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

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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 a 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 can not 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 andpolitical conditions, taxation, government policies, and so forth. Systematic risk can be calculated by multiplying the variance of the market with the beta. Beta is a measure of volatility of a security or portfolio return to the market return.Unsystematic risk is a risk that can be eliminated by diversification. This risk occurs in a particular company or industry due to the problem intheir: structure of capital, asset structure, liquidity, yield and so forth.

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-1period ([7] et.al, 2003:238)

$$Ri = \frac{(P_t - P_{t-1}) + D_t}{P_{t-1}} \quad (1)$$

where:

R_i = realized return

P_t = Price of stock period t

P_{t-1} = Price of stock period t-1

D_t = dividendat period t

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

$$E(Ri) = \sum_{t=1}^{n} \frac{R_{it}}{n} \quad (2)$$

Where:

$E(R_i)$ = expected return of $stock_i$

R_{it} = return $stock_i$ at period t

n = period

$$\sigma_i^2 = \sum_{1}^{n} \frac{[Rit - E(Ri)]^2}{n} \quad (3)$$

Where :

σ_i^2 = varians return stock i

R_{it} = returnstock i at period t

$E(R_i)$= expected return stock i

n = period of observation

2. The te 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):

$$Rm,t = \frac{IHSG_t - IHSG_{t-1}}{IHSG_{t-1}} \quad (4)$$

Where:

Rm = market return return at period t

$IHSG_t$ = composite indexat period t

$IHSG_{t-1}$ = composite index at period t-1

Market expected rate of return is calculated:

$$E(Rm) = \frac{\sum_1^n R_m}{n} \quad (5)$$

where:

$E(R_m)$ = market expected rate of return

R_m = market rate of return

n = period

Marketriskisthe difference between market's expectedreturnand its realized return, can be calculated bythe formula:

$$\sigma_m{}^2 = \sum_{t=1}^{n} \frac{[R_{mt} - E(R_m)]^2}{n} \quad (6)$$

where:

$\sigma_m{}^2$ = varians market return

$E(R_m)$ = market expected return

R_{mt} = market return period t

n = periodi

3. Beta and Alpha

Beta is a coefficient that measures the effect of changes in the market returns to changes in stock returns. Betacan be calculatedby firstcalculating thecovariancebetweenstock returnsand market return. Covariancebetweenthe stock returnand themarket returncan be calculatedby ([6], 2010:176):

$$\sigma_{im} = \sum_{t=1}^{n} [R_i - E(R_I)][R_m - E(R_m)] \quad (7)$$

where:

σ_{im} = *the covariance between securityand 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):

$$\beta_i = \frac{\sigma_{im}}{\sigma_m{}^2} \quad (8)$$

where:

β_i = stock's beta

σ_{im} = covarians return between $stock_i$ and market return

$\sigma_m{}^2$ = varians market return

Alphais a variablethat isnotinfluencedby themarket return. In other words, this variableis anindependentvariable, in contrast tothe betawhich is thedependent variablebecause itis affectedby themarket return, it can becalculated by([1] *et.al*, 2002:295):

$$\alpha_i = E(R_i) - \beta_i.E(R_m) \quad (9)$$

where :

α_i = alpha of a stock

$E(R_i)$= the expected value of the return on security

$E(R_m)$= expected market return

4. The Varians of residual error

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

$$\sigma_{ei}^2 = \sigma_i^2 - \beta_i^2 . \sigma_m^2 \qquad (10)$$

where:

σ_{ei}^2 = variance of residual error

σ_i^2 = varians of stock$_i$

β_i^2 = stock's beta

σ_m^2 = variance of market return

5. The Determining the Optimal Portfolio Using Single Index Model

After we calculatereturn, variance, beta, andalphaof eachstock, the next step is to determine the optimal portfolio using asingle index model by calculating the degree of Excess Return toBeta(ERB) and determines Cut off Rate (Ci), as follows:

Excess Return to Betalevel (ERB) is the difference between the expected return and the market return divided by beta. ERB descript the relation of return per-unit riskof a security. ERBcan becalculated by ([5], 2003:253):

$$ERBi = \frac{E\,(Ri) - Rrf}{\beta_i} \qquad (11)$$

where :

ERBi = excess return to beta of stock$_i$

E(Ri) = expected return of stock$_i$

Rbr =risk free rate of return

β_i = Beta$_i$

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

$$C_i = \frac{\sigma_m^2 \sum [E(R_i) - R_{br}] . \beta_i}{1 + \sigma_m^2 \sum \frac{\beta_i^2}{\beta_{ei}^2}} \qquad (12)$$

where:

E(Ri)= expected return of stock$_i$

Rbr = risk free rate of return

β_i = Beta$_i$

σ_m^2 = variance of market return

σ_{ei}^2 = variance of residual error

II. USING THE TEMPLATE

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

Once theportfoliois formed, thenwe can determinethe proportion offunds(Wi) of each stock, Wican be calculatedby:

$$W_i = \frac{X_i}{\sum_{j=1}^{k} X_j} \qquad (13)$$

With Xi :

$$X_i = \frac{\beta_i}{\sigma_{ei}^2}(ERB_i - C*) \qquad (14)$$

where:

Wi = proportion of stock$_i$

k = number of stocks in the optimal portfolio

β_i = Beta$_i$

σ_{ei}^2 = variance of residual error

*ERB*i= excess return to beta of stock$_i$

*C** = *cut-off point*(which is thelargest value)

7. The temp Calculate Return and Risk of Portfolio

Expected return of a portfoliois aweighted averageof thereturnsof the individual stock in the portfolio, it can be calculatedby

$$E(R_p) = \alpha_p + \beta_p . E(R_m) \qquad (15)$$

where:

E(R_p)= expected return of portfolio

α_p *= weighted average of each stock's alpha*

β_p *= weighted average of each stock's beta*

$E(R_m)$= expected market return

Portfolio riskcan be calculatedby determining the magnitude ofthe variance of the portfolio. Portfolio variancecan be calculated by:

$$\sigma_p{}^2 = \beta_p{}^2 . \sigma_m{}^2 + \sum_{t=1}^{n} W_i{}^2 . \sigma_{ei}{}^2 \quad (16)$$

where:

$\sigma_p{}^2$ = *variance of portofolio*

$\beta_p{}^2 . \sigma_m{}^2$ = *risks that related to market*

$W_i{}^2 . \sigma_{ei}{}^2$ = *weighted average of each stock's risk*

RESULT OF THE STUDY

Tabel 1 Number of Samples

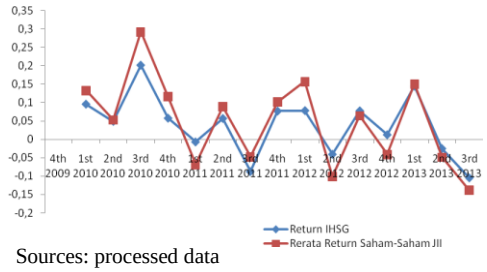
The population in this research is allcompanies' stocklisted in the Indonesia Stock Exchange during the period of 2010-2013. Based onpredeterminedcriteriasample, thenumber of samplesinthis study were28 companies. Twocompaniesdo notmeet the criterialistedinthe samplebecause they start listedin JII in 2012.

Analysis of Market's return and Stock's return

Chart1illustratescomparison of meanreturn of IHSG and return of 28 stocks listed in theJakarta 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.

Chart 1

***Return* IHSG &*Return* JII, 2010-2013**



Sources: processed data

Return of the stocks listed in the Jakarta Islamic Index and return of the composite index is relatively quite the same. In 2010 the JII return was relatively higher than those of the composite index. In the year of 2011 to 2013 the JII return was fluctuate, butthe value oftheindexreturnsare notmuch different fromstock indexreturns, thismeans thatstocksthatare listed in theJakarta Islamic Indexis generally liquid.

Analysis of Expected Return

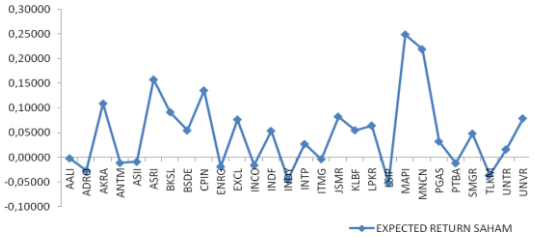
In calculating expectedmarket return, we use the composite index data because it is more comprehensive compare to using the Jakarta Islamic Index. Market expected return is calculated by summing overthe returnof composite index and thendividedby the number ofperiods.

During the period of the study the expected return onthe marketis3.922%, it means that during that period on average stocks listed in the composite index had a positive growth.

Expectedstock returnsinthis studyare calculated using averagestock returnover the period 2010to 2013, becausethe data usedis the historical data. It is considered lesssuitable using trend method to calculate the value ofthe expected return.

Chart 2

Expected Return of Stock listed in the JII 2010-2013



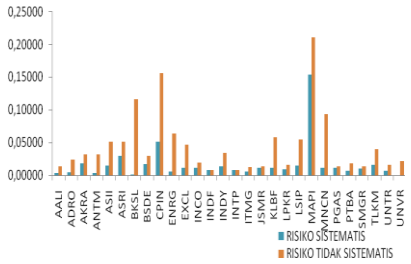
Sources: processed data

In the graphs above,the expected returnof 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 BumiSerpongDamaiTbk, PT Charoen Pokphand Indonesia Tbk, PT XL Axiata Tbk, PT Indofood Sukses MakmurTbk, PT Jasa Marga (Persero) Tbk, PT Kalbe Farma Tbk, PT Lippo Karawaci Tbk, PT Mitra AdiperkasaTbk, PT Media Nusantara Citra Tbk, PT Semen Gresik (Persero) Tbk, danPT Unilever Indonesia Tbk

Analysis Systematic and Unsystematic Risks

Chart 4

Systematic and Unsystematic Risksof Stocks listed in JII



Thesystematicrisk is risk that can't beeliminated by diversification; it is influencedbymacrofactorsthatcanaffectthe overall market. The unsystematic riskis ariskthatcan beeliminatedthroughdiversification; this riskis onlypresent inaparticular 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.

AnalysisStock's Beta

Betais ameasure ofthe volatility ofa security'sreturnstomarketreturns. Volatilityis itself afluctuationofreturnof a securityin a given period. Table2 below list the betavaluesof each sharesobtainedfromthe regressionresults, using thestock returnas the dependent variableandthe market returnorreturnJCIas an independent variable.

The regressionequation using time series datawillgeneratebeta coefficients. Beta coefficients areassumed to bestableover timeduringthe period ofobservation. Assuming that betais stable,the longerperiod of observationthe better theresultsofthe beta, due to smaller measurementerror. Low stock's beta value($\beta < 1$) means the stock's level ofrisk is low,while high stock's beta($\beta > 1$) means stock's risk is high. Stock's betavalue equal toone($\beta = 1$) means that fluctuation of stock's return relatively follow those of market return.

Table 2

Beta of Stocks listed in the JII 2010-2013

β < 1		β > 1				
AALI	ENRG	AKRA	CPIN	INDY	LPKR	PGAS
0,67145	0,98114	1,70914	2,84146	1,44108	1,18588	1,30772
ADRO	ITMG	ASII	EXCL	INTP	LSIP	SMGR
0,85905	0,89701	1,50335	1,35830	1,13137	1,49895	1,26013
ANTM	PTBA	ASRI	INCO	JSMR	MAPI	TLKM
0,73255	0,99603	2,13224	1,35287	1,32078	4,90331	1,55290
BKSL	UNVR	BSDE	INDF	KLBF	MNCN	UNTR
-0,39292	-0,06039	1,63351	1,09500	1,36073	1,36098	1,06845

In Table 2 above, there were 8 stocks with $\beta < 1$, it means that price sensitivity of those stocks is lower than the composite index. Beta stocks that have negative values imply stock prices move in the opposite direction of the composite index. There are 20 stocks with $\beta > 1$; this means that the Jakarta Islamic Index generally consist of stocks with high levels of risk, but also promises high returns.

Analysis of Stock's Proportion in Optimal Portfolio

Table 3 below shows Excess Return to Beta (ERB) for all stocks. Excess Return to Beta (ERB) is the difference between the expected return and the market return is then divided by the beta. ERB reflects the returns that are likely to be achieved

Cutoff rate(Ci) is apointthat isusedtodeterminewhether or not astockcan beincluded intoa portfolio. Stocks with $Ci \leq ERB$ will be chosen to be included in portfolio. The purpose of comparing Cutoff rate(Ci) withExcess ReturntoBeta(ERB) is make a portfoliothat havea high returnratewitha reasonablerisk. The value of Cutoff rate(Ci) for each stock is presented in table 3. The highest Cutoff rate(Ci) value will use as a cut-off point(C *). This cut off point will use to calculate proportion of fund to be invested for each stock chosen in the portfolio (Wi). PTAlamSutera RealtyTbk has the highest value ofCutoff rate(Ci) i.e. 0.02398.

Table 3

Variance, Beta, Systematic and Unsystematic Risk, ERB, *Cut-off Rate*, and Proportion of each stock in Optimal Portfolio Period 2010 – 2013

NO	CODE	EXPECTED *RETURN*OF STOCK	VARIANCE σ_i^2	BETA β_i	SYSTEMATIC RISK $\beta_i^2 . \sigma_m^2$	UNSYSTEMATIC RISK σ_{ei}^2	ERB	Ci
1	AALI	-0,00191	0,01649	0,67145	0,00288	0,01361	-0,02642	-0,00461
2	ADRO	-0,02696	0,02813	0,85905	0,00471	0,02342	-0,04981	-0,00834
3	AKRA	0,10924	0,05068	1,70914	0,01864	0,03204	0,05465	0,02010
4	ANTM	-0,01131	0,03504	0,73255	0,00342	0,03161	-0,03706	-0,00362
5	ASII	-0,00890	0,06598	1,50335	0,01442	0,05156	-0,01645	-0,00360
6	ASRI	0,15784	0,08057	2,13224	0,02902	0,05156	0,06660	0,02398
7	BKSL	0,09170	0,11653	-0,39292	0,00099	0,11554	-0,19308	-0,00163
8	BSDE	0,05456	0,04709	1,63351	0,01703	0,03006	0,02371	0,00857
9	CPIN	0,13584	0,20681	2,84146	0,05153	0,15528	0,04223	0,01052
10	ENRG	-0,01872	0,07027	0,98114	0,00614	0,06413	-0,03522	-0,00308
11	EXCL	0,07686	0,05887	1,35830	0,01177	0,04710	0,04493	0,00899
12	INCO	-0,01592	0,03081	1,35287	0,01168	0,01913	-0,02347	-0,00890
13	INDF	0,05374	0,01510	1,09500	0,00766	0,00744	0,03462	0,01755
14	INDY	-0,04556	0,04752	1,44108	0,01325	0,03427	-0,04260	-0,01188
15	INTP	0,02711	0,01663	1,13137	0,00817	0,00847	0,00997	0,00490
16	ITMG	-0,00368	0,01798	0,89701	0,00514	0,01284	-0,02175	-0,00621
17	JSMR	0,08270	0,02446	1,32078	0,01113	0,01333	0,05063	0,02304
18	KLBF	0,05512	0,06947	1,36073	0,01182	0,05765	0,02887	0,00491
19	LPKR	0,06455	0,02510	1,18588	0,00898	0,01613	0,04108	0,01469
20	LSIP	-0,05188	0,06941	1,49895	0,01434	0,05507	-0,04517	-0,00933
21	MAPI	0,24929	0,36379	4,90331	0,15344	0,21035	0,04761	0,02008
22	MNCN	0,21958	0,10513	1,36098	0,01182	0,09330	0,14971	0,01683
23	PGAS	0,03223	0,02452	1,30772	0,01091	0,01360	0,01254	0,00558
24	PTBA	-0,01177	0,02452	0,99603	0,00633	0,01819	-0,02771	-0,00716
25	SMGR	0,04830	0,02413	1,26013	0,01013	0,01399	0,02577	0,01082
26	TLKM	-0,03649	0,05567	1,55290	0,01539	0,04028	-0,03369	-0,00931
27	UNTR	0,01605	0,02373	1,06845	0,00729	0,01644	0,00020	0,00006
28	UNV	0,07910	0,02183	-0,06039	0,00002	0,02180	-1,04756	-0,00112
						Cut Off Point (C)*		0,02398

After comparingthe values ofthe ERBandCi,there are 14stocks thathaveCi ≤ 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 BumiSerpongDamaiTbk, PT Indocement Tunggal Prakarsa Tbk, Perusahaan Gas Negara (Persero) Tbk dan PT United Tractors Tbk.

Conclusions

Table 4

Alpha Portfolio, Beta Portfolio, Expected Return Portfolio, and Variance Portfolio Period 2010 – 2013

NO	Companies stock code	Wi	αp	βp
1	JSMR	24,852%	0,03090	1,32078
2	ASRI	16,587%	0,07421	2,13224
3	AKRA	15,398%	0,04221	1,70914
4	INDF	14,721%	0,01079	1,09500
5	LPKR	11,835%	0,01804	1,18588
6	EXCL	5,684%	0,02358	1,35830
7	MAPI	5,184%	0,05697	4,90331
8	CPIN	3,143%	0,02438	2,84146
9	SMGR	1,511%	-0,00112	1,26013
10	KLBF	1,086%	0,00175	1,36073
TOTAL		100%	0,28170	19,16698
$E(R_p)$ **(Expected Return Portfolio)**			**0,1033**	
σ_p^2 **(Riskof Portfolio)**			**0,0007**	
σ_p **(Standard Deviation Portfolio)**			**0,0274**	

Sumber : Data Diolah

Table 4 shows that a portfolio made up of 10 companies with the proportion of funds to beinvested. 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.

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