

Comparison Analysis Of Optimal Portfolio Formation Results Using Single Index Model With Markowitz Model During The Covid 19 Pandemic In LQ 45 Index Company

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Abstract.

Investors with a conservative type have a tendency to avoid risk (avoid risk) can invest their funds. Therefore, a diversification is needed to determine the optimal stock portfolio, including the Markowitz model and the Single Index Model. This study aims to find out the comparison of optimal portfolio formation results by using markowitz model and single index model in the covid 19 pandemic as the object of research there are companies listed in LQ Index 45. For the period used is for 3 periods, namely February 2020 to July 2021. For data processing using the Microsoft Excel application program. The results of the expectations of return and risk from the Markowitz model and single index model show that the portfolio that is better used is the markowitz model because it has a higher return than the single index model.

Keywords: *Portofolio Optimal, Model Markowitz and Single Index Model*

I. INTRODUCTION

Since the covid 19 pandemic in Indonesia and the limited community activities, this is not a barrier for investors to invest in stocks. Many investors take advantage of the ease of supporting digital facilities, this is what causes new investors in the stock market to increase more rapidly. Therefore, 2020 is referred to as the year of the rise of domestic retail investors. [1]. Based on KSEI data recorded until November 19, 2000 the number of stock investors in idx has reached 1,503,682. There were an increase of 417,366 new single investor identification (SID) or an increase of 28% throughout 2020 [2]. Furthermore, according to KSEI data for April 2021, the number of capital market investors has reached 5,088,093 SID. This number increased by 31.11% from the end of 2020. [1]. Based on this data, this indicates that the capital market has become an attractive place to ask investors or potential investors, especially among millennials to invest. With this capital market, investors have many options to invest in accordance with the level of profit expectations while still paying attention to the risks that will be borne. Therefore, the need for a right decision for investors in investing because this is about the future that contains uncertainty.

In other words, investment is inseparable from the level of return and risk, the higher the expected level of return, the greater the risk that will be borne by investors. By paying attention to the risks that will be borne, investors need to diversity

by measuring the level of return and risk that will be obtained on the selection of portfolio stocks. To conduct portfolio analysis, a model is expected to provide clear information for investors in future investment decision making. These models are the Single Index Model and the Markowitz Model. The Single Index model uses the beta index as a risk while markowitz's model uses the principle of diversification. In other words, markowitz's model is done by combining assets in a portfolio with returns that have a less than perfect correlation with the aim of reducing portfolio risk without reducing returns. [3]. There are several studies that discuss the Single Index Model with Markowitz model, among others, according to Yuwono dan Ramdhani [4] The rate of return obtained using the markowitz model and the single index model is no higher than the risk-free asset.

Portfolio returns obtained using the markowitz model and single index models do not have a significant difference. According to Septyanto and Kertopati [5] Markowitz's model and the Single Index Model can be used to determine the stocks that make up the optimal portfolio and its proportions, but to get the best results, you can use the Single Index Model calculation. The portfolio formed from this calculation is a portfolio consisting of stocks only. So the above portfolio is not used for mutual funds, because mutual funds use risk-free investments of 20% and risk 80%. According to Rachmatullah, dkk [6] Markowitz's portfolio performance had a sharpe index value of 0.1116, treynor index of 0.0066, and jensen index of 0.0052. While the performance of the Single Index Model portfolio has a sharpe index value of 0.5919, treynor index of 0.0042, and jensen index of 0.0035. Based on some of the results of the study and the background of the problem, this study aims to find out the comparison of optimal portfolio formation results by using markowitz models and single index models in the covid 19 pandemic in companies listed in the LQ Index 45.

II. LITERATURE REVIEW

Return and Risk

Return

The rate of return in investing is referred to as return. Return can be grouped into 2 parts [7].

1. *Realized Return* (R_i)

In performing the calculation of return realization this uses historical data. This return is used as one of the measurements of the company's performance.

2. *Expected Return* ($E(R_i)$)

Furthermore, the rate of return expected by investors for the future is referred to as Expected Return. The difference from return realization with return expectations can be seen from the event where for return relation the rate of return is based on the current event while for the return expectation of the rate of return based on future events[7].

Risk

From the aspect of investment, in general, risk can be classified into 2. i.e. [7]:

1. *Systematic risk* is a macro risk which means that any changes that occur in the market as a whole can result in variability in investment returns.

2. *Unsystematic risk* risk is a risk associated with the micro condition of the company. Thus, it will specifically affect the return on investment of the company.

A method that is often used to calculate risk is a standard deviation that aims to measure the absolute deviation of values that have occurred with the value of expectations. [7].

Portfolio

In investing there are several traits of an investor that need to be known among others. [8] i.e. (1) Investors who have a conservative nature are investors who have a low tolerance to investment, (2) investors who have a moderate nature are investors who still tolerate risk in investing and (3) while investors who have an aggressive nature are investors who are accustomed to fluctuations in capital market prices, even against fluctuations that are classified as extreme. To minimize the risk that will be borne by the investor, a stock portfolio is needed. A portfolio is an investment in various types of securities, stocks, bonds, money markets and derivative products. As a combination of different types of securities with different investment weight compositions each type of securities is in one portfolio package [9] .

Markowitz Model

Markowitz's model proved to be able to provide benefits to investors in the form of portfolio risk reduction. This is because the Markowitz model uses various assumptions, including the time used only 1 period, the absence of transaction costs, investors only based on return expectations and portfolio risks only, and the last is the absence of deposits and risk-free guarantees [7]. So that markowitz approach investors can use all information as a basic reference for optimal portfolio formation [10].

Single Index Model

This single index model is a simplification of Markowitz's model theory by minimizing the input of portfolio theory analysis and reducing the number of variabel that need to be estimated [5]. In the formation of a portfolio using a single index model by collecting historical data on individual stocks that are used as inputs and analyzed to be used as outputs that can describe the performance of each portfolio [11].

III. METHODS

Type of research

The approach taken in this research is by way of quantitative approach, using event study and using data in the form of stock price list (closing price), LQ 45 data; and BI interest rates

Population and Sample

The population in this study is all companies registered in LQ 45 with the period January 2020 - July 2021 which is as many as 50 population. The sampling technique used in this study was purposive sampling. The criteria of this purposive sampling are companies listed in LQ 45 for the period February 2020 - July 2021 are companies that remain consistently included in the LQ 45 index. From these criteria obtained 40 companies that will be sampled in this study.

Variables and Research Data

The data used in this study is secondary data, obtained from www.idx.co.id, www.bi.go.id, and www.investing.com websites. Here is the decryption of variables, the data used :

Table 1. Variable Operational Definition using the Markowitz Model

No	Information	Formula
1	Calculating the stock return (R _i)	$R_i = \frac{P_t - P_{t-1}}{P_{t-1}}$
2	Calculating expected return (E(R _i))	$E(R_i) = \frac{\sum R_i}{n}$
3	Calculating Stock Risk (σ ² _i)	$\sigma^2_i = \frac{\sqrt{\sum (R_i - E(R_i))^2}}{(n-1)}$
4	Calculating Covariance Between Two Stocks (σ _{ij})	$\sigma_{ij} = \sum \frac{[(R_{it} - E(R_i))(R_{jt} - E(R_j))]}{n}$
5	Calculating Expected Portfolio Return (E(R _p))	$E(R_p) = \sum W_i E(R_i) + \sum W_j E(R_j)$
6	Calculating Portfolio Risk (σ ² _p)	$\sigma^2_p = \sqrt{\sum W_i W_j \sigma_{ij}}$

Table 2. Operational Definition of Variables using the Single Index Model

No	Information	Formula
1	Calculating the Realized Return Value (R _i)	$R_i = \frac{P_t - P_{t-1}}{P_{t-1}}$
2	Calculating expected return (E(R _i))	$E(R_i) = \frac{\sum R_i}{n}$
3	Calculating the Return Value of Market Realization (R _m)	$R_m = \frac{\text{Indeks Pasar}_t - \text{Indeks Pasar}_{t-1}}{\text{Indeks Pasar}_{t-1}}$
4	Calculating the Expected Market Return Value (E(R _m))	$E(R_m) = \frac{\sum R_m}{n}$
5	Calculating Individual Return Variance (σ ² _i)	$\sigma^2_i = \sum \frac{(R_i - E(R_i))^2}{n}$
6	Calculating Market Return Variance (σ ² _m)	$\sigma^2_m = \sum \frac{(R_m - E(R_m))^2}{n}$
7	Calculating Covariance R _i and R _m (σ _{im})	$\sigma_{im} = \sum \frac{[(R_i - E(R_i))(R_m - E(R_m))]}{n}$
8	Calculating Beta (β _i)	$\beta_i = \frac{\sigma_{im}}{\sigma^2_m}$
9	Counting Alpha (α _i)	$\alpha_i = E(R_i) - (\beta_i \cdot E(R_m))$
10	Calculate variance residual error / unsystematic risk	$\sigma^2_{ei} = \beta^2 \cdot \sigma^2_m + \sigma^2_i$
11	Calculate risk-free returns	$R_f = \frac{\sum R_f}{12}$
12	Calculating Excess Return to Beta (ERB)	$ERB = \frac{E(R_i) - R_f}{\beta_i}$
13	Calculate the value A _i	$A_i = \frac{[E(R_i) - R_f] \beta_i}{\sigma^2_{ei}}$
14	Calculate the value B _i	$B_i = \frac{\beta_i^2}{\sigma^2_{ei}}$
15	Calculating C _i and Cut Off	$C_i = \frac{\sigma^2_m [A_i]}{1 + \sigma^2_m [B_i]}$
16	Calculating the Proportion of Funds (W _i)	$W_i = \frac{Z_i}{\sum Z_j}$ $Z_i = \frac{\beta_i}{\sigma^2_{ei}} (ERB - C^*)$
17	Calculating Portfolio Beta (β _p)	$\beta_p = \sum W_i \cdot \beta_i$
18	Calculating Alpha Portfolio (α _p)	$\alpha_p = \sum W_i \cdot \alpha_i$
19	Calculating Unsystematic Risk Portfolio (σ ² _{ep})	$\sigma^2_{ep} = \sum W_i \cdot \sigma^2_{ei}$
20	Calculate the Optimal Portfolio Expectation Return	$E(R_p) = \alpha_p + \beta_p \cdot E(R_m)$

IV. RESULT AND DISCUSSION

Result

Model Markowitz

The next step in the study is to calculate the expected return of shares for each sample of the company. Of the sample number of 40 samples, companies that have a positive expectation return value of 19 companies can be seen in table 3 as follows :

Table 3. Expected Return listed on LQ Index 45 Period February 2020 – July 2021

No	Issuer Code	E(R _i)	No	Issuer Code	E(R _i)
1	ADRO	0,00976	11	ITMG	0,04334
2	AKRA	0,01263	12	JPFA	0,01464
3	ANTM	0,09442	13	JSMR	0,00571
4	BBTN	0,00978	14	PTBA	0,00447
5	CPIN	0,00045	15	PTPP	0,00103
6	CTRA	0,0192	16	TBIG	0,06964
7	ERAA	0,05779	17	TKIM	0,01136
8	EXCL	0,00439	18	TOWR	0,03937
9	INCO	0,04094	19	UNTR	0,00597
10	INKP	0,01625			

Sumber : Data diolah (2021)

From table 3 of research expected return that has a positive value. The company will be used as an optimal portfolio candidate by comparing with the company's risk. After being compared, 6 companies were obtained as portfolio candidates. The following presented stock return, expected return to be the optimal portfolio candidate as well as standard deviation in companies listed in LQ Index 45 period February 2020 - July 2021 as follows:

Table 4. Stock Return, Expected Return and Standard Deviation of Companies listed in LQ Index 45 Period February 2020 – July 2021

No	Issuer Code	ΣR _i	E(R _i)	Σi	σ _i ²
1	ANTM	1,699637	0,09442	0,23507	0,05526
2	ERAA	1,04016	0,05779	0,17864	0,03191
3	INCO	0,736998	0,04094	0,13872	0,01924
4	ITMG	0,780142	0,04334	0,1835	0,03367
5	TBIG	1,253431	0,06964	0,16427	0,02698
6	TOWR	0,708723	0,03937	0,13825	0,01911

Source: Data processed (2021)

From table 4, the highest value of return expectations is obtained in pt Aneka Tambang, Tbk (ANTM) which is 0.09442 with a risk level of 0.05526, this shows that the expected return rate has a straight relation to the risk received by an investor. After calculating the expectation of return and the level of risk, the next step is to find the

value of covariance between stocks in the optimal portfolio formation as seen in table 5.

Table 5. Covariance Between Optimal Portfolio Forming Stocks

	ANTM	ERAA	INCO	ITMG	TBIG	TOWR
ANTM	0,05525602	0,022429	0,02092	0,00388	0,01344	0,00456
ERAA	0,02242872	0,031912	0,01119	0,00331	0,02278	0,00564
INCO	0,02092356	0,011186	0,01924	0,00726	0,00801	0,01036
ITMG	0,0038767	0,003308	0,00726	0,03367	-0,0043	0,00498
TBIG	0,01344432	0,022778	0,00801	-0,0043	0,02698	0,00523
TOWR	0,0045599	0,005636	0,01036	0,00498	0,00523	0,01911

Source: Data processed (2021)

The final step in calculating optimal portfolio formation using the Markowitz model is to determine the proportion of each stock portfolio, presented in table 6.

Table 6. Proportion of Optimal Portfolio Shares

No	Issuer Code	Wi
1	ANTM	0,0946
2	ERAA	-0,1764
3	INCO	0,0268
4	ITMG	0,2949
5	TBIG	0,4511
6	TOWR	0,3092

Source: Data processed (2021)

From table 6 it can be known that the value of the highest proportion of shares is in PT Tower Bersama Infrastructer, Tbk (TBIG) of 0.4511 (45.11%) while for the lowest proportion of shares in PT Erajaya Swasembada, Tbk (ERAA) of -0.1764 (-17.64%). From table 6 this can be described the proposi chart of each stock that can be seen in figure 1

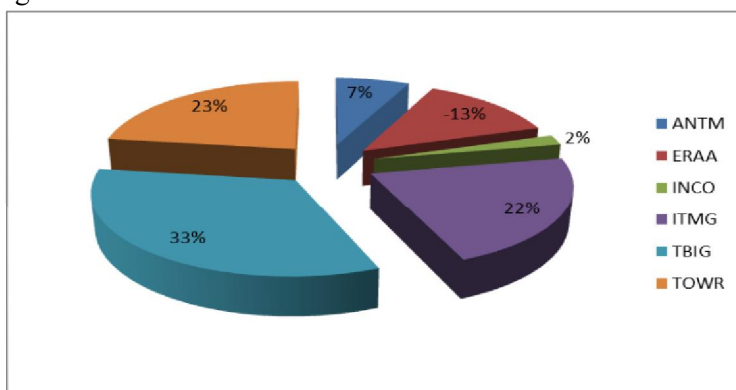


Fig 1. Markowitz Model Optimal Stock Portfolio Proprosy Graph

Source: Data processed (2021)

After calculating the proportion of the stock, the calculation is done to find the return of the portfolio of the stock with the markowitz model. The results obtained can be seen in table 6 as follows:

Table 7. Calculation of Portfolio Return and Portfolio Risk markowitz model

Description	Value
Portfolio Return (R_p)	0,05619
Portfolio Risk (σ_p)	0,09876

Source: Data processed (2021)

Based on table 7, it can be found that the portfolio return value obtained under the markowitz model is 0.05619 (5.619%) with a risk level of 0.09876 (9.876%).

Single Index Model

A single index model is a model used to find an optimal portfolio. In determining the optimal portfolio, calculations need to be done to determine the cut off point (C^*). This cut off point is the largest value of the C_i stock pool and is compared to the ERB value. If the ERB is greater than the Cut off point value then the stock meets the criteria for entry into the optimal portoflio and vice versa if the ERB value is less than the Cut off point value then the stock does not meet the criteria for entering into the optimal portfolio. Here is presented table 8 to determine the optimal portfolio stocks by using the single index model.

Table 8. Stocks That Enter the Optimal Portfolio Using the Single Index Model

No	Issuer Code	ERB	Aj	Bj	Ci	C*
1	ANTM	1,74983	0,00724	0,00414	1,81528E-06	C*
2	BBTN	-0,0111	-0,3305	29,8676	-0,5986809	C*
3	CPIN	-0,0476	-0,3114	6,53777	-0,12345058	C*
4	CTRA	-0,009	-0,2505	27,919	-0,42413576	C*
5	EXCL	-0,0254	-0,3676	14,4532	-0,32218556	C*
6	INKP	-0,0143	-0,2089	14,6191	-0,18525154	C*
7	JPFA	-0,0178	-0,2197	12,3322	-0,16429687	C*
8	JSMR	-0,0206	-0,3532	17,1161	-0,36661466	C*
9	PTPP	-0,0126	-0,5113	40,4537	-1,25451038	C*
10	TKIM	-0,011	-0,3081	27,9403	-0,52202976	C*
11	TOWR	-0,0004	-0,004	8,83925	-0,00212151	C*
12	ADRO	-2,1726	-0,004	0,00184	-4,477E-07	--
13	AKRA	-1,1088	-0,0053	0,00474	-1,508E-06	--
14	ERAA	0,01087	0,16529	15,2009	0,152381716	--
15	INCO	0,00068	0,01232	18,1876	0,013588683	--
16	ITMG	0,00241	0,02731	11,3444	0,018786327	--
17	PTBA	-0,0614	-0,2183	3,55308	-0,04703417	--
18	TBIG	0,03591	0,15021	4,18249	0,038101409	--
19	UNTR	-0,0567	-0,115	2,02767	-0,01414502	--

Source: Data processed (2021)

From table 8 it can be known that 11 companies fall into the optimal portfolio category based on the Single Index Model. Of the 11 companies, it is necessary to determine the proportion of funds to be allocated into the shares of the protfolio candidate's shares. The proportion of the funds is determined by using the presentation of funds (W_i). Calculation of the proportion of funds can be seen in table 8 as follows:

Table 9. Proposisi of funds on Stocks That Enter the Optimal Portfolio Using The Single Index Model

No	Issuer Code	β	ERB	σ_{ie2}	C*	Zi	wi	Proporsi
1	ANIM	0,03118	1,74983	0,23503	-4,47699E-07	0,232	0,005	0,5%
2	BBTN	2,71872	-0,0111	0,24747	-0,598680898	6,455	0,148	14,8%
3	CPIN	0,82769	-0,0476	0,10479	-0,123450579	0,599	0,014	1,4%
4	CTRA	2,30333	-0,009	0,19003	-0,424135756	5,032	0,115	11,5%
5	EXCL	1,39505	-0,0254	0,13465	-0,322185559	3,074	0,070	7,0%
6	INKP	1,6528	-0,0143	0,18686	-0,185251541	1,512	0,035	3,5%
7	JPFA	1,41629	-0,0178	0,16265	-0,164296865	1,275	0,029	2,9%
8	JSMR	1,65525	-0,0206	0,16007	-0,366614663	3,578	0,082	8,2%
9	PTPP	3,07251	-0,0126	0,23336	-1,254510378	16,351	0,375	37,5%
10	TKIM	2,58568	-0,011	0,23929	-0,522029757	5,522	0,127	12,7%
11	TOWR	1,10542	-0,0004	0,13824	-0,002121509	0,013	0,000	0,0%

Source: Data processed (2021)

From table 9, the largest proportion of funds is in PT Pembangunan Perumahan (Persero), Tbk (PTPP) which is 37.5% and the lowest is in pt Sarana Menara Nusantara, Tbk (TOWR) company by 0%. Based on the data, it can be described a graph of the proportion of funds for optimal portfolio stocks with a single index model that can be seen in figure 2 as follows:

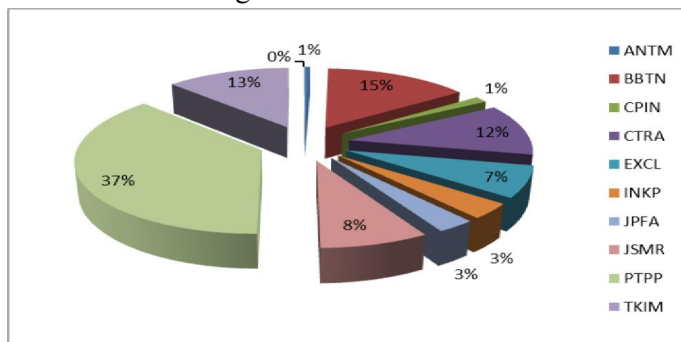


Fig 2. Proposisi Proposisi Stock Portfolio Optimal Single Index Model

Source: Data processed (2021)

After calculating the proportion of shares, calculations are carried out to find the return of the portfolio of the stock with a single index model. The results obtained can be seen in table 10 as follows:

Table 10. Calculation of Portfolio Return and Portfolio Risk Single Index Model

Description	Value
Expectations of Return ($E(R_p)$)	0,00777
Portfolio Risk (σ_p)	0,0466569

Source: Data processed (2021)

Based on table 10, it can be known that the value of portfolio return expectations obtained based on the Single index model is 0.00777 (0.77%) with a risk level of 0.0466569 (4.66569%).

V. DISCUSSION

Markowitz Model Optimal Portfolio Level

After calculations from the research sample, 19 stocks were obtained that had a positive expected return value, and only 6 companies were optimal portfolio candidates. The composition of shares resulting from the formation of the optimal portfolio with markowitz model, among others, PT Aneka Tambang, Tbk (ANTM) amounted to 0.0946 (9.46%), PT Erajaya Swasembada, Tbk (ERAA) amounted to -0.1764 (-17.64%), PT Vale Indonesia, Tbk (INCO) by 0.0268 (2.68%), PT Indo Tambangraya Megah, Tbk (ITMG) by 0.2949 (29.49%), PT Tower Bersama Infrastructer, Tbk (TBIG) by 0.4511 (45.11%) and PT Sarana Menara Nusantara, Tbk (TOWR) amounted to 0.3092 (30.92%)

Optimal Portfolio Level Single Index Model

Based on the results of calculations from 40 research samples, 19 stocks were obtained that became optimal portfolio candidates, namely stocks that had a positive return expectation value. There are 11 stocks that have an ERB value higher than the cut off rate that can be incorporated into the optimal portfolio. Of the eleven stocks, it is necessary to calculate the proportion of funds of each stock to obtain a maximum return with a certain risk or a minimum return with minimal risk. Based on the results of calculations carried out for the formation of optimal stock portfolios in research obtained the composition of optimal portfolio forming stocks with a single index model consisting of 11 companies. The eleven companies with the following proportion of funds pt Aneka Tambang, Tbk (ANTM) amounted to 0.5 PT Bank Tabungan Negara (Persero), Tbk (BBTN) by 14.8%, PT Charoen Pokphand Indonesia, Tbk (CPIN) by 1.4%, PT Ciputra Development, Tbk (CTRA) by 11.5%, PT XL Axiata, Tbk (EXCL) by 7.0%, PT Indah Kiat Pulp and Paper, Tbk (INKP) by 3.5%, PT Japfa Comfeed Indonesia Tbk (JPFA) by 2.9%, PT Jasa Marga (Persero), Tbk (JSMR) by 8.2%, PT Pembangunan Perumahan (Persero), Tbk (PTPP) by 37.5%, PT Tjiwi Kimia Paper Mill, Tbk (TKIM) by 12.5% and PT Sarana Menara Nusantara, Tbk (TOWR) by 0%.

Comparison of Markowitz Model Portfolio Level Formation Results with Single Index Models

Results obtained from companies that entered the optimal portfolio candidates in this study showed that the Optimal Portfolio with the Markowitz model provided a return on the formed portfolio of 0.05619 (5.619%) with a risk level of 0.09876 (9.876%). While the optimal portfolio with a single index model provides an expected return result of the portfolio formed is 0.00777 (0.77%) with a risk level of 0.0466569 (4.66569%). The expected return and risk of the Markowitz model and single index model show that a better-used portfolio is the markowitz model because it has a higher return than the single index model. This is not in line with the research conducted by Septyanto and Kertopati. [5].

IV. CONCLUSION

Based on the results of the analysis, it can be concluded that for the markowitz model there are 6 companies that are optimal portfolio candidates while in the Single Index model there are 11 companies. In the formation of this optimal portfolio the Markowitz model is superior when compared to the Single Index model. This is due to the expected rate of return of the markowitz model investor is higher and this is proportional to the risk received by the investor (directly proportional). As for the single index model, the expected return rate is lower than the risk received by the investor. For the next researcher who will conduct this research should focus more on research objects that include companies that belong to the category of blue chip companies because this company is the company that is the most desirable choice by investors. Further researchers are also expected to use different analytical tools that use risk concepts and use study periods with longer timescales with daily closing prices.

V. ACKNOWLEDGMENTS

The research team thanked the Ministry of Ristekdikti who had financed the study from start to finish, and LPPM STIE Sultan Agung which had facilitated the team in conducting the research. This research is the result of a Beginner Lecturer Research grant fully financed by the Ministry of Ristekdikti.

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