PORTFOLIO DETERMINATION AND MARKOWITZ EFFICIENT FRONTIER IN FIVE INDONESIAN INDUSTRIAL SECTOR

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Abstract-The goal of this thesis is to construct an optimal and efficient portfolio of 5 Indonesia indsutrial sector stocks. The time horizon of this thesis is from February 2011 until November 2012. There are 2 portfolios that have been created. Those 2 are Maximum Return portfolio, and Minimum Standart Deviation portfolio. The creation of those 2 portfolios was helped by the MS Excel Solver add-ins to determine the weights of each stock in a portfolio. Then those 2 portfolios compared to each other and the market with some performance measurements like Sharpe ratio, Treynor measure, and Jensen's Alpha. The outputs of this research are the portfolio which generates the highest return also turns out to have the best perfomance among other portfolios based on Sharpe Ratio and Jensen Alpha. This portfolio has a Sharpe Ratio of 19,59% with Jensen Aplha of 0,37%. This research has its scope and limited based on stocks that has been chosen by the writer which consistently included in the index from February 2012 until November 2012. All the stocks that the writer chose is based on the fundamental factor of each stock such as Price Earning Ratio (PER), Earning per Share (EPS), Return on Asset (ROA), and Return on Equity (ROE) which is often used by the investors to analize the company's stocks for long term investment. The outcome of this thesis is an investment to the Maximum return portfolio which has the best performance among the other portfolios and the market from February 2011 until November 2012. This research creates an optimal and efficient portfolio of Five Indonesian indsutrial sector for investors.

Keywords: Portfolio Construction, Performance Analysis, Sharpe Ratio, Treynor's Measure, Jensen Alpha.
Category: Finance; Performance Management.

Introduction

Capital market is an economic sphere where investors seek to optimize risk and return from instruments such as stocks, bonds, and other financial instruments. To succesfully undertake this condition, whether to gain a high expected return or minimize the standart deviation of their portfolio, the investors need to analyze and calculate the best portfolio of assets that can maximize their return or minimize their risk. With the growing of financial market in Indonesia, surely the investors both local and foreign will want to invest in Indonesia's stock market. But as we know, to invest we must deal with the risk losing our money. The investor that does not understand how to choose the right composition for their portfolio might lose their money instead of receive the expected return.

IHSG stands for "Index Harga Saham Gabungan" or in international market known as JSX Composite. It was introduce for the first time in April 1st 1983. The first day JSX Composite begin at August 10st 1982 with the starting price Rp100 with 13 Stocks. The Formula for calculating the market value of JSX Composite is:

$$IHSG = \frac{\sum p}{d} x 100$$

Where p is the closing price in the reguler market.
x, is the number of stocks.
and d, is base price.

From the first time it open in 1983, the price of the index has increasing from time to time. Just look at the figure below.
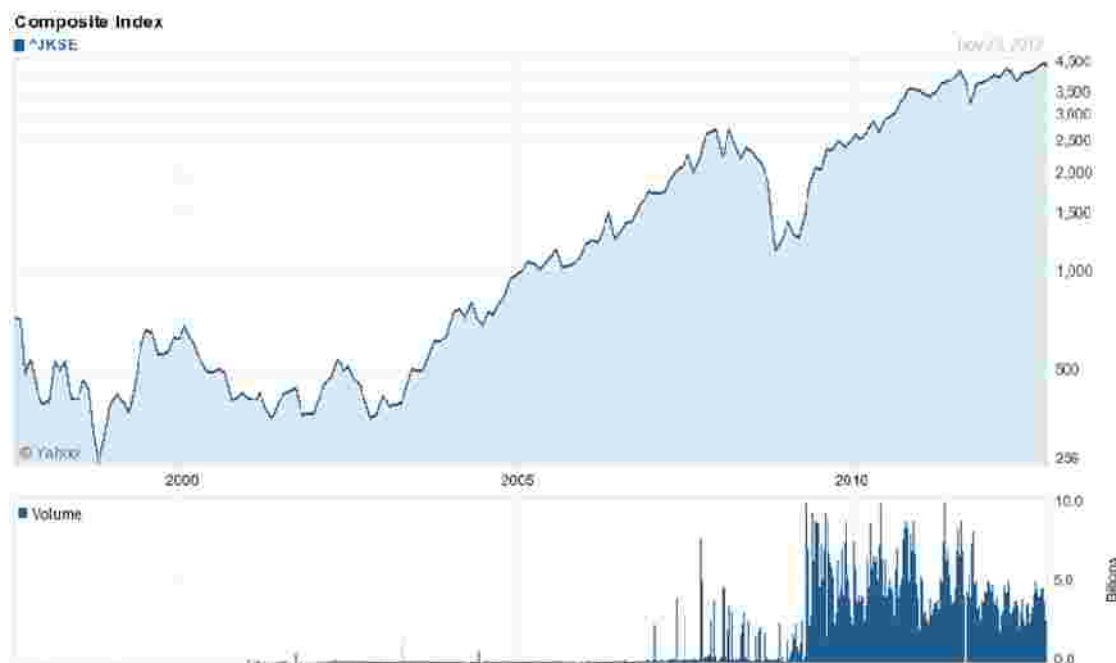
Figure 1.1 – Basic Price Chart of JSX Composite

From the figure above, we can see that the price of JSX Composite has been increasing since 2000 and now reaching it's highest price in 2012.

Because the price of the index is increasing, we must take this opportunity to invest in this stocks. And the writer is choosing various stock from different sector. The writer decides to choose various stocks from different sector is to diversity the portfolio. The stocks that are chosen for this research is Garda Tujuh Buana Tbk. (GTBO), which represent the mining sector stock. Surya Semesta Internusa Tbk. (SSIA), which represent the property sector stock. Citra Marga Nusaphala Persada Tbk. (CMNP), which represent Infrastructur sector stock. Lippo Securities Tbk. (LPPS), which represent Financial sector stock. And Star Pacific Tbk. (LPLI), which represent Trade sector stock.

Literature review

Investment
According to book Fundamentals of Investing (Gitman, Lawrence J. 1990), investment is any vehicle into which funds can be placed with expectation that it will generate positive income and/or preserve or increase its value. And according to investor words, there are two types of investment. First is the difinition of investment in Finance which is, the purchase of the financial product or other item of value with an expectation of favorable future returns. In general terms, investment means the use money in the hope of making more money. And another definition of investment in business which is, the purchase by a producer of a physical good, such as durable equipment or inventory, in

the hope of improving future business. While for investment, there are many type of investment in this world. Two of the investment types are securities and property.

There are two types of investors. the first one is individual investor. Individual investors are investors who manage their own funds in order to achieve their own financial goals. The second type of investors is institutional investors. Institutional investors are investment professional who are paid to manage other people's money. Beside those types of investors, there are also many types of investor according to their characteristic. Their characteristic has a huge role in determining how they choose stocks or how they manage their investment to gain the profits. One of the characteristic of investor in investing is about the risk profile or risk preferences.

The risk profile is determining about how much risk that investor can take for the investment. Since the risk of each stock is different one to another, the characteristic of each investor is determining how they choose the stock. According to Gitman in his book Principles of Managerial Finance (Gitman, Lawrence J. 2007), there are three basic types of risk preferences which are risk-indifferent, risk-averse, and risk-seeking. The explanation of those types is as follows:

- Risk-indifferent means that the attitude toward risk in which no change in return would be required for an increase in risk. This characteristic is can't be found in almost any business context.
- Risk-averse means that the attitude toward risk in which an increased return would be required for an increase in risk. This characteristic required higher expected returns to compensate for taking higher risk.
- Risk-seeking means that the attitude toward risk in which a decreased returns would be accepted for an increase in risk. This characteristic is willing to give up some return to take more risk.

Capital Market Instrumen
Investment in common stock

Common Stock
Common stock is a form of corporate equity ownership, a type of security. If the company's profit is increased, the stock price will also increase so that the value in these companies will also increased. Common stock usually carries with it the right to vote on certain matters, such as electing the board of directors. However, a company can have both a "voting" and "non-voting" class of common stock. That means the holder of the common stock has the influence to the corporation through votes on establishing corporate objectives and policy, stock splits, and electing the company's board of directors.

Stock's Fundamental Analysis
The stocks fundamental analysis is crucial to determine whether the stocks that has been chosen is good or not for long term investment. The writer decides to choose the stocks by using 4 criteria for fundamental analysis:

Earning Per Share
Earnings per share are generally considered to be the single most important variable in determining a share's price. It is also a major component used to calculate the price-to-earnings valuation ratio. Earning Per Share can be calculated as:

<u>Earnings After Tax</u>
Number of Shares outstanding
2.2.1.2.2 P/E Ratio

In general, a high P/E suggests that investors are expecting higher earnings growth in the future compared to companies with a lower P/E. However, the P/E ratio doesn't tell us the whole story by itself. It's usually more useful to compare the P/E ratios of one company to other companies in the same industry, to the market in general or against the company's own historical P/E. It would not be useful for investors using the P/E ratio as a basis for their investment to compare the P/E of a technology company (high P/E) to a utility company (low P/E) as each industry has much different growth prospects. P/E Ratio can be calculated as:

Market   Value   per   Share
Earnings per Share (EPS)

Return on Assets

ROA tells you what earnings were generated from invested capital (assets). ROA for public companies can vary substantially and will be highly dependent on the industry. This is why when using ROA as a comparative measure, it is best to compare it against a company's previous ROA numbers or the ROA of a similar company. The formula of ROA is:

$$= \frac{\text{Net Income}}{\text{Total Assets}}$$

Return on Equity

The amount of net income returned as a percentage of shareholders equity. Return on equity measures a corporation's profitability by revealing how much profit a company generates with the money shareholders have invested. ROE is expressed as a percentage and calculated   as:

Return on Equity = Net Income/Shareholder's Equity

Optimum Portfolio

the optimum portfolio concept falls under the modern portfolio theory by Harry Markowitz. The investors is trying to minimize risk while seeking the highest return as possible. To find the optimum portfolio for the investor, means the investors needs to find the best combination of the risk-free asset and the market portfolio.
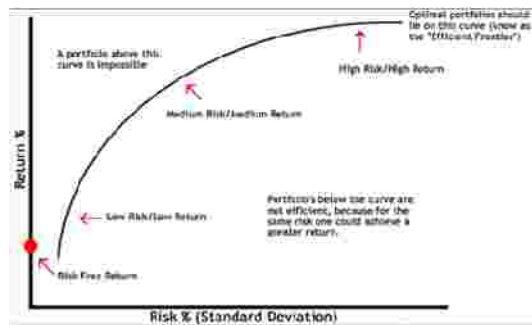

Figure 2.1 – illustration of optimum portfolio

The chart above illustrates how the optimal portfolio works. The portfolio combination that falls along the curve known as the "Efficient Frontier" indicates that the portfolio is in the right position, thus they can be deemed Efficient. So far, the writer have seen that the investors have two portfolio that the investors can choose. If the investor's desires a minimum amount of risk, the investors must take the portfolio that has minimum variance portfolio. If the investors desires to maximize the return   of   the   portfolio,   the   tangency   portfolio   must   taken   by   the   investors.

Risk and Return

According to book written by Gitman, Principles of Managerial Finance (Gitman, Lawrence J. 2007), risk is defined as the change of financial loss or, more formally, the variability of returns associated with a given assets. The term risk is fit to represent the uncertainty of the conditions that will happen in the future. The more certain of some conditions in the investment, then it means the more certain the return of some investment, and means that the less risk and vice versa.

Gitman also defined return in his book as the total gain or loss experienced on an investment over a given period of time; calculated by dividing the asset's cash distributions during the period, plus change in value, by its beginning-of-period investment value. From that definition, return is not always express the profit, it also express the loss that the investors gain from their investment. The relationship between risk and return may be derived from the basic investment decision in which there is a risk, the return that follows must be equal. If the investors faces high risk in investment, then the rate of return earned must be high too (high risk, high return).

Rate of Return

Rate of return is the ratio of the return of money gain or loss from the investment that the investor does. The money invested may be referred to as asset, capital, principal, or the cost basis of the investment. The rate of return is expected of an investor can be calculated from the data that already exist and future investors expectations. The result of rate of return is usually expressed as a percentage. There are two types of calculation that can be use for calculating rate of return which are arithmetic rate of return and logarithmic rate of return. Both arithmetic and logarithmic formula can be defined as follows:

Arithmetic Rate of Return

$$r_{arith} = \frac{(P_1 - P_0)}{P_0}$$

(2.1)

Where
P_0 = beginning price of an asset
P_1 = ending price of an asset

Standart Deviation

The standart deviation is often used by the investors to measure the risk of their assets. Gitman define the standard deviation as the most common statistical indicator of an asset's risk which measures the dispersion around the expected value. The higher the standard deviation means that it has greater risk and vice versa. The formula of standard deviation is as follows:

$$\sigma = \sqrt{\frac{\sum_{i=1}^{n}(r_i - \bar{r})^2}{n - 1}}$$

Where
s = standard deviation
r_i = return for outcome i
$\bar{r}$ = average return
n = total number of outcomes

Coefficient of Variation
From the Gitman's book, the coefficient of variation, CV, is a measure of relative dispersion that is useful in comparing the risk of assets with differing expected returns. The higher the coefficient of variation, the greater the risk and therefore the higher the expected return. The formula of coefficient of variation is as follows:

$$CV = \frac{\sigma_r}{\bar{r}}$$

(2.4)

Where
s_r = standard deviation
$\bar{r}$ = average return

Beta Coefficient
According to book written by Gitman, the beta coefficient is a relative measure of nondiversifiable risk. It is an index of the degree of movement of an asset's return in response to a change in the market return. Whereas the market return is the return on the market portfolio of all traded securities, in this case is IHSG. The formula to calculated beta is as follows:

$$\beta = \frac{Cov\,(R_i,\ R_m)}{Var\,(R_m)}$$

(2.5)

Where:
ß = beta
Cov (x,y) = covariance of the component x and y
Var (x) = variance of the component x
R_i = return on investment
R_m = return on market

Portfolio Return
From the book written by Gitman, the return on a portfolio is a weighted average of the returns on the individual assets from which is formed. The formula of portfolio expected return is as follows:

$$r_p = (w_1 \times r_1) + (w_2 \times r_2) + \cdots + (w_n \times r_n) = \sum_{i=1}^{n} (w_i \times r_i)$$

(2.6)

Where
r_p = portfolio return
w_n = weight on asset n
r_n = return on asset

Portfolio Standard Deviation
Portfolio standard deviation measures the risk or volatility of the investor's portfolio. The portfolio which most of them consist of individual asset that has high standard deviation will create a portfolio which has a high risk also. According to the book Capital Markets written by Fabozzi and Modigliani, the formula of portfolio standard deviation is defined as follows:

$$\sigma_P = \sqrt{w_x^2\sigma_x^2 + w_y^2\sigma_y^2 + 2w_xw_y\sigma_x\sigma_y\rho_{xy}}$$

(2.7)

Where:
s_p = portfolio standard deviation
w_x or w_y = weight of stock x or y
s_x or s_y = standard deviation of stock x and y
$?_{xy}$ = correlation between stock x and y

Portfolio Variance
A formulation which measures the portfolio risk that based on statistical approach from an average of two assets is called portfolio variance. Portfolio variance is defined as portfolio standard deviation squared. According to Fabozzi and Modigliani, the formula of portfolio variance is as follows:

$$\sigma_P^2 = w_x^2 \sigma_x^2 + w_y^2 \sigma_y^2 + 2w_x w_y \sigma_x \sigma_y \rho_{xy}$$

Where:
s_P^2 = portfolio variance
w_x or w_y = weight of stock x or y
s_x or s_y = standard deviation of stock x and y
$?_{xy}$ = correlation between stock x and y

Portfolio Beta
According to Gitman, portfolio beta is indicating the degree of responsiveness of the portfolio's return to changes in the market return. The beta of a portfolio can be easily estimated by using the betas of the individual assets it includes. The formula of portfolio beta is as follows:

$$\beta_p = (w_1 \times \beta_1) + (w_2 \times \beta_2) + \cdots + (w_n \times \beta_n) = \sum_{i=1}^{n} (w_i \times \beta_i)$$

Where:
β_p = portfolio beta
w_n = weight of asset n
β_n = beta of asset n

The beta for the market is equal to 1. Therefore, stock that has beta greater than 1 is more risky than the market and stock that has beta lower than 1 is less risky from the market. From the formula above, it can be conclude that a portfolio containing mostly low beta assets will have a low beta portfolio and vice versa.

Portfolio Correlation
The best way to minimize risk of a portfolio is by diversifying of asset that included in the portfolio itself. The correlation is used to measure the relation between series of number representing any kind of data, in this case is asset. According to Gitman in his book Principles of Managerial Finance, the concept of correlation is essential to developing an efficient portfolio. Gitman also said that to reduce overall risk, it is best to diversify by combining, or adding to the portfolio, assets that have a negative (or a low positive) correlation. In general, the lower the correlation between assets returns the greater potential diversification of risk, which means the greater potential to minimize the portfolio's risk. That is why to construct a better portfolio, it is best to combine stocks that have a negative correlation or a low positive correlation to reduce or to minimize the portfolio's risk itself.

Markowitz Efficient Frontier Theory
Markowitz Efficient Frontier Theory is a theory in finance which developed by Harry Markowitz and also known as Modern Portfolio Theory (MPT). This theory helps to create a set of efficient portfolio that gives the highest return at any given level of risk. A portfolio can be considered as efficient portfolio if there is no other portfolio that gives higher expected return with the same or lower risk. According to this theory, the key to construct a portfolio that gives the highest return at any given level of risk is on the proportion or weight of various assets in the portfolio. By carefully choosing the proportion from various assets, an efficient portfolio can be constructed. The Modern Portfolio

Theory also can be describe as the mathematical concept of diversification in investing since this theory also can be used to reducing the portfolio risk with a given level of return.

Along with the time, the implementation of this model is different with the conditions in the real world. Therefore several assumptions have been set by Markowitz for the implementation of MPT. Those assumptions are as follow:
1. All investors aim to maximize economic utility (in other words, to make as much money as possible, regardless of any other considerations).
2. All investors are rational and risk-averse.
3. All investors are price takers and their actions do not influence prices.
4. Risk/Volatility of an asset is known in advance or is constant.
5. Correlations between assets are fixed and constant forever.
6. There are no taxes or transaction costs.
7. Investors have an accurate conception of possible returns.
8. Investors are interested in the mean-variance optimization.

After constructing a number of sets of efficient portfolios, an efficient frontier is formed. From the sets of efficient portfolio, there will be one portfolio that can be called as the optimal portfolio. According to Markowitz, the optimal portfolio is the efficient portfolio which generating the highest reward-to-volatility ratio (Sharpe ratio). An optimal portfolio which has the highest Sharpe ratio shows that the portfolio is generating higher excess return from every risk level taken than the other portfolios.

Sparse and Stable Markowitz Portfolio
According to the paper published by Brodie, Sparse and Stable Markowitz Portfolio (Brodie, Joshua. 2008). Considering the problem of portfolio selection within the classical Markowitz mean-variance framework, reformulated as a constrained least square regression problem. We propose to add to the objective function a penalty proportional to the sum of the absolute values of the portfolio weight.
This penalty stabilizes the optimization problem, thus, encourages sparse portfolio. (i.e., portfolios with only few active positions), and allows accounting for transaction cost.

In this paper, Brodie discussed a regularization of Markowitz's portfolio construction and augmenting the original Markowitz objective function by adding a penalty term proportional to the sum of the absolute values of the portfolio weights. They adjust the importance of this penalty with a "tunable" coeeficient. For large values of this coefficient, optimization of the penalized objective function turns out to be equivalent to solving the original problem under an additional positivity condition on the weights.

In conclusion, they have devised a method that constructs stable and sparse portfolios by introducing a penalty in the Markowitz portfolio optimization. They obtain as special cases the no-short-positions portfolios that also comprise few active assets. Such a sparsity property of the non-negatives portfolios has not been previously noticed in the literature. The portfolios they propose can be seen as natural extension of the no-short-positions portfolios and maintain or improve their performances while preserving their sparse nature as much as possible.

Portfolio Selection
According to Harry Markowitz, Portfolio Selection (Markowitz, Harry. 1952), the process of portfolio selection is divided into two stages. The first stage is observing and experience with the end result of believing about the future performances of avalaible securities. The second stage is choosing the portfolio with the relevant beliefs about future performances of the portfolio itself.

There is a rule which implies both that the investors should divesify and that the investors should maximize their expected return. It assumes that there is a portfolio which gives both maximum

expected return and minimum variance, and it commends this portfolio to the investors. The portfolio with maximum expected return is not necessarily the one with minimum variance. There is a rate at which the investors can gain expected return by taking on variance, or reduce variance by giving up the expected return.

Asset Allocation Models
According to the paper Asset Allocation Models Using the Markowitz Approach (D. Kaplan, Paul. 1998). A basic premise of economics is that, due to the scarcity of resources, all economic decisions are made in the face of trade-offs.

Markowitz identified the trade-off facing the investor, risk versus expected return. The investment decision is not merely which securities to own, but how to divide the investor's wealth among securities. And this is the problem of portfolio selection.

The efficient frontier represents the trade-off between risk and expected return faced by an investor when forming his portfolio. Most of the efficient frontier represents well diversified porfolios. This is because diversification is a powerful means of achieving risk reduction. Thus, mean-variance analysis gives precise mathematical meaning to the adage "Don't put all of your eggs in one basket."

Asset allocation is the selection of a portfolio of investments where each component is an asset class rather than an individual security. In many respects, asset allocation is a more suitable application of mean-variance analysis than is stock portfolio selection. Mean-variance analysis requires not only knowledge of the expected return and standart deviation on each asset, but also the correlation of returns for each and every pair of assets.
Since stocks generally move together, the benefits of divesification within a stock portfolio are limited. In contrast, the correlation across asset classes (for example stocks, bond, cash, real estate, and gold) is usually low and in some cases negative.

Hence, mean-variance is a powerful tool in asset allocation for uncovering large risk reduction opportunities through diversification.

Optimal Portfolio Allocation
From the paper Optimal Portfolio Allocation for Latin American Stock Indices (Arcos Mora, Mauricio. 2009). The optimal portfolio allocation can be used in analyzing a stock indices. This paper uses several methods to derive optimal portfolio comprising investments in the seven most representative stock exchanges in latin America from 2001 to 2006 and it studies their composition and stability through time. From a practical point of view, this result is significant because less rebalancing can mean greater potential savings.

Optimal Portfolio Concept on Government Tax
The concept of optimal portfolio not only can be seen in analyzing the assets. The optimal portfolio concept can also be used in estimating the government tax revenue. For example on this particular paper by Nathan Seegert, Optimal Tax Portfolios an Estimation of Government Tax Revenue Minimum-Variance Frontiers (Seegert, Nathan. 2000).

When there's a government budget crisis in 2000s were magnified by the increase in tax revenue volatility governments experienced. Governments can decrease the variance of their tax revenues by holding the efficient "portfolio" or in this case taxes. In this conceptualization, each tax base is a potential asset the government can hold and the tax rate on a given base is the weight they put on the asset.

In conclusion, with the method from this paper of estimating government minimum-variance frontiers governments can quantify the cost of additional volatility caused by their redistribution

policies which is necessary for them to make an informed decision on what level of redistribution to implement.

Objection against Efficient Frontier
According to the paper Is The Efficient Frontier Efficient? (Scheel, William C. Blatcher, William J. Kirschner, Gerald S. And Denman, John J. 2000), there is a problem in the efficient frontier theory which is sampling error. This paper defines plausible ways to measure sampling error within efficient frontier, particularly when they are derived using dynamic financial analysis (DFA). The implications for DFA usage of efficient frontiers is that sampling error may degrade the ability to effectively distinguish optimal and non-optimal points in risk-return space.

There are many possible frontiers that optimally fit different empirical samples. Sampling error among the could cause the frontiers to traverse different regions within risk-return space, perhaps at points that are disparate in a decision sense.

In conclusion, users of the efficient frontier should be aware that the term "efficient" in efficient frontier has a good chance of being operationally false. The efficiency of portfolio composition is unlikely to be manifest in better performance of the on-frontier portfolio compared to other, off-frontier portfolios. The risk-return surface is not adequately measured by a single efficient frontier, and sampling error may lead to unwarranted conclusions about the efficacy of portfolios measured in such singular optimizations.

Performance Analysis
According to the paper Performance Analysis of Property Securities Funds (Keng, Tan Yen. 2003), the risk-adjusted performance is assesed using three popular measures; namely Jensen alpha, Treynor ratio and Sharpe ratio. This ratio can be used to rank the property securities funds (PSFs) according to their risk-adjusted performance.

The objective of this paper is to evaluate and analyze PSF performance. PSFs is ranked corresponding to their risk-adjusted performance and relationship between performance.

In conclusion, this paper reveals that the best performing PSFs are selected on risk-adjusted basis simply because the consistencyof returns is equally important as the absolute value of return. This paper also suggest that the use of implied property type allocations is useful in explaining the performance of PSFs.

Sharpe's Measure
Sharpe's measure is also known as Sharpe ratio or reward-to-volatility ratio. According to the book Fundamentals of Investing (Gitman, Lawrence J. 1990), Sharpe's measure is a measure of portfolio performance that gives the risk premium per unit of total risk, which is measured by the portfolio's standard deviation of return. The risk premium on a portfolio itself is the total portfolio return minus the risk free rate. In other words, Sharpe's measure divides average portfolio excess return by the standard deviation of returns on the same time period. Sharpe's Measure can be expressed in the following formula:

$$S_P = \frac{\bar{r}_p - \bar{r}_f}{\sigma_P}$$

Where
- $\bar{r}_P$ = average return of the portfolio
- $\bar{r}_f$ = average return of risk free asset
- s_P = portfolio standard deviation

2.12.2 Treynor's Measure
Similar to Sharpe's measure which uses portfolio standard deviation to measure the portfolio's risk, Treynor's measure uses the portfolio beta to measure the portfolio's risk. Based on the book Fundamentals of Investing (Gitman, Lawrence J. 1990), Treynor's measure is a measure of portfolio performance that gives the risk premium per unit of non-diversifiable risk, which is measured by the portfolio's beta. The formula to calculate Treynor's measure is as follow:

$$T_P = \frac{\bar{r}_P - \bar{r}_f}{\beta_P}$$

Where
- r_P = average return of the portfolio
- r_f = average return of risk free asset
- β_P = beta portfolio

Jensen's Measure
Jensen's measure is also known as Jensen's alpha based on the book Fundamentals of Investing (Gitman, Lawrence J. 1990), is a measure of portfolio performance that uses the portfolio's beta and CAPM to calculate its excess return, which may be positive, zero or negative. A positive value on Jensen's measure shows that the portfolio earned a return in excess of its risk and market adjusted required return. While zero value on Jensen's measure show that the portfolio earned exactly its required return and the negative value indicate that the portfolio failed to meet the required return. The Jensen's measure formula is as follows:

$$\alpha_P = \bar{r}_P - [\bar{r}_f + \beta_P(\bar{r}_M - \bar{r}_f)]$$

(2.12)

Where
- r_P = average return of the portfolio
- r_f = average return of risk free asset
- β_P = beta portfolio
- r_M = average return of the market

Implementation of Sharpe, Treynor, and Jensen
To see how the Sharpe, Treynor and Jensen measure implementation in the real case, the writer will use the journal by Nesrin Alptekin. According to the journal Performance Evaluation of Turkish Type A Mutual Funds and Pension Stock Funds by Using TOPSIS Method (Alptekin, Nesrin. 2009), it is evaluated performance of Turkish Type A mutual funds and pension stock funds by using TOPSIS method which is multicriteria decision making approach. Both of these funds compose of stock in their portfolio, so it can be enabled to compare each other. At this point, it is used traditional performance measurement techniques of funds like Sharpe Ratio, Treynor index and Jensen's alpha.

Performance evaluation of funds has an importance for investors and portfolio management companies. After the development of portfolio theory in early 60s, and CAPM in subsequent years, studies on portfolio performance evaluation have picked up speed.

In this journal, TOPSIS method is used for determining the final ranking of Turkish Type A mutual funds and pension stock funds with the following steps: normalized the decision matrix, form a weighted normalized decision matrix, determine PIS (positive ideal solution) and NIS (negative ideal solution), and calculate the distance of each alternative from PIS and NIS.

(2.11)

In conclusion, the final rankings of the funds are obtained by using TOPSIS method which is a multicriteria decision making approach. The aim of this method is to choose the alternative that should have the shortest distance from the positive ideal solution and the farthest from the negative ideal solution. It is found that Pension Stock Mutual Funds have superior performance than the Type A Stock Mutual Funds.

Methodology

The objectives of this thesis are to construct an optimal and efficient portfolio containing five Indonesian indsutrial sector stocks that surpass the market's performance. The tool that will help to construct the portfolio is MS Excel Solver add-ins. Most of the data that will be analyzed in this research are collected from related financial websites like Yahoo Finance, Indonesian Stock Exchange websites, and Bank of Indonesia websites. The required data are selected by the writer through the historical data of JSX Composite index, the historical data that will be collected is from February 2011 until November 2012.

To analyze the data, it has several of calculations in the process with the application of MS Excel to calculate the risk and return of each individual mutual fund and the optimal portfolio. Most of the calculations are using matrix multiplication which has been proved to be the same as calculating manually. To create the optimal portfolio, the author used the MS Excel's analysis tool, MS Excel Solver add-ins to determine each mutual fund weight to achieve the optimal portfolio. The last analysis is to measure the performance of the optimal portfolio and the market. This analysis is done by calculating their Sharpe ratio, Treynor measure, and Jensen's Alpha. Then their performance will be compared to each other and the market.

Data Analysis

Choosing the Stocks From JSX Composite
In the first step of data analysis, the writer is filtering the stocks from JSX Composite that has a good fundamental value for long term investment. The fundamental value here means that the perceived value of an assets future, such as future cash flow, expected growth and risk. The objective of this step is to find the best stocks combination to create the efficient and optimum porfolio. The stocks that has been chosen by the writer is the stocks that has listed in JSX Composite from 14th February 2012 until 21st November 2012, which ranges an array of 200 days of data. After filtering all possible stocks from each industry, the writer decides to take 5 stocks that has the best fundamental value based on PER, EPS, ROA, and ROE. The reason why the writer only chose 5 stocks to this research is simply because this 5 stocks has the best PER, EPS, ROA and ROE. Because the objective is to find the best stock combination, there is no need to put the stock that has bad fundamental value. And from the screening software in Ipotnews.com, these 5 stocks is the only stocks that has the best PER, EPS, ROA and ROE.

Table 4.1 – Fundamental Value of the Stocks (annual)

Industry	Stock	Last	Quarter Date	PER	EPS	ROA	ROE
Mining	GTBO	3.900	30/09/2012	7	642	97,43	87,59
Property	SSIA	1.120	30/09/2012	7	156	18,53	41,73
Infrastruktur	CMNP	2.100	30/06/2012	10	214	12,66	17,88
Finance	LPPS	155	30/09/2012	2	65	21,77	21,03
Trade	LPLI	290	30/09/2012	1	323	23,9	24,25

From the table above, the chosen stocks has PER that are below or equal to 10, that means the period of returning the earnings is equal or below 10 periods. Also the EPS is more that 0, that

means this year these companies is giving divident to their shareholders. Which indicates these companies has a good financial cash flow.

With respect also to the table above, the ROA from all the stocks are positive and quite high since the formula to calculate the ROA is Net Income / Total Assets. That shows us the companies are able to generate a higher income than their assets. The last indicator is ROE, which expressed by Net Income / Shareholder's Equity. That reveals how much profit these companies generates with the money shareholders have invested. And all these companies ROE is positive which means these companies can productively handle their shareholder's money to generate a higher income for the companies.

The writer decides to choose these stocks based on PER, EPS, ROA and ROE because these are the best indicators to determine whether these stocks are good or not for long term investment. Although the financial manager usually using more than just PER, EPS, ROA, and ROE to filtering the best stocks for their portfolio, the writer is certain that with just these indicators, the writer can construct the most efficient portfolio.

Calculating the Risk and Return of Each Stock

After the first step is done, the next step the writer will do is calculate the risk and the return of each stock. To do that, the writer needs the historical data for the past 200 days of each stock. We refer and obtain the data from Indonesian Capital Market (JSX Composite) from 14th February 2012 until 21st November 2012. The adjusted closing price is used in this calculation because the stock price has been adjusted to corporate actions such as dividents, and stock splits.

The writer is using Microsoft Office Excel 2010 to calculate the logarithmic return since Markowitz modern portfolio model needs normally distributed stock price. From the calculation made using Microsoft Office Excel 2010, the writer is able to calculate the average return, variance, and of course standart deviation of each stock.

Table 4.2 – Average Risk and Return of each stock

Stock	GTBO	SSIA	CMNP	LPPS	LPLI
Average	1,01%	0,15%	0,06%	0,10%	0,12%
Variance	0,28%	0,07%	0,04%	0,10%	0,18%
Stadev	5,25%	2,74%	2,01%	3,14%	4,20%

From the table above, we can see that all of the stocks that has been chosen by the writer generates a positive return in 200 days of transactions in JSX Composite, which GTBO generates the highest return from all the stocks which is 1,01%. But also, GTBO generates the highest Standart Deviation among others stocks which is 5,25%. CMNP generates the lowest standart deviation which is 2,01%. But the return CMNP generates is 0,06%.

After calculating the return and risk of each stock, the next step is to calculate the return of risk free assets. In this research, the writer will use the average interest rates on deposits from several banks in Indonesia. The writer decides to use the interest rates on deposits rather than SBI is because the interest on deposits is higher than SBI (Suku Bunga Indonesia), the interest on deposits calculation is

basically the addition of SBI and market risk and divided by the inflation rate (Fisher Equation). So if we want to compare the portfolio investment, it will be fair to compare it with the interest on deposits rather than SBI since SBI is less reliable to compare with the investment because SBI did not consider the market risk. After the writer decides to use the average interest rates on deposits, the writer will need the data of interest rates on deposits from several banks in Indonesia so that the value of the interest from each bank can be calculated as an average. The average interest rates on deposits from these banks is taken by the end of November 2012.

From the table of interest rates on deposits from several banks in Indonesia, the average interest rates on deposits from several banks in Indonesia in yearly average is 4,75%. With daily average is about 0,0132%. The interest rates on deposits is considered sufficient for this research since the goal is to find the CAPM to compare it with the ratio such as Sharpe, Treynor, and Alpha Jensen to measure the stocks performance in 200 days of transaction.

Calculating the Correlation between each Stocks
The next step is to find the correlation between these stocks. The correlation is needed to construct the porfolio. In order to calculate the correlation between each stock, the writer constucts 5x5 matrix of correlation that represent the correlation between the 5 stocks. The matrix of the correlation is in the table below.

Table 4.4 – Correlation Matrix of Each Stock

Correlation

	GTBO	SSIA	CMNP	LPPS	LPLI
GTBO	1	0,036	0,015	-0,016	0,008
SSIA	0,036	1	0,281	0,085	0,040
CMNP	0,015	0,281	1	-0,057	-0,096
LPPS	-0,016	0,085	-0,057	1	0,345
LPLI	0,008	0,040	-0,096	0,345	1

From the table above, the most extreme correlation between these stocks is LPLI and LPPS which is 0,345, which represent there is a weak positive correlation between these two assets. And for the negative correlation is between CMNP and LPLI. Although it is a weak negative correlation.

Next step is to calculate the beta coefficient from each stock. The beta coefficient from each stock is needed to measure the movement of the stock or portfolio against the market for later use in the portfolio measurement, which is treynor's Ratio. The beta coefficient of each stock is obtain by dividing the covariance of each stock with standart deviation square, also from each stock. The writer is using Microsoft Office Excel to calculate the beta coefficient of each stock by using the slope function. The beta of each stock is compare with the average return of the portfolio.

Table 4.5 – Beta Coefficient to Portfolio Average Return

Stocks	GTBO	SSIA	CMNP	LPPS	LPLI
Beta Against Portfolio	1,78	0,02	0,22	(0,07)	0,46

From the table above, it can be seen that most of the stock has positive beta except for LPPS Stock, which has negative value of -0,07. The highest beta coefficient is generate by GTBO which is 1,78.

Constucting the Efficient Portfolio

Efficient portfolio of 5 stocks that the writer chose now can be constructed from the result of the previous calculation. To achieve the optimum portfolio, the first thing the writer need to do is to find what happens if the investor put the money in all of the 5 stocks in equal weight because that step is crucial to find the best combination of the stocks that can produce the highest return or the lowest standart deviation or risk. The table below is showing the equal weight of each asset.

Table 4.6 – The equal weight of each stock

	E.Weight
Constraining Variable	
Value of Constraint	
GTBO	20%
SSIA	20%
CMNP	20%
LPPS	20%
LPLI	20%
$\sum w$	1

The table above shows that the investor is put their money in equal share on each stock. And the table below is showing the average return, standart deviation and sharpe ratio of each asset.

Table 4.7 – Average Return, Standart deviation, Sharpe ratio of each asset

Individual Asset			
Asset	s	μ	s /μ
GTBO	1,01%	5,25%	19,19%
SSIA	0,15%	2,74%	5,52%
CMNP	0,06%	2,01%	2,77%
LPPS	0,10%	3,14%	3,26%
LPLI	0,12%	4,20%	2,79%

The next step is to find how much the expected return that the investor will have if they choose to put their money in equal share. To find the expected return, the writer will use the matrix

multiplication by multiply the weight of individual assets with the average return of each asset. The result from this multiplication can be seen from the table below.

Table 4.8 – The Expected Return from Equal Share

	E.Weight
Var. Constrain	
Val. Constrain	
	Portfolio Weight
GTBO	20%
SSIA	20%
CMNP	20%
LPPS	20%
LPLI	20%
?w	1
Return s	0,29%

The table above shows that with putting the equal share on each asset will generate 0,29% return, which is higher than if the investor put their money in single asset. Which means that if the investor is putting their money with this order, their return will exceed the possible return they could get by putting their money in single asset other than GTBO which generates the highest return for single asset.

Now for the expected return table, the formula is as follow: =S19*T5+(1-S19)*U5. This expected return formula represents the expected return of SSIA asset in each percentage from 0% to 100%.
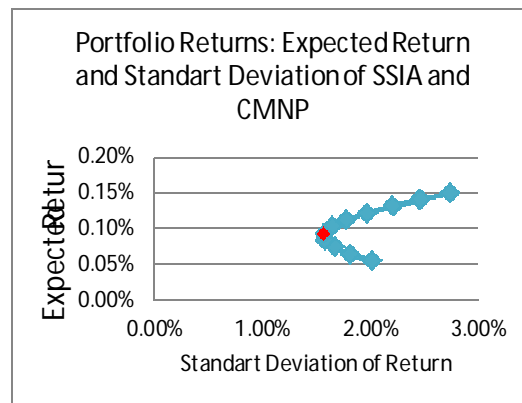

Figure 4.1 - Efficient Frontier Diagram for SSIA and CMNP

From figure above, we can see that the most efficient portfolio composition is if we put our money 40% in SSIA.

Now the writer will demonstrate another example of Markowitz Efficient Frontier diagram. Now using GTBO and SSIA as an asset. The same step will be used by the writer to constuct the Markowitz Efficient Frontier Diagram.

Table 4.12 – Portfolio Statistics for GTBO-SSIA Portfolio

1	S	T	U
2	PORTFOLIO STATISTICS FOR GTBO-SSIA		
3	PORTFOLIO		
4		GTBO	SSIA
5	Average Return	1,008%	0,151%
6	Variance	0,276%	0,075%
7	Standart Deviation	5,253%	2,737%
8	Covariance of returns (rGTBO,rSSIA)	0,005%	
9			
10	Portfolio return and risk		
11	Percentage in GTBO	50%	
12	Percentage in SSIA	50%	
13			
14	Expected portfolio return	0,580%	
15	Portfolio variance	0,090%	
16	Portfolio standart deviation	3,003%	
17	Percentage in SSIA	Sigma	Expected Return
18			
19	0	2,74%	0,15%
20	0,1	2,54%	0,24%
21	0,2	2,46%	0,32%
22	0,3	2,52%	0,41%
23	0,4	2,71%	0,49%
24	0,5	3,00%	0,58%
25	0,6	3,37%	0,67%
26	0,7	3,80%	0,75%
27	0,8	4,26%	0,84%
28	0,9	4,74%	0,92%
29	1	5,25%	1,01%

The Sigma and Expected Return table is using the same formula as the table of portfolio statistics between SSIA and CMNP. And the resul of Markowitz Efficient Frontier Diagram is at the figure below
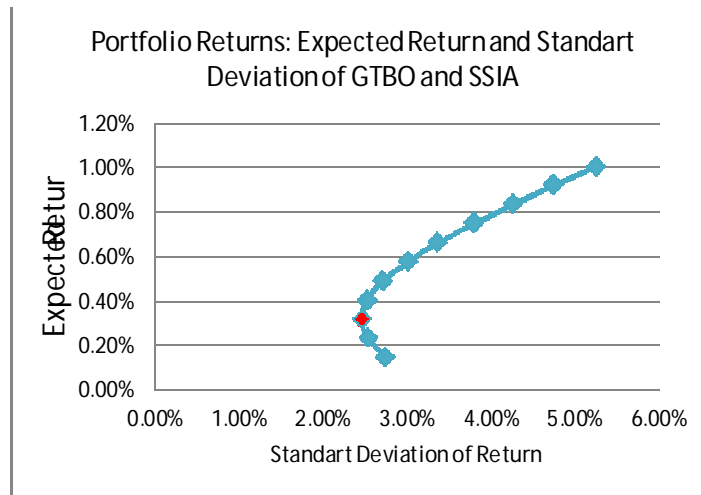
Figure 4.2 - Efficient Frontier Diagram for GTBO and SSIA

From the figure above, we can see that the red dot in the figure is what it is called Efficient Frontier. The figure above is suggesting us to put our money 20% in SSIA stock.

Constucting the Optimum Portfolio

After demonstrate of how the efficient portfolio according to Markowitz Efficient Frontier theory looks like, the writer now will try to construct the optimum portfolio. The optimum portfolio that the writer wants to do is a classic example of how the investor think about the optimum portfolio which is how to maximize the return of the portfolio and how to minimize the risk of the portfolio.

In order to maximize the return or minimize the risk of the portfolio, the writer will use Microsoft Excel: Solver add-ins as a tool to combine all of the stocks that the writer chose to create a perfect combination to pursue the goal which is creating an optimum portfolio.
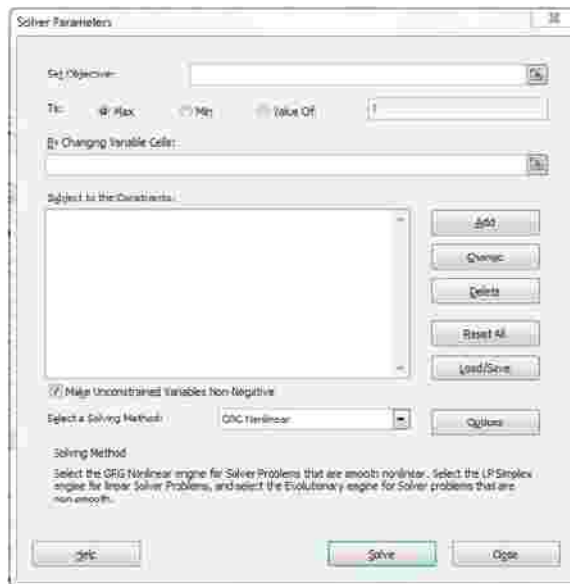

Figure 2.3 - Microsoft Excel: Solver add-ins

The same step will be use by the writer to generate the highest expected return. The first step to achieve the highest expected return from the portfolio is to set the objective from the cell target that the writer aim, or in this case the portfolio return and the portfolio standart deviation. The solver can be set to maximum value, minimum value or value that the writer wants. By changing the variable cells such as weight of the asset, the writer will be able to change the weight of each asset in order to maximize the expected return of the portfolio.

Because the purpose of this research is to create an efficient portfolio for long term investment, the writer will not use short selling in Excel Solver.
The first step the writer will use the solver to generate a maximum expected return of the portfolio, the writer will need the data from previous calculation and use the solver to
change the weight of each asset in order to create the highest expected return from the portfolio. The result of the solver used by the writer is in the table below.

Table 4.13 – The Expected Return and Standart Deviation of the Portfolio using solver

	E.Weight	Max Return based on stadev
Var. Constrain		Stadev <=
Val. Constrain		2,01%
Portfolio Weight		
GTBO	20%	33%
SSIA	20%	18%
CMNP	20%	27%
LPPS	20%	15%
LPLI	20%	7%
?w	1	1
Return s	0,29%	0,39%
Stadev μ	1,78%	2,01%

From the table above we can see that our target is to maximize the expected return of the portfolio by changing the weight of each asset. Without short selling, the expected return of the portfolio is increasing if compare to previous calculation without using solver. The standart deviation of the portfolio is also increasing from the previous calculation without using solver.

But, since the goal is to maximize the expected return of the portfolio, the standar deviation is set with the lowest standart deviation of single asset which in this case CMNP who has the lowest standart deviation. The solver recommend us to put 33% of the money in GTBO. That makes sense since GTBO generates the highest return among other stock. And also the solver recommend us to put 27% of the money in order to minimize the risk since GTBO generates the highest standart deviation among other stock.

Minimize the Standart Deviation of the Portfolio
Same step will be use by the writer, using solver to create a perfect combination of stocks that will generate the minimize standart deviation at certain return. The data from previous calculation will be used to change the weight of each stock by using solver to generate the lowest standart deviation. The result of the solver is in the table below.

Table 4.14 – The Expected Return and Standart Deviation of the Portfolio using solver

	E.Weight	Max Return based on stadev	Minimal Stedev on Max Return
Var. Constrain		Stadev <=	Return =>
Val. Constrain		2,01%	1,01%
Portfolio Weight			
GTBO	20%	33%	7%
SSIA	20%	18%	15%
CMNP	20%	27%	50%
LPPS	20%	15%	18%
LPLI	20%	7%	9%
?w	1	1	1
Return s	0,29%	0,39%	0,15%
Stadev µ	1,78%	2,01%	1,45%

From the table above, we can see that our goal to generate the minimum standart deviation of the portfolio is accomplish. But the return of the portfolio is lower than previous calculation where the writer is try to maximize the return. The solver recommend us to put half of the money in CMNP, which makes sense because CMNP has the lowest standart deviation among other stock.

Measuring Portfolio Performance
Now that the writer is able to construct the optimum portfolio which is maximize the return and minimize the risk of the portfolio using solver in Microsoft Excel, the next step needed to be done is measuring the performance of the portfolio. Since the investors nowadays know how to maximize the return or minimize the risk of their portfolio, the writer decides to analyze the portfolio both in return and risk together. In order to do that, the writer will use three sets of performance measurement tools to assist the writer with portfolio evaluations. Those three sets is Sharpe, Treynor, and Jensen Ratio.

Sharpe Ratio
The Sharpe Ratio works by dividing the return of the portfolio with the standart deviation of the portfolio itself. The writer will analyze the performance of the portfolio in to three scenario. The first one is the portfolio that contains the same weight of all 5 assets, the second one is the portfolio that gives the maximum return based on solver in excel, and the third one is the portfolio that gives the minimum risk based on solver in excel.

Table 4.15 – The Sharpe Ratio of three portfolios

Portfolio	Return	Std. Deviation	Sharpe Ratio
A	0,29%	1,78%	0,161
B	0,39%	2,01%	0,196
C	0,15%	1,45%	0,106

From the table above, portfolio A represent the portfolio that contains the same weight of all 5 stocks. Portfolio A gives 0,29% in return and 1,78% in risk. By dividing the return and standart deviation from the portfolio, it gives 0,161 in Sharpe Ratio. Portfolio B represent the portfolio with maximum return using solver. It gives 0,39% in return and 2,01% in risk. The Sharpe Ratio from portfolio B is 0,196.

Portfolio C represent the portfolio with minimum risk or standart deviation using solver. It gives 0,15% in return and 1,45% in risk. The Sharpe Ratio from portfolio C is 0,106. From the calculation of Sharpe Ratio, the writer finds that the best portfolio combination that creates the highest Sharpe Ratio is portfolio B which is the portfolio that gives the highest return from the calculation using solver.

Treynor Measure
The Treynor Measure is basically the same with Sharpe Ratio. The differences between these two is if Sharpe Ratio using standart deviation as a divider, the Treynor Measure using the beta of the portfolio as a divider. Different from Sharpe Ratio, Treynor Measure is clear from the market risk itself. Because Treynor Measure used the beta from the portfolio instead of standart deviation. Therefore, the number that will come up from this calculation will be less than the Sharpe Ratio.

The Treynor Measure works by dividing the return of the portfolio with the beta of the portfolio itself.

Table 4.16 – The Treynor Value of three portfolios

Portfolio	Return	Weighted Beta	Treynor Value
A	0,29%	0,4714	0,0061
B	0,39%	0,6526	0,0060
C	0,15%	0,2606	0,0059

Same with the calculation of Sharpe Ratio, portfolio A represent the portfolio that contains the same weight of all 5 assets, portflio B represent the portfolio with maximum return, and portfolio C represent the portfolio with minimum risk or standart deviation. From the table above, portfolio A gives the Treynor value of 0,0061. Portfolio B gives the Treynor value of 0,0060. And portfolio C gives the Treynor value of 0,0059, which makes portfolio A slighly better than portfolio B and C.

4.6.3 Jensen's Alpha Measure
The Jensen's Alpha Measure is quite different from Sharpe Ratio and Terynor Measure. Jensen's Alpha Measure is using CAPM (Capital Asset Pricing Model). In order to calculate the Jensen's Alpha Measure, the writer needs to calculate the CAPM first.
But same as Treynor Measure, Jensen's Alpha Measure did not have the risk from the market since the calculation of Jensen's Alpha is by reducing the return of the portfolio with CAPM. The calculation of CAPM is as follows:
- First the writer needs to find a risk free asset, which in this case the interest rates on deposits from several banks in Indonesia. The average interest rates on deposits this year is 4,75%, with daily average is 0,0132%. The writer using daily average interest rate because the data of stocks that has been collected is also daily.
- Next, the writer needs to calculate the average return of the market. Because the writer decided to take the data of 200 days of transaction, the market return is also taken in 200 days of transaction. And the result is 0,05%.
- Then the writer calculate the weighted beta of the portfolio. Which the result is 0,47.
After all those numbers been collected, the next step is to calculate the CAPM based on the formula which is:

(Ri) = Rf + ß (Rm – Rf)

    Where :

    Rf = Rate of return for a risk-free security

    Rm = Market return

    ? = Beta of the asset

And the result from this calculation is that the writer get 0,0290% as CAPM.

And now the writer will use this CAPM number to analyze the performance of each portfolio. The Jensen's Alpha Measure is using the return of the portfolio and reducting it with CAPM number as you can see in the table below.

Table 4.17 – The Jensen's Alpha of three portfolios

Portfolio	Return	CAPM	Jensen's Alpha
A	0,29%	0,029%	0,258%
B	0,39%	0,029%	0,366%
C	0,15%	0,029%	0,125%

From the table above, all three portfolios that the writer chose create a positive number of Jensen's Alpha Measure. That means all of the portfolios has a good performance than the market which is interest rates on deposits. Portfolio B has the biggest Jensen's Alpha ratio than the other two portfolios which is 0,366%.

Conclusion and recommendation

Conclusion

In this research, the writer is selecting the stocks that has a good fundamental value based on PER, EPS, ROA and ROE. And after screening of all possible stocks that are listed in IHSG, the writer decides to take 5 stocks that has a good fundamental value. All the stocks that has been chosen is from different sector in order to create a diversity in the portfolio so that the unsystematic risk could be avoided. The 5 stocks that has been chosen by the writer is GTBO which represent mining sector, SSIA which represent property sector, CMNP which represent infrastructur sector, LPPS which represent finance sector and LPLI which represent trade sector. All of the stocks that has been chosen is the stocks that gives the best fundamental value for the last 1 year. GTBO, SSIA, CMNP, LPPS, and LPLI is the stocks that has the biggest chance to generate the highest value for the future if we look from the PER, EPS, ROA, and ROE.

From the calculation using Markowitz Efficient Frontier Theory, the writer is able to construct 3 portfolios. 1 portfolio with equal share in each stock, 1 portfolio that generates the maximum return using solver, and 1 portfolio that generates the minimum risk or standart deviation. And after the writer analyze the performance of each portfolio with Sharpe Ratio, Treynor Measure and Jensen's Measure, the 3 portfolios that has been construct by the writer is giving different result. As you can see in the table below.

Table 5.1 – Portfolio with equal share of each stock

	E.Weight
Var. Constrain	
Val. Constrain	
	Portfolio Weight
GTBO	20%
SSIA	20%
CMNP	20%
LPPS	20%
LPLI	20%
?w	1
Return s	0,29%
Stadev μ	1,78%
Weighted Beta	0,471415096
Sharpe s /μ	16,11%
Treynor	0,61%
Alpha jensen	0,26%

In portfolio 1, the writer is putting equal share of money into each of the stock. And that generates 0,29% of return, 1,78% of risk or standart deviation, Sharpe Ratio of 16,11%, Treynor Measure of 0,61%, and Jensen's Measure of 0,26%. If we following this scenario, the combination of equal share of each stock can generates that number based on the calculation with the solver. Now for portfolio 2, which generates the maximum return, and portfolio 3 that generates the minimum risk or standart deviation. As you can see in the table below:

Table 5.2 – Portfolio with maximum return and minimum risk

Portfolio	2	3
	Max Return based on stadev	Minimal Stedev on Max Return
Var. Constrain	Stadev <=	Return =>
Val. Constrain	2,01%	1,01%
	Portfolio Weight	
GTBO	33%	7%
SSIA	18%	15%
CMNP	27%	50%
LPPS	15%	18%
LPLI	7%	9%
?w	1	1
Return s	0,39%	0,15%
Stadev μ	2,01%	1,45%
Weighted Beta	0,652628499	0,260595974
Sharpe s /μ	19,59%	10,58%
Treynor	0,60%	0,59%
Alpha jensen	0,39%	0,15%

From the table above, portfolio 2 which is portfolio that generates a maximum return recommend to put 33% of the money in to GTBO stock, 18% to SSIA stock, 27% to CMNP stock, 15% to LPPS stock and 7% to LPLI stock. And from that combination, this portfolio generates 0,39% of return, 2,01% of risk or standart deviation, Sharpe Ratio of 19,59%, Treynor Measure of 0,60%, and Jensen's Measure of 0,39%.

Portfolio 3, which is portfolio that generates a minimum risk or standart deviation recommend to put 7% of the money in to GTBO stock, 15% to SSIA stock, 50% to CMNP stock, 18% to LPPS stock, and 9% to LPLI stock. And from that combination, this portfolio generates 0,15% of return, 1,45% of risk or standart deviation, Sharpe Ratio of 10,58%, Treynor Measure of 0,59%, and Jensen's Measure of 0,15%.

Based on the calculation above, the writer is able to find the best combination of stocks that generates the highest value to the investors. As you can see it in the table below:

Table 5.3 – Statistics of all the portfolios

	Portfolio		
	1	2	3
Return	0,29%	0,39%	0,15%
Standart Deviation	1,78%	2,01%	1,45%
Sharpe Ratio	16,11%	19,59%	10,58%
Treynor Measure	0,61%	0,60%	0,59%
Jensen's Measure	0,26%	0,37%	0,12%

Portfolio 1 generates the highest Treynor Measure Value. Portfolio 3 generates the lowest risk or standart deviation while portfolio 2, which generates the highest return turns out also generates the highest value of Sharpe Ratio and Jensen's Measure. The portfolio performance which is shown by Sharpe Ratio, Treynor Measure, and Alpha Jensen's exceed the market performance. Although this result only consist from 200 days of transaction.

Recommendation
For Further Study
- The Markowitz model is based on assumptions and the behaviour of investor. The market itself still have some of the unpredicted risk that the investor must calculate. The Markowitz Model will be more effective if it's combine with other modern method. Since the markowitz model did not calculate both risk and return at the same time.
- The observation period of this research is too short, only 200 days of transaction, therefore it is necessary to extend the range of data on the next observation for more accurate results.
- The study of this research could be used to analyze not just stocks, but another asset such as bonds and currency.

For Investors
Investing in stock market is one of the alternative that can be chosen by the investors. Based on this research, investors must understand the basic concept of investing in stock market. So when the investor wants to put their money in the stock market, they don't just put their money in every stock. That way, the investor will lose their money instead of generates a return that the inventors

expected. The investors need to calculate and consider the best composition that generates the best value of return and standard deviation as this research demonstrates.

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