990
PANI	0.01019
PCAR	-0.01907
PEHA	-0.00585
PYFA	-0.01625
ROTI	0.00778
SCPI	0
SIDO	0.00708
SKBM	0.01119
SKLT	-0.00563
STTP	-0.01614
TCID	-0.00980
TSPC	-0.00210
ULTJ	0.01452
UNVR	0.00369
WOOD	-0.00878

Based on table 5 above, stocks whose expected profit is positive are stocks that are worthy of being an alternative in investing.

Stock Risk

COCO Stocks:

$$\sigma_i = \frac{\sqrt{((0) - (0,01522))^2 + ((0,24306) - (0,01522))^2 + \dots + ((-0,06667) - (0,01522))^2}}{12 - 1}$$

$$= \frac{\sqrt{0,06084}}{11} = \sqrt{0,00553} = 0,07437$$

Table 6: Stock Risk Calculation Results

INVEST NAME	STANDARD DEVIATION (σ_{in})
BTEK	0
COCO	0.07437
DVLA	0.04004
GOOD	0.01083
IHKP	0
KEJU	0.07486
KICI	0.04909
KLBF	0.05131
PANI	0.04040
ROTI	0.01297
SCPI	0
SIDO	0.03969
SKBM	0.08221
ULTJ	0.05748
UNVR	0.04736

Based on the table of stock risk calculation results above, it can be seen that the largest stock risk is in SKBM shares, which is **0.08221**.

a. Market Return

Form = 1, so:

$$R_1 = \frac{5940,05 - 6076,46}{6076,46} = -0,02245$$

Based on the calculation of the market return above, it can be seen that the market return in January or the market return at m=1 is -0.02245,

Table 7: Market Return Calculation Results

BULAN	IHSG
JANUARI	-0.02245
FEBRUARI	0.00304
MARET	0.02819
APRIL	0.03264
MEI	0.00794
JUNI	0.00073
JULI	0.00754
AGUSTUS	-0.02023
SEPTEMBER	-0.00539
OKTOBER	-0.00103
NOVEMBER	-0.02894
DESEMBER	-0.01207
$\sum R_m$	-0.01005

Based on table 7 above, it can be seen that the total market return yield is negative, namely -0.01005, so it can be concluded that the market return (IHSG) tends to decrease.

b. Market Return Expectations

$$E_{(R_m)} = \frac{-0.01005}{12} = -0.00084$$

Based on the above calculation results, the expected market return is -0.00084, which means the market price index is falling which results in losses.

c. Market Risk

$$\begin{aligned} \sigma_m &= \sqrt{\frac{((-0.02245) - (-0.00084))^2 + ((0.00304) - (-0.00084))^2 + \dots + ((-0.01207) - (-0.00084))^2}{12 - 1}} \\ &= \sqrt{\frac{0.00047 + 0.00002 + \dots + 0.00013}{12 - 1}} \\ &= \sqrt{\frac{0.00391}{11}} \\ &= \sqrt{0.00036} \\ &= 0.01885 \end{aligned}$$

Based on the calculation results above, the market risk is 0.01885, which means the market risk is greater than the market's expected profit.

d. Covariance between stock and market returns

Table 8: Results of Calculation of Covariance Between Stock and Market Returns

Invest Name	Covariance
BTEK	0
COCO	-1,72E-09
DVLA	1,03E-09
GOOD	-1,03E-09
IKP	0
KEJU	1,72E-09
KICI	1,37E-09
KLBF	1,03E-09
PANI	6,86E-10
ROTI	-6,86E-10
SCPI	0
SIDO	1,72E-09
SKBM	-6,86E-10
ULTJ	-6,86E-10
UNVR	-1,37E-09

Based on Table 8 above, it can be seen that there is a negative and positive covariance between stock returns and market returns. A positive covariance value means that the stock moves in the same direction between stock and market returns. While a negative covariance value means that the stock moves in the opposite direction between stock returns and the market.

e. Beta (β) and Alpha (α)

Table 9. Calculation Results of Beta (β) and Alpha (α)

INVEST NAME	Beta (β)	Alpha (α)
BTEK	0	0
COCO	-4,8E-06	0,0152
DVLA	2,9E-06	0,0098
GOOD	-2,9E-06	0,0011
IIKP	0	0
KEJU	4,8E-06	0,0052
KICI	3,8E-06	0,0110
KLBF	2,9E-06	0,0114
PANI	1,9E-06	0,0102
ROTI	-1,9E-06	0,0078
SCPI	0	0
SIDO	4,8E-06	0,0071
SKBM	-1,9E-06	0,0112
ULTJ	-1,9E-06	0,0145
UNVR	-3,8E-06	0,0037

Based on the table of calculation results above, it can be seen that there are positive and negative stock betas. If beta is positive then the increase in market return will cause an increase in stock returns, otherwise if beta is negative then the increase in market returns will cause a decrease in stock returns. Alpha (α) is the expected stock return value which is not affected by return. market due to the calculation of the expected return on the stock.

f. Total Risik

Table 10: Calculation Results of Total Risk of Each Share

Invest Name	SYSTEMATIC RISK(e)	RISK IS NOT SYSTEMATIC(e_i^2)	TOTAL RISK ($\sigma_{e_i}^2$)
BTEK	0	0	0
COCO	8,2E-15	5,5E-03	5,5E-03
DVLA	2,9E-15	1,6E-03	1,6E-03
GOOD	2,9E-15	1,2E-04	1,2E-04
IIKP	0	0	0
KEJU	8,2E-15	5,6E-03	5,6E-03
KICI	5,2E-15	2,4E-03	2,4E-03
KLBF	2,9E-15	2,6E-03	2,6E-03
PANI	1,3E-15	1,6E-03	1,6E-03
ROTI	1,3E-15	1,7E-04	1,7E-04
SCPI	0	0	0
SIDO	8,2E-15	1,6E-03	1,6E-03
SKBM	1,3E-15	6,8E-03	6,8E-03
ULTJ	1,3E-15	3,3E-03	3,3E-03
UNVR	5,2E-15	2,2E-03	2,2E-03

Based on the table of calculation results above, it can be seen that the stocks that have the largest systematic risk are COCO, KEJU and SIDO stocks, namely 8.2E-15, the largest unsystematic risk is SKBM shares, namely 6.8E-03 and the largest total risk is in SKBM shares, namely 6.8E-03.

g. Excess Return to Beta (ERB) dan C_i (Cut Off Point)

Tabel 11: Hasil Perhitungan Excess Return to Beta (ERB)

Invest Name	ERB	C_i	Information
BTEK	-	-	-
COCO	5709,77	-9,8E-06	More than
DVLA	-11429,13	-1,2E-05	Less than
GOOD	14483,88	-1,5E-05	More than
IHKP	-	-	-
KEJU	-7815,35	-1,3E-05	Less than
KICI	-8277,37	-1,1E-05	Less than
KLBF	-10855,92	-1,1E-05	Less than
PANI	-16955,69	-1,2E-05	Less than
ROTI	18220,41	-1,2E-05	More than
SCPI	-	-	-
SIDO	-7413,49	-1,3E-05	Less than
SKBM	16430,90	-1,1E-05	More than
ULTJ	14683,38	-1,0E-05	More than
UNVR	10198,25	-1,4E-05	More than

Based on the results of table 11, it can be seen that there are 6 stocks that are included in the optimal portfolio criteria, because of their ERB values $\geq C_i$ that is in stock COCO, GOOD, ROTI, SKBM, ULTJ, and UNVR. Value C_i^* available in stock ULTJ.

h. The proportion of each security in the portfolio is optimal.

$$Z_i = \frac{-4,8E - 06}{5,50E - 03} (5709,77 - (-1,0E - 05)) = -35,54295$$

$$W_i = \frac{-5,0E + 00}{-5,9E + 02} = 8,4E - 03$$

Table 12: The results of the calculation of the proportion (w_i)

Invest Name	w_i
COCO	8,4E-03
GOOD	5,9E-01
ROTI	3,5E-01
SKBM	7,8E-03
ULTJ	1,4E-02
UNVR	3,0E-02

Based on the table above, it can be seen that the proportion of funds in each stock that makes up the optimal portfolio is COCO 0.84%, GOOD 59%, ROTI 35%, SKBM 0.78%, ULTJ 1.4%, and UNVR 3%.

i. Expected Portfolio Returns and Portfolio Risk

Table 13: Calculation Results of Portfolio Return Expectations ($E(R_p)$) Risk Ekspektasi (σ_p^2)

Invest name	Portfolio Return Expectations ($E(R_p)$)	Portfolio Risk (σ_p^2)
COCO	1,3E-04	3,9E-07
GOOD	6,5E-04	4,2E-05
ROTI	2,7E-03	2,0E-05
SKBM	8,7E-05	4,1E-07
ULTJ	2,1E-04	6,8E-07
UNVR	1,1E-04	2,0E-06

TOTAL	3,9E-03	6.6E-05
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Based on the table of calculation results above, it can be seen that the expected return of the portfolio with the single index model is 0.39% and the portfolio risk with the single index model is 0.0066%.

CONCLUSION

From the results of the study, it can be concluded that the application of the single index model in the formation of the optimal stock portfolio obtained 6 stocks which are included in the optimal stock portfolio. The proportion value of each stock is COCO 0.84%, BAIK 59%, ROTI 35%, SKBM 0.78%, ULTIJ 1.4%, and UNVR 3% with an expected portfolio return value of 0.39% and a risk of 0.0066%.

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