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Comparison between Markowitz Optimization Method and Market Capitalization-Weighted Portfolio Performance Applied in Indonesia Stock Exchange (IDX)

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This research aims to compare the performance of portfolio created using Markowitz optimization method ("optimization portfolio") against the one created using market capitalization-weighted method ("market capitalization portfolio"). In this research 22 stocks that consistently appear in LQ45 for 5 years (2009-2013) are chosen as the portfolio components. The optimization portfolio data is generated from daily stock prices, while the market capitalization portfolio from one-point-in-time price. The results show that the optimization portfolio underperforms market capitalization portfolio in terms of Treynor's, Sharpe's, and Alpha measure. Both portfolios are back-tested to assess their performance in the latter period.

JEL Codes: G11

1. Introduction

Mutual funds have gained more popularity in Indonesia emerging market. According to Indonesia Financial Services Authority, the mutual funds in Indonesia have grown to total net asset of 201.8 trillion by the second quarter of 2014. This growth is primarily supported by stock mutual fund, which occupied 42.69% portion, followed by protected mutual fund with 20.49% and fix income mutual fund with 14.85%. Indonesian people's interest in mutual fund is shown by increasing investment units from 123.46 billion units to 124.24 in May 2014. The Indonesia Mutual Fund Manager Association also targeted 15% increase of mutual fund investors by 2015. These raising popularity are supported by the fact that mutual fund is simple yet able to preserve stock diversity.

In general there are two types of strategies used in managing mutual funds portfolio, active and passive strategy. Active strategy aims to beat the market by taking advantage of mispricing assets, while passive strategy holds that market prices are fair, hence there are less chances of any mispricing. This research focuses on passive strategy, a style of management associated with mutual and exchange-traded funds (ETF) where fund's portfolio mirrors market index. The purpose of this research is to address the following issue:

1) Which of the passive strategy, Markowitz optimization or market capitalization-weighted method is more superior in terms of performance?
2) How is the performance of portfolio formed using Markowitz optimization method and market capitalization-weighted method when being assessed in the latter period?

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The hypotheses from this research are:

1) Markowitz optimization method is more superior that market capitalization-weighted method in terms of performance.
2) The performance of portfolio formed using Markowitz optimization method maintains its superiority over market capitalization-weighted method when being assessed in the latter period.

Prior studies have shown some initiatives in using Markowitz modern portfolio theory in Indonesia stock market. However those studies are neither comparing the findings to conventional market capitalization-weighted method nor doing back-testing to measure the performance of findings in the latter period. Both actions are seen as important to give investors a perception about how effective the method is. Currently the studies about the effectiveness of modern portfolio theory application in Indonesia are still developing.

Overall, this paper begins with an introduction and research background, which explains the research hypothesis and the reasons why this research is unique. Following the introduction is the literature review, provided to elaborate related theories and studies used in this research. The third part is methodology, which describes the flow of analysis and the tools used. After that, the research describes the results of analysis in findings section. Lastly the conclusion section summarizes the research.

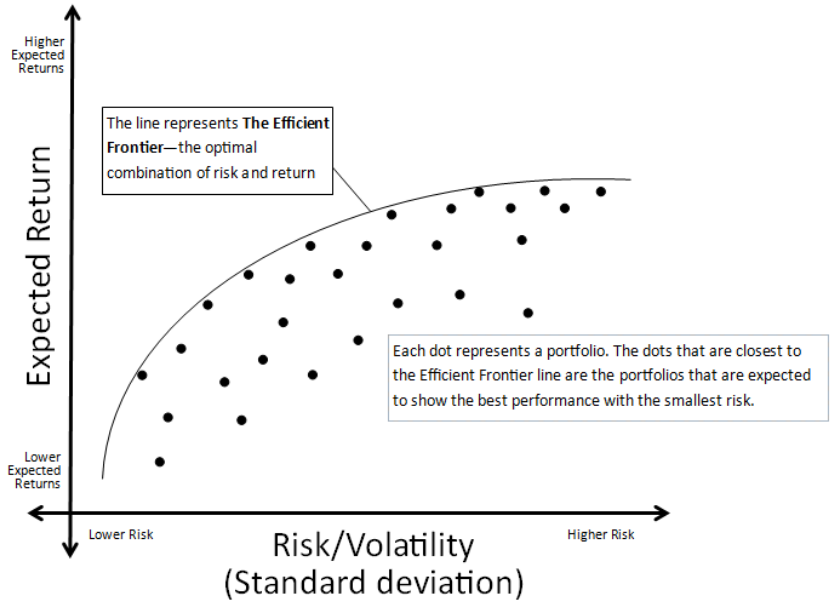
2. Literature Review

2.1 Modern Portfolio Theory

In 1952, modern portfolio theory (“MPT”) was being made popular by Professor Harry Markowitz through his paper ‘Portfolio Selection’ published by Journal of Finance. He provided a framework for measuring the risk-reduction benefit of diversification. The research investigated how combining risky securities into a portfolio affected the portfolio’s risk and expected return. Markowitz’ works assumed that investors are basically risk-averse. They demand higher returns to compensate higher risks.

Investing is a tradeoff between risk and expected return. In general, assets with higher return are riskier. MPT describes how to select a portfolio with the highest possible expected return for a given amount of risk. Or, for a given expected return, MPT explains how to select portfolio with the lowest possible risk. In this theory Markowitz invented the idea of efficient frontier line, where the optimal combinations of expected return for every possible risk lie. According to MPT, risky portfolios constituted of only a single asset are inefficient. Diversifying investments leads to portfolios with higher expected returns and lower standard deviations.

Figure 1: Markowitz efficient frontier curve



Formulation of MPT for optimal portfolio selection is found by minimizing the following expression

$$\min_{x} \frac{1}{2} x^T V x \quad (1)$$

$$\text{subject to, } \mu_i{}^T x = m \quad (2)$$

$$\sum_{i=1}^{n} x_i = 1$$

Where x is the weight of each asset, V is the variance-covariance matrix, μ_i is the stock mean return, m is the specified mean return for the portfolio and n is the number of stocks.

2.2 Market Capitalization-Weighted

In order to assess the effectiveness of this MPT in Indonesia stock market, this research compare its performance with the other portfolio formed using market capitalization-weighted method. Market capitalization is calculated by multiplying company's outstanding shares with the current price of one share. In other words, market capitalization is the total dollar market value of all company's outstanding shares. In market capitalization-weighted portfolio, each portfolio weight is calculated through the following formula

$$x_i = \frac{\text{number of outstanding shares}_i * P_{it}}{\sum_{i=1}^{n} \text{number of outstanding shares}_i * P_{it}} \quad (3)$$

Where x is the weight of the asset and P is the price of the asset.

Market capitalization-weighted method weights each individual components of the portfolio according to their market capitalization, therefore larger components carry a larger percentage weighting. The reason market capitalization-weighted method is chosen as a comparison to MPT method is because the method is commonly used in passive strategy. Similar with MPT method, this method requires no (little) active management and therefore no (little) management fee.

2.3 Return

This research use logarithmic rate of return to calculate each stock price's daily return, as follow

$$\mu_d = \ln\left(\frac{P_{t_1}}{P_{t_0}}\right) \quad (4)$$

Where the time between t_0 and t_1 is called the holding period and (4) is called the holding period return. To avoid misunderstanding, the holding period refers to daily holding period. Next, in order to get mean stock return, μ_i, or usually called expected return, $E(r)$, several series of daily returns are being averaged using the following formula

$$E(r) = \mu_i = \frac{1}{n}\sum_{t=1}^{n} \mu_d \quad (5)$$

Where n is the number of days in observation and μ_d is daily return.

2.4 Risk

In this research there are two types of risk being used, total risks or simply risk (σ) and systematic risk (β). Risk is measured by the standard deviation of the rate of return (σ). The higher value of these squared deviations the higher the volatility of outcomes. Hence, the variance and standard deviation measure the uncertainty of outcomes, as shown in the following formula

$$\sigma_i = \sqrt{\sigma_i^2} = \sqrt{\frac{1}{n-1}\sum_{t=1}^{n} (\mu_{dt} - \mu_i)^2} \quad (6)$$

Where σ^2 is variance of return, σ is standard deviation or risk, μ_{dt} is daily return in period t, μ_i is the mean stock return, and n is the number of days in observation. The portfolio variance and standard deviation is calculated as follow

$$\sigma_p = \sqrt{\sigma^2_p} = \sqrt{\sum_{i,j=1}^{N} x_i x_j \mathrm{Cov}(\mu_i \mu_j)} \quad (7)$$

Where σ_p is portfolio standard deviation, $\sigma^2{}_p$ is portfolio variance, N is the number of stocks, x_i is weight of the first stock, x_j is weight of second stock, μ_i is mean return of first stock, and μ_j is mean return of second stock.

Meanwhile, the systematic risk is measured using beta coefficient or beta. Beta measures the extent to which returns on stock and the market move together. The market portfolio of all investable assets has beta exactly 1. Formally beta is defined as

$$\beta_i = \frac{\sigma_{iM}}{\sigma^2_M} \quad (8)$$

Where β_i is beta of stock *i* relative to market index, σ_{iM} is covariance between stock i and market index, and $\sigma^2_M$is variance of market index
The portfolio beta is calculated as

$$\beta_P = \sum_{i=1}^{n} \beta_i x_i \quad (9)$$

Where β_i is beta of stock *i* and x_i is weight of stock *i*.

2.5 Portfolio Performance Evaluation

In order to address the first research question of which of the passive strategy, Markowitz optimization or market capitalization-weighted method is more superior in terms of performance, this research used 3 different methods of performance evaluation: Treynor's measure, Sharpe's measure, and Jensen's Alpha.

1) Treynor's measure

Performance has two components, risk and return. Because investors are risk averse, they will require higher compensation for higher risk in the form of higher returns. Treynor's measure (Treynor, 1961) is a common measure of portfolio performance which divides the stock excess return with systematic risk as shown in following formula

$$\frac{\bar{r}_P - \bar{r}_f}{\beta_P} \quad (10)$$

Where $\bar{r}_P$ is average portfolio return, $\bar{r}_f$ is average risk-free asset return and β_P is portfolio beta. To give clearer understanding, Beta is a measure of volatility, or systematic risk, of a portfolio in comparison to the market as a whole. A higher beta suggests a higher systematic risk, a risk that affects the overall market and thus cannot be mitigated through diversification.

2) Sharpe's measure

Sharpe's measure (Sharpe, 1964) is similar to Treynor's measure, except that the risk measure is a total risk, unsystematic risk added by systematic risk, as shown by the following formula

$$\frac{\bar{r}_P - \bar{r}_f}{\sigma_P} \quad (11)$$

Where $\bar{r}_P$ is average portfolio return, $\bar{r}_f$ is average risk-free asset return, and σ_P is portfolio standard deviation or total risks.

3) Jensen's measure

Like the other measures discussed, Jensen measure is also based on systematic risk. The Jensen's measure calculates the excess return of a portfolio above that predicted by the CAPM, given the portfolio's beta and the average market return. Jensen's measure is the portfolio alpha value as shown in the following formula

$$\alpha_P = \bar{r}_P - [\bar{r}_f + \beta_P(\bar{r}_M - \bar{r}_f)] \quad (12)$$

Where α_P is portfolio alpha, $\bar{r}_f$ is average risk-free asset return, β_P is portfolio beta, $\bar{r}_M$ is average market return $\bar{r}_f$ is average risk-free asset return. The sign of α_P indicates whether the portfolio has outperformed the market. If α_P is positive, then the portfolio has outperformed the market; if α_P is negative, the portfolio has underperformed the market.

In consideration of the second research question of the performance of portfolio formed using MPT method and market capitalization-weighted method when being assessed in the latter period, this research used back-testing method. Back-testing refers to applying a trading

system to historical data to verify how a system would have performed during the specified time period. Using historical data of stock and IDX prices in January to May 2014, the same portfolio composition is reapplied and the performance is reassessed. Both of portfolios are measured in terms of risk, return, Treynor's measure, Sharpe ratio, and Jensen's Alpha. Through this way, the portfolio's effectiveness when being used in latter period could be analyzed.

2.6 Prior Studies

Recently there are several studies done using the concept of MPT in Indonesia stock market. However, there has not been any research that tries to compare the performance of portfolio with market capitalization-weighted method and at the same time reassess the result using data in latter period (back-tested). Related studies are summarized in Table 1.

Table 1: Prior studies on modern portfolio strategy in Indonesia stock market

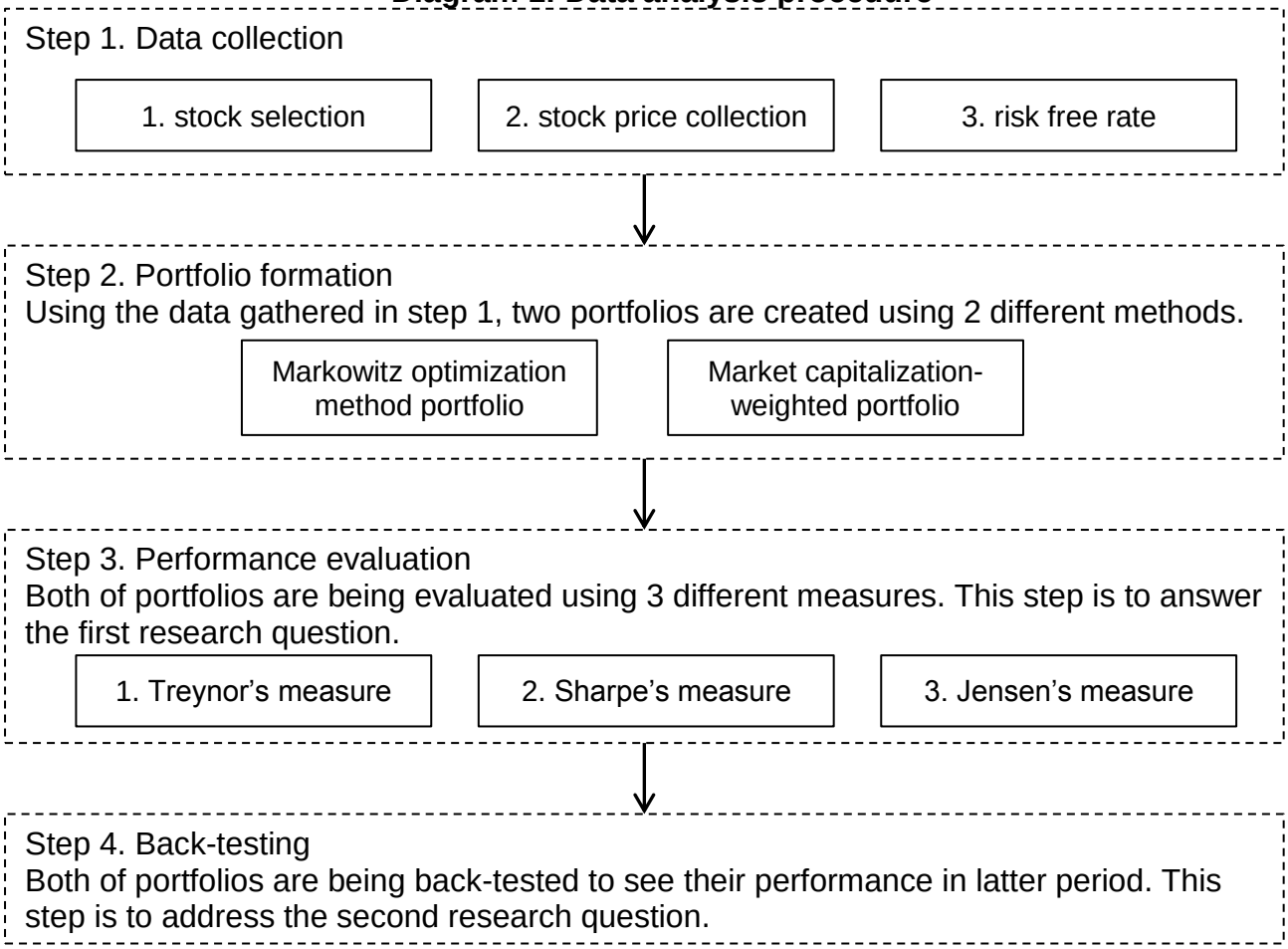
Study	Data	Methodology	Major findings
Determining Optimal Portfolio Using Combination Method and Markowitz Portfolio Theory: Case Study LQ 45 Stocks Period 2012–2013 Giovanny Agnes Mahami and Ir. Achmad Herlanto Anggono (2013)	9 stocks listed in IDX which are consistently appear in LQ45 for 10 years	Theory of combination and Modern Portfolio Theory by Harry Markowitz	The research summarized the combination of stocks that create maximum return, minimum risk, and maximum Sharpe ratio
Optimal Portfolio Analysis with Risk-Free Assets using Index-Tracking and Markowitz Mean-Variance Portfolio Optimization Model Nasha Pinashtika and Budhi Arta Surya (2014)	6 stocks which continuously remained in the top 20 Indonesia market capitalization list for period 2007-2013 and have positive Jensen Alpha's measure	Markowitz Modern Portfolio theory and index-tracking models by Edirisinghe	The results concluded that the addition of risk free assets lower the risk of both Markowitz and index-tracking portfolios
Optimal Portfolio Strategy of Indonesian Government Bond and Foreign Exchange Using Markowitz Efficient Theory Mirza Malik and Ir. Budhi Arta Surya (2013)	4 fixed rate coupon of Indonesia government bonds and 2 foreign exchange currency pairs: SGD/IDR and MYR/IDR	Markowitz Modern Portfolio Theory by Harry Markowitz	The research summarized the combination of bonds, foreign exchanges, and mixed of bonds and foreign exchanges portfolios that maximize investors' return

3. The Methodology and Model

In order to answer the research questions, this research conducted a study upon 22 stocks that are consecutively being incorporated in LQ45 index for 5 years, January 2009 -

December 2013. In order to analyze the data, there are 4 steps of data analysis established in this paper. The steps started with data collection and ended with answering the research questions, as further elaborated in the following diagram:

Diagram 1: Data analysis procedure



Every steps of data analysis are conducted to answer the research questions addressed previously. Investors or readers of this research can apply these steps to different collection of data, preferably the big one, to form portfolio, measure its performance, and reassess its effectiveness in the latter period.

3.1 Data Collection

1) Stock selection

This research used 22 stocks which have the following criteria:

- Consecutively being incorporated in LQ45 index for 5 years, January 2009 to December 2013.

  The reason behind the selection of the period is that firstly this research wants to address a full-year stock prices result and secondly the period of 5 years is big enough to safely assume the data is normally distributed. Furthermore, the reason behind the selection of LQ45 index is that LQ45 index covers only top 60 companies with the highest market capitalization as well as the highest transaction value in the last 12 months. This means that the stocks being selected in LQ45 index have good financial conditions, prospect of growth, high transaction value and frequency.

- Have been listed in Indonesia Stock Exchange (IDX) since 2008 or earlier.

In addition, there are 3 assumptions being used in forming the portfolio, which are:

- Data is normally distributed
- No short sell is allowed
- Transaction cost is not considered

The selected 22 stocks, based on two criteria mentioned above are presented in Table 2.

Table 2: List of selected stocks

No.	Code	Company Name	Registration Date
1	AALI	Astra Agro Lestari Tbk	9 December 1997
2	ADRO	Adaro Energy Tbk	16 July 2008
3	ASII	Astra International Tbk	4 April 1990
4	BBCA	Bank Central Asia Tbk	31 May 2000
5	BBNI	Bank Negara Indonesia Tbk	25 November 1996
6	BBRI	Bank Rakyat Indonesia Tbk	10 November 2003
7	BDMN	Bank Danamon Indonesia Tbk	6 December 1989
8	BMRI	Bank Mandiri Tbk	14 July 2003
9	INCO	Vale Indonesia Tbk	16 May 1990
10	INDF	Indofood Sukses Makmur Tbk	14 July 1994
11	INTP	Indocement Tunggal Perkasa Tbk	5 December 1989
12	ITMG	Indo Tambangraya Megah Tbk	18 December 2007
13	JSMR	Jasa Marga Tbk	12 November 2007
14	KLBF	Kalbe Farma Tbk	30 July 1991
15	LPKR	Lippo Karawaci Tbk	28 June 1996
16	LSIP	PP London Sumatera Indonesia Tbk	5 July 1996
17	PGAS	Perusahaan Gas Negara Tbk	15 December 2003
18	PTBA	Tambang Batubara Bukit Asam Tbk	23 December 2002
19	SMGR	Semen Indonesia Tbk	8 July 1991
20	TLKM	Telekomunikasi Indonesia Tbk	14 November 1995
21	UNTR	United Tractors Tbk	19 September 1989
22	UNVR	Unilever Indonesia Tbk	11 January 1982

2) Stock data collection

Daily prices of each stock for period January 2009 - December 2013 are obtained from http://finance.yahoo.com. Besides, daily Indonesia Stock Exchange (IDX) prices for the same period are obtained from the same source. Both daily stock and IDX prices are used to form the first portfolio, which is Markowitz optimization method portfolio. Meanwhile, to form the second portfolio, the market capitalization-weighted portfolio, this research gathered the number of shares outstanding from each stock as of 31st December 2013 as well as its closing price at the same time. The number of shares outstanding from each stock is obtained from www.bloomberg.com.

3) Risk free rate

In order to measure the Jensen's Alpha, we need a risk free rate. This risk free rate data is gathered from 10 years maturity of Indonesia government bond. The data is obtained from Finance Ministry data for 2014 bond coupons. The name of the bond is FR0070 with 8.375% return per annum.

3.2 Portfolio Formation

As discussed above, there are two types of portfolio being formed in this research, one is Markowitz optimization method portfolio ("optimization portfolio") and the other one is market capitalization-weighted portfolio ("market capitalization portfolio"). Optimization portfolio is formed by finding a composition of stocks that minimize the portfolio risk given a targeted return of 22%. The 22% of target return is chosen as it represents the annual return of IDX for period January 2009 - December 2013, the same period with the period of stock prices data collection. The portfolio is formed using formula (1) and subject to formula (2).
The second portfolio, which acts as the comparison of the first portfolio is called market capitalization portfolio. Using data of stock price and number of shares outstanding as of 31st December 2013, the composition of stocks in this portfolio is calculated using formula (3).

3.3 Performance Evaluation

After two portfolios are formed, both of them are being compared using three measurement tools, namely Treynor's measure (10), Sharpe's measure (11), and Jensen's measure (12). The objective is to find which portfolio is more superior in terms of giving excess return.

3.4 Back Testing

By still maintaining the same stock composition, both portfolios are being compared once again using different collection of stock prices, from January to May 2014.

4. The Findings

In order to answer the first research question of which passive strategy, Markowitz optimization method or market capitalization-weighted method is more superior in terms of portfolio performance, two portfolios are created. The portfolio creation method is elaborated in section 3.2, Portfolio Creation.

4.1 Markowitz Optimization Portfolio

Using portfolio creation method explained in previous section, the 22 stocks weights are calculated in such a way that minimizes the portfolio risk with targeted return of 22%. The target return of 22% is selected as it represents the average IDX return over the past 5 years (2009-2014), the same period where the stock data is collected. The weight of each stock is provided in Table 3.

Table 3: Markowitz optimization portfolio result, sorted by the highest weight

Stock	Weight
JSMR	16.19%
AALI	13.03%
PGAS	12.56%
LPKR	12.09%
BBCA	10.49%
UNVR	7.70%
BDMN	7.25%
INDF	6.12%
PTBA	4.93%
INCO	3.18%
ADRO	2.87%
SMGR	2.33%
TLKM	1.25%
BBRI	0.01%
ASII	0.00%
BBNI	0.00%
BMRI	0.00%
INTP	0.00%
ITMG	0.00%
KLBF	0.00%
LSIP	0.00%
UNTR	0.00%

By minimizing the portfolio variance given a specific targeted return of 22%, 14 out of 22 stocks contributes in portfolio composition. JSMR dominates the weight contribution with 16.19%, followed by AALI with 13.03%, PGAS with 12.56%, LPKR with 12.09%, and BBCA with 10.49%. The subsequent 9 stocks have weight contributions of less than 10% namely: UNVR, BDMN, INDF, PTBA, INCO, ADRO, SMGR, TLKM, and BBRI. The rest 8 stocks having zero contributions are ASII, BBNI, BMRI, INTP, ITMG, KLBF, LSIP and UNTR.

4.2 Market Capitalization Portfolio

Market capitalization method underlines the total dollar amount of every stock as compared to the whole portfolio. This research used each stock's outstanding share and prices per 31st December 2013. The details are provided in Table 4.

Table 4: Market capitalization-weighted's stocks details

Stocks	Number of Shares Outstanding (million) as of 31st December 2013	Share Price as of 31st December 2013	Market Capitalization
AALI	1,575	IDR 25,100	IDR 39,532,500
ADRO	31,986	IDR 1,090	IDR 34,864,740
ASII	40,484	IDR 6,800	IDR 275,291,200
BBCA	24,655	IDR 9,600	IDR 236,688,000
BBNI	18,649	IDR 3,950	IDR 73,663,550
BBRI	24,669	IDR 7,060	IDR 174,165,854
BDMN	9,585	IDR 3,775	IDR 36,183,375
BMRI	23,333	IDR 7,687	IDR 179,358,438
INDF	8,780	IDR 6,600	IDR 57,948,000
INTP	3,681	IDR 20,000	IDR 73,620,000
ITMG	1,130	IDR 28,500	IDR 32,205,000
JSMR	6,800	IDR 4,725	IDR 32,130,000
KLBF	46,875	IDR 1,250	IDR 58,593,750
LPKR	23,078	IDR 910	IDR 21,000,980
LSIP	6,823	IDR 1,930	IDR 13,168,390
PGAS	24,242	IDR 4,475	IDR 108,482,950
PTBA	2,304	IDR 10,200	IDR 23,500,800
SMGR	5,932	IDR 14,150	IDR 83,937,800
TLKM	100,800	IDR 2,085	IDR 210,191,184
UNTR	3,730	IDR 19,000	IDR 70,870,000
UNVR	7,630	IDR 26,000	IDR 198,380,000
Total market capitalization		IDR 2,060,106,910	

Using market capitalization-weighted portfolio method as explained in section 3.2, the portfolio composition result is shown in Table 5.

Table 5: Market capitalization-weighted portfolio

Stock	Weight
ASII	13.36%
BBCA	11.49%
TLKM	10.20%
UNVR	9.63%
BMRI	8.71%
BBRI	8.45%
PGAS	5.27%
SMGR	4.07%
BBNI	3.58%
INTP	3.57%
UNTR	3.44%
KLBF	2.84%
INDF	2.81%
AALI	1.92%
BDMN	1.76%
ADRO	1.69%
ITMG	1.56%
JSMR	1.56%
INCO	1.28%
PTBA	1.14%
LPKR	1.02%
LSIP	0.64%

The top 5 stocks dominated the portfolio are ASII with 13.36%, BBCA with 11.49%, TLKM with 10.20%, UNVR with 9.63%, and BMRI with 8.71%. It is obvious that none of the stock gives zero contributions, as all of stock must have its shares outstanding.

4.3 Risk, Return and Beta Portfolio Comparison

1) Standard deviation

With a yearly target return of 22%, the two portfolios give different risk. Portfolio created using Markowitz method provides a yearly risk of 19.21% while portfolio created using market capitalization-weighted method with 26.20%. This finding shows that using the treatment explained above, the market capitalization-weighted portfolio's return is more likely to deviate from its average return compared to Markowitz optimization portfolio.

2) Return

The optimization portfolio's return is capped at 22%, while the market capitalization portfolio shows 45% expected annual return.

3) Beta

In this research optimization portfolio gives slightly lower beta than market capitalization portfolio. Portfolio created using Markowitz optimization method gives beta of 0.035, while portfolio created using market capitalization-weighted method 0.036. This results means that

Markowitz portfolio is slightly less volatile in terms of systematic risk than market capitalization-weighted portfolio.

4.4 Performance Evaluation

In order to answer the first research question, 3 performance evaluations are conducted to both portfolios.

1) Treynor's Measure

Using formula 10, the Treynor's ratio is calculated. Through this measurement the additional return earned over risk free investment per unit of systematic risk could be found. In this research, Markowitz optimization portfolio gives Treynor's measure of 3.843 while market capitalization portfolio 10.138. The Treynor's measure of market capitalization-weighted method is rather optimistic due to higher annual return and the fact that the return is not capped. Between two portfolios, it can be concluded that optimization portfolio provides less excess return per unit of systematic risk compared to market capitalization-weighted portfolio.

2) Sharpe's Measure

Sharpe's ratio measures the excess return per unit of portfolio risk. Markowitz optimization portfolio gives a Sharpe's ratio of 0.707 while market capitalization portfolio 1.397. In this research, in can be concluded that portfolio formed using Markowitz optimization method gives slightly less excess return over the same risk born.

3) Jensen's Measure (Alpha)

A portfolio's Alpha is an excess return of portfolio being adjusted to the market index (in this research IDX). Jensen's alpha of Markowitz optimization portfolio is 0.139, while market capitalization is 0.369. In this research Markowitz optimization portfolio is undervalued compared to market capitalization portfolio, which also shows more attractiveness.

Table 6: Portfolio comparison and performance evaluation result

	Markowitz	Market Capitalization
$E(r_P)$	0.220	0.450
σ_p	0.193	0.262
β_P	0.035	0.036
Treynor	3.843	10.138
Sharpe	0.707	1.397
Alpha	0.139	0.368

Given the above result, it is concluded that the first hypothesis is not proven. The superiority of market capitalization-weighted portfolio result might be caused by the fact that the 22 stocks being used in this research are superior already. They are the stocks that consecutively having high capitalization as well as frequency for a period of 5 years. During good market condition, the fact that the return of market capitalization portfolio is not capped makes it possible for the portfolio to achieve as high return as possible while having low deviation from average return, or in other words, risk.

Nevertheless, this is not necessarily the case when market condition is down, market capitalization portfolio could have as low return as possible (no limit) along with high deviations from average return since the return is not targeted. Such condition is where Markowitz portfolio is required to minimize the potential risk given the targeted return.

4.5 Back Testing

Using the stock prices data from January to May 2014, with the same composition of portfolio the two portfolios are once again compared. Markowitz optimization portfolio has provided an expected return of 40.08% with a standard deviation of 0.322, while the market capitalization shows an expected return of 41.07% given a standard deviation of 0.315. The Treynor's measure shows that Markowitz optimization portfolio outperforms the market capitalization method in giving a better systematic risk to return trade off of 0.297 compared to 0.260. The Sharpe's measure shows that Markowitz optimization portfolio underperforms with 0.986 as compared to 1.0367. In this research, the Jensen's alpha of Markowitz portfolio is 0.009 compared to market capitalization portfolio's Alpha of -0.0367. The negative alpha shows an underperformance of market capitalization portfolio as compared to optimization portfolio.

Table 7: Back testing performance result

	Markowitz	Market Capitalization
$E(r_P)$	0.401	0.411
σ_p	0.322	0.315
β_P	1.067	1.257
Treynor	0.297	0.260
Sharpe	0.986	1.037
Alpha	0.009	-0.037

The second hypothesis of sustainability of Markowitz optimization portfolio's superiority over market capitalization-weighted is not proven. First, it is because in this research the Markowitz optimization portfolio performance is not superior to market capitalization-weighted portfolio, and second it turns out the some measures result might change in the latter period. In this case Treynor's measure of Markowitz portfolio change from being underperformed to market capitalization-weighted portfolio to outperformed it.

5. Summary and Conclusions

This research's purpose is to compare the performance of portfolio created using Markowitz optimization method and portfolio created using market capitalization-weighted method. The Markowitz optimization portfolio is formed by minimizing the portfolio variance given an expected return of 22% per year. On the other hand, the market capitalization-weighted portfolio is created by weighing the dollar amount of each stock in portfolio at one point of time.

The two portfolios are examined using 3 indicators of performance Treynor's measure, Sharpe's measure, and Jensen's measure. In addition beta, return, and standard deviation of portfolio are also examined. Markowitz optimization portfolio underperforms market capitalization portfolio in terms of Treynor's (3.843 as compared to 10.138) and Sharpe's measure (0.707 as compared to 1.397). Meanwhile, the optimization portfolio is judged as slightly more overvalued than market capitalization portfolio by providing Alpha of 0.139 compared to 0.369. This research concluded that market capitalization portfolio is superior due to the fact that the stocks selected are superior already. When the return is not capped and the market is having good condition, it does make sense that these superior stocks give superior performance. However this might not necessarily be the case when the market is in bad condition.

Back testing also provided that Markowitz optimization portfolio outperforms in giving excess return over systematic risk and supposedly predicted return by CAPM, but underperformed in Sharpe's measure. In this back test, the difference gap between the three indicators becomes smaller.

References

Bodie, Z, Kane, A, Marcus, AJ, 2008, *Investments*, McGraw Hill/Irwin, New York.

Bodie,Z, Kane, A, Marcus, AJ, 2003, *Essentials of Investment,* Fifth Edition, McGraw Hill, USA.

Folger, J n.d., *Backtesting and Forward Testing: The Importance of Correlation*, viewed 15 June 2014, <http://www.investopedia.com/articles/trading/10/backtesting-walkforward-important-correlation.asp>.

Kementrian Keuangan Republik Indonesia 2014, *Rencana Lelang Surat Utang Negara*, Kementrian Keuangan Republik Indonesia, viewed 9 June 2014, <http://www.kemenkeu.go.id/SP/rencana-lelang-pembelian-kembali-surat-utang-negara-dengan-cara-penukaran-debt-switch-tanggal-11>.

Jensen, M 1968, 'The performance of mutual funds in the period 1945-1964', *Journal of Finance*, 23 (2), pp. 389-416.

Markowitz, H 1952. 'Portfolio Selection', *Journal of Finance*, vol. 7, no. 1, pp. 77–91.

Levine, DM, Krehbiel, TC, and Berenson, ML 2006, *Business Statistics, A First Course*, Pearson Prentice Hall LTD, USA.

Sarker, MR 2013, 'Optimal Portfolio Construction: Evidence from Dhaka Stock Exchange in Bangladesh', *World Journal of Social Sciences*, vol. 3 no. 6., pp. 75-87.

Sharpe, WF 1964, 'Capital Asset Prices: A Theory of Market Equilibrium under Conditions of Risk', *Journal of Finance*, vol. 19, no. 3, pp. 425–442.

Treynor, JL 1961, 'Toward a Theory of Market Value of Risky Assets', Unpublished manuscript.