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OPTIMAL INVESTMENT PORTFOLIO ANALYSIS USING THE MARKOWITZ MODEL FOR STOCK IN EACH SECTOR IN THE INDONESIA STOCK MARKET DURING COVID 19 (2020-2021)

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Abstract: The COVID 19 pandemic in early March 2020 starting from Wuhan had a very large impact on the global economy and the Indonesian economy, the COVID 19 pandemic forced the government to establish a PPKM policy (Implementation of Restrictions on Community Activities) to suppress the spread of Covid 19 in Indonesia. Indonesia's State Gross Domestic Product fell in the second quarter 2021 amounting to -5.32% and also having an impact on the stock market in Indonesia at January 02 2020 the JCI was recorded at 6283 fell to 3937 in March 24 2020 (minus 36.77%) in March 2020. The results of this study using 22 of the stocks representing 11 sectors in the stock market in Indonesia obtained a maximum Sharpe ratio calculation of 31.57% with a weekly yield of 1.48% and a standard deviation of 4.39% and a maximum yield with a Sharpe ratio of 31.29% and a yield weekly yield of 1.37% and a standard deviation of 4.08%, the result of the minimum standard deviation with a Sharpe ratio of 5.92% with a weekly yield of 0.24% and a standard deviation of 2.51% and the results of Portfolio in the efficient frontier namely portfolio 6 with a Sharpe ratio of 30.94% and weekly yield of 1.3% and a standard deviation of 3.9%. For investors who want to optimize their portfolio, they can choose stocks with optimal Sharpe ratios that already pay attention to risk-adjusted return.

Keywords: optimum portfolio; investment; Markowitz; Sharpe ratio.

INTRODUCTION

Pandemic Covid 19 that hit the world since November 2019 from Wuhan China and entered Indonesia since March 2020 is an event that has never happened before and was never predicted by the market and investors. This situation had a significant impact on the world economy. There are many things have changed since Covid 19, because this virus does not have the vaccine. To avoid this virus spread fast from people to people all the countries all over the world do restriction in Travel, and lockdown in some countries. The IMF has announced that this condition has an impact on global economic growth. The Indonesian economy had a recession in COVID 19. GDP decreased 2,07% overall in 2020 from a year earlier, marking the first full-year decline since the Asian financial crisis of 1998. This was close in the middle of the government's predicted range of a 1,7-2,2% fall and slightly greater than the 2 percent contraction. On a yearly basis, the GDP increased by 5% in 2019. Indonesia has struggled to this condition and find the way out of this recession. This condition impact to the Indonesia stock exchange, market response to this unpredictable condition and fall down the Jakarta composite index, in 24 March 2020 the Jakarta Composite Index hit the level 3.937, as we know in the early 2020 the JCI in level 6300. The condition of this recession impact mostly stocks in the capital market.

In this condition that has never happened before, author want to observe the sector in Jakarta Stock Exchange that drag the JCI to the worst level, and during since covid 19 in march 2020 until end of December 2021 author want to see which sector are impact to this condition. Through the recession and expansion in the business cycle phase. The author will observe the condition of the market during business cycle and in this condition in Covid 19 during recession and expansion, and after weight the portfolio we can forecasted, what sectors will perform compared to others. As the economy moves forward different sectors of the business tend to perform better than the others. Sector rotation strategy is taken advantages in investing in the industries or sectors that are rising and avoiding sectors that are failing to generate superior return and how to get the optimal portfolio during Covid 19.

Table 1. GDP Growth Indonesia

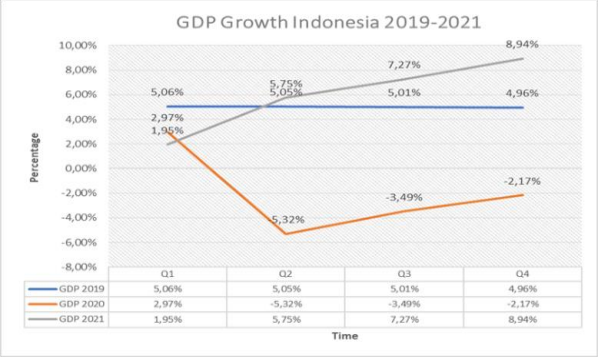


Table above is the condition of GDP growth Indonesia from 2019-2021, the negative GDP growth from quarter 2 and quarter 3 in 2020, the impactful of this pandemic take economic in Indonesia in Quarter 4 2020 into recession.

Literature Review

a. Risk and Return

We need a definition of risk that focuses on the fact that the outcomes of financial and economic decisions are almost always unknown at the time the decision are made. The definition of Risk is "a measure of uncertainty about the future payoff to an investment, assessed over some time horizon and relative to a benchmark. The elements of this definition are risk measure that can be quantified, risk arises from uncertainty about the future, risk has to do with the future payoff an investment, which is unknown, risk refers to an investment or group of investment, risk must be assessed over some time horizon, and risk must be assessed relative to a benchmark rather than in isolation.

The two measurements of risk, the first is based on a statistical concept called the standard deviation and is strictly a measure of spread, and the second called value at risk is a measure of riskiness of the worst case.

1. Variance and standard deviation

The variance is defined as the average of the squared deviations of the possible outcomes from their expected value, weighted by the probabilities. It takes several steps to compute the variance of an investment, first compute the expected value and then subtract it from each of the possible payoffs. Then square each one of the results, multiply by its probability and finally add up the results.

The standard deviation is the positive square root of the variance. The standard deviations are more useful than the variance because it is measured in the same unit as the payoff: dollars, (variance is measured in dollars squared). The more spread out the distributions of possible payoffs from an investment the higher standard deviations and the bigger risk. Standard deviation is the most common measure of financial risk, and for most purposes it is adequate.

The Sharpe ratio is one of the most widely used methods for measuring risk adjusted relative return and also described the compensation that investor that can take for the expected return to investment. The Sharpe ratio can be used to evaluate a portfolio's risk-adjusted performance. The greater a portfolio's Sharpe ratio the better risk performance. A negative Sharpe ratio means the risk free or benchmark rate is greater than the portfolio's expected return.

$$\boldsymbol{Sharpe\ ratio} = \frac{\boldsymbol{E}\ (\boldsymbol{rp}) - \boldsymbol{r_f}}{\boldsymbol{\sigma_P}}$$

$\boldsymbol{E}\ (\boldsymbol{rp})$: Expected excess return of the portfolio

$\boldsymbol{r_f}$: Rate of return on a risk-free asset

$\boldsymbol{\sigma_P}$: standard deviation of the return of the market portfolio

The higher the Sharpe ratio value, the better because it reflects that the reward is better per standard deviation and in other words the portfolio will be more efficient. Calculation by comparing return and risk is also known as mean-variance analysis. Sharpe with the maximum value is in the mean-variance efficient frontier (Kourtis, 2016).

b. Markowitz Model

Modern portfolio theory uses the

Markowitz model, commonly referred to as the mean-variance model, as a mathematical tool to assist investors in maximizing expected return while lowering portfolio risk. It was created in 1952 by Harry Markowitz and is a crucial tenet of contemporary financial theory. The approach is predicated that the variation of a portfolio's returns can be used to investor's risk appetite. The model presupposes that investors will aim to minimize the variation of their portfolio returns while still attempting to maximize their expected return since they are risk averse.

Calculation the log return of each risky assets

$$R_{it=} LN \frac{P_{it}}{P_{it-1}}$$

R_{it} *: Return on individual asset period time*

P_{it} *: stock price period time*

P_{it-1} *: stock price period time-1*

Calculation Expected return of each risky assets

$$E_{ri=} \frac{\sum_{i=1}^{N} R_{it}}{N}$$

$E_{(ri)}$ *: Average expected Return*

R_{it} *: Return on individual asset period time*

N *: Number of Risky assets*

Calculation variance and Standard Deviation

$$\sigma_i^2 = \frac{\sum_{j=1}^{N}((R_{ij} - E(R_{ij}))^2}{N}$$

$$\sigma_i = \sqrt{\sigma_i^2}$$

Calculation co-variance stocks in the portfolio

$$Cov\,(R_i R_j) = \rho_{ij}\sigma_i\,\sigma_j$$

Calculation the weight (Wi) of each stock by using Solver Add-in Excel

Calculation Expected Return of the Portfolio

$$\boldsymbol{E(R_p)} = \sum_{i=1}^{n} \boldsymbol{W_i}\, \boldsymbol{E(R_i)}$$

Calculation variance of the portfolio

$$Var\,(\boldsymbol{R_p}) = \boldsymbol{\sigma_i}^2 = \boldsymbol{W_i^2\sigma_j^2} + \boldsymbol{W_i^2\sigma_j^2} + 2\boldsymbol{W_i W_j}\, Cov\, \boldsymbol{R_i R_j}$$

This formula modified by the number of the risky asset.

MATERIALS AND METHODS

In this paper we will evaluate stock in the Jakarta Composite Index that related to the sector, in Jakarta Composite Index there are stock that classified by the sector and there is the index that reflect to the performance of the sectoral stock name JASICA (Jakarta Stock Industrial Classification), but in 25 January 2021, Jakarta stock exchange implemented new index sectoral name IDX-IC.

The Author will use the data of Jakarta Composite Index (JCI) from 2020-2021 and the sectoral index will used data from 2020-2021. In this research we also we divine the condition before, during and after Pandemic COVID 19 in the stock market in Jakarta Composite Index. Figure 3.2 and 3.3 show to us the condition of the Sectoral Index during 2019 until 2021. In 2019-2020

the sector that get the best performance is IDX Mining this condition related to the trade war between US and China and in 2020-2021 the IDX Energy performance significantly above the benchmark JCI.

Risk Free Rate

Risk free rate return is the rate of return of an Investment with Zero Risk, this indicates how much return that the investor needs from the investment over a specified period. In practice the risk-free rate of return does not truly exist, every investment will at least have a small amount of risk. In Indonesia we use 10-year government bond yield as the risk-free rate and as the consideration that there is default risk (for local who invest in Indonesia assume that there is no risk for local people, interest rate risk (assume that we will hold the bond until it matured) and Reinvestment risk (assume that we invest to the bond that have zero coupon bond). In this paper the author uses the average historical data weekly of 10-year Government Bond. Data in 2020-2021.

Data Analysis Method

This step is methodology that use in this research, there are many different methods for analysing data and which one is best depends on the specific goals of the analysis and the characteristics of the data. In this final research we use quantitative data analysis. This involves analysing data that is in numerical form. It typically involves using statistical techniques to summarize and interpret the data. Some common techniques used in quantitative data analysis is Inferential statistics, this involves using statistical test to make inferences about a population based on a sample of population and regression analysis this involves modelling the relationship between one or more independent variables and a dependent variable. This Quantitative data analysis can be used to test hypotheses make prediction and identify patterns and trends in the data.

RESULTS AND DISCUSSION

The analysis of the portfolio using the Markowitz model and identify the risk and return of each risky assets, we will define the result of the Portfolio that we choose and the performance of the market. We also define the beta of each asset and from the beta we calculate the Treynor ratio and the Sharpe Ratio, then the result we can see the performance of our portfolio comparison with the market, the comparison here is using Jakarta Composite Index. we can see with the Markowitz Model and diversification our investment we can optimalization our portfolio even the market only can give 0.09 % return weekly we still can get higher than the market with the minimum risk. From the yearly performance of the portfolio, we can see a very big difference by comparing the standard deviation which is not too big.

In this paper the author has evaluate the condition of the condition of the Pandemic situation in March 2020 and the condition after the market recovery and market can predict the condition after pandemic, the data identification is in 2020 and 2021. From the calculation the author finds that even the market are recession in the Quarter 1 2020 (March) for the first time

case of Covid 19 are announced bring the Jakarta Composite Index to the lower level in but the condition is recovery bring the Jakarta Composite Index to the lower level in 16 March 2020 with the closed price 4194,94 but the condition recovery in the end of year 2020 to 5879.07 and in end of year 2021 6581.48. Even in the pandemic that impact to the market stock in Indonesia, the investor still need cash in their investment and by using buy and hold strategy in the end the market still back to the high level.

The calculation of the efficient frontier is the simulation to find the maximum return of the risky assets and get the minimum standard deviation. The efficient frontier is the set of the optimal portfolio. Successful optimization of the return versus risk should place the portfolio along the efficient frontier line. Markowitz also makes several other assumptions in his theory, including the notions that investors are rational and seek to minimize risk, that there are insufficient investors to have an impact on market prices, and that investors have unrestricted access to borrowing and lending money at the risk-free interest rate. The market, however, includes irrational and risk-taking investors, there are sizable market participants who could affect market pricing, and there are investors who do not have unrestricted access to borrowing and lending money. These facts demonstrate that the market is not completely rational.

This are the solver parameters to find the efficient frontier:

1. Open Excel, Data Solver and set the objective the Standard Deviation and setting to the minimum
2. The changing value is the weight of the portfolio of the risky assets
3. Make some constraints, the total of portfolio must be 1 or 100%
4. The weight of risky assets is >=0
5. Set the expected return = the expected that the author has decided

In the table we can see the solver parameters and constrained

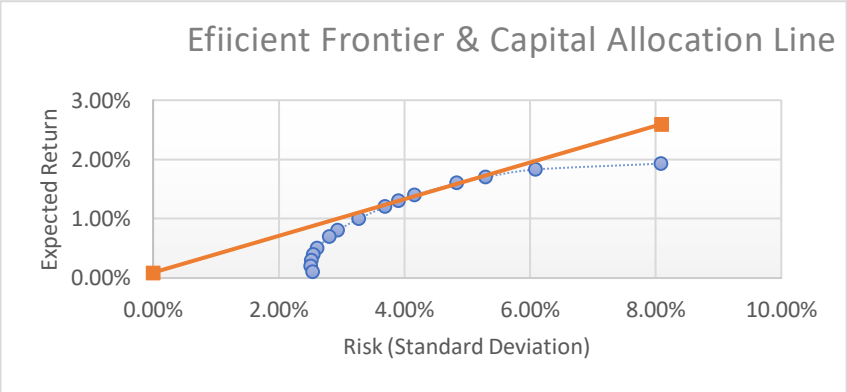
Capital Allocation Line

The Capital Allocation Line (CAL) is a graphical presentation of the efficient frontier for two or many assets portfolio, this CAL showing us the expected return and the risk of risky assets. The CAL is the straight line that starts from the risk-free asset and extend to the risky portfolio. the portfolio can be created by combining the risk-free assets and the risky portfolio. Positive slope of CAL will occur if the risky portfolio has less risk than the risk-free asset, but if the risky portfolio has more risk than the risk-free asset, the CAL will have a negative slope. This CAL uses in investment to help the investor to choose the optimum portfolio in investment based on their risk appetite.

Table 2. Capital Allocation Line

Capital Allocation Line		
Risk-free Rate	0,09%	
Portfolio 6 Return	1,300%	
Portfolio 6 Variance	3,904%	
CML Slope/Sharpe Ratio	30,938%	
Variance (X)	0,00000	0,08085
CAL (Y)	0,09%	2,59%

Figure 1. Efficient Frontier and Capital Allocation Line



From the calculation above we can see the capital allocation line of this asset is the portfolio that intersects with the risk-free asset, we find the portfolio in the capital allocation line and more left of the assets higher expected return with minimum of risk.

Table 2. Portfolio 6 in the efficient frontier

Weight of stock								Return	Risk (SD)	Beta	Sharpe
TBIG	EMTK	ASSA	MTDL	MIKA	UNTR	BBCA	ADRO				
24,74%	24,13%	18,71%	13,39%	11,38%	4,77%	2,18%	0,70%	1,30%	3,90%	0,86	30,94%
								0,09%	2,92%	1	-0,07%

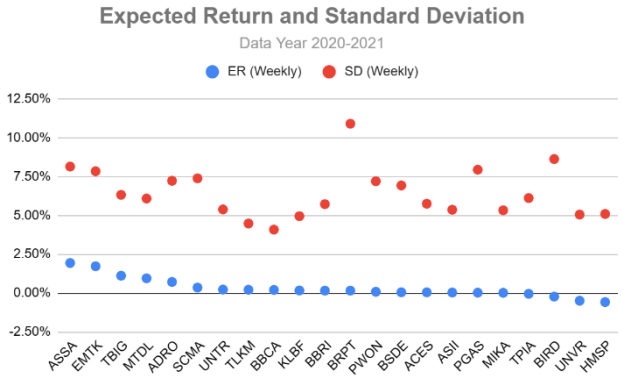
Table 3. Portfolio 6 Risk and Return

Investment	Weight of stock								Return (weekly	Risk (SD)	Return (yearly)	Risk (SD)
	TBIG	EMTK	ASSA	MTDL	MIKA	UNTR	BBCA	ADRO				
Portfolio 6	24,74%	24,13%	18,71%	13,39%	11,38%	4,77%	2,18%	0,70%	1,30%	3,90%	96%	28,15%
JCI									0,09%	2,92%	4,8%	21,07%

Table 4. Stock Selection

No	Sector	2020-2021	
		Kode Saham	Saham
1	**Energy**	PGAS	Perusahaan Gas Negara
		ADRO	Adaro Energy
2	**Basic Materials**	TPIA	Chandra Asri Petrochemical
		BRPT	Barito Pacific
3	**Industrials**	ASII	Astra International
		UNTR	United Tracktors
4	**Consumer Non Cyclicals**	UNVR	Unilever
		HMSP	HM Sampoerna
5	**Consumer Cyclicals**	SCMA	Surya Citra Media
		ACES	Ace Hardware Indonesia
6	**Healthcare**	KLBF	Kalbe Farma
		MIKA	Mitra Keluarga Karyasehat
7	**Financials**	BBCA	Bank BCA
		BBRI	Bank BRI
8	**Properties and Real Estate**	PWON	Pakuwon Jati
		BSDE	Bumi Serpong Damai
9	**Technology**	EMTK	Elang Mahkota Teknologi
		MTDL	Metrodata Electronics
10	**Infrastructure**	TLKM	Telkom Indonesia
		TBIG	Tower Bersama Infrastructure
11	**Transportation and Logistic**	ASSA	Adi Sarana Armada
		BIRD	Blue Bird

Table 5. Risk and return of risky asset



Stock calculation of the return by calculating stock from the data weekly from January 2020-December 2021. We can see the from the data chart that the Stock ASSA that give highest return does not stock with highest standard deviation. The highest standard deviation of the stock BRPT (Basic Materials) which the Standard Deviation is 10.89 % and the return is 0.151%

CONCLUSIONS

The strategy of individual investment is based on risk appetite to investor, if we can see from table above the minimum expected return, we can get is 13.32% with standard deviation is 18.09 % and Sharpe ratio is 5.92 %, and the second is the equal weight of each stock of portfolio with expected return 17.25% with standard deviation 25.83% and the Sharpe Ratio 5.98%. We can see that the portfolio 6 and the maximum expected return have almost the same number of calculations for Maximum expected return the expected Return is 102.79 % and standard deviation 29.42 % with Sharpe ratio 31.29 % and for The Portfolio 6 the Expected return 95.75%,

standard deviation 28.15 % and the Sharpe ratio 30.94%. The aggressive investor can choose the portfolio Maximum Sharpe Ratio with Expected Return 114.615, standard deviation 31.69 % and Sharpe Ratio 31.57%. however, investors must know that this is a historical calculation that can be applied in making investments. However, as investors, we must also look at other aspects, such as top-down analysis, fundamental analysis, technical analysis for the selection of stocks used from each sector. In this calculation it can be concluded that the Markowitz model can be used in every business cycle.

Investor can use this Markowitz Model to do their investment in doing diversification, the investor can use this strategy in any kind of business cycle and the investor can get the maximum return. A higher Sharpe ratio indicates that an investment has a higher return relative to its risk. The Sharpe ratio is widely used measure of risk adjusted return. It is calculated by dividing the excess return of an investment (the return in excess of the risk-free rate)

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