Evaluation of Risk Reduction for Portfolio in Islamic Investment Using Modern Portfolio Theory

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Abstract— *Main objective of this study is to maximize expected return and in the same time lowering investment risk. The methodology implemented in this study is modern portfolio theory through diversification assets that has low or negative correlation factor. This study tried to discover the portfolio expected risk and portfolios risk for 3 stocks namely Top Glove Corporation Berhad, AirAsia X Berhad and Axiata Group Berhad. Data for the analysis is selected from June 2015 until September 2018 involving 40 monthly observations. Result indicates the correlation factor between Top Glove and Airasia X is negative; meanwhile other correlation is not significant. Therefore, the selection of these three stocks is complying with the requirement of modern portfolio theory. Result indicates there are nine optimal combinations that calculated in this study which are suitable to develop non-linear line of efficient frontier. Data shows with the increment weightage in Top Glove stock, the expected average return will be increase. This is because the mean average return for share price of Top Glove 3.65%. This is the highest return comparing to other two stocks. However the risk of share price of Top Glove is 8.6 %, which is on the risky side. In addition, this study concludes the portfolio can attained lower risk by combining three stocks. The important implication of this study is it will help investors to develop optimal investment to attain maximum expected return based on a given level of market risk.*
Keywords— *Investment, Modern Portfolio Theory, Three stock combination, Portfolio Risk, Portfolio Expected Return*

I. INTRODUCTION

Portfolio optimization is one of the most interesting researches in the financial area. It was attracted most investors to get high return from the selection of portfolio at a pre-specified level of risk. In the global economy, portfolio optimization has become an important issue in generate high return and reduce the level of investment risk. Therefore, diversification of investment is looking as one of the alternative in generating high return.

Diversification is a portfolio strategy that is designed to reduce the overall risk exposure by combining a variety of assets into one basket of portfolio. Small capital stocks tend to produce a higher return since these stocks are far less accessible to international investors due to the high transaction costs associated with their limited liquidity, capital rationing and information availability (Bin and Yuan, 2016).

Recent evidence suggests that diversification of investment can reduce the level of risk. Study by Abu Bakar and Rosbi (2018) regarding Modern Portfolio Theory found the optimal combination of securities was generated maximizes return for any given level of risk.

In recent years, there has been an increasing interest in *shariah*-compliant companies industry. Investors are not only concerned about what is profitable but also what makes their investments ethical (Mohd-Sanusi, et, al., 2015; Ulrich and Marzban, 2008). Therefore, Malaysia Stock Exchange was established a *shariah* board in 1997 in order to fulfill the ethical investments in *shariah* law. Since *shariah* board was established, out of 693 companies from 901 was *shariah*-complaint companies (Securities Commission Malaysia, 2018). Thus, investors have many choices to choose an optimal investment either in *shariah*-compliant companies or non *shariah*-compliant companies.

Thus, this main objective of this study is to discover the relationship between portfolios expected return with respect to portfolio risk using combination of three stocks namely Top Glove Corporation Berhad, AirAsia X Berhad and Axiata Group Berhad. This study was evaluating risk reduction for portfolio in Islamic investment using Modern Portfolio Theory. Modern Portfolio Theory has become the backbone of finance as it

gives better understanding of the best possible investment portfolio for financial assets (Mohd Ali, 2006).

II. LITERATURE REVIEW

A considerable amount of literature has been published on the portfolio optimization (Deng, 2018; Jothimani, et al., 2017; Fabozzi, 2002) and performance of *shariah*-compliant companies (Abu Bakar and Rosbi, 2017; Abu Bakar and Rosbi, 2016). The first serious discussions and analyses of diversification of investment emerged during 1952 by Harry Markowitz (Markowitz, 1952). Before Modern Portfolio Theory was developed, most of the investment are followed Theory of Investment that stated it was enough looking into only one stock (Kazan and Uludag, 2014). But, Markowitz suggested the benefits of diversification and explores how risk-averse investors construct portfolios to optimize expected returns against market risks (Bin and Yuan, 2016).

Therefore, several studies have used Modern Portfolio Theory in measuring the performance of stock market (Azizan and Sorooshian, 2014; Alrabadi, 2016; Chen and Pan, 2013). Study that focus on the Modern Portfolio Theory regarding asset allocation found Modern Portfolio Theory are more intuitively appropriate for decision making in international and direct real estate investing (Ho, et al., 2010). Study regarding the benefits of further diversifying a global portfolio of financial assets in New Zealand farm real estate found that the risk reduction benefits of diversifying with farm real estate are larger than the risk enhancement benefits (Nartea and Eves 2010). Giannotti, et al., (2011) provides in-depth analysis of Markowitz diversification approach and found that the standard geographic and sector diversification allow for a good results and more efficient portfolios.

A large and growing body of literature has investigated the performance of *shariah*-compliant companies. Bahlous and Mohd. Yusof (2014) investigates the benefits of international diversification among Islamic funds, suggests that investors can reduce risk even more substantially if they hold an internationally diversified fund as globally diversified portfolios among Islamic funds only. Abu Bakar and Rosbi (2018) develop an efficient frontier line for investment portfolio in Malaysia market. Each point on the efficient frontier line represents an optimal combination of securities that maximizes the return for any given level of risk (standard deviation).

Numerous studies have attempted to explain the performance of Malaysian stock market. Zainal Abidin, et al., (2004) provide evidence whether international portfolio diversification gain exists in equity investment from a Malaysian perspective and it is feasible for Malaysian investors to construct a purely domestic portfolio which is more superior to an internationally diversified portfolio under certain conditions peculiar to this market.

III. RESEARCH METHODOLOGY

This study try to discover the relationship between portfolios expected return with respect to portfolio risk using combination of three stocks. The methodology implemented in this study involved with data selection process, correlation diagnostics and evaluation of Markowitz theory of diversification approach.

3.1 Data selection process

This study involved with share prices from three companies namely Top Glove Corporation Berhad, AirAsia X Berhad and Axiata Group Berhad. Data of share price is collected in daily basis from database of Datastream Thomson Reuters. The collected data is starting from 1st June 2015 until 30th September 2018. Then, this study calculated average monthly value for share price.

The calculation for share price is described in Equation (1).

$$\mathrm{Re}_{i,n} = \left(\frac{SP_{n+1} - SP_n}{SP_n} \right) \times 100\% \ \dots\dots\dots\dots\dots$$

(1)

where,

$\mathrm{Re}_{i,n}$ = return for stock *i* at period *n*,

SP_n = monthly share price for stock *i* at period *n*,

SP_{n+1} =monthly share price for stock *i* at period *n+1*.

3.2 Correlation diagnostics

Next, this study performed the calculation for correlation between share price return among three selected companies. This study implemented Pearson correlation for statistical approach. The type of data in Pearson correlation analysis should be interval or ratio.

Pearson correlation coefficient between two variables (stocks) is defined as covariance of the two variables divided by the product of their standard deviations. Pearson correlation coefficient is represented as ρ in Equation (2) for population .

$$\rho_{X,Y} = \frac{\mathrm{cov}(X,Y)}{\sigma_X \sigma_Y} = \frac{E\left[(X - \mu_X)(Y - \mu_Y)\right]}{\sigma_X \sigma_Y} \ \dots(2)$$

where,

cov is covariance,

σ_X is standard deviation of X,

σ_Y is standard deviation of Y,

μ_X is mean of X, μ_Y is mean of Y,

The sample of Pearson correlation coefficient is represented as r in Equation (3).

$$r_{XY} = \frac{\sum_{i=1}^{n}\left(X_i - \bar{X}\right)\left(Y_i - \bar{Y}\right)}{\sqrt{\sum_{i=1}^{n}\left(X_i - \bar{X}\right)^2}\sqrt{\sum_{i=1}^{n}\left(Y_i - \bar{Y}\right)^2}} \quad \text{…….……..(3)}$$

3.3 Evaluation of Markowitz theory in diversification approach for investment portfolio.

Modern portfolio theory is a theory of finance that attempts to maximize portfolio expected return for a given amount of risk, or minimize risk for a given level of expected return (Markowitz, 1952). Modern portfolio theory is an investment theory based on the idea that risk-averse investors can construct portfolios to optimize or maximize expected return based on a given level of market risk, emphasizing that risk is an inherent part of higher reward (Fabozzi et al., 2002)

The Markowitz portfolio theory is based on the risk in a portfolio of diverse individual stocks will be less than the risk inherent in holding any one of the individual stocks. There are two concepts that underlying for Markowitz portfolio theory:

(a) The objective of investor is to develop investment portfolio that contributes maximum return for any given level of risk.

(b) Investors are risk-averse and thus have a preference for expected return and dislike for risk.

The expected return for a portfolio consist of three stocks is represented by Equation (4).

$$E\left(r_P\right) = w_A E\left(r_A\right) + w_B E\left(r_B\right) + w_C E\left(r_C\right) \quad \text{………(4)}$$

where

$E\left(r_P\right)$ is expected return for portfolio,

$E\left(r_A\right)$ is expected return for stock A,

$E\left(r_B\right)$ is expected return for stock B,

$E\left(r_C\right)$ is expected return for stock C,

w_A is stock A weigthage, w_B is stock B weigthage and

w_C is stock C weigthage.

The variance of rate of return for two type of stocks in a portfolioi is described in Equation (5).

$$\sigma_P^2 = \left(w_A \sigma_A\right)^2 + \left(w_B \sigma_B\right)^2 + \left(w_B \sigma_B\right)^2$$
$$+ 2\left(w_A \sigma_A\right)\left(w_B \sigma_B\right)\rho_{AB}$$
$$+ 2\left(w_A \sigma_A\right)\left(w_C \sigma_C\right)\rho_{AC} \quad \text{…………..(5)}$$
$$+ 2\left(w_B \sigma_B\right)\left(w_C \sigma_C\right)\rho_{BC}$$

where, σ_A is stock A standard deviation, σ_B is stock B standard deviation, ρ_{AB} is correlation coefficient between stock A and B, ρ_{AC} is correlation coefficient between stock A and C, and , ρ_{BC} is correlation coefficient between stock B and C.

IV. RESULT AND DISCUSSION

The objective of this study is to evaluate the effectiveness of the investment portfolio using modern portfolio theory. Three stocks are selected in the analysis namely Top Glove Corporation Berhad, AirAsia X Berhad and Axiata Group Berhad. All three selected companies are listed in main market of Bursa Malaysia in Malaysia.

4.1 Data selection and analysis

The first company that selected in this study is Top Glove Corporation Berhad. Figure 1 shows the dynamic behavior of share price for Top Glove Corporation Berhad. Monthly data is collected using database of Datastream Thomson Reuters. The monthly observation started from June 2015 until September 2017. The total observations are 40 months. The initial value of share price in June 2015 is MYR 3.006. The maximum value of share is MYR 11.233 in June 2018.

Figure 2 shows the return rate for Top Glove Corporation Berhad. The maximum value of share price return is 25.5753 % on January 2018. Meanwhile, the minimum value of share price is -15.734 % on February 2016.

The second selected company is AirAsia X Berhad. Figure 3 shows the dynamic behavior of share price for AirAsia X. The initial share price is MY 0.2318 in June 2015. The maximum value of share price is MYR 0.4743 on May 2017. Meanwhile, the minimum value is MYR 0.1810 on August 2015.

Figure 4 shows the return rate for AirAsia X Berhad. The maximum value of share price return is 22.25 % on February 2016. Meanwhile, the minimum value of AirAsia X share price is -21.14 % on June 2015.

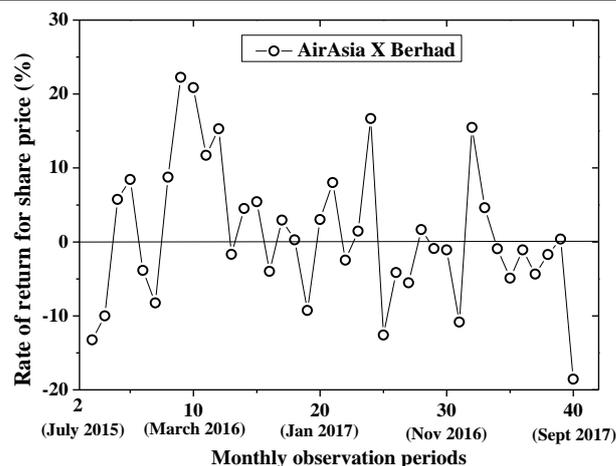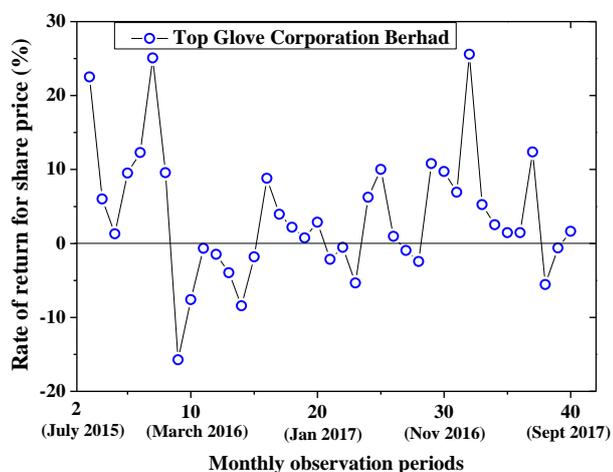*Fig. 1: Dynamic behavior of share price (Top Glove)*

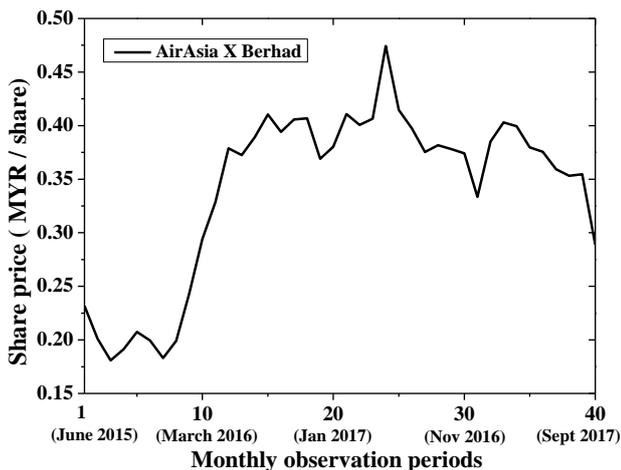*Fig. 2: Rate of return for share price (Top Glove Corporation Berhad)*

Fig. 3: Dynamic behavior of share price (AirAsia X Berhad)

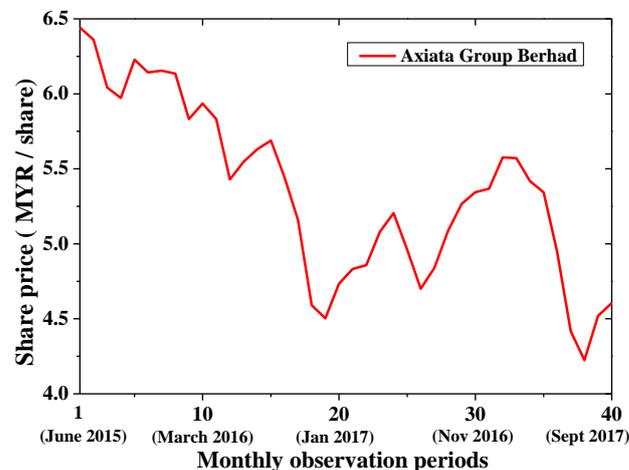*Fig. 4: Rate of return for share price (AirAsia X Berhad)*

The third selected company is Axiata Group Berhad. Figure 5 shows the dynamic behavior of share price for Axiata Group Berhad. The initial share price is MY 6.441 in June 2015. The minimum value of share price is MYR 4.225 on July 2018. The value of share price at the end of the last observation period (September 2018) is MYR 4.605. Figure 5 indicates there are decrements of share price value from the June 2015 until September 2018.

Figure 6 shows the return rate of share price for Axiata Group Berhad. The maximum value of share price return is 6.993 % on August 2018. Meanwhile, the minimum value of return for Axiata Group Berhad share price is -10.996 % on November 2016.
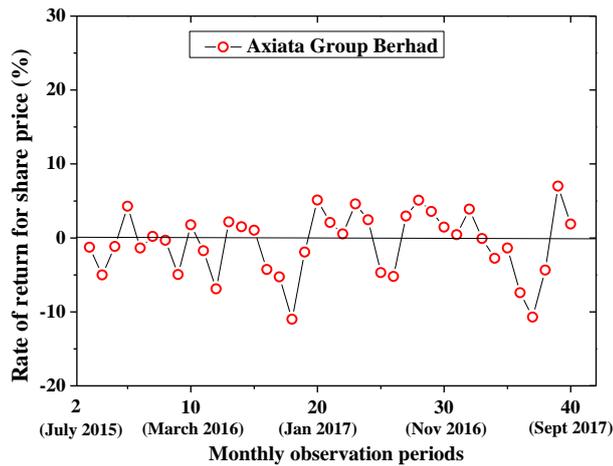

Fig. 5: Dynamic behavior of share price (Axiata Group Berhad)

Fig. 6: Rate of return for share price (Axiata Group Berhad)

4.2 Pearson product moment correlation analysis

This section describes the correlation analysis between the share price return of selected companies. The analysis carried out using graphical analysis, including statistical analysis.

Figure 7 shows the correlation diagram between two share price returns namely Top Glove and AirAsia X. The red line indicates linear relationship between two share prices. The analysis shows there is negative slope of liner line.

Next, the statistical test performed to validate the linear relationship between two share price returns of Top Glove and AirAsia X. Table 1 shows the value of Pearson correlation value and significant level of correlation. The Pearson correlation value is -0.326 that indicates there is weak negative correlation. The significant value is 0.045 which is less than 0.05. That indicates this study reject null hypothesis of Pearson correlation statistical analysis. Therefore, Table 1 indicates there is significantly weak and negative correlation between two share price returns ($r = -0.326$, $n = 39$, $p = 0.045$).
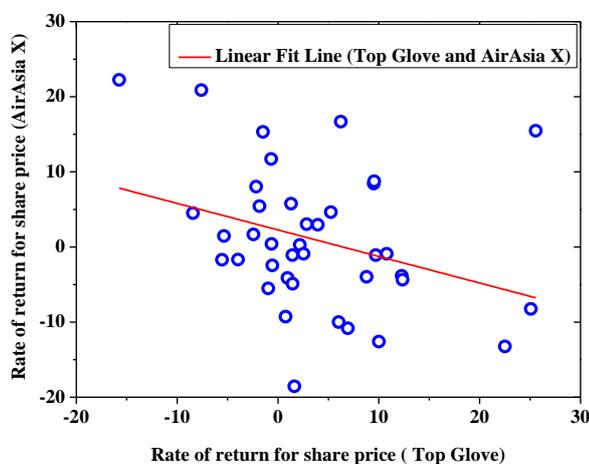

Fig. 7: Correlation diagram between share prices (Top Glove and AirAsia X)

Table 1: Statistical test for correlation analysis (Top Glove and AirAsia X)

Pearson correlation	-0.326
Significant level (two-tailed statistics)	0.043

Figure 8 shows the correlation diagram between two share price returns namely Top Glove and Axiata Group. The red line indicates linear relationship between two share prices. The analysis shows the slope is near to zero value.

Next, the statistical test performed to validate the linear relationship between two share price returns of Top Glove and Axiata Group. Table 1 shows the value of Pearson correlation value and significant level of correlation. The Pearson correlation value is 0.002 that indicates there is very weak positive correlation. The significant value is 0.992 which is larger than 0.05. That indicates this study failed to reject null hypothesis of Pearson correlation statistical analysis. Therefore, Table 2 indicates there is very weak positive correlation between two share price returns and the correlation is not significant ($r = 0.002$, $n = 39$, $p = 0.992$).
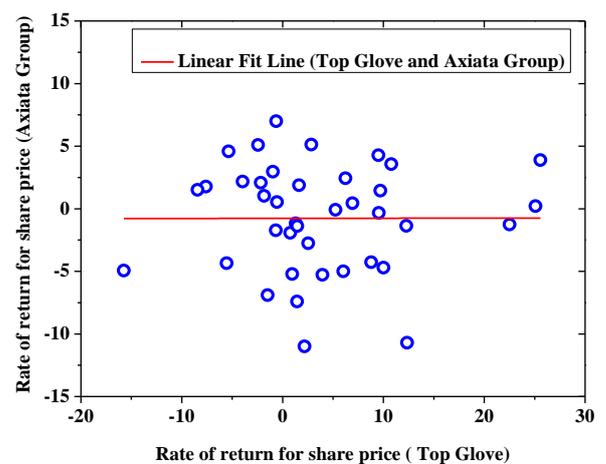

Fig. 8: Correlation diagram between share prices (Top Glove and Axiata Group)

Table 2: Statistical test for correlation analysis (Top Glove and Axiata Group)

Pearson correlation	0.002
Significant level (two-tailed statistics)	0.992

Figure 9 shows the correlation diagram between two share price returns namely AirAsia X and Axiata Group. The red line indicates linear relationship between two share prices. The analysis shows the slope is positive value.

Next, the statistical test performed to validate the linear relationship between two share price returns of AirAsia X and Axiata Group. Table 3 shows the value of Pearson correlation value and significant level of correlation. The Pearson correlation value is 0.126 that indicates there is very weak negative correlation. The significant value is 0.443 which is larger than 0.05. That indicates this study failed to reject null hypothesis of Pearson correlation statistical analysis. Therefore, Table 3 indicates there is very weak positive correlation between two share price returns ang the correlation is not significant ($r = 0.126$, $n = 39$, $p = 0.443$).
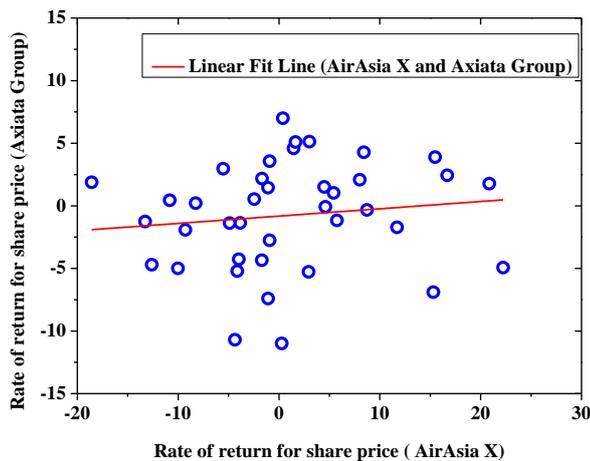

Fig. 9: Correlation diagram between share prices (AirAsia X and Axiata Group)

Table 3: Statistical test for correlation analysis (Airasia X and Axiata Group)

Pearson correlation	0.126
Significant level (two-tailed statistics)	0.443

4.3 Evaluation of correlation for portfolio risk and portfolio return using Modern Portfolio Theory

The main objective of this paper is to evaluate the risk of portfolio investment with correlation to expected return. Modern Portfolio Theory is an investment theory based on the idea that risk-averse investors can construct portfolios to optimize or maximize expected return based on a given level of market risk, emphasizing that risk is an inherent part of higher reward. It is one of the most important and influential economic theories dealing with finance and investment.

Modern portfolio theory emphasized about the selected of stocks that is important to reduce risk at expected return setting by investor.

Figure 10 shows the correlation between portfolio risk and portfolio return for investment portfolio consists of combination with three share prices namely Top Glove Corporation Berhad, AirAsia X Berhad and Axiata Group

Berhad. The weightage of investment for each of share price is adjusted to find better portfolio expected return for given portfolio risk.

This study adjusted the value of contribution for each of the stocks with reference to Top Glove Corporation Berhad as the main contributors for portfolio expected return. Figure 10 illustrates red dots that represented the combination of portfolio between three stocks. Figure 10 concludes for a same value portfolio risk (x-axis value), there a few combination of portfolio that contributes to different value of expected return (y-axis value).
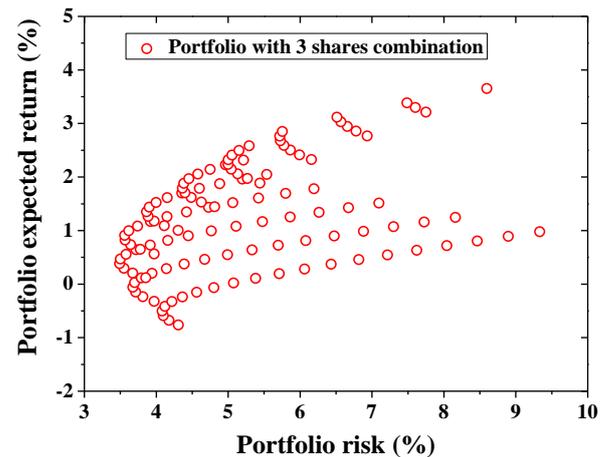

Fig. 10: Correlation between portfolio risk and portfolio return for investment portfolio consists of 3 share prices

Next, this study developed the optimal combinations of portfolio investment using efficient frontier analysis. Figure 11 shows the efficient frontier for portfolio investment of 3 stocks combination namely Top Glove Corporation Berhad, AirAsia X Berhad and Axiata Group Berhad.

There are nine optimal combinations that calculated in this study to develop non-linear line of efficient frontier. Table 4 shows the combinations of 3 stocks for efficient frontier development. Data shows with the increment weightage in Top Glove stock, the expected average return will be increase. This is because the mean average return for share price of Top Glove 3.65%. This is the highest return comparing to other two stocks. However the risk of share price of Top Glove is 8.6 %, which is on the risky side. The portfolio can attained lower risk by combining three stocks.
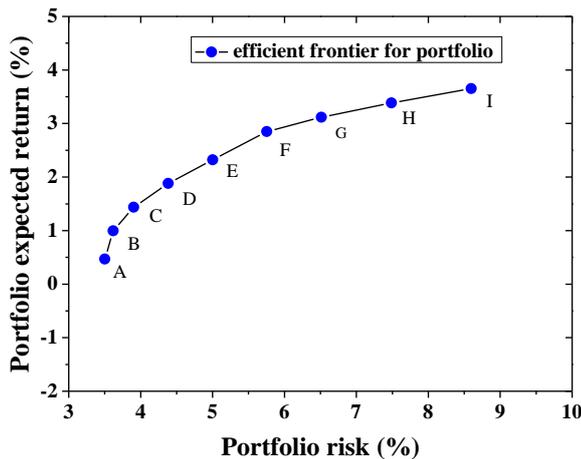
Fig. 11: Efficient frontier for portfolio investment of 3 stocks combination

Table 4: The combinations of 3 stocks for efficient frontier development

Combination	Combination stocks weightage		
	Top Glove	AirAsia X	Axiata Group
A	0.2	0.2	0.6
B	0.3	0.25	0.45
C	0.4	0.25	0.35
D	0.5	0.25	0.25
E	0.6	0.25	0.15
F	0.7	0.3	0
G	0.8	0.2	0
H	0.9	0.1	0
I	1	0	0

V. CONCLUSION

The main objective of this study is to evaluate the correlation of portfolio risk and portfolio expected return by combining 3 share prices namely namely Top Glove Corporation Berhad, AirAsia X Berhad and Axiata Group Berhad. Method implemented in this study is using Markowitz portfolio theory approach. The main findings of this study are:

(a) The mean expected return for Top Glove share price is 3.65% with standard deviation is 8.6%. Next, the mean expected return for Airasia X is 0.98 % with standard deviation is 9.33%. The third selected share price is Axiata Group Berhad with mean expected return is -0.76% and standard deviation is 4.31% .

(b) The correlation value for share price return of dynamic movement between Top Glove and Airsia X is -0.326. Negative correlation is preferable in Modern portfolio Theory because negative correlation will reduce the portfolio risk. Therefore negative value is supporting the theory of diversification in Markowitz approach.

The correlation value between Top Glove and Axiata Group is 0.002. Next, the correlation value between AirAsia X and Axiata Group is 0.126.

(c) There are nine optimal combinations that calculated in this study to develop non-linear line of efficient frontier. Data shows with the increment weightage in Top Glove stock, the expected average return will be increase. This is because the mean average return for share price of Top Glove 3.65%. This is the highest return comparing to other two stocks. However the risk of share price of Top Glove is 8.6 %, which is on the risky side. This study concludes the portfolio can attained lower risk by combining three stocks.

The significant of this study is it will help investors to attain required expected return for a given investment risk using diversification of investment portfolio. The combination of 3 stocks will help investors to achieve higher return on lower risk.

The further study of this analysis can be extending to increase of number of assets in order to achieve better expected return with lower risk. In the same time, the implementation of artificial intelligent is crucial to find optimal weightage of portfolio in developing efficient frontier of optimal investment portfolio.

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