RISK-ADJUSTED PORTFOLIO PERFORMANCE

By

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A final year project submitted to the Department of Mathematical and
Actuarial Sciences,
Faculty of Engineering and Science,
Universiti Tunku Abdul Rahman,
in partial fulfillment of the requirements for the degree of
Master of Mathematical Science
January 2012

ABSTRACT

Diversification is important when it comes to investment. But how do we buy a lot of stocks if we have limited amount of capital? Mutual funds have provided a means for everyone to invest. Large capital is not required and we can even withdraw our EPF savings to invest in EPF approved mutual funds if we don't have enough savings in our bank accounts. So how does one choose which mutual funds to invest? Everyone wants to achieve high returns out of their investment but it is important that we do not overlook the risk taken to achieve those returns. This study aims to find out whether risk-adjusted return measurements is useful in evaluating performance of portfolios.

This study uses R program to perform the computation of four risk-adjusted measurements: a. Sharpe Ratio, b. Treynor Ratio, c. Jensen's Alpha, and d. Modigliani Ratio. The results computed are then compared against the fund's ranking provided by Lipper Investment-Management software. The practical outcome of this research suggests some general guidelines for evaluating the performance of portfolios.

ACKNOWLEDGEMENTS

I’m deeply grateful to Dr. Chin Seong Tah who has provided me guidance, assistance and support from the preliminary to the concluding level in developing this project. In particular, Dr. Chin's recommendations and suggestions have been invaluable for the project.

I would also like to thank my parents who has provided me guidance and support that has become a source of motivation for me to overcome the obstacles that I’ve faced in completing this project.

APPROVAL SHEET

This final year project entitled "**<u>RISK-ADJUSTED PORTFOLIO PERFORMANCE</u>**" was prepared by YVONNE CHEAH AI LIN and submitted as partial fulfillment of the requirements for the degree of Master of Mathematical Sciences at Universiti Tunku Abdul Rahman.

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PERMISSION SHEET

It is hereby certified that **YVONNE CHEAH AI LIN** (ID No: **09UEM09009**) has completed this final year project / ~~dissertation / thesis~~* entitled "RISK-ADJUSTED PORTFOLIO PERFORMANCE" under the supervision of Dr. Chin Seong Tah (Supervisor) from the Department of Mathematical and Actuarial Sciences, Faculty of Engineering and Science, and ____________________________________ (~~Co-Supervisor~~)* from the Department of ____________________________________, Faculty of Engineering and Science.

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DECLARATION

I hereby declare that the final year project is based on my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously or concurrently submitted for any other degree at UTAR or other institutions.

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Date ______________________________

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LIST OF ABBREVIATIONS

α	Alpha
β	Beta
CAPM	Capital Asset Pricing Model
EPF	Employee Provident Funds
FBMKLCI	Financial Times Stock Exchange Bursa Malaysia Kuala Lumpur Composite Index
KLIBOR	Kuala Lumpur Interbank Overnight Rate
RAP	Risk Adjusted Performance
SML	Security Market Line
F1	AmBond
F2	CIMB-Principal Bond
F3	Public Bond
F4	AMB Value Trust
F5	CIMB-Principal KLCI-Linked
F6	Pacific Millennium
F7	Eastspring Investments Balanced
F8	AMB Balanced Trust
F9	ING OA Inv- ING Managed Growth
JA	Jensen's Alpha
SR	Sharpe Ratio
TR	Treynor Ratio
MR	Modigliani Ratio

CHAPTER 1

INTRODUCTION

Modern world of finance has abundance of financial instruments for generating wealth. Various types of instruments ranging from risky financial derivatives to conservative bonds and fixed deposit accounts are readily available. This raises a question. What is the best investment instrument for us? The answer to this question depends on the preferences of individual investor based on certain factors such as the initial capital, returns generated, risk appetite, market condition, time horizon and so on.

A typical conservative investor would probably invest in less risky assets for regular income as well as for medium to long-term capital appreciation. On the other hand, other than investing for long term capital growth, an aggressive investor would probably also go for equities that provide fast and higher return. But higher return comes with higher risk. In anticipation of potentially higher returns, these investors must be willing to take higher risks and accept that returns may fluctuate widely over the short term and may even be negative. Market condition also plays an important deciding factor when it comes to investing. Generally, people are risk averse. They are reluctant to invest when the market is moving in a downward trend. However, the common goal of all investors is to achieve a high return on their investment with minimum risk.

So how does one achieve a high return while minimizing risk? If one portfolio is having a return that is higher than the others, does that mean that the portfolio is the best in terms of performance? Does higher return means that the portfolio is having a higher risk? Risk measurement provides us with a perspective on this matter. In this project, a study will be carry out to examine portfolios with different risk degree to find out if risk-adjusted return measurements are useful in evaluating performance of portfolios.

OBJECTIVES

The aim of this study is to find out whether risk-adjusted return measurements is useful in evaluating performance of portfolios. For this purpose, three groups of mutual funds, each with a different degree of risk are selected for risk-adjusted returns calculation. These three groups of funds, each with three funds, consist of an equity group to represent aggressive portfolios, a balanced group to represent balanced portfolios and a fixed income group to represent conservative portfolios. A market index will also be included for comparison against the funds and to calculate the sensitivity measure *beta*.

Four sets of performance measurement tools will be used for portfolio evaluations. These are Treynor, Sharpe, Jensen and Modigliani ratios. They combine risk and return performance into a single value, but each is slightly different from the other. This again raises another question. Which performance measure is most useful in evaluating a portfolio? How does a market condition affect these performance measurements if there is any? Risk adjustments measure provides us a means of comparing portfolios with different risk appetite.

The portfolios and the market index will be evaluated using the risk-adjusted return measurements in different market conditions. The practical outcome of this research suggests some general guidelines for evaluating the performance of portfolios.

PROBLEM STATEMENT

Many investors mistakenly base the success of their portfolios on returns alone. It is naive to use only return as a measure of performance. A portfolio can be exposed to many risks such as stock specific risk, company specific risk, country risk and currency risk. Diversification helps to lower the risk of a particular portfolio without compromising the returns and could potentially lead to higher returns.

What if we have two portfolios generating the same return? Naturally, we will be tempted to think they're the same. Then how do we determine which of the two is a better investment? Few consider the risk that they took to achieve those returns. To rank performance only on return ignores the influence of risk in producing portfolio return. According to Cathy Pareto, "Since the 1960s, investors have known how to quantify and measure risk with the variability of returns, but no single measure actually looked at both risk and return together."[13] Investors need to consider whether the portfolio's return, less all expenses, is adequate to compensate for the risk taken. Hence, there is a need to evaluate portfolio performance measures in terms of risk and return together.

CHAPTER 2

LITERATURE REVIEW

2.1 Capital Asset Pricing Model (CAPM)

2.1.1 A Simple Concept

Suppose we have an equation

$$y = \alpha + \beta x$$

where y is a dependent variable whose value depends linearly on the independent variable x. This equation represents a straight line with slope beta (β). We have $dy = \beta dx$ and therefore, beta is a sensitivity measure. It determines the change in y resulting from a change in the value of x. In investment parlance this becomes a risk measure.

Alpha, on the other hand, is simply an intercept of the line on the y axis. If $\alpha = 0$ then $y = \beta x$ and this is still an equation of a straight line, the only difference being that this straight line passes through the origin. The intercept can therefore be looked upon as the value of y when $x = 0$.

The same concept can be applied to the theory of investments where the return of a stock R_{stock}, is assumed to be linearly dependent on the return of certain market index (a stock market index such as FBMKLCI). Hence, we can write the return equation as:

$$R_{stock} = \alpha + \beta R_{index}$$

In the above equation beta is once again the slope of the line and it represents the "systematic risk" of the stock. Systematic risk is the amount of the risk for the stock which is explained by the market (index). If the market moves up by one unit and the stock also moves up by one unit then beta of the stock will be one. If the market moves up by one unit and the stock moves down by one unit then the beta of the stock will be negative one.

2.1.2 Definition and Formula

The CAPM is a model for pricing an individual security or a portfolio. The model was introduced by Jack Treynor (1961, 1962),[6] William Sharpe (1964), John Lintner (1965) and Jan Mossin (1966) independently, building on the earlier work of Harry Markowitz on diversification and modern portfolio theory. For individual securities, we make use of the security market line (SML) and its relation to expected return and systematic risk (beta) to show how the market must price individual securities in relation to their security risk class. Security market line (SML) is the graphical representation of the Capital asset pricing model. It displays the expected rate of return of an individual security as a function of systematic, non-diversifiable risk (its beta). The SML enables us to calculate the reward-to-risk ratio for any security in relation to that of the overall market. Therefore, when the expected rate of return for any security is deflated by its beta coefficient, the reward-to-risk ratio for any individual security in the market is equal to the market reward-to-risk ratio, thus:

$$\frac{E(R_i) - R_f}{\beta_i} = E(R_m) - R_f$$

The market reward-to-risk ratio is effectively the market risk premium and by rearranging the above equation and solving for $E(R_i)$, we obtain the Capital Asset Pricing Model (CAPM).

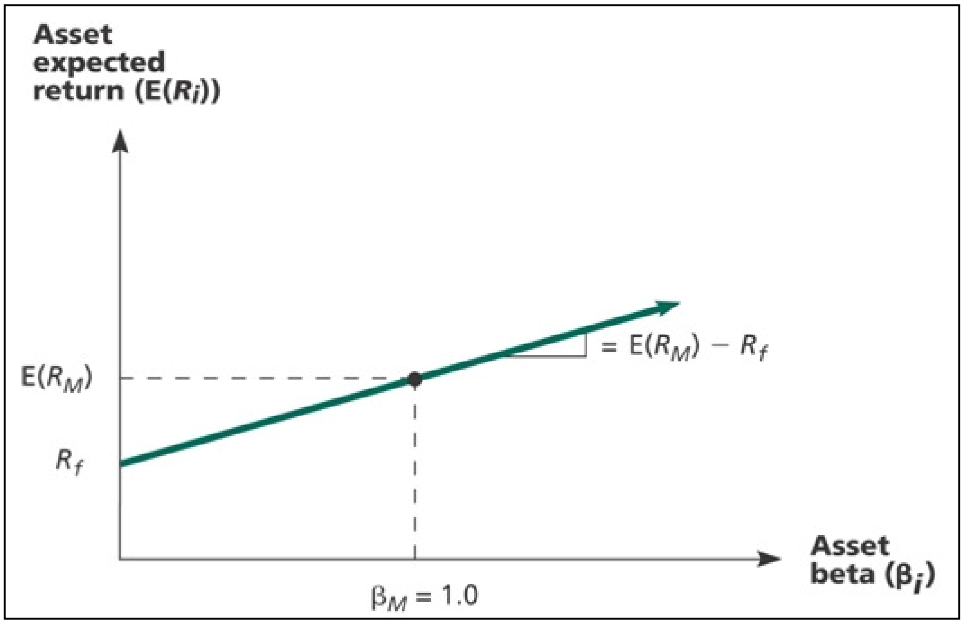

Figure 1: The Security Market Line, seen here in a graph, describes a relation between the beta and the asset's expected rate of return.

$$E(R_i) = R_f + \beta_i [E(R_m) - R_f]$$

where:

$E(R_i)$ is the expected return on the capital asset i

R_f is the risk-free rate of interest such as interest arising from government bonds

β_i (the beta) is the sensitivity of the expected excess asset returns to the expected excess market returns

$E(R_m)$ is the expected return of the market

$E(R_m) - R_f$ is sometimes known as the *market premium* or *risk premium* (the difference between the expected market rate of return and the risk-free rate of return).

2.1.3 Assumptions underlying the standard CAPM[11]

1. No transaction costs.

2. Assets are infinitely divisible.

3. Absence of personal income tax.

4. An individual cannot affect the price of a stock by his buying or selling action. All investors are price takers.

5. Unlimited short sales are allowed.

6. Unlimited lending and borrowing at the riskless rate.

7. Investors are assumed to be concerned with the mean and variance of returns, and all investors are assumed to define the relevant period in exactly the same manner.

8. All investors are assumed to have identical expectations with respect to the necessary inputs to the portfolio decision.

Both (7) and (8) are called the “homogeneity of expectations".

The CAPM relies on the mean-variance approach, homogeneity of expectation of investors, and no market frictions. In equilibrium, every investor must invest in the same fund of risky assets and in the risk free asset.

2.2 Simple Measures of Return

There are many ways to measure returns. However this paper will only introduce the most basic measure of return for mutual fund. Some mutual funds will pay out dividends to their investors while others don't. Mutual funds will also incur capital gains or losses due to the increase or decrease in the value of security. Hence, when calculating returns, it is necessary to include both income (in the form of dividends or interest payment) and capital gains or losses.

According to Katerina Simons[15],

> The return is calculated by taking the change in a fund's net asset value, which is the market value of securities the fund holds divided by the number of the fund's shares during a given time period, assuming the reinvestment of all income and capital-gains distributions, and dividing it by the original net asset value. The return is calculated net of management fees and other expenses charged to the fund. Thus, a fund's monthly return can be expressed as follows:
>
> $$R_t = \frac{NAV_t + DIST_t - NAV_{t-1}}{NAV_{t-1}}$$
>
> where R_t is the return in month t, NAV_t is the closing net asset value of the fund on the last trading day of the month, NAV_{t-1} is the closing net asset value of the fund on the last day of the previous month, and $DIST_t$ is income and capital gains distributions distributed during the month.
>
> Note that because of compounding, an arithmetic average of

monthly returns for a period of time is not the same as the monthly rate of return that would have produced the total cumulative return during that period. The latter is equivalent to the geometric mean of monthly returns, calculated as follows:

$$R = \sqrt[T]{\prod (1 + R_t)}$$

where R is the geometric mean for the period of T months.

Thus, a fund's month return is basically

$$R_t = \frac{EMV - BMV + C}{BMV}$$

where R_t is the return in month t, EMV is the ending market value of the fund, BMV is the beginning market value and C is the cash flow which represents any dividend distributions or other expenses.

An arithmetic average of monthly returns for a period of time is simple the sum of the monthly returns divided by the number of periods. On the other hand, a geometric mean is basically the nth root of the product of all the data points under study.[20] The formula below shows how to calculate a geometric mean from a sequence of returns,

$$R = \sqrt[n]{\prod_{i=1}^{n} (1 + r_i) - 1}$$

The Global Investment Performance Standards requires the use of geometric rather than arithmetic average returns when reporting investment results.[21] This has become the norm for the investment industry even though it is known that the arithmetic mean is always higher than the geometric mean.

2.3 Measure of Risk (Standard Deviation)

Nowadays, investors are becoming more aware and concern on the risks taken to achieve their returns. Risk can be defined as the uncertainty of the expected return, and uncertainty is generally equated with variability. Naturally, investors demand and receive higher returns with increased variability, suggesting that variability and risk are related. This implies that, on average, investors are risk-averse.

In statistics, the basic measure of variability is the standard deviation. In investment, the standard deviation is also known as the volatility. Specifically, it measures the variability of actual returns from their expected (average) values and the dispersion of these variations over time.[19] For a mutual fund, the standard deviation is defined as follows:

$$\mathrm{STD} = \sqrt{{}^{1}/_{\mathrm{T}} * \sum_{t=1}^{n} (\mathrm{R}_t - \mathrm{AR})^2}$$

where STD is the monthly standard deviation, AR is the average monthly return, and T is the number of months in the period for which the standard deviation is being calculated. A higher value for standard deviation indicates a wider dispersion of these variations from their mean (average) value and hence would be associated with a higher degree of risk because the predictability of returns is much less certain. Standard deviation is closely related to variance because it is the square root of variance. We can annualize the monthly standard deviation by multiplying it with the square root of 12.

For mutual funds, we are most often interested in the standard deviation of excess returns over the risk-free rate. Sometimes, the performance of fund managers are measured by how well they are able to track the returns on some benchmark index related to the fund's announced purpose. The standard deviation of the difference in returns between the fund and the appropriate benchmark index is known as the tracking error.

2.4 Risk Adjusted Performance

2.4.1 Sharpe Ratio

The Sharpe ratio is a measure of reward-to-volatility trade off developed by William Forsyth Sharpe.[14] The Sharpe Ratio is calculated as the average excess return over the volatility of excess return. The excess return is the portfolio return in excess of the risk free rate return. The volatility of the excess return is measured by the standard deviation of the excess return. Since its revision by the original author in 1994, it is defined as:

$$S = \frac{(R - R_f)}{\sigma} = \frac{E[R - R_f]}{\sqrt{var[R - R_f]}}$$

where R is the asset return, R_f is the risk free rate return, $E[R - R_f]$ is the expected value of the excess of the asset return over the risk free rate return, and σ is the standard deviation of the excess of the asset return. Note, if R_f is a constant risk free return throughout the period,

$$\sqrt{var[R - R_f]} = \sqrt{var[R]}$$

The Sharpe ratio is used to characterize how well the return of an asset compensates the investor for the risk taken, the higher the Sharpe ratio number the better. Sharpe's ratio is used in performance analysis when two alternative portfolios (or investment funds) represent the entire invested assets. Investors are often advised to pick investments with high Sharpe ratios. However like any mathematical model it relies on the data being correct.

It has been pointed out that there are some issues in the use of Sharpe Ratio. First of all, Sharpe ratio is not considered a reliable measure for hedge funds' performance. The main reason is the distribution of hedge fund returns deviates significantly from normality.[10] The numerator for Sharpe ratio is the excess return. Returns are assumed to be normally distributed. However, this is not the case for hedge funds. For an average investor not intimately familiar with the regression analysis and the modern theory of finance, the Sharpe ratio might seem to be a meaningless figure as it is difficult to interpret. Therefore, Sharpe ratio is best used in conjunction with other statistically independent measures of risk/reward when attempting to rank the performance of mutual funds. Nobelist Franco Modigliani and Leah Modigliani later addresses the second issue in 1997 by introducing the Modigliani risk ratio more popularly known as M squared.

2.4.2 Treynor Ratio

Treynor ratio is a risk-adjusted measure of performance developed by Jack L. Treynor, also known as reward-to-variability ratio.[2] It is calculated as the average excess return divided by beta over a given period. The Treynor ratio relates excess return over the risk-free rate to the additional risk taken; however, systematic risk is used instead of total risk. Higher Treynor ratio means better fund performance in excess of risk-free performance after adjusting for the market risk associated with a benchmark. The Treynor ratio is defined as

$$T = \frac{(R_i - R_f)}{\beta_i}$$

where R_i is the portfolio i's return, R_f is the risk free rate and β_i is the portfolio i's beta. Like the Sharpe ratio, the Treynor ratio (T) does not quantify the value added, if any, of active portfolio management. It is a ranking criterion only. A ranking of portfolios based on the Treynor Ratio is only useful if the portfolios under consideration are sub-portfolios of a broader, fully diversified portfolio. If this is not the case, portfolios with identical systematic risk, but different total risk, will be rated the same. But the portfolio with a higher total risk is less diversified and therefore has a higher unsystematic risk which is not priced in the market.

An alternative method of ranking portfolio management is Jensen's alpha, which quantifies the added return as the excess return above the security market line in the capital asset pricing model. As these two methods both determine rankings based on systematic risk alone, they will rank portfolios identically.

2.4.3 Jensen's Alpha

Jensen's alpha is a measure of fund performance adjusted for the risk associated with a benchmark over a given period.[8] Jensen's alpha is the average return on the fund portfolio over and above that predicted by the Capital Asset Pricing Model (CAPM), given the fund portfolio's beta and the average market return. Jensen's alpha is usually used to evaluate the contribution to performance by active management. Higher Jensen's alpha means better fund performance after adjusting for the risk associated with the benchmark.

Jensen's alpha was first used as a measure in the evaluation of mutual fund managers by Michael Jensen in 1968. The CAPM return is supposed to be 'risk adjusted', which means it takes account of the relative riskiness of the asset. After all, riskier assets will have higher expected returns than less risky assets. If an asset's return is even higher than the risk adjusted return, that asset is said to have "positive alpha" or "abnormal returns". Investors are constantly seeking investments that have higher alpha. The Jensen's alpha is defined as

$$\alpha_J = R_i - [R_f + \beta_{iM} \bullet (R_M - R_f)]$$

where R_i is the portfolio's return, R_f is the risk free rate, β_{iM} is the portfolio's beta, and R_M is the market return.

Like the Treynor ratio, Jensen's alpha also uses beta instead of sigma. This means that the ranking is only based on systematic risk and not total risk. Hence the portfolio with the highest risk-adjusted return by the criteria of Jensen's alpha or the Treynor ratio will not necessarily be the portfolio capable of achieving the highest return for any level of risk.

2.4.4 M squared

M squared was first introduced by Franco Modigliani and Leah Modigliani in 1997.[12] They proposed an alternative measure of risk adjusted performance called RAP. The concept of RAP is to use the market opportunity cost of risk, or trade-off between risk and return, to adjust all portfolios to the level of risk in the unmanaged market benchmark, thereby matching a portfolio's risk to that of the market, and then measuring the returns of this risk-matched portfolio. RAP is measured in basis points, something which investors are familiar with and understand. The basic M squared formula is defined as

$$M^2 = \left[\frac{(\bar{r}_p - \bar{r}_{free})}{\sigma_p} \times \sigma_b\right] + \bar{r}_{free}$$

where r_p is the return of the portfolio, r_{free} is the return of the benchmark, σ_p is the portfolio risk and σ_b is the benchmark risk.

The above equation allows us to construct a new version of portfolio based on an existing one having any desired level of dispersion. This can be accomplished by a financial operation called levering or unlevering the original portfolio. By unlevering a portfolio we mean selling a portion of that portfolio and using the proceeds to buy riskless securities. This operation will reduce the risk, but also decrease the expected return of the portfolio at the same time. For example, if we sell d% of the portfolio and use the proceeds to purchase riskless securities, this will reduce the dispersion of the returns of the portfolio by d%. It also reduces the excess return of the portfolio by the same d%.

On the other hand, if we increase the investment in the portfolio through borrowing, this will increase the risk and also increase the expected return of the portfolio. If an additional amount, say d% is invested in the portfolio, and this investment is financed by borrowing, then both the sigma and the excess return of the portfolio will increase by d%.

There are a few approaches to calculate M squared. There is the basic mixed arithmetic/geometric approach, the fully arithmetic approach called the Feibel's approach and then there is the authors’ approach which is the fully geometric approach. Using the authors' approach, the M squared is calculated each month

$$\mathrm{M}^2_{\mathrm{monthly}} = \left(\frac{\sigma_b}{\sigma_p} \times r_{p_i}\right) + \left[\left(1 - \frac{\sigma_b}{\sigma_p}\right) \times r_{\mathrm{RiskFree}_i}\right]$$

where r_{p_i} is the return of the portfolio for month i, r_{Riskfree_i} is the return of the benchmark for month i, σ_p is the portfolio risk and σ_b is the benchmark risk.

Some have suggested that the M squared method only uses the Sharpe Ratio or standard deviation as its risk measure. This, however, is incorrect. The reason for this perhaps is due to the fact that so many examples are shown using standard deviation or the Sharpe Ratio. However, the authors indicated that virtually any risk measure may be used, “provided that is satisfies two more general conditions:

leverage changes the risk and reward of portfolios in the same direction, and

leverage does not change the ranking of portfolios at any level of risk."[16]

CHAPTER 3

RESEARCH METHODOLOGY

In order to find out if risk-adjusted return measurements are useful in evaluating performance of portfolios, a study is carried out to examine three different types of portfolios using the four measurements previously discussed.

3.1 Portfolio Selection

The funds will be selected from Lipper's database provided by Thomson Reuters.[22] We will narrow our fund selection to include only Malaysia's funds by selecting the Lipper Malaysia classification as our classification scheme in the Lipper database. In addition, our focus is primarily on non-islamic funds with exposure in Malaysia and hence the funds selected are fully invested in Malaysia. The funds selected are from the Equity Malaysia category, Bond MYR category and Mixed Asset MYR Bal-Malaysia for the equity group, the fixed income group, and the balanced group respectively. The funds shown below are the funds selected for the study.

Table 1: List of funds grouped by asset classes selected from Lipper-IM database.

Equity Group	**Fixed Income Group**	**Balanced Group**
AMB Value Trust	AmBond	AMB Balanced Trust
Pacific Millennium	Public Bond	Eastspring Investments Balanced
CIMB Principal KLCI Linked	CIMB Principal Bond	ING OA Inv- ING Managed Growth

3.2 Timeframe

We carried out this study using more recent data from 2005-2010. The monthly returns of the funds are obtained from the Lipper database. When possible, the funds' respective benchmark returns are also obtained from Lipper. Otherwise the monthly returns are calculated from the prices obtained from Bloomberg and quant shop, Malaysian Bond Index provider. The risk-adjusted return measurements are calculated using monthly returns for one year, three years and five years period.

3.3 Tools

We used Lipper-Investment Management software to extract monthly returns, Bloomberg and quant shop to extract prices. R program is used to perform the computations of the risk-adjusted returns measurements.

3.4 Approach

Based on CAPM, we will use lm function in R to fit the benchmark and fund returns and to find the beta of the fund with respect to the benchmark. In order to calculate Sharpe ratio, we use the mean function to calculate the numerator which is the expected excess return of the fund and the sd function to calculate the denominator, the standard deviation of the excess return. The Modigliani ratio is calculated using the same formula as Sharpe ratio multiply with the standard deviation of the benchmark. For Treynor ratio, we also use the mean function to calculate the numerator which is the expected excess return of the fund divided by the beta which we have found earlier using the lm function. Last but not least, the Jensen's alpha is calculated using the mean function to find out the excess return of the fund and the excess return of the benchmark and using the beta that we have found earlier, we can place all these figures into the equation.

Conclusions are drawn based on the analysis of the four risk-adjusted returns measurements, Sharpe ratio, Treynor ratio, Jensen's alpha and M-squared. The higher the risk-adjusted returns measurements means better fund performance after adjusting for the risk associated with the benchmark.

3.5 Assumptions

1. Returns data follows lognormal distribution. Asset return is measured by

$$R_t = \frac{S_t - S_{t-1}}{S_{t-1}}$$

where S_t is this period's asset price and S_{t-1} is last period's asset price. The above equation assumes no dividend payments. Suppose we have N periods in one time interval then the total return of the entire interval is simply the sum of all the individual period's returns,

$$R_T = \sum_{t=1}^{N} R_t = \sum_{t=1}^{N} \left(\frac{S_t - S_{t-1}}{S_{t-1}} \right)$$

Taking the limit, the above equation will reduce to

$$R_T = \lim_{\Delta t \to 0} \sum_{t=1}^{N} R_t = \lim_{\Delta t \to 0} \sum_{t=1}^{N} \left(\frac{\Delta S_t}{S_t} \right)$$

In the limiting case if $\Delta t \to 0$, then $\Delta S \to dS$ and the summation sign will get replaced by an integral. Therefore, the expression for the asset return becomes:

$$R_t = \int_{S=S_0}^{S=S_T} \frac{dS}{S} = [\ln(S_T) - \ln(S_0)] = \ln\left(\frac{S_T}{S_0}\right)$$

Therefore, in a time interval [0, T], if we assume a continuous time process, the asset return will be expressed as the natural logarithm of the final price over the initial price.

2. Risk free rate used is the 3 months KLIBOR.

CHAPTER 4

RESULTS

The first set of results involves ranking funds within their respective asset class category for the three time periods according to the risk adjusted performance and then comparing these results against Lipper consistent ratings.[23] Does the ranking of these funds matches with the Lipper consistent ratings? While we start by examining the significance of the risk adjusted performance measurement, we quickly turn to questions about whether a particularly asset class tends to perform better in terms of risk adjusted returns.

4.1 Ranking results within asset classes

The funds ranked at each point in time are the funds available for purchase at that point in time.

Table 2 shows the risk adjusted performance for the funds in three different periods and their rankings within each asset classes for each of the risk adjusted performance measurement. The column headings show the period and the different types of risk adjusted performance measurement.

Table 2: Ranking of funds within each asset class based on risk adjusted performance measurement for 1, 3 and 5 year period.

Fund	1 Year								3 Years								5 Years								Lipper Consistent Rating		Average Risk Adjusted Performance Ranking	
	JA		SR		TR		MR		JA		SR		TR		MR		JA		SR		TR		MR		3Y	5Y	3Y	5Y
Bond																												
F1	0.28	*2*	1.48	*1*	3.64	*2*	0.56	*1*	0.15	*3*	0.32	*1*	0.41	*2*	0.26	*1*	0.14	*2*	0.20	*3*	0.35	*2*	0.15	*2*	*5*	*5*	*2*	*2*
F2	0.24	*3*	1.06	*3*	6.76	*1*	0.40	*2*	0.16	*2*	0.31	*2*	0.58	*1*	0.25	*2*	0.12	*3*	0.23	*2*	0.39	*1*	0.17	*1*	*5*	*4*	*2*	*2*
F3	0.31	*1*	1.11	*2*	0.03	*3*	0.02	*3*	0.24	*1*	0.25	*3*	(0.06)	*3*	0.01	*3*	0.20	*1*	0.24	*1*	(0.12)	*3*	0.01	*3*	*4*	*4*	*3*	*2*
Equity																												
F4	0.57	*1*	0.71	*1*	1.95	*1*	1.86	*1*	0.84	*1*	0.26	*1*	1.43	*1*	1.32	*1*	1.10	*1*	0.42	*1*	2.19	*1*	1.91	*1*	*5*	*5*	*1*	*1*
F5	0.20	*2*	0.56	*3*	1.49	*3*	1.49	*3*	0.17	*3*	0.04	*3*	0.19	*3*	0.19	*3*	0.16	*3*	0.19	*3*	0.88	*3*	0.87	*3*	*4*	*4*	*3*	*3*
F6	0.17	*3*	0.60	*2*	1.65	*2*	1.59	*2*	0.37	*2*	0.09	*2*	0.50	*2*	0.48	*2*	0.40	*2*	0.25	*2*	1.23	*2*	1.19	*2*	*5*	*5*	*2*	*2*
Mixed Asset																												
F7	0.09	*2*	0.57	*3*	0.80	*3*	0.68	*3*	0.08	*1*	0.04	*1*	0.13	*1*	0.11	*1*	0.27	*1*	0.25	*1*	0.65	*1*	0.58	*1*	*3*	*5*	*1*	*1*
F8	0.19	*1*	0.61	*1*	0.92	*1*	0.80	*2*	(0.04)	*2*	0.02	*2*	0.05	*2*	0.04	*2*	0.02	*3*	0.16	*3*	0.42	*3*	0.38	*3*	*3*	*2*	*2*	*3*
F9	0.05	*3*	0.59	*2*	0.87	*2*	0.80	*1*	(0.12)	*3*	(0.01)	*3*	(0.04)	*3*	(0.03)	*3*	0.07	*2*	0.20	*2*	0.52	*2*	0.47	*2*	*2*	*2*	*3*	*2*

The 1-Year, 3-Years and 5-Years column shows the Jensen alpha, Sharpe ratio, Treynor ratio and Modigliani ratio for each of the fund. These ratios are computed using R. The Lipper Consistent Rating column shows the 3 years and 5 years rating and these are extracted from Lipper-IM software. One year period is excluded because Lipper does not have consistent rating for one year period. The higher the risk adjusted performance, the better the ranking of the fund. Since there is only three funds within each asset classes, the fund with the highest risk adjusted performance will be rank one for that specific risk ratio and three if it has the lowest risk adjusted performance. Average risk adjusted performance ranking are the average ranks for funds computed across all the four risk adjusted performance measurement for the three and five year period respectively using the mean function in R. The average rank for all the risk adjusted performance measurement for the three year and five year period is at least similar, if not the same, with Lipper's Consistent rating. This shows that funds are generally ranked similarly to Lipper consistent rating, with the highest ranked fund having the highest consistent rating.

4.2. Ranking results across all funds

Table 3 shows the risk adjusted performance for the funds in three different periods and their rankings across all funds for each of the risk adjusted performance measurement. The column heading shows the period and the different types of risk adjusted performance measurement. The 1-Year, 3-Years and 5-Years column are the same as Table 2. Since we are ranking funds across all asset classes, we have nine funds now and the fund with the highest risk ratio will be ranked one and the lowest nine.

Table 3: Ranking of funds across all asset class based on risk adjusted performance measurement for 1, 3 and 5 year period.

Fund	1 Year								3 Years								5 Years								Average Risk Adjusted Performance Ranking		
	JA		SR		TR		MR		JA		SR		TR		MR		JA		SR		TR		MR		1Y	3Y	5Y
Bond																											
F1	0.28	*3*	1.48	*1*	3.64	*2*	0.56	*7*	0.15	*6*	0.32	*1*	0.41	*4*	0.26	*3*	0.14	*6*	0.20	*6*	0.35	*8*	0.15	*8*	*3.25*	*3.50*	*7.00*
F2	0.24	*4*	1.06	*3*	6.76	*1*	0.40	*8*	0.16	*5*	0.31	*2*	0.58	*2*	0.25	*4*	0.12	*7*	0.23	*5*	0.39	*7*	0.17	*7*	*4.00*	*3.25*	*6.50*
F3	0.31	*2*	1.11	*2*	0.03	*9*	0.02	*9*	0.24	*3*	0.25	*4*	(0.06)	*9*	0.01	*8*	0.20	*4*	0.24	*4*	(0.12)	*9*	0.01	*9*	*5.50*	*6.00*	*6.50*
																									4.25	*4.25*	*6.67*
Equity																											
F4	0.57	*1*	0.71	*4*	1.95	*3*	1.86	*1*	0.84	*1*	0.26	*3*	1.43	*1*	1.32	*1*	1.10	*1*	0.42	*1*	2.19	*1*	1.91	*1*	*2.25*	*1.50*	*1.00*
F5	0.20	*5*	0.56	*9*	1.49	*5*	1.49	*3*	0.17	*4*	0.04	*7*	0.19	*5*	0.19	*5*	0.16	*5*	0.19	*8*	0.88	*3*	0.87	*3*	*5.50*	*5.25*	*4.75*
F6	0.17	*7*	0.60	*6*	1.65	*4*	1.59	*2*	0.37	*2*	0.09	*5*	0.50	*3*	0.48	*2*	0.40	*2*	0.25	*2*	1.23	*2*	1.19	*2*	*4.75*	*3.00*	*2.00*
																									4.17	*3.25*	*2.58*
Mixed Asset																											
F7	0.09	*8*	0.57	*8*	0.80	*8*	0.68	*6*	0.08	*7*	0.04	*6*	0.13	*6*	0.11	*6*	0.27	*3*	0.25	*3*	0.65	*4*	0.58	*4*	*7.50*	*6.25*	*3.50*
F8	0.19	*6*	0.61	*5*	0.92	*6*	0.80	*5*	(0.04)	*8*	0.02	*8*	0.05	*7*	0.04	*7*	0.02	*9*	0.16	*9*	0.42	*6*	0.38	*6*	*5.50*	*7.50*	*7.50*
F9	0.05	*9*	0.59	*7*	0.87	*7*	0.80	*4*	(0.12)	*9*	(0.01)	*9*	(0.04)	*8*	(0.03)	*9*	0.07	*8*	0.20	*7*	0.52	*5*	0.47	*5*	*6.75*	*8.75*	*6.25*

Using the same method as Table 2, the average rank for all funds is computed across all the risk adjusted performance measurement for each of the period using the mean function in R. Based on the average ranking, for one and three year period, Equity has higher risk adjusted returns followed by bond and mixed asset respectively. For five year period, Equity also has the highest risk adjusted returns followed by mixed asset then bond.

4.3. Risk adjusted performance results using ranks

While our observations showed that the combination of the risk adjusted performance measurements produce similar results as Lipper consistent ratings, of perhaps more practical significance is an answer to the question, "Can risk adjusted performance measurements help investors in fund selection?"

Table 4: Three and five year correlation of ranking of funds within each asset classes based on risk adjusted performance measurements against Lipper's consistent rating.

Asset Class	Jensen's Alpha		Sharpe Ratio		Treynor Ratio	
	3YR	5YR	3YR	5YR	3YR	5YR
Bond	0.70	0.90	0.82	0.86	0.72	0.62
Equity	0.77	0.73	0.78	0.78	0.70	0.66
Mixed Asset	0.89	0.89	0.89	0.76	0.86	0.49

Table 4 exclude Modigliani Ratio as it is not available in Lipper-Investment Management software. Based on the samples that we've collected for the three asset classes, we find that generally there is a high correlation between Lipper consistent rating and the ranking of funds using the risk adjusted performance measurement. In Table 4, we can see that the correlation for three years period is at least 0.70. For the five year period, comparatively, only Jensen alpha and Sharpe ratio has high correlation with Lipper consistent rating. Sharpe ratio has the highest correlation with Lipper consistent rating across all asset classes for the three year period. On the other hand, Treynor Ratio showed the lowest correlation against Lipper consistent rating across all asset class for the five year period.

In terms of asset classes, mixed asset has the highest correlation for all three performance measurement against Lipper consistent rating. So which performance measure is most useful in evaluating a portfolio? Based on our results, for mixed asset funds, Jensen’s alpha have the highest correlation with Lipper consistent rating and this is followed by Sharpe ratio and Treynor ratio. For equity, Sharpe ratio has the highest correlation with Lipper consistent rating followed by Jensen’s alpha and Treynor ratio. For three year period, Sharpe ratio has the highest correlation with Lipper consistent rating followed by Treynor ratio and Jensen’s alpha for bond. For five year period, bond has the same results as mixed asset funds.

4.4 Returns and risk adjusted performance

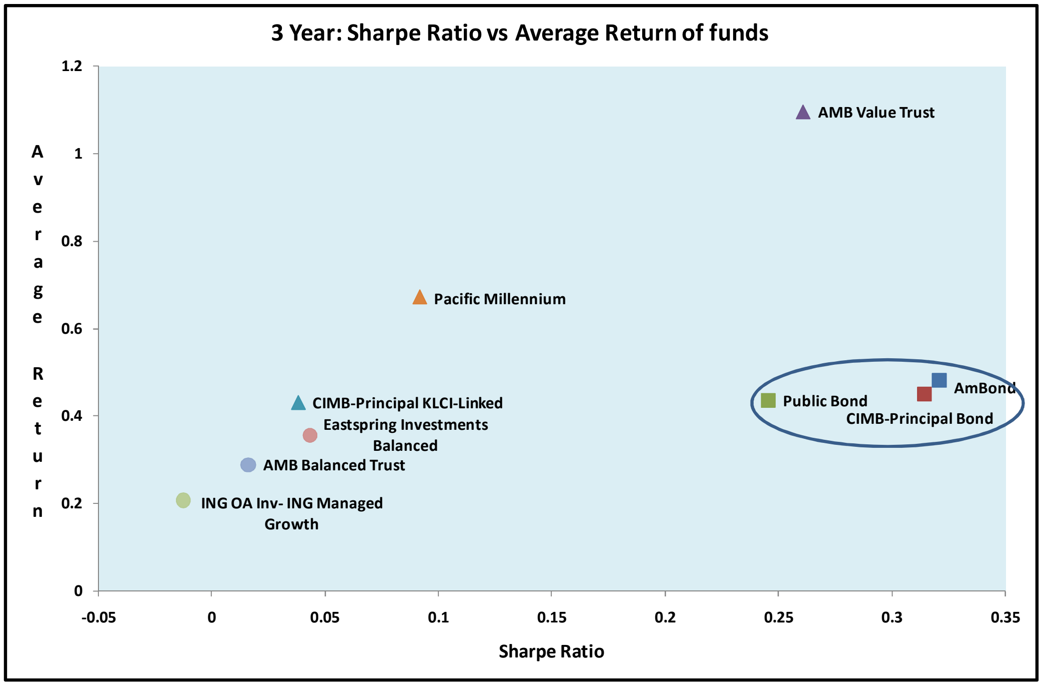

Figure 2: Sharpe Ratio vs Average Returns of funds.

In Figure 2, our observation showed that Pacific Millennium has a higher average return over three year period than all the bond funds. However, the Sharpe ratio of all the bond funds is higher than Pacific Millennium. Hence fund with higher performance does not necessarily produce better risk adjusted performance. Selecting a fund solely based on the performance criteria alone is inadequate.

In section 4.2, we find that Equity has the highest risk adjusted returns among all asset class. The general idea is that, equity produces high return at the expense of higher risk. This leads to the question, "Does higher return means that the portfolio is having a higher risk?" The answer is no. Based on

Figure 2 again, we see that all the bond funds have an average return that is higher than CIMB-Principal KLCI-Linked fund. The Sharpe Ratio for the bond funds is also higher than the CIMB-Principal KLCI-Linked fund. This means that the bond funds are able to achieve high returns at lower risk. CIMB-Principal KLCI-Linked fund could be taking additional unnecessary risk to achieve the desired returns. In terms of risk adjusted performance, the bond funds are better managed than the CIMB-Principal KLCI-Linked fund.

CHAPTER 5

CONCLUSION

Risk adjusted performance measurements has different correlation with Lipper consistent rating for the three asset classes. However, Treynor ratio compared with other risk adjusted performance measurements is almost always rank last based on the correlation with Lipper consistent rating. We can therefore conclude that Jensen's alpha and Sharpe ratio is a better performance measure when it comes to fund selection.

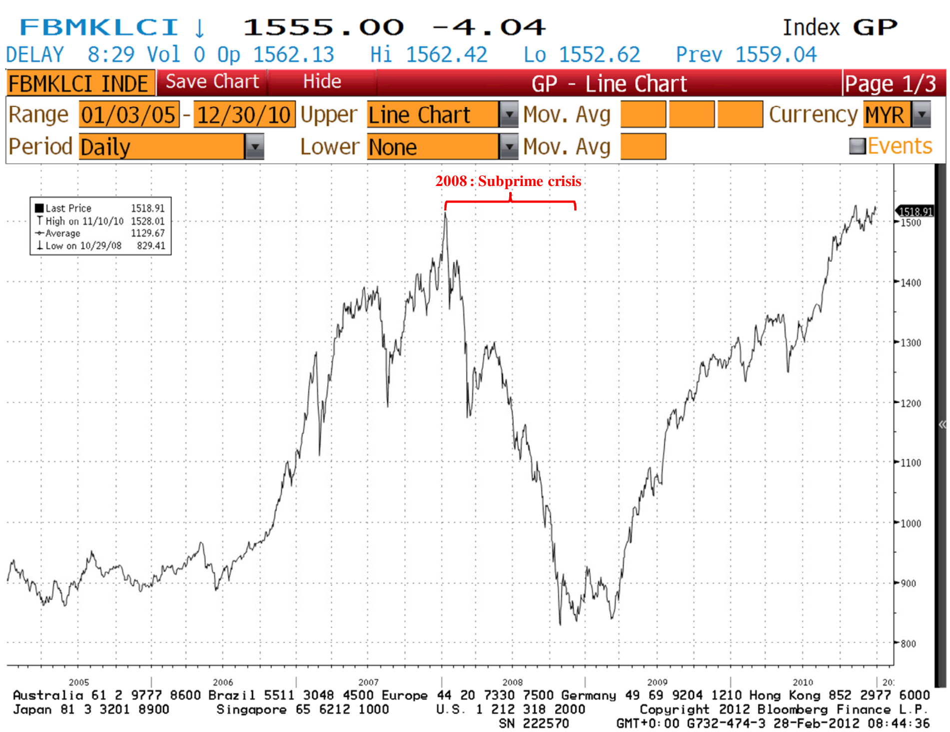

Figure 3: Daily market (FTSE Bursa Malaysia KLCI Index) price movement from 2005-2010.

Our sample data, taken from 2005-2010 include the period where the subprime crisis erupted in 2008. In Figure 3, we can see that the market has started recovering in beginning of 2009. The subprime crisis could have impacted the bond market as we can observed from Table 2 that the bond funds has better one year risk adjusted performance measure compared to three and five year period. The exclusion of the subprime crisis period could have contributed to the better risk adjusted performance.

The lack of information for Modigliani ratio in Lipper Investment Management software make it impossible for this study to conclude on the usefulness of this ratio in helping investors in fund selection. However, this ratio is still considered new and is constantly being revised and not being used widely in the fund management industry. Alternatives software such as Matlab can also be used to perform the computation of risk adjusted performance figures. We choose R simply because it is free and readily available.

In order to avoid being worried all the time, each of us need to identify with our own risk appetite when it comes to fund selection. Once we identify our risk appetite, then we are able to invest comfortably. Based on the risk appetite, one can decide on which asset class to invest in. Again, once we have identify which asset class we want to invest in, then we can employ what we have done in this study, which is to use the risk adjusted performance measures to select a particular fund. Overall, these risk adjusted performance measurements does provide useful information for investors when selecting funds.

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[21] The GIPS standards are a set of standardized, industry-wide ethical principles that provide investment firms with guidance on how to calculate and report their investment results to prospective clients. URL: http://www.gipsstandards.org/

[22] Thomson Reuters Corporation is a provider of information for the world's businesses and professional and is created by the Thomson Corporation's purchase of Reuters on 17 April 2008.

[23] The Consistent Return measure is a more sophisticated risk-adjusted mutual fund return performance measure than others currently available in the marketplace. It takes into account both short- and long-term risk-adjusted performance relative to fund classification. The measure is based on the Effective Return computation. Effective Return is a risk-adjusted return measure that looks back over a variety of holding periods (measured in days, weeks, months, and/or years). The highest 20% of funds in each classification receive a rating of 5, the next 20% receive a rating of 4, the middle 20% are rated 3, the next 20% are rated 2, and the lowest 20% are rated 1.

APPENDIX A

List of Funds extracted from Lipper-Investment Management Software on 2nd of August 2011

Name	Schemes Lipper Global
Affin Capital	Bond MYR
AmanahRaya Syariah Trust	Bond MYR
AmanahRaya Unit Trust	Bond MYR
AMB Dana Arif	Bond MYR
AMB Income Trust	Bond MYR
AmBon Islam	Bond MYR
AmBond	Bond MYR
AmDynamic Bond	Bond MYR
Areca enhancedINCOME	Bond MYR
Areca Income Trust	Bond MYR
Areca Steady fixedINCOME	Bond MYR
ASBI Dana Al-Fakhim	Bond MYR
CIMB Islamic Institutional Sukuk	Bond MYR
CIMB Islamic Sukuk	Bond MYR
CIMB-Principal Bond	Bond MYR
CIMB-Principal Institutional Bond	Bond MYR
CIMB-Principal Institutional Bond 2	Bond MYR
CIMB-Principal Institutional Bond 3	Bond MYR
CIMB-Principal Institutional Bond 4	Bond MYR
CIMB-Principal Strategic Bond	Bond MYR
Hong Leong Bond	Bond MYR
HwangDBS AIIMAN Income Plus	Bond MYR
ING Enhanced Yield	Bond MYR
ING OA Inv- ING Bon Islam	Bond MYR
ING OA Inv- ING Income Plus	Bond MYR
KAF Bond	Bond MYR
Kenanga Bond	Bond MYR
Libra ASnitaBOND	Bond MYR
Libra BondEXTRA	Bond MYR
Libra IncomeEXTRA	Bond MYR
MAAKL As-Saad	Bond MYR
MAAKL Bond	Bond MYR
Manulife Malaysia Bond	Bond MYR
Optimus	Bond MYR
Opus Dynamic Income	Bond MYR
Opus Fixed Income	Bond MYR
OSK-UOB Energy	Bond MYR
OSK-UOB Income	Bond MYR
Pacific Dana Murni	Bond MYR
Pacific SELECT Bond	Bond MYR
PB Fixed Income	Bond MYR
PB Infrastructure Bond	Bond MYR
PB Islamic Bond	Bond MYR
PRUbond	Bond MYR
PRUdana wafi	Bond MYR
Public Bond	Bond MYR
Public Institutional Bond	Bond MYR
Public Islamic Bond	Bond MYR
Public Islamic Income	Bond MYR
Public Islamic Infrastructure Bond	Bond MYR
Public Islamic Select Bond	Bond MYR
Public Islamic Strategic Bond	Bond MYR
Public Select Bond	Bond MYR
Public Strategic Bond	Bond MYR
Public Sukuk	Bond MYR
RHB Bond	Bond MYR
RHB Income Plus Fund 2	Bond MYR
RHB Islamic Bond	Bond MYR
RHB Islamic Income Plus Fund 2	Bond MYR
Alliance Dana Alif	Mixed Asset MYR Bal - Malaysia
Alliance First	Mixed Asset MYR Bal - Malaysia
AMB Balanced Trust	Mixed Asset MYR Bal - Malaysia
AMB Dana Ikhlas	Mixed Asset MYR Bal - Malaysia
AmBalanced	Mixed Asset MYR Bal - Malaysia
AmIslamic Balanced	Mixed Asset MYR Bal - Malaysia
Apex Dana Al-Faiz-i	Mixed Asset MYR Bal - Malaysia
ASBI Dana Al-Falah	Mixed Asset MYR Bal - Malaysia
ASBI Dana Al-Munsif	Mixed Asset MYR Bal - Malaysia
ASM Balanced	Mixed Asset MYR Bal - Malaysia
CIMB Islamic Balanced	Mixed Asset MYR Bal - Malaysia
CIMB Islamic Balanced Growth	Mixed Asset MYR Bal - Malaysia
CIMB-Principal Balanced Income	Mixed Asset MYR Bal - Malaysia
CIMB-Principal Income Plus Balanced	Mixed Asset MYR Bal - Malaysia
Dana Islamiah Affin	Mixed Asset MYR Bal - Malaysia
Dana Makmur Pheim	Mixed Asset MYR Bal - Malaysia
Hong Leong Balanced	Mixed Asset MYR Bal - Malaysia
Hong Leong Dana Maa'rof	Mixed Asset MYR Bal - Malaysia
HwangDBS Select Balanced	Mixed Asset MYR Bal - Malaysia
ING OA Inv- ING Diversified	Mixed Asset MYR Bal - Malaysia
ING OA Inv- ING Managed Growth	Mixed Asset MYR Bal - Malaysia
ING OA Inv- ING Shariah Balanced	Mixed Asset MYR Bal - Malaysia
Kenanga Balanced	Mixed Asset MYR Bal - Malaysia
Kenanga Islamic Balanced	Mixed Asset MYR Bal - Malaysia
Libra SyariahEXTRA	Mixed Asset MYR Bal - Malaysia
Libra VersatileEXTRA	Mixed Asset MYR Bal - Malaysia
MAAKL Al-Umran	Mixed Asset MYR Bal - Malaysia
MAAKL Balanced	Mixed Asset MYR Bal - Malaysia
OSK-UOB KidSave	Mixed Asset MYR Bal - Malaysia
OSK-UOB Muhibbah Income	Mixed Asset MYR Bal - Malaysia
OSK-UOB Smart Balanced	Mixed Asset MYR Bal - Malaysia
Pacific Select Balance	Mixed Asset MYR Bal - Malaysia
PB Balanced	Mixed Asset MYR Bal - Malaysia
Pheim Emerging Companies Balanced	Mixed Asset MYR Bal - Malaysia
PRUbalanced	Mixed Asset MYR Bal - Malaysia
Public Balanced	Mixed Asset MYR Bal - Malaysia
Public Islamic Balanced	Mixed Asset MYR Bal - Malaysia
RHB Income	Mixed Asset MYR Bal - Malaysia
RHB Mudharabah	Mixed Asset MYR Bal - Malaysia
TA Dana Optimix	Mixed Asset MYR Bal - Malaysia
TA Income	Mixed Asset MYR Bal - Malaysia
Tabung Kumpulan Modal Bumiputra Pahang	Mixed Asset MYR Bal - Malaysia
Affin Equity	Equity Malaysia
Affin Islamic Equity	Equity Malaysia
Affin Quantum	Equity Malaysia
Affin Select Growth	Equity Malaysia
Alliance Dana Adib	Equity Malaysia
Alliance Optimal Income	Equity Malaysia
Alliance Tactical Growth	Equity Malaysia
Amanah Saham Bank Simpanan Nasional	Equity Malaysia
Amanah Saham Darul Iman	Equity Malaysia
Amanah Saham Kedah	Equity Malaysia
AmanahRaya Islamic Equity	Equity Malaysia
AMB Dana Yakin	Equity Malaysia
AMB Dividend Trust	Equity Malaysia
AMB Ethical Trust	Equity Malaysia

Name	Schemes Lipper Global
AMB Index-Linked Trust	Equity Malaysia
AMB Unit Trust	Equity Malaysia
AMB Value Trust	Equity Malaysia
AmDividend income	Equity Malaysia
AmIslamic Growth	Equity Malaysia
AmIttikal	Equity Malaysia
AmMalaysia Equity	Equity Malaysia
AmTotal Return	Equity Malaysia
Apex Dana Al-Sofi-i	Equity Malaysia
Apex Malaysia Growth	Equity Malaysia
Areca Equity Trust	Equity Malaysia
ASM Amanah Saham Pekerja TNB	Equity Malaysia
ASM Dana Al-Aiman	Equity Malaysia
ASM Dana Bestari	Equity Malaysia
ASM Dana Mutiara	Equity Malaysia
ASM First Public	Equity Malaysia
ASM Index	Equity Malaysia
ASM KMB Dana Pertumbuhan	Equity Malaysia
ASM KMBY Kesebelas	Equity Malaysia
ASM Premier	Equity Malaysia
ASM Syariah Aggressive	Equity Malaysia
ASM Syariah Dividend	Equity Malaysia
BIMB i Dividend	Equity Malaysia
BIMB i Growth	Equity Malaysia
CIMB Islamic DALI Equity	Equity Malaysia
CIMB Islamic DALI Equity Growth	Equity Malaysia
CIMB Islamic DALI Equity Theme	Equity Malaysia
CIMB Islamic Equity Aggressive	Equity Malaysia
CIMB-Principal Equity	Equity Malaysia
CIMB-Principal Equity 2	Equity Malaysia
CIMB-Principal Equity Aggressive 1	Equity Malaysia
CIMB-Principal Equity Aggressive 3	Equity Malaysia
CIMB-Principal Equity Growth & Income	Equity Malaysia
CIMB-Principal KLCI-Linked	Equity Malaysia
CIMB-Principal Wholesale Equity	Equity Malaysia
Hong Leong Blue Chip	Equity Malaysia
Hong Leong Dana Makmur	Equity Malaysia
Hong Leong Dividend	Equity Malaysia
Hong Leong Growth	Equity Malaysia
Hong Leong Penny Stock	Equity Malaysia
HwangDBS AIIMAN Growth	Equity Malaysia
HwangDBS Select Dividend	Equity Malaysia
HwangDBS Select Opportunity	Equity Malaysia
ING OA Inv- ING Blue Chip	Equity Malaysia
ING OA Inv- ING Ekuiti Islam	Equity Malaysia
ING OA Inv- ING Shariah Growth Opportunities	Equity Malaysia
InterPac Dana Safi	Equity Malaysia
InterPac Dynamic Equity	Equity Malaysia
Kenanga Growth	Equity Malaysia
Kenanga Islamic	Equity Malaysia
Kenanga Malaysian Inc	Equity Malaysia
Kenanga Premier	Equity Malaysia
Kenanga Syariah Growth	Equity Malaysia
Libra Amanah Saham Wanita	Equity Malaysia
Libra DividendEXTRA	Equity Malaysia
Libra EquityEXTRA	Equity Malaysia
MAAKL Al-Faid	Equity Malaysia
MAAKL Al-Fauzan	Equity Malaysia
MAAKL Dividend	Equity Malaysia
MAAKL Equity Index	Equity Malaysia
MAAKL Growth	Equity Malaysia
MAAKL Regular Savings	Equity Malaysia
MAAKL Syariah Index	Equity Malaysia
MAAKL Value	Equity Malaysia
Manulife Malaysia Equity	Equity Malaysia
MIDF Amanah Dynamic	Equity Malaysia
MIDF Amanah Growth	Equity Malaysia
MIDF Amanah Islamic	Equity Malaysia
OSK-UOB Dana Islam	Equity Malaysia
OSK-UOB Equity	Equity Malaysia
OSK-UOB KLCI Tracker	Equity Malaysia
OSK-UOB Malaysia Dividend	Equity Malaysia
OSK-UOB Smart Treasure	Equity Malaysia
Pacific Dana Aman	Equity Malaysia
Pacific Dividend	Equity Malaysia
Pacific ELITE Dividend	Equity Malaysia
Pacific Millennium	Equity Malaysia
Pacific Premier	Equity Malaysia
Pacific Recovery	Equity Malaysia
PB Growth	Equity Malaysia
PB Islamic Equity	Equity Malaysia
Phillip Master Equity Growth	Equity Malaysia
PJB Dana Johor	Equity Malaysia
PRUdana al-ilham	Equity Malaysia
PRUequity income	Equity Malaysia
PRUgrowth	Equity Malaysia
Public Aggressive Growth	Equity Malaysia
Public Dividend Select	Equity Malaysia
Public Equity	Equity Malaysia
Public Growth	Equity Malaysia
Public Index	Equity Malaysia
Public Industry	Equity Malaysia
Public Islamic Alpha-40 Growth	Equity Malaysia
Public Islamic Dividend	Equity Malaysia
Public Islamic Equity	Equity Malaysia
Public Islamic Optimal Growth	Equity Malaysia
Public Islamic Sector Select	Equity Malaysia
Public Islamic Select Enterprises	Equity Malaysia
Public Islamic Select Treasures	Equity Malaysia
Public Ittikal	Equity Malaysia
Public Optimal Growth	Equity Malaysia
Public Regular Savings	Equity Malaysia
Public Savings	Equity Malaysia
Public Sector Select	Equity Malaysia
Public Select Alpha-30	Equity Malaysia
RHB Capital	Equity Malaysia
RHB Dynamic	Equity Malaysia
RHB Islamic Growth	Equity Malaysia
RHB Malaysia DIVA	Equity Malaysia
Saham Amanah Sabah	Equity Malaysia
TA Comet	Equity Malaysia
TA Dana Fokus	Equity Malaysia
TA Growth	Equity Malaysia
TA High Growth	Equity Malaysia
TA Islamic	Equity Malaysia

APPENDIX B

Example of R code for 1 Year Risk-Ajusted Performance Measurement

```
> data <-
read.table('C:\\Users\\Yvonne\\Documents\\Yvonne\\Project1\\TestData1Yrs.tx
t', header=T)
Warning messages:
1: In if (!header) rlabp <- FALSE :
  the condition has length > 1 and only the first element will be used
2: In if (header) { :
  the condition has length > 1 and only the first element will be used
>
>
> lm.F1 <- lm(data$F1 ~ data$B1)
> lm.F2<- lm(data$F2 ~ data$B2)
> lm.F3 <- lm(data$F3 ~ data$B3)
> lm.F4 <- lm(data$F4 ~ data$B4)
> lm.F5 <- lm(data$F5 ~ data$B5)
> lm.F6 <- lm(data$F6 ~ data$B6)
> lm.F7 <- lm(data$F7 ~ data$B7)
> lm.F8 <- lm(data$F8 ~ data$B8)
> lm.F9 <- lm(data$F9 ~ data$B9)
> fitted <- cbind(lm.F1$fit, lm.F2$fit, lm.F3$fit, lm.F4$fit, lm.F5$fit,
lm.F6$fit, lm.F7$fit, lm.F8$fit, lm.F9$fit)
>
> summary(lm.F1)

Call:
lm(formula = data$F1 ~ data$B1)

Residuals:
     Min       1Q   Median       3Q      Max 
-0.20085 -0.17048 -0.08881  0.08903  0.38437 

Coefficients:
            Estimate Std. Error t value Pr(>|t|)    
(Intercept)  0.48799    0.09916   4.921 0.000604 ***
data$B1      0.08314    0.17587   0.473 0.646568    
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 0.2184 on 10 degrees of freedom
Multiple R-squared: 0.02186,    Adjusted R-squared: -0.07596 
F-statistic: 0.2235 on 1 and 10 DF,  p-value: 0.6466 

> summary(lm.F2)

Call:
lm(formula = data$F2 ~ data$B2)
```

```
Residuals:
     Min       1Q   Median       3Q      Max 
-0.38658 -0.12541  0.01595  0.08908  0.48742 

Coefficients:
            Estimate Std. Error t value Pr(>|t|)   
(Intercept)  0.45787    0.11451   3.998  0.00252 **
data$B2      0.03731    0.20310   0.184  0.85791   
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1 

Residual standard error: 0.2522 on 10 degrees of freedom
Multiple R-squared: 0.003363,	Adjusted R-squared: -0.0963 
F-statistic: 0.03375 on 1 and 10 DF,  p-value: 0.858 

> summary(lm.F3)

Call:
lm(formula = data$F3 ~ data$B3)

Residuals:
     Min       1Q   Median       3Q      Max 
-0.32481 -0.26372 -0.02707  0.11575  0.68518 

Coefficients:
            Estimate Std. Error t value Pr(>|t|)  
(Intercept)   -2.267      1.460  -1.553    0.151  
data$B3       12.624      6.380   1.979    0.076 .
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1 

Residual standard error: 0.3251 on 10 degrees of freedom
Multiple R-squared: 0.2813,	Adjusted R-squared: 0.2095 
F-statistic: 3.915 on 1 and 10 DF,  p-value: 0.07605 

> summary(lm.F4)

Call:
lm(formula = data$F4 ~ data$B4)

Residuals:
     Min       1Q   Median       3Q      Max 
-1.41531 -0.51428  0.09908  0.52178  1.07768 

Coefficients:
            Estimate Std. Error t value Pr(>|t|)    
(Intercept)  0.59961    0.26631   2.252   0.0481 *  
data$B4      0.86868    0.09053   9.595 2.32e-06 ***
---
```

```
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 0.7906 on 10 degrees of freedom
Multiple R-squared: 0.902,	Adjusted R-squared: 0.8922
F-statistic: 92.07 on 1 and 10 DF,  p-value: 2.318e-06

> summary(lm.F5)

Call:
lm(formula = data$F5 ~ data$B5)

Residuals:
     Min       1Q   Median       3Q      Max
-0.24619 -0.14153 -0.03475  0.14850  0.28046

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept)  0.19147    0.06461   2.963   0.0142 *
data$B5      1.03540    0.02196  47.142 4.45e-13 ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 0.1918 on 10 degrees of freedom
Multiple R-squared: 0.9955,	Adjusted R-squared: 0.9951
F-statistic:  2222 on 1 and 10 DF,  p-value: 4.447e-13

> summary(lm.F6)

Call:
lm(formula = data$F6 ~ data$B6)

Residuals:
     Min       1Q   Median       3Q      Max
-1.60547 -0.29974  0.00632  0.44329  0.90136

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept)  0.18965    0.24264   0.782    0.453
data$B6      0.89918    0.07961  11.294 5.16e-07 ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 0.7002 on 10 degrees of freedom
Multiple R-squared: 0.9273,	Adjusted R-squared:  0.92
F-statistic: 127.6 on 1 and 10 DF,  p-value: 5.156e-07

> summary(lm.F7)

Call:
lm(formula = data$F7 ~ data$B7)
```

```
Residuals:
    Min      1Q  Median      3Q     Max
-1.2838 -0.4362  0.1046  0.3623  1.3888

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept)   0.1672     0.3157   0.530 0.607796
data$B7       1.0854     0.1974   5.497 0.000263 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.8671 on 10 degrees of freedom
Multiple R-squared: 0.7514,     Adjusted R-squared: 0.7265
F-statistic: 30.22 on 1 and 10 DF,  p-value: 0.0002627

> summary(lm.F8)

Call:
lm(formula = data$F8 ~ data$B8)

Residuals:
     Min       1Q   Median       3Q      Max
-1.26742 -0.64285 -0.19286  0.08163  2.59563

Coefficients:
             Estimate Std. Error t value Pr(>|t|)
(Intercept) 0.0008126  0.4077193   0.002 0.998449
data$B8     1.4102018  0.2730982   5.164 0.000423 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 1.086 on 10 degrees of freedom
Multiple R-squared: 0.7273,     Adjusted R-squared:   0.7
F-statistic: 26.66 on 1 and 10 DF,  p-value: 0.0004229

> summary(lm.F9)

Call:
lm(formula = data$F9 ~ data$B9)

Residuals:
    Min      1Q  Median      3Q     Max
-0.9843 -0.4741 -0.0787  0.3847  1.4488

Coefficients:
             Estimate Std. Error t value Pr(>|t|)
(Intercept) -0.004261   0.277271  -0.015    0.988
data$B9      1.254566   0.166327   7.543 1.96e-05 ***
---
```

```
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.7468 on 10 degrees of freedom
Multiple R-squared: 0.8505,     Adjusted R-squared: 0.8356
F-statistic: 56.89 on 1 and 10 DF,  p-value: 1.964e-05

#### alpha
> c(lm.F1$co[1], lm.F2$co[1], lm.F3$co[1], lm.F4$co[1], lm.F5$co[1], lm.F6$co[1], lm.F7$co[1], lm.F8$co[1], lm.F9$co[1])
 (Intercept)  (Intercept)  (Intercept)  (Intercept)  (Intercept)  (Intercept)
(Intercept)  (Intercept)  (Intercept)
 0.4879943979  0.4578711052 -2.2673844576  0.5996118443  0.1914662521
0.1896468937  0.1672471176  0.0008125809 -0.0042613641

#### beta
> c(lm.F1$co[2], lm.F2$co[2], lm.F3$co[2], lm.F4$co[2], lm.F5$co[2], lm.F6$co[2], lm.F7$co[2], lm.F8$co[2], lm.F9$co[2])
   data$B1      data$B2      data$B3      data$B4      data$B5      data$B6
data$B7    data$B8    data$B9
 0.08313717  0.03731052 12.62368635  0.86868128  1.03539909  0.89918053
1.08537799  1.41020179  1.25456583


#### Treynor index
> c(mean(data$F1)-mean(data$RFR), mean(data$F2)-mean(data$RFR), mean(data$F3)-mean(data$RFR), mean(data$F4)-mean(data$RFR), mean(data$F5)-mean(data$RFR), mean(data$F6)-mean(data$RFR), mean(data$F7)-mean(data$RFR), mean(data$F8)-mean(data$RFR), mean(data$F9)-mean(data$RFR)) / c(lm.F1$co[2], lm.F2$co[2], lm.F3$co[2], lm.F4$co[2], lm.F5$co[2], lm.F6$co[2], lm.F7$co[2], lm.F8$co[2], lm.F9$co[2])
  data$B1    data$B2    data$B3    data$B4    data$B5    data$B6    data$B7
data$B8    data$B9
3.63595905  6.75993406  0.03111743  1.95087855  1.48667313  1.65045649
0.92378723 0.79722042 0.86803602

#### Jensen index
> c(mean(data$F1)-mean(data$RFR), mean(data$F2)-mean(data$RFR), mean(data$F3)-mean(data$RFR), mean(data$F4)-mean(data$RFR), mean(data$F5)-mean(data$RFR), mean(data$F6)-mean(data$RFR), mean(data$F7)-mean(data$RFR), mean(data$F8)-mean(data$RFR), mean(data$F9)-mean(data$RFR))-c(lm.F1$co[2], lm.F2$co[2], lm.F3$co[2], lm.F4$co[2], lm.F5$co[2], lm.F6$co[2], lm.F7$co[2], lm.F8$co[2], lm.F9$co[2])*c(mean(data$B1)-mean(data$RFR), mean(data$B2)-mean(data$RFR), mean(data$B3)-mean(data$RFR), mean(data$B4)-mean(data$RFR), mean(data$B5)-mean(data$RFR), mean(data$B6)-mean(data$RFR), mean(data$B7)-mean(data$RFR), mean(data$B8)-mean(data$RFR), mean(data$B9)-mean(data$RFR))
  data$B1    data$B2    data$B3    data$B4    data$B5    data$B6    data$B7
data$B8    data$B9
```

0.28455018 0.24425833 0.31181468 0.57047331 0.19932101 0.16727589 0.18619178 0.09183294 0.05222467

MM index

```
> c((mean(data$F1)-mean(data$RFR))/sd(data$F1-data$RFR)*sd(data$B1),
(mean(data$F2)-mean(data$RFR))/sd(data$F2-
data$RFR)*sd(data$B2),(mean(data$F3)-mean(data$RFR))/sd(data$F3-
data$RFR)*sd(data$B3),(mean(data$F4)-mean(data$RFR))/sd(data$F4-
data$RFR)*sd(data$B4),(mean(data$F5)-mean(data$RFR))/sd(data$F5-
data$RFR)*sd(data$B5),(mean(data$F6)-mean(data$RFR))/sd(data$F6-
data$RFR)*sd(data$B6),(mean(data$F7)-mean(data$RFR))/sd(data$F7-
data$RFR)*sd(data$B7),(mean(data$F8)-mean(data$RFR))/sd(data$F8-
data$RFR)*sd(data$B8),(mean(data$F9)-mean(data$RFR))/sd(data$F9-
data$RFR)*sd(data$B9))
[1] 0.55563881 0.39552269 0.01711439 1.85720469 1.48675765 1.59283567
0.80350236 0.68277571 0.80482051
```

Sharp ratio

```
> c((mean(data$F1)-mean(data$RFR))/sd(data$F1-data$RFR),
(mean(data$F2)-mean(data$RFR))/sd(data$F2-data$RFR),(mean(data$F3)-
mean(data$RFR))/sd(data$F3-data$RFR),(mean(data$F4)-
mean(data$RFR))/sd(data$F4-data$RFR),(mean(data$F5)-
mean(data$RFR))/sd(data$F5-data$RFR),(mean(data$F6)-
mean(data$RFR))/sd(data$F6-data$RFR),(mean(data$F7)-
mean(data$RFR))/sd(data$F7-data$RFR),(mean(data$F8)-
mean(data$RFR))/sd(data$F8-data$RFR),(mean(data$F9)-
mean(data$RFR))/sd(data$F9-data$RFR))
[1] 1.4839148 1.0563012 1.1138351 0.7053499 0.5646574 0.6007128
0.6067935 0.5692449 0.5944931
>
```