JOURNAL OF
BUSINESS AND MANAGEMENT
Vol. 3, No.3, 2014: 267-277

THE CONSTRUCTION OF OPTIMAL BALANCED FUND CONSISTING INDONESIAN STOCKS AND BONDS (CASE STUDY: LQ45 STOCKS AND GOVERNMENT BONDS DURING PERIOD JULY 2009 – JUNE 2014)

Adellia Debyane Lontoh and Achmad Herlanto Anggono
School of Business and Management
Institute of Technology Bandung, Indonesia
adellia@sbm-itb.ac.id

Abstract- *This study concerns about the optimization construction of a balanced fund consisting the LQ45 stocks and Indonesian Government Bonds, which also includes the assessment of each single asset risk-return tradeoff and the performance measurement of the constructed optimal balanced fund portfolio. The time scope of this study ranges as of 1 July 2009 to 30 June 2014. Several data required to conduct the analysis of this study that include the historical daily price of stocks, bonds, Jakarta Composite Index, and LQ45, as well as the monthly data of BI Rate as the risk-free rate used in this study. The selected stocks and bonds were further analyzed in the asset allocation as a part of the portfolio optimization, by attaining the possible maximum return at a given risk and the possible minimum variance at a given expected return, as refers to the Mean-Variance analysis in Markowitz Portfolio Theory. The Efficient Frontier was also constructed to ensure that the constructed portfolios lie in the Efficient Frontier. The constructed balanced fund was ultimately selected based on the 3 (three) measurement indices. The selected balanced fund was assessed to perform above the markets regarding its high return, Sharpe Ratio, and Treynor Index, as well as low standard deviation as below the JCI and LQ45, and Alpha that positively identified above the markets. The author believes this study may ensure readers to invest in balanced fund that provides minimum risk for certain return with high excess return.*

Keywords: *Balanced Fund, Portfolio, Optimization, LQ45 Index, Stocks, Indonesian Government Bonds, Jakarta Composite Index, BI Rate, Mutual Fund, Markowitz Portfolio Theory*

Introduction

Capital market has been one of the arising global issues for the last decade. It provides a platform for investors to compete with the market in order to against inflation. The presence of robust, deep, regulated, and liquid capital markets is essential for any economy to function efficiently. For an emerging and growing economy like Indonesia, it is especially crucial. To avoid the vicious cycle of low returns on savings leading to low domestic consumption, the existence of investment options in the form of sound capital markets is a matter of necessity rather than a choice. Currently, the individual investors are choosing not to trade securities directly for their own accounts, instead, they direct their funds to the investment companies that purchase securities on their behalf. The most important of these financial intermediaries are mutual funds. There are a number of reasons why an individual investor may choose to buy mutual funds instead of individual investment vehicles. The most common are that mutual funds offer diversification, convenience, and lower costs. Mutual fund development in Indonesia currently increases along with the growth of a nation's economy and

capital market development. Indonesia's mutual fund industry booked a 10.9% rise in total Net Asset Values, in which the growing number improving interest from investors and rising value of investments (The Jakarta Globe, 2014). The growth of mutual funds in Indonesia is presented clearly in the following figure throughout period 2006 - 2014.

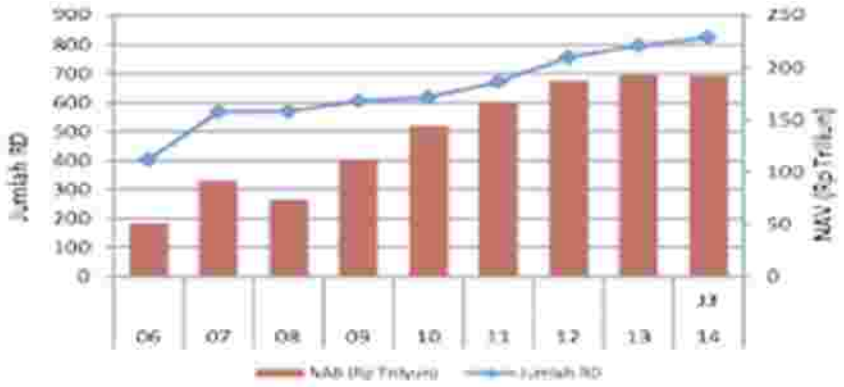

Figure 1. Mutual Funds Growth in Indonesia *(Source: Otoritas Jasa Keuangan, 2014)*

Choosing between equity and debt is difficult in the best of times according to the market conditions. Balanced funds allow investors to invest in a combination of equity and debt. Balanced funds do well when stock markets are in a difficult phase as they have a cushion of debt. Hence, they are better equipped to withstand shocks in falling markets. As a result, in the sagging scheme of stock markets, the balanced fund returns are not as bad as the equity fund's. On a contrary, when stock markets rise, they may not do as well as funds with 100% equity components. The comparison of Net Asset Values performance in 2014 between each type of mutual funds is presented in the following figure.

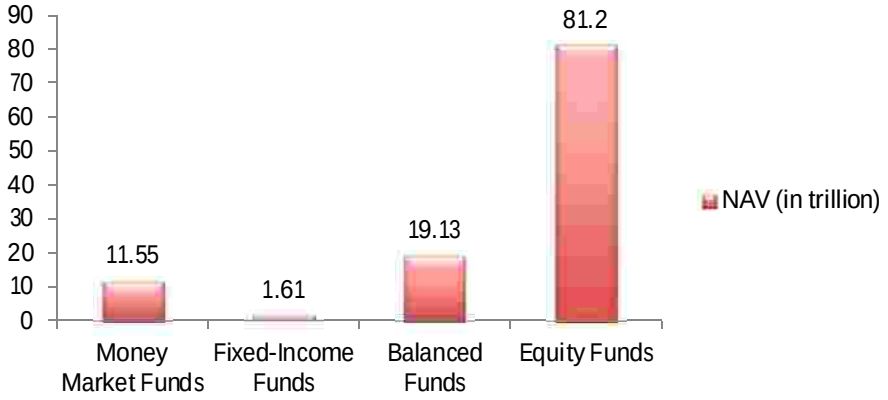

Figure 2. NAV Performance in January 2014 *(Source: Otoritas Jasa Keuangan, 2014)*

The ideal investment is a balanced fund that offers exposure to investment assets that are negatively correlated. Thus, when one market falls, the other may provide safety. This is the fundamental idea of balanced funds. Looking at the aforementioned facts, the author was motivated to practice an act as a portfolio analyst in mutual fund industry in purpose of constructing the optimal balanced fund. The author selected the Indonesian LQ45 stocks and government bonds to be constructed within the balanced fund. The reason the author selected LQ45 stocks is because the stocks listed in the LQ45 Index are assessed as the most liquid companies and have the largest market capitalization. Moreover, the LQ45 stocks also cover around 65% of the market capitalization in the Indonesian stock market. The author also selected government bonds rather than corporate bonds, regarding the lower risk that is carried by government bonds. While

corporations have a higher probability of default, governments guarantee repayment of debt towards the creditors since there is merely a small probability for a city or government to go bankrupt.

Literature Review

Mutual Fund

According to the Law of Capital Market No. 8 Year 1995 Article 1 Verse 27, mutual fund is an investment vehicle that is made up of a pool of funds collected from many investors to be invested in a portfolio of securities such as stocks, bonds, and money market instruments, operated by the fund managers.

Balanced Funds

Balanced Funds are mutual funds that put a maximum 79% of the funds into money markets, stocks, or bonds, with a flexible investment composition that may change overtime throughout the holding period of the fund, in accordance to the market conditions that affect the securities within the portfolio. These funds have an adequately high potential gain with medium to long-term investment (4 – 5 years). (Rudiyanto, 2013)

Jakarta Composite Index

The Indonesia Stock Exchange (1982) defines Jakarta Composite Index (JCI) as an index that uses all listed companies as the components to calculate the market index. It acts as a benchmark in measuring market activities.

LQ45 Index

The Indonesia Stock Exchange (1982) defines LQ45 Index as a market capitalization-weighted index that captures the performance of 45 most liquid companies listed on the Indonesia Stock Exchange, which included in the top 60 companies with the highest market capitalization in the last 12 months, included in the top 60 companies with the highest transaction value in a regular market in the last 12 months, have been listed in the Indonesia Stock Exchange for at least 3 months, and have good financial conditions, prospect of growth, and high volume and frequency.

BI Rate

The BI Rate is the policy rate reflecting the monetary policy stance adopted by Bank Indonesia and announced to the public. It is implemented in Bank Indonesia monetary operations conducted by means of liquidity management on the money market to achieve the monetary policy operational target. (Bank Indonesia, 2014)

Markowitz Portfolio Theory

Markowitz Portfolio Theory is an investment framework for the selection and construction of investment portfolios based on the maximization of expected returns of the portfolio and the simultaneous minimization of investment risk. (Fabozzi et al., 2002)

Efficient Frontier

Different combinations of securities produce different levels of return. The Efficient Frontier represents the best of these securities combinations – those that produce the maximum expected return for a given level of risk, or vice versa.

Risk-Return Theory of Single Asset

Geometric Average

The geometric average calculated by compounding the actual period-by-period returns and then finding the per-period rate that will compound to the same final value. (Bodie et al., 2009)

$$R_G = \ln\,(1 + R_a)$$

Rates of Return Quotation

Returns on assets usually are quoted as annual percentage rates or APRs, which annualize per period rates using a simple interest approach, ignoring compound interest. (Bodie et al., 2009)

$$APR = Per\ period\ rate\ x\ Periods\ per\ year$$

Standard Deviation

To give the measure of risk the same dimension as expected return, the standard deviation is applied as the square root of the variance. (Bodie et al., 2009)

$$\sigma = \sqrt{\frac{\sum_{t=1}^{N}(R_t - E(R_i))^2}{(N-1)}}$$

Beta

The beta of a security is the standardized covariance of a security's return with the return on the market portfolio (Ross et al., 2010).

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

Portfolio Theory

Portfolio Expected Return

The expected return of a portfolio is simply defined as the weighted average of returns on the single assets within the portfolio. (Bodie et al., 2009)

$$E(R_p) = \sum_{i=1}^{N} w_i * E(R_i)$$

Correlation

Correlation and covariance measure how two random variables are related. They both measure the relationship between the return on one stock to another (Ross et al., 2010).

$$\rho_{ij} = \frac{n\sum_{t=1}^{n} R_i(t)R_j(t) - (\sum_{t=1}^{n} R_i(t))(\sum_{t=1}^{n} R_j(t))}{\sqrt{n\sum_{t=1}^{n} R_i(t)^2 - (\sum_{t=1}^{n} R_i(t))^2}\sqrt{n\sum_{t=1}^{n} R_j(t)^2 - (\sum_{t=1}^{n} R_j(t)^2)}}$$

Covariance

Covariance is defined as a statistic measuring the interrelationship between two securities. For given variances of the individual securities, positive covariance between two securities increases the variance of the entire portfolio. Negative covariance between two securities decreases the variance of the entire portfolio. (Ross et al., 2010).

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

Portfolio Variance

The variance of the return on a portfolio with many securities is more dependent on the covariance between the individual securities than on the variances of individual securities (Ross et al., 2010).

$$\sigma^2{}_p = \sum_{i=1}^{N} w^2\sigma^2 + \sum_{i=1}^{N}\sum_{j=1}^{N} w_i w_j\, Cov(R_i R_j)$$

Portfolio Standard Deviation

The portfolio standard deviation is defined as a statistical measurement of dispersion, which depicts how widely a mutual fund's returns varied over a certain period of time. (Bodie et al., 2009)

$$\sigma_p = \sum_{i=1}^{N} (w_i^{\top} \Sigma w)^{1/2}$$

Portfolio Beta

The beta of a portfolio is simply the weighted sum of the individual asset betas, in accordance to the proportions of the investments in the portfolio. (Ross et al., 2010)

$$\beta_p = \sum_{i=1}^{N} w_i \times \beta_i$$

Portfolio Optimization

The portfolio construction problem can be generalized to the case of many risky securities and a risk-free asset. The problem is separated into parts that include the following 3 (three) steps (Bodie et al., 2009):

1. Identify the risk-return combinations available from the set of risky assets.
2. Identify the optimal portfolio by finding the portfolio weights that results using Solver Add-ins in Microsoft Excel based on the maximum possible expected return that can be attained with a given portfolio risk and the minimum possible risk that can be attained with a given portfolio expected return.
3. Choose an appropriate complete portfolio by mixing the risk-free asset with the optimal risky portfolio using the Efficient Frontier. All the portfolios that lie on the efficient frontier provide the best risk-return combinations and thus candidates for the optimal portfolio.

Portfolio Performance Measurement

Sharpe Ratio

The higher a fund's Sharpe Ratio, the better a fund's returns to the investment risk.

$$S = \frac{E(R_p) - R_f}{\sigma_p}$$

Jensen's Alpha

The Jensen's Alpha measures the performance of a fund compared with the actual returns over the period. If the value is positive, the portfolio is earning excess returns.

$$\alpha = E(R_p) - [R_f + \beta_p (R_m - R_f)]$$

Treynor Index

It measures the return earned in excess of a riskless investment per unit of market risk assumed.

$$T = \frac{E(R_p) - R_f}{\beta_p}$$

Mutual Fund Net Asset Value

$$Net\ Asset\ Values = \frac{Total\ Asset - Liabilities}{Total\ Outstanding\ Shares}$$

Methodology

Problem Identification

The issues cover the analysis towards all the possible asset allocation for achieving the optimal balanced fund portfolios consisting stocks and bonds, as well as the measurement of the optimal balanced fund.

Theoretical Foundations

Literature review displays some important theories used to advocate this study. The theories implemented in this study were obtained from several textbooks, journals, papers, and some legal entity websites. This study applied Solver Add-ins tool in Microsoft Excel in conducting the analysis towards the portfolio optimization.

Data Collection

The data collected was retrieved from trusted sources, and then selected for certain periods to be estimated further. The data collection covers stocks, bonds, and market data. There are 2 (two) sources of data for stocks, the LQ45 Index Semiannual Report as of August 2008 to July 2014 that was obtained from the Indonesia Stock Exchange website and the historical daily price that was obtained from the Yahoo Finance website. While for bonds, the data was obtained from the Indonesia Bond Pricing Agency. As a benchmark in this study, Jakarta Composite Index and LQ45 were used, with historical daily price data that was also obtained from Yahoo Finance website. There is also the BI Rate data that was obtained from Bank Indonesia website, to be used as the risk-free rate on this study. All the stocks, bonds, and market data ranges from 1 July 2009 to 30 June 2014.

Data Analysis

The collected data was analyzed using the gradual procedure as expressed with the following figure below.

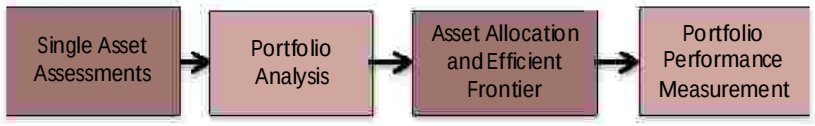

Figure 3. Analysis Procedure

The initial filtering process over stocks and government bonds resulted 29 single assets consisting 16 stocks and 13 bonds that were further analyzed in purpose of the construction for a balanced fund. All stocks were filtered based on their consistency appearance in the LQ45 Index as of August 2008 to July 2014. Meanwhile, government bonds were initially filtered based on their mature dates and listed dates. Assuming the constructed balanced fund will be active as of 1 January 2015 with 4 years to maturity, all bonds with maturity before 1 January 2019 and those listed after 1 July 2009 were filtered, in case if there is any debt securities in the constructed balanced fund that is required a replacement with other debt security before the fund's maturity.

Single Asset Assessments

The initial filtering process over stocks and government bonds resulted 29 single assets consisting 16 stocks and 13 bonds that were further analyzed in purpose of the construction for a balanced fund. The historical daily price was used to calculate the historical daily returns of each single asset, by applying the Geometric Average formula.

The expected return of each single asset could then be computed by using the formula =AVERAGE(number 1, ... , number 5) in Microsoft Excel, where number 1 to 5 indicates per period rate of return. The standard deviation of each single asset was also computed by using the formula =STDEV.P(number 1, ... , number 5) that indicates the standard deviation of an asset population, where number 1 to 5 indicates per period rate of return. These 29 assets were then sorted from the highest to the lowest expected return, as well as being assessed above the market, and resulted:

Table 1. List of Selected Single Assets

No.	Asset Code	Asset Name	$E(R_i)$	s_i	$Var(R_i)$	$Cov(R_i, R_m)$	$ß_i$
1	ASII	Astra International Tbk	58.92%	51.89%	26.92%	7.79%	1.9
2	INDF	Indofood Sukses Makmur Tbk	40.86%	52.49%	27.56%	10.08%	2.4
3	BBRI	Bank Rakyat Indonesia (Persero) Tbk	38.80%	22.00%	4.84%	3.12%	0.7
4	BMRI	Bank Mandiri (Persero) Tbk	35.74%	32.33%	10.45%	5.56%	1.3
5	TLKM	Telekomunikasi Indonesia (Persero) Tbk	35.50%	26.09%	6.81%	-1.25%	-0.3
6	BBCA	Bank Central Asia Tbk	35.38%	28.54%	8.14%	5.32%	1.3
7	SMGR	Semen Indonesia (Persero) Tbk	34.92%	35.70%	12.75%	4.77%	1.1
8	BBNI	Bank Negara Indonesia (Persero) Tbk	33.11%	26.84%	7.20%	4.43%	1.1
9	UNTR	United Tractors Tbk	28.80%	44.79%	20.06%	5.88%	1.4
10	LSIP	London Sumatra Plantation Tbk	27.08%	46.36%	21.49%	1.80%	0.4
11	FR0050	Obligasi Negara RI Seri FR0050	8.96%	20.02%	4.01%	1.40%	0.3
12	FR0047	Obligasi Negara RI Seri FR0047	8.12%	17.28%	2.99%	1.53%	0.4
13	FR0042	Obligasi Negara RI Seri FR0042	7.89%	17.12%	2.93%	1.61%	0.4
14	FR0044	Obligasi Negara RI Seri FR0044	7.34%	16.61%	2.76%	1.67%	0.4
15	FR0040	Obligasi Negara RI Seri FR0040	7.07%	16.60%	2.75%	1.65%	0.4
16	FR0037	Obligasi Negara RI Seri FR0037	6.95%	16.69%	2.78%	1.68%	0.4

Portfolio Analysis

In analyzing the portfolio, there are 2 (two) important things to calculate, the correlation and covariance between the selected single assets. From the correlation matrix in this study, it can be seen that each single asset is somehow positively correlated to each other, except TLKM that is negatively correlated to other assets. Besides TLKM, there are also negative correlations shown between LSIP and SMGR (-0.3279), BBRI and FR0050 (-0.2015), BBRI and FR0047 (-0.0563), as well as BBRI and FR0042 (-0.0184). The smallest correlation happens between TLKM and UNTR with a value of -0.8601. The role of covariance in the Modern Portfolio Theory lies in its impact on the diversification effects of adding different asset classes into a portfolio. Therefore, it provides possibility to reduce the risk for a given expected return by adding asset classes whose returns exhibit low covariance between the single assets in the portfolio. In this study, the author also built a covariance matrix in a spreadsheet by using the portfolio covariance formula. It can be seen that as the correlation between securities is negative, the covariance between those two securities is also negative.

Portfolio Optimization

The portfolio optimization is generally based on the minimum variance and maximum return, which technically comes into 3 (three) aspects in using Solver Add-ins tool in Microsoft Excel, which include the target cell, decision variables, and constraints. The minimum variance can be achieved by setting the target cell of standard deviation as minimum, with asset weighs as variables, and the fixed constraints cover: the total weight of stocks and the total weight of bonds must be respectively less or equal to 0.79 regarding the study objective in constructing the optimal balanced fund, the total weight must also be equal to 1, and the expected return must be greater or equal to the given expected return. The maximum return can be achieved by setting the target cell of expected return as maximum, with asset weighs as variables, and the fixed constraints likewise the MVP except the standard deviation must be greater or equal to the given standard deviation. From the 32 portfolios constructed, there are several portfolios removed based on certain criteria that include:

1. Portfolios that merely consist of one stock and one bond and could not attain the given expected return or the given standard deviation
2. Portfolios with the same results as the other constructed portfolio

Based on the aforementioned criteria, there are 22 portfolios that were obtained.

Table 2. Portfolio Ranks Based on The Expected Return

No.	Rank	$E(R_p)$	s_p	Sharpe Ratio
1	Portfolio 23	45.13%	35.70%	108.28%
2	Portfolio 20	43.81%	32.33%	115.50%
3	Portfolio 22	42.29%	28.54%	125.52%
4	Portfolio 24	41.60%	26.84%	130.88%
5	Portfolio 21	41.29%	26.09%	133.44%
6	Portfolio 2	40.86%	25.08%	137.12%
7	Portfolio 19	39.51%	22.00%	150.21%
8	Portfolio 3	38.80%	20.45%	158.13%
9	Portfolio 27	38.60%	20.02%	160.50%
10	Portfolio 28	37.24%	17.28%	178.09%
11	Portfolio 29	37.16%	17.12%	179.25%
12	Portfolio 32	36.92%	16.69%	182.46%
13	Portfolio 30	36.88%	16.61%	183.07%
14	Portfolio 31	36.87%	16.60%	183.14%
15	Portfolio 4	35.74%	14.69%	199.31%
16	Portfolio 5	35.50%	14.29%	203.11%
17	Portfolio 6	35.38%	14.10%	205.06%
18	Portfolio 7	34.92%	13.36%	212.88%
19	Portfolio 8	33.11%	10.74%	248.11%
20	Portfolio 9	28.80%	6.72%	332.14%
21	Portfolio 10	27.08%	6.01%	343.14%
22	Portfolio 11	25.62%	5.96%	321.19%

In order to ensure whether those 22 portfolios provide the optimal combination of assets, the Efficient Frontier is the best measure.

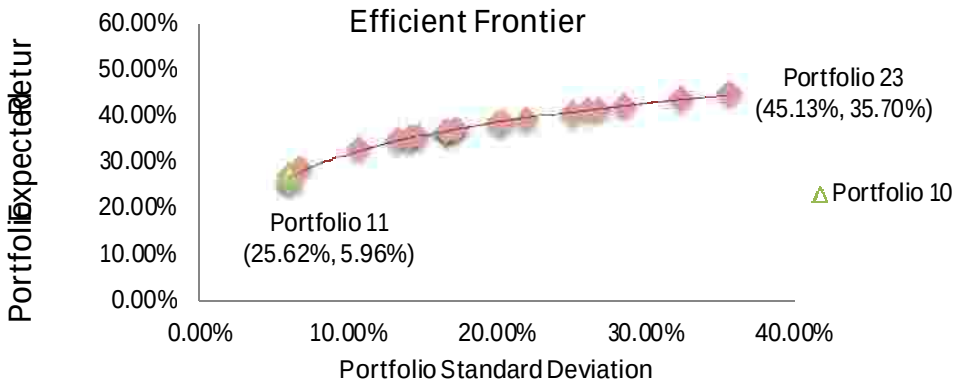

Figure 4. Efficient Frontier of 22 Constructed Portfolios

It is clearly seen that the 22 portfolios built an efficient frontier. Portfolio 23 provides the highest expected return, while Portfolio 11 provides the lowest risk. However, Portfolio 10 provides the highest Sharpe Ratio with risk and return between the minimum variance and the maximum return portfolios. Portfolio with the highest Sharpe Ratio is considered as the most efficient optimal portfolio since it provides the highest excess return with the maximum possible expected return at

certain risk level. Therefore, Portfolio 10 was selected as the most optimal constructed balanced fund, which consists of 5 assets that include BMRI, BBRI, TLKM, LSIP, and FR0044.

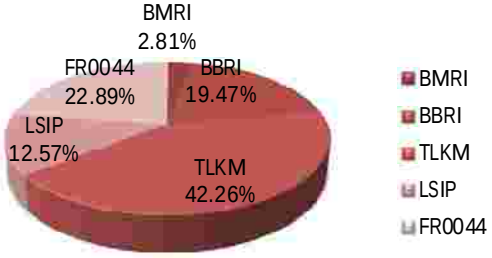

Figure 5. Asset Allocation of Portfolio 10

Optimal Balanced Fund Performance Measurement

The assessment of the constructed optimal balanced fund performance was measured by 3 (three) measurement indices that cover Sharpe Ratio, Jensen's Alpha, and Treynor Index. The performance was compared to the Jakarta Composite Index and LQ45 Index since it is usually used in comparing the performance of a portfolio.

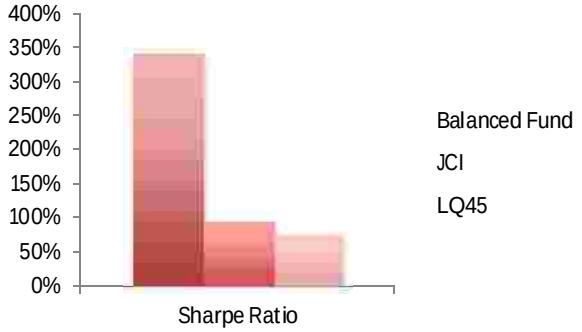

Figure 6. Sharpe Ratio Comparison between The Balanced Fund and Market

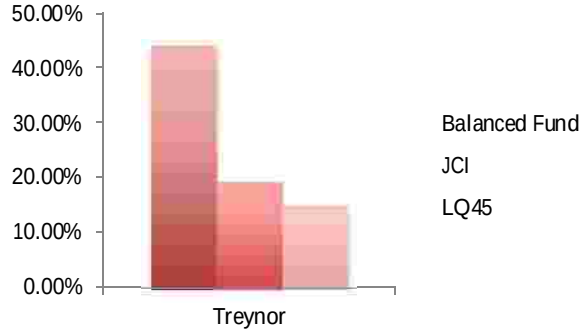

Figure 7. Treynor Index Comparison between The Balanced Fund and Market

The figures above denote that the constructed balanced fund earns very much higher Sharpe Ratio compared to the two market indices, as well as a higher Treynor Index than JCI and LQ45. Other than that, the Jensen's Alpha of the constructed balanced fund resulted positive value, which means that it performs above the market.

Conclusion and Recommendations

Conclusion

After conducting the analysis towards the data collected for this study, the author found several conclusions to be summarized from the entire analysis.

- The optimal portfolio with the highest excess return of 343% resulted in Portfolio 10 that consists of 5 assets. Although this portfolio is ranked second from the bottom of all the constructed portfolios, but this portfolio turns out produces the highest excess return that is shown by the highest Sharpe Ratio. This portfolio is the most efficient of all, and is suitable for risk-averse investors. The optimal portfolio with the highest expected return of 45.13% resulted in Portfolio 23 that consists of 3 assets. The expected return of this portfolio may be the highest, but the portfolio risk is also the highest. However, the Sharpe Ratio turns out not as satisfying as Portfolio 10, which amounted 108.28%. This portfolio is suitable for aggressive investors who seek for high returns.
- The results of Portfolio 10 and Portfolio 23 concluded that the risk-return tradeoff is somehow still implied in the optimal portfolio. However, the risk is more diversified by allocating the assets weight. It can also be seen that the more assets consisted in a portfolio, the more diversified the risks are, but the lower also the portfolio expected return is.
- The selected balanced fund portfolio (Portfolio 10) exhibits good performance based on its expected return, standard deviation, Sharpe Ratio, Jensen's Alpha, and Treynor Index in comparison to the market indices, the Jakarta Composite Index and the LQ45 Index.
- The author also found that by including negatively correlated assets in a portfolio, it could diversify the risks in the portfolio. In this case, all the constructed portfolios that have been filtered consist of TLKM in order to lower the risk of investing.
- The optimal constructed portfolios in this study denoted that the optimal balanced fund generally consists of merely one government bond in order to achieve the maximum return for a given risk and the minimum risk for a given expected return, as well as comprised of 79% exposure to equity and 21% to debt.

Recommendations

For investors with risk-averse profile can invest in a balanced fund of Portfolio 10. The expected return might not as high as Portfolio 23, but it is still satisfying considering the risk is low. Meanwhile, aggressive investors can choose to invest in a balanced fund of Portfolio 23 that provides a high return, but also a high risk of investing. Both portfolios are considered as optimal, but it also depends on the investors' characteristics.

The author also intends to give some recommendations for further research. The analysis for Markowitz Portfolio Theory requires valid data, by means that the calculations in this study have to be as specific as possible. For example, in calculating the returns, it is recommended for academicians to use the Geometric Average method to make it more accurate. Furthermore, the author also recommends academicians to conduct a further research from this study concerning the single asset future forecast movements by using E-Views for more precise results. Therefore, the investors may know when to sell or replace one single asset that performs under the expected return of the single asset. Thereby, the balanced fund may keep on track to meet the expected return of the portfolio at the end of the investment period.

References

Bodie, Z., Kane, A., & Marcus, A. J., 2009, *Essentials of Investments* (8th ed.), New York, McGraw-Hill/Irwi

Fabozzi, F., Gupta, F., & Markowitz, H., 2002, The Legacy of Modern Portfolio Theory, *Journal of Investing*, 7-22

Grau-Carles P., Sainz J., Otamendi J., & Doncel L. M., 2009, Managing Financial Instability in Capitalist Economics, *Different Risk-Adjusted Fund Performance Measures: A Comparison*, 54:4-6

Kushwaha, R., 2011, *Opportunities in Indian Market of Mutual Funds Investment*, 1

Mangram M. E., 2013, A Simplified Perspective of The Markowitz Portfolio Theory, *Global Journal of Business Research,* 7:60-62

Markowitz, H. M., 1952, Portfolio Selection. *The Journal of Finance*, 7 7:77-91

Ravipati, A., 2012, Operations Research, *Markowitz's Portfolio Selection Model and Related Problems*, 4-6

Ross, S. A., Westerfield R. W., & Jaffe, J., 2010, Capital Market Theory: An Overview, *Corporate Finance* (9th ed.), New York, McGraw-Hill/Irwin

Roychoudhury, S., 2007, *The Optimal Portfolio and The Efficient Frontier*, 9-35

Rudiyanto, 2013, *Sukses Finansial dengan Reksa Dana*, Jakarta, PT Elex Media Komputindo Kompas Gramedia

Sharpe, W., 1964, Capital Asset Prices: A Theory of Market Equilibrium Under Conditions of Risk, *Journal of Finance*, 19:425-442