The Analysis of Optimal Portfolio Using Single Index Model, The Case of Stocks Listed In Jakarta Islamic Index 2010-2013

Doddi Prastuti¹ and Erti Septina²
¹,²Sekolah Tinggi Ilmu Ekonomi Indonesia (STEI)
Jakarta, Indonesia
doddi_prastuti@yahoo.com

Abstract—The purpose of this study is to apply the single index model in order to make an optimal portfolio for stocks listed in Jakarta Islamic Index (JII). The model is used in order to analyze what stocks to be chosen as components of a portfolio stock and how much proportion to be invested in each stock. This research use stocks that are listed in Jakarta Islamic Index. The reason for choosing stocks listed in JII is because many Indonesians, mostly Muslims, still not familiar with the stock that is accordance with the requirement of Sharia. The data use in this study is secondary data, among others: quarterly stock price data during period of 2010-2013, composite index, interest rate. Sample in this study are 28 companies’ stocks listed in the Jakarta Islamic Index, two companies’ stock did not meet the criteria of the sample because the companies start listed in the index in 2012. Data analysis methods use in this study are: stocks’ return and expected return, stocks’ risk, market’s return and risk, beta and alpha, variance of residual error, rate of excess return to beta, determine the cut off rate, proportion of fund invested in optimal portfolio, and risk of optimal portfolio. Result of this study showed that there are 10 stocks that meet the criteria of optimal portfolio formation. Those stocks and their proportion are: 24,852% stock of JMSR, 16,587% stock of ASRI, 14,721% stock of INDF, 15,398% stock of AKRA, 11,835% stock of LPKR, 5,684% EXCL, 5,184% MAPI, 3,143% CPIN, 1,511% SMGR and 1,086% stock of KLBF. Based on the calculation, the portfolio’s expected return is 10,33% and the risk is 2,74%.

Keywords—co Optimal Portfolio, Single Index Model, Jakarta Islamic Index

I. INTRODUCTION

One of the reasons why investors invest in stocks is to get a good expected rate of return on the stocks they bought. By investing in stocks investors will be exposed to expected return as well as risk. The yield from investing in stocks consists of dividend yield and capital gains yield. In order to reduce the risk of investment, the investors can invest in portfolio of stocks. By investing in stock portfolio means that the investors have to decide how much allocation of fund they will put in each of stocks in the portfolio and they also have to choose which stocks they buy.

Portfolio is a combination of various investment instruments ([9], 2011:1). Portfolio return is the difference between the market value of the portfolio at the end of the period and the beginning of the period plus dividends from stocks in the portfolio received during the observation period, then divided by the value of the initial investment ([9], 2011:10). Investment risk can be minimized through the establishment of an efficient portfolio, so the risk is lower than the risk of each investment instrument (eg shares) that make up the portfolio ([9], 2011:19).

Rational investors’ steps in making investment decision are: make analysis of current situation, design optimal portfolio, make investment policy, make investment strategy, monitor and supervise performance the fund manager ([6] 2000).

Indonesia as the biggest Muslim country in the world is holds an enormous market for the development of sharia finance industry. Sharia capital market, which is part of the Sharia finance industry, has an important role in increasing the market share of Sharia finance industry in Indonesia. Although its development is still new compared to the Sharia banking, Indonesia’s sharia capital market is expected experience rapid growth along with significant growth in Indonesian capital Market Industry ([www.idx.co.id]). On July 3rd 2000 The Jakarta Stock Exchange (JSX) has issued the Jakarta Islamic Index. This index is expected to attract Muslim investors to invest in stock exchange market. This is the reason why the stocks in the JII are chosen in this study.

Based on the reason mentioned above, this research is focusing on: The Analysis of Optimal Portfolio Using Single Index Model, The Case of Stocks Listed in The Jakarta Islamic Index 2010-2013

Problem’s Formulation and objective

Research problem’s formulation in this study is: how to make optimal portfolio of stocks that are listed in the Jakarta Islamic Index using single index model, period 2010 until 2013.

The purpose of this study is to make optimal portfolio of stocks that are listed in the Jakarta Islamic Index using single index model, period 2010 until 2013.
Research Scope

The research scope of this study is the stock that listed in the Jakarta Islamic Index during the period of 2010 until 2013. The data use in this study is secondary data. The data use are: quarterly stock price data during period of 2010-2013, composite index, interest rate.

Theoretical Frameworks

Stock return consists of capital gain yield and dividend yield. Capital gain yield is the difference between the selling price and the purchase price per share divided by purchase price of the share, and the dividend yield is dividend per share divided by the stock purchase price per share. [9] (2011:4).

Return can be divided into: realization return, i.e. the return that has already happened and expected return, i.e. the expected return will be earned by investors in the future.

Risk is defined as the difference between the expected return and its realization. The greater the deviation, the higher the risk, return and investment risk are two words that cannot be separated, [9] (2011:19). Risk can be divided into: systematic risk and unsystematic risk. Systematic Risk is a risk that cannot be eliminated by diversification. This risk is influenced by fluctuations in macro factors that can affect the overall market, such as changes in economic and political conditions, taxation, government policies, and so forth. Systematic risk can be calculated by multiplying the variance of the market with the beta.

Investors usually want to maximize their expected return with given risk when they invest in portfolio, this is called efficient portfolio. While optimal portfolio is a portfolio choose by the investors among alternatives of efficient portfolios. [8], 2001:74. Usually investors choose the portfolio that is in accordance with their preferences of risk and return. To calculate

To calculate exactly how much return that will be earned by an investment in the future is very difficult, it can only be estimated. An investment’s return in the future is called expected return. The expected return of an investment can be very different with its realized return. Besides calculating his investment’s return, an investor has to calculate the risk of his investment also. An investment’s risk is a deviation between expected return and actual return ([8], 2001:51).

Single index model is a model develop by Sharpe, this method can be used to simplify the calculation in Markowitz method by using input parameter. Single index model can also use to calculate expected return and risk of portfolio ([5], 2003:231). Single index model assumed that stocks’ return have same reaction to one factor or single index included in the model. The sensitivity of stocks’ return is calculated by beta ([3], 2005:82).

RESEARCH METHOD

This study use quantitative method using time series quarterly data from 2010 to 2013. The analysis data in this study are as follows:

1. Stock’s rate of return and risk.

Return is calculated by reducing closing price t period with t-1 period, add it with dividend paid then divided it with closing price t-1 period ([7] et.al, 2003:238)

\[
R_t = \frac{(P_t - P_{t-1}) + D_t}{P_{t-1}}
\]  

Where:
- \( R_t \) = realized return
- \( P_t \) = Price of stock period t
- \( P_{t-1} \) = Price of stock period t-1
- \( D_t \) = dividend at period t

Expected return is calculated using the following formula ([9], 2011:5):

\[
E(R_i) = \frac{\sum_{t=1}^{n} R_{it}}{n}
\]

Where:
- \( E(R_i) \) = expected return of stock i
- \( R_{it} \) = return stock i at period t
- \( n \) = period

\[
\sigma_i^2 = \frac{\sum_{t=1}^{n} [R_{it} - E(R_i)]^2}{n}
\]

Where:
- \( \sigma_i^2 \) = variances return stock i
- \( R_{i,t} \) = return stock i at period t
- \( E(R_i) \) = expected return stock i
- \( n \) = period of observation
2. The market rate of return and risk Tingkat return dan risiko pasar

Market rate of return

Market rate of return is calculated from return of the composite index (IHSG) ([5], 2003:232):

\[
R_{m,t} = \frac{IHSG_t - IHSG_{t-1}}{IHSG_{t-1}}
\]  
(4)

Where:

- \(R_{m,t}\) = market rate return at period \(t\)
- \(IHSG_t\) = composite index at period \(t\)
- \(IHSG_{t-1}\) = composite index at period \(t-1\)

Market expected rate of return is calculated:

\[
E(R_m) = \frac{\sum_{i=1}^{n} R_{m_i}}{n}
\]  
(5)

where:

- \(E(R_m)\) = market expected rate of return
- \(R_{m_i}\) = market rate of return
- \(n\) = period

Market risk is the difference between market’s expected return and its realized return, can be calculated by the formula:

\[
\sigma_m^2 = \frac{\sum_{i=1}^{n} [R_{m_i} - E(R_m)]^2}{n}
\]  
(6)

where:

- \(\sigma_m^2\) = variance of market return
- \(E(R_m)\) = market expected return
- \(R_{m_i}\) = market return period \(t\)
- \(n\) = period

3. Beta and Alpha

Beta is a coefficient that measures the effect of changes in the market returns to changes in stock returns. Beta can be calculated by first calculating the covariance between stock returns and market return. Covariance between the stock return and the market return can be calculated by ([6], 2010:176):

\[
\sigma_{im} = \sum_{i=1}^{n} [R_i - E(R_i)][R_{m_i} - E(R_{m_i})]
\]  
(7)

where:

- \(\sigma_{im}\) = the covariance between security and market
- \(R_i\) = one possible return on security
- \(E(R_i)\) = the expected value of the return on security
- \(m\) = the number of likely outcomes for a security for the period

Next Beta is calculated by ([1] et.al, 2002:302):

\[
\beta_i = \frac{\sigma_{im}}{\sigma_m^2}
\]  
(8)

where:

- \(\beta_i\) = stock’s beta
- \(\sigma_{im}\) = covariance return between stock \(i\) and market return
- \(\sigma_m^2\) = variance of market return

Alpha is a variable that is not influenced by the market return. In other words, this variable is an independent variable, in contrast to the beta which is the dependent variable because it is affected by the market return, it can be calculated by ([1] et.al, 2002:295):

\[
\alpha_i = E(R_i) - \beta_iE(R_m)
\]  
(9)

where:

- \(\alpha_i\) = alpha of a stock
- \(E(R_i)\) = the expected value of the return on security
- \(E(R_m)\) = expected market return

4. The Variance of residual error

The variance of the residual error is a variable that indicates the magnitude of the risk that is unique to the company, it can be calculated with ([1] et.al, 2002:295):

\[
\sigma_{\epsilon}^2 = \sum_{i=1}^{n} [\epsilon_i]^2
\]
\[ \sigma_{ei}^2 = \sigma_i^2 - \beta_i^2 \sigma_m^2 \]  

(10)

where:
- \( \sigma_{ei}^2 \) = variance of residual error
- \( \sigma_i^2 \) = variances of stock \( i \)
- \( \beta_i^2 \) = stock’s beta
- \( \sigma_m^2 \) = variance of market return

5. The Determining the Optimal Portfolio Using Single Index Model

After we calculate return, variance, beta, and alpha of each stock, the next step is to determine the optimal portfolio using a single index model by calculating the degree of Excess Return to Beta (ERB) and determines Cut off Rate (Ci), as follows:

Excess Return to Beta level (ERB) is the difference between the expected return and the market return divided by beta. ERB describes the relation of return per unit risk of a security. ERB can be calculated by ([5], 2003:253):

\[ \text{ERB}_i = \frac{E(R_i) - R_{rf}}{\beta_i} \]  

(11)

where:
- \( \text{ERB}_i \) = excess return to beta of stock \( i \)
- \( E(R_i) \) = expected return of stock \( i \)
- \( R_{rf} \) = risk free rate of return
- \( \beta_i \) = Beta \( i \)

Cut off Rate (Ci) is a cut-off point used to determine whether a stock can be included in a portfolio or not. Shares that are chosen to be included in the portfolio are stocks that have \( Ci \leq \text{ERB} \). Ci for each of the securities is calculated by ([2], 2001:194):

\[ C_i = \frac{\sigma_m^2 \sum E(R_i) - R_{pr} \beta_i}{1 + \sigma_m^2 \sum \frac{\beta_i^2}{\sigma_m^2}} \]  

(12)

where:
- \( \sigma_m^2 \) = variance of market return
- \( \sigma_{ei}^2 \) = variance of residual error

II. USING THE TEMPLATE

6. After Determine Proportion of fund Invested in Portfolio (Wi)

Once the portfolio is formed, then we can determine the proportion of funds (Wi) of each stock. Wi can be calculated by:

\[ W_i = \frac{X_i}{\sum_{j=1}^{k} X_j} \]  

(13)

With \( X_i \):

\[ X_i = \frac{\beta_i}{\sigma_{ei}^2} (ERB_i - C_i) \]  

(14)

where:
- \( W_i \) = proportion of stock \( i \)
- \( k \) = number of stocks in the optimal portfolio
- \( \beta_i \) = Beta \( i \)
- \( \sigma_{ei}^2 \) = variance of residual error
- \( \text{ERB}_i \) = excess return to beta of stock \( i \)
- \( C_i \) = cut-off point (which is the largest value)

7. The temp Calculate Return and Risk of Portfolio

Expected return of a portfolio is the weighted average of the returns of the individual stock in the portfolio. It can be calculated by:

\[ E(R_p) = \alpha_p + \beta_p E(R_m) \]  

(15)

where:
- \( E(R_p) \) = expected return of portfolio
- \( \alpha_p \) = weighted average of each stock’s alpha
- \( \beta_p \) = weighted average of each stock’s beta
\[ E(R_m) = \text{expected market return} \]

Portfolio risk can be calculated by determining the magnitude of the variance of the portfolio. Portfolio variance can be calculated by:

\[ \sigma_p^2 = \beta_p^2 \cdot \sigma_m^2 + \sum_{i=1}^{n} W_i^2 \cdot \sigma_{e_i}^2 \] (16)

where:
\[ \sigma_p^2 \] = variance of portfolio
\[ \beta_p \cdot \sigma_m^2 \] = risks that related to market
\[ W_i \cdot \sigma_{e_i}^2 \] = weighted average of each stock's risk

RESULT OF THE STUDY

Tabel 1 Number of Samples

The population in this research is all companies’ stock listed in the Indonesia Stock Exchange during the period of 2010-2013. Based on the predetermined criteria, sample, thenumber of samples in this study were 28 companies. Two companies do not meet the criteria listed in the sample because they start listed in JII in 2012.

Analysis of Market’s return and Stock’s return

Chart 1 illustrates comparison of mean return of IHSG and return of 28 stocks listed in the Jakarta Islamic Index during 2010-2013. Chart 1 illustrates comparison of mean return of IHSG and return of 28 stocks listed in the Jakarta Islamic Index during 2010-2013.

In calculating expected market return, we use the composite index data because it is more comprehensive compared to using the Jakarta Islamic Index. Market expected return is calculated by summing over the return of composite index and then divided by the number of periods.

During the period of the study the expected return on the market is 3.922%, which means that during that period on average stocks listed in the composite index had a positive growth.

Expected stock returns in this study are calculated using average stock return over the period 2010 to 2013. Because the data used is the historical data, it is considered less suitable using trend method to calculate the value of the expected return.

Analysis Systematic and Unsystematic Risks

In the graphs above, the expected return of 14 stocks were higher than expected market return. This means that those stocks’ return have positive influence. Those stocks are: PT AKR Corporindo, PT AlamSutera Realty Tbk, PT Sentul City Tbk, PT Bumi Serpong Damai Tbk, PT Charoen Pokphand Indonesia Tbk, PT XL Axiata Tbk, PT Indofood Sukses Makmur Tbk, PT Jasa Marga (Persero) Tbk, PT Kalbe Farma Tbk, PT Lippo Karawaci Tbk, PT Mitra Adiperkasa Tbk, PT Media Nusantara Citra Tbk, PT Semen Gresik (Persero) Tbk, dan PT Unilever Indonesia Tbk.
The systematic risk is risk that can’t be eliminated by diversification; it is influenced by macrofactorsthat can affect the overall market. The unsystematic risk is risk that can be eliminated through diversification; this risk is only present in a particular company or industry. Total systematic and unsystematic risk of a stock is the variance of that stock.

PT Mitra Adiperkasa Tbk has higher of systematic and unsystematic risk, this means that it experienced significant price fluctuation. On the other hand PT Unilever Indonesia Tbk has the lowest systematic risk. This means that PT Mitra Adiperkasa Tbk has higher opportunity of diversification risk than PT Unilever Indonesia Tbk. PT Unilever Indonesia Tbk has lower systematic risk but its stock has higher variance or total risk compare to PT Mitra Adiperkasa Tbk.

**Analysis Stock's Beta**

Beta is a measure of the volatility of a security's returns to market returns. Volatility itself is a fluctuation of return of a security in a given period. Table 2 below list the betavalues of each shares obtained from the regression results, using the stock return as the dependent variable and the market return or return JCI as an independent variable.

The regression equation using time series data will generate beta coefficients. Beta coefficients are assumed to be stable over time during the period of observation. Assuming that beta is stable, the longer period of observation the better the results of the beta. Due to lower measurement error, low stock’s beta value (β < 1) means the stock’s level of risk is low, while high stock’s beta (β > 1) means stock’s risk is high. Stock’s betavalues equal to one (β = 1) means that fluctuation of stock’s return relatively follow those of market return.

**Table 2**

<table>
<thead>
<tr>
<th>Beta of Stocks listed in the JII 2010-2013</th>
</tr>
</thead>
<tbody>
<tr>
<td>β &lt; 1</td>
</tr>
<tr>
<td>AA LI</td>
</tr>
<tr>
<td>145 114</td>
</tr>
<tr>
<td>AD</td>
</tr>
<tr>
<td>905 701</td>
</tr>
<tr>
<td>AN</td>
</tr>
<tr>
<td>255 603</td>
</tr>
<tr>
<td>BK</td>
</tr>
<tr>
<td>351 500</td>
</tr>
<tr>
<td>NO</td>
</tr>
<tr>
<td>----</td>
</tr>
<tr>
<td>1</td>
</tr>
<tr>
<td>2</td>
</tr>
<tr>
<td>3</td>
</tr>
<tr>
<td>4</td>
</tr>
<tr>
<td>5</td>
</tr>
<tr>
<td>6</td>
</tr>
<tr>
<td>7</td>
</tr>
<tr>
<td>8</td>
</tr>
<tr>
<td>9</td>
</tr>
<tr>
<td>10</td>
</tr>
<tr>
<td>11</td>
</tr>
<tr>
<td>12</td>
</tr>
<tr>
<td>13</td>
</tr>
<tr>
<td>14</td>
</tr>
<tr>
<td>15</td>
</tr>
<tr>
<td>16</td>
</tr>
<tr>
<td>17</td>
</tr>
<tr>
<td>18</td>
</tr>
<tr>
<td>19</td>
</tr>
<tr>
<td>20</td>
</tr>
<tr>
<td>21</td>
</tr>
<tr>
<td>22</td>
</tr>
<tr>
<td>23</td>
</tr>
<tr>
<td>24</td>
</tr>
<tr>
<td>25</td>
</tr>
<tr>
<td>26</td>
</tr>
<tr>
<td>27</td>
</tr>
<tr>
<td>28</td>
</tr>
</tbody>
</table>
After comparing the values of the ERB and CI, there are 14 stocks that have CI ≤ ERB. Four stocks out of those 14 stocks have negative proportion, so these four stocks will not be considered to be chosen. Those stocks are PT Bumi Serpong Damai Tbk, PT Indocement Tunggal Prakarsa Tbk, Perusahaan Gas Negara (Persero) Tbk, and PT United Tractors Tbk.

Conclusions

Table 4 shows that a portfolio made up of 10 companies with the proportion of funds to be invested. Risk generated by the portfolio ends to be lower than the risk of individual stocks listed in the Jakarta Islamic Index. This is proved that there turn and risk of the stock would be optimal if one is making diversification and doing analysis to make optimal portfolio, rather than investing only in one company’s stock, investing using random model and not doing any analysis at all.

References