

**PORTFOLIO RISK MANAGEMENT AND CAPITAL ASSET  
PRICING MODEL  
CASE: THE COMPARISON AMONG PORTFOLIOS IN THE SAME AND  
DIFFERENT REGIONS.**

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Thesis

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The objective of this thesis is to figure out the profitability in stock investment through portfolio risk management and the practical application of Capital Asset Pricing Model (CAPM) in specific empirical study. In this paper, readers will have the overall information about different aspects of portfolio risk management, the role of diversification in investment, general knowledge about Capital Asset Pricing Model as well as its contribution in investment evaluation. Additionally, the study will review some basic academic knowledge, principles and related theories in order to support deep comprehension about the thesis's content.

The research methods used are quantitative research along with deductive approach. Literally, the primary and secondary sources will be utilized to explain the whole content of this paper. In logical and scientific methods, the needed data is collected from Bloomberg terminal and Excel application.

Based on the short-term analysis of chosen portfolios in the period of 28 days, the practice of theory in current market will be evaluated. In addition, the empirical sample mentioned will be a good source to be referenced. The outcomes of this research are reliable and valid, which have significant meaning for further financial study in the future. Last but not least, the author will emphasize some significant improvement suggestions that are highly assessed and criticized by prestigious professors at the end of the paper.

### **Key words**

Capital Asset Pricing Model, Risk, Return, Portfolio, Diversification.

## TABLE OF CONTENT

LIST OF TABLES.....	1
LIST OF FIGURES .....	2
ABBREVIATIONS .....	3
<b>1 INTRODUCTION.....</b>	<b>4</b>
1.1 Background .....	4
1.2 Thesis objectives and research questions .....	7
1.3 Contribution of the thesis.....	7
1.4 Research methods & Data collection .....	8
1.4.1 Research Approaches .....	8
1.4.2 Research Methods:.....	8
1.4.3 Data collection: .....	9
<b>2 INVESTMENT SETTING.....</b>	<b>10</b>
2.1 Risks.....	10
2.1.1 Systematic risk.....	11
2.1.2 Unsystematic risks .....	12
2.1.3 Risk Measurement.....	14
2.2 Return.....	15
2.2.1 Ex-post Return (historical return).....	15
2.2.2 Ex-ante return (expected return).....	16
2.2.3 Required rate of return.....	17
2.3 Relationship between risk and return .....	18
<b>3 PORTFOLIO RISK MANAGEMENT .....</b>	<b>21</b>
3.1 Diversification .....	21
3.2 Portfolio Return and Risk .....	22
3.2.1 Portfolio Return.....	22
3.2.2 Portfolio Risk.....	23
3.3 Co-variance and Correlation .....	24
3.4 Portfolio Optimal Allocation .....	26
3.4.1 Risky assets (Mean-variance portfolio allocation) .....	26
3.4.2 Risky and risk free assets.....	28
3.5 Portfolio Measurement .....	31
3.5.1 Systematic group.....	31

3.5.2 Global risks .....	32
<b>4 CAPITAL ASSET PRICING MODEL .....</b>	<b>34</b>
4.1 CAPM Assumption .....	34
4.2 Formula .....	35
4.3 Systematic risk (beta).....	36
4.4 Security Market Line.....	37
4.5 Critics .....	38
<b>5 CASE ANALYSIS .....</b>	<b>40</b>
5.1 Stock Selection.....	41
5.2 Sub-case 1 .....	42
5.2.1 Calculation .....	43
5.2.2 Observation .....	45
5.3 Sub-case 2 .....	47
5.3.1 Calculation .....	47
5.3.2 Observation .....	49
5.4 Portfolio Evaluation with CAPM (Phase 3).....	50
5.5 Results & Finding .....	55
<b>6 DISCUSSION .....</b>	<b>56</b>
6.1 Summary .....	56
6.2 Validity & Reliability .....	58
6.3 Recommendation for further study .....	59
<b>BIBLIOGRAPHY .....</b>	<b>60</b>
<b>APPENDICES.....</b>	<b>63</b>

**LIST OF TABLES**

Table 1: Largest domestic equity market capitalizations at year-end 2013 .....	5
Table 2: An empirical example relating diversification to risk reduction.....	6
Table 3: Probability and return sample .....	17
Table 4: Portfolio sample index.....	24
Table 5: Diversification criticized by correlation range.....	26
Table 6: The range of Beta reflection.....	37
Table 7: Stock Selection in each Portfolio .....	41
Table 8: Equal allocation in each portfolio .....	42
Table 9: Individual Stock Figure.....	43
Table 10: Correlation & Co-Variance Matrix .....	43
Table 11: Descriptive statistic .....	44
Table 12: Individual Stock Figure.....	44
Table 13: Co-relation & Co-Variance Matrix .....	44
Table 14: Descriptive statistic .....	45
Table 15: Risk of Portfolio A & B.....	45
Table 16: Weight of portfolio with minimum risk .....	47
Table 17: Risk of Portfolio A & B.....	48
Table 18: Descriptive Statistic.....	51

## LIST OF FIGURES

Figure 1: Deductive approach.....	8
Figure 2: The thesis's research process .....	9
Figure 3: Types of financial risk .....	11
Figure 4: Systematic and unsystematic risk.....	13
Figure 5: Standard deviation demonstrating.....	15
Figure 6: Relationship Between Risk and Return .....	18
Figure 7: Movement Along SML .....	19
Figure 8: Change in market Risk premium .....	19
Figure 9: The shifting of SML.....	20
Figure 10: Efficient Frontier.....	27
Figure 11: Optimal Portfolio .....	28
Figure 12: Capital Allocation Line .....	29
Figure 13: Efficient frontier in 1 <sup>st</sup> case .....	30
Figure 14: Efficient Frontier in 2 <sup>nd</sup> case .....	30
Figure 15: Sharpe's ratio.....	32
Figure 16: The change of beta comparing to market's beta .....	37
Figure 17: Securities Market Line .....	38
Figure 18: Empirical research Structure .....	40
Figure 19: Portfolio A's risk.....	46
Figure 20: Portfolio B's risk .....	46
Figure 21: Efficient Frontier (Portfolio A) and Portfolio with minimum risk.....	48
Figure 22: Efficient Frontier (Portfolio B) and Portfolio with minimum risk.....	49
Figure 23: The Portfolio A with Minimum risk .....	49
Figure 24: The Portfolio B with Minimum risk .....	50
Figure 25: Security Market Line .....	51
Figure 26: New Efficient Frontier of Portfolio A .....	52
Figure 27: New Efficient Frontier of Portfolio B.....	52
Figure 28: Risk & Return Comparison .....	53
Figure 29: Profit & Loss Attribution of Portfolio A .....	54
Figure 30: Profit & Loss Attribution of Portfolio B.....	54

## ABBREVIATIONS

CAPM	Capital Asset Pricing Model
CAL	Capital Allocation Line
CML	Capital Market Line
Cov	Co-variance
D	Dividend
$E(R)$ , Ex-ante Return	Expected Return
$R_A, R_B$ (Ex-Post Return)	Return of stock A, B
<i>HPY</i>	Holding period yield
$E(HPY)$	Expected value of the holding period yield
$R_{A,i}, R_{B,i}$	Return of stock A,B with possibility i
$R_{A,t}, R_{B,t}$	Return of stock A, B in time t
$R_m$	Market Return
$R_f$	Risk free rate
NRFR	Nominal Risk Free Rate
$Var(R), \sigma^2$	Variance of stock
$\sigma_p$	Standard deviation of portfolio
S	Sharp ratio
SML	Security Market Line
Stdv, $\sigma$	Standard deviation
$\beta$	Beta
$\rho$	Correlation
w	Weight of stock in portfolio

## 1 INTRODUCTION

### 1.1 Background

Stock exchange market is the aggressive market with many challenges existed, and it is big defiance to all investors nowadays. The amount of trade in the world's stock market accounts for a huge part and plays the main role in economic of every country in the world. For instance, the average value of total world share trade in 2012 took 69.4 percent of GDP, and 99.8 percent of market capitalization (World Federation of Exchange 2012). The reasons of dramatic increasing of world stock market trading volume are rooted from the fierce competitiveness in business environment, the escalation of market demands, and the development of emerging stock exchange markets in the rest of the world. Therefore, in order to successfully face with the dramatic fluctuation of the financial market, investors need to be equipped with adequate field knowledge, skills and sharpened mind to make wise investment decisions.

The purpose of investors when investing in financial market but not in other safety zones is achieving the financial freedom. In fact, they have the options to use their money with less risky possibility, for example, saving in the bank account to get stable amount of money through compound interest; however, many of them preferably step out of that stable path. Making money stably in that manner is not really a good compromise for their future if they are in negative position to wait for the unstable income decided by the banks and market in the era of economic booming. As a result, it is better for them to take risks and actively find opportunities by themselves in order to secure their life on their own. As said by one of the greatest investors " Don't be afraid of risk, but learn how to manage it".



The investment contract can be executed daily, monthly, or annually in the financial market through the clearing house (stock exchange market) which can be described as the common place for trading between sellers and buyers. It also reflects the supply and demand of the market. There are several types of financial markets that are categorized on the basis of specific criteria such as capital market, money market, spot market, derivative market, etc. These markets open all days around across continents and countries. The table hereafter will show some leading stock exchange markets in the world.

Table 1: Largest domestic equity market capitalizations at year-end 2013  
(Sources: World Federation of Exchange 2013)

Exchange	USD billion end-2013	USD billion end-2012	% change in USD	% change in local currency
1. NYSE Euronext (US)	17 950	14 086	27%	27%
2. NASDAQ OMX (US)	6 085	4 582	33%	33%
3. Japan Exchange Group	4 543	3 681	23%	50%
4. London Stock Exchange Group	4 429	3 397	30%	25%
5. NYSE Euronext (Europe)	3 584	2 832	27%	21%
6. Hong Kong Exchanges	3 101	2 832	9%	10%
7. Shanghai SE	2 497	2 547	-2%	-5%
8. TMX Group	2 114	2 059	3%	10%
9. Deutsche Börse	1 936	1 486	30%	25%
10. SIX Swiss Exchange	1 541	1 233	25%	21%

Profits always come along with risks, and the more risks you take, the more profits you gain. Risk management is one of key factor supporting the invertors in predicting for the potential income and optimizing return in their portfolio. Hence, it needs to be taken into account by the people who want to make wise investment decisions.

Before talking about the risk management, every investor always bears in mind diversification. In general, diversification is about varying the options and spreading risks aiming of balancing portfolio and reducing the overall

risks in portfolio. Due to its important meaning, some researches are made to observe the relation between risks and diversification as following.

Table 2: An empirical example relating diversification to risk reduction  
(Source: Elton, Gruber 1977, 415-37)

Number of Stocks in Portfolio	Average Standard Deviation of Annual Portfolio Returns	Ratio of Portfolio Standard Deviation to Standard Deviation of a Single Stock
1	49.24%	1.00
2	37.36	0.76
4	29.69	0.60
6	26.64	0.54
8	24.98	0.51
10	23.93	0.49
20	21.68	0.44
30	20.87	0.42
40	20.46	0.42
50	20.20	0.41
400	19.29	0.39
500	19.27	0.39
1000	19.21	0.39

The study will go through all the related knowledge to help investors have the overall appraisal about risks and diversification. The author thereby attempts to prove the practical application of theory and show why risks and diversification are chiefly concerned in the stock exchange market. It needs to be noted that risks are not the only thing to be considered when building an effective portfolio. Venture capitalist should also prepare adequate financial information, skills, strategy and especially, the iron mind to cope with the market evolution.

## 1.2 Thesis objectives and research questions

The main objective of this study is to figure out how to make the highest return with the same level of risk by managing portfolio risks based on Capital Asset Pricing Model then giving the investment decisions along with the specific way of measurement. Additionally, due to the popularity of the CAPM model, it will be fully captured through empirical evidence whether it is still applicable in the market nowadays. To achieve the set goal, the following research questions will be answered.

- What is the component of investment?
- What are the diversification and its contributions?
- What are the portfolio setting and the way to manage portfolio risks?
- What is Capital Asset Pricing Model?

## 1.3 Contribution of the thesis

As showed in the title of the study itself and the details provided in the outline of the thesis, its contribution can be described clearly through 4 main points: (1) the process of building and managing the portfolio with the highest profitability for the same level of risk (2) the significance of diversification and its explanation (3) the practical application of CAPM, (4) the benchmark to give investment decision. Some researches will be done to support the implementation and selection of evaluation model.

Throughout this thesis, there are some further approaches that will contribute to the deep understanding of financial investment. The minor contribution of this thesis is the dedication to the overall knowledge of investment setting. Moreover, it will be the reliable input for the further researches, for example, for creating or developing the concept of portfolio optimization. In sum, this thesis contributes more or less to the potential development in the advanced knowledge of financial analysis.

## 1.4 Research methods & Data collection

### 1.4.1 Research Approaches

The research approaches are in coherence with the objectives specified in beginning of this thesis including both deductive and inductive methods. Deductive method mentions theory testing. It is based on the existing theories of phenomenon, which can be analyzed to improve or prove the applicable hypothesizes. In contrary, the inductive approach aims at creating or developing the theories from data collecting. As a whole, this study will use the deductive approaches as the manner to demonstrate the applicability of theory.

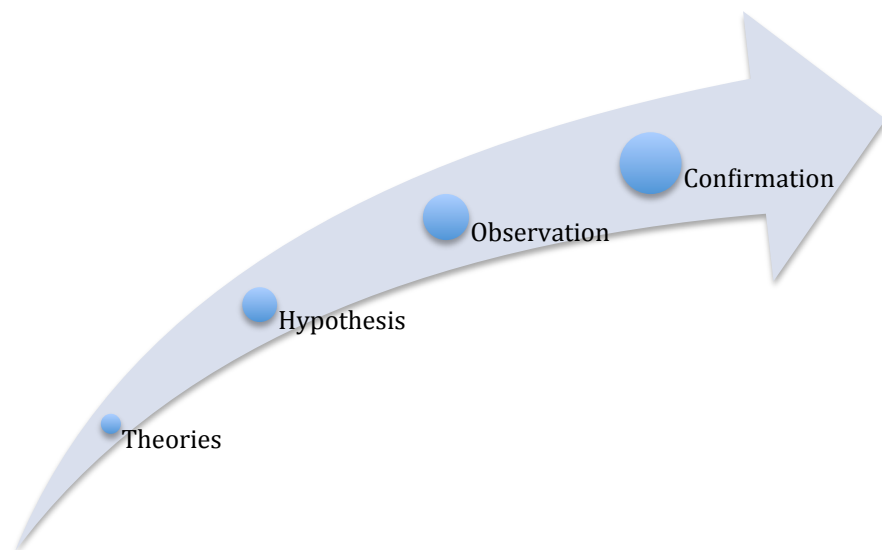


Figure 1: Deductive approach (Burney 2008)

### 1.4.2 Research Methods:

There are 3 common research methods: qualitative, quantitative, and mixed methods. Supporting the purpose and nature of this study, the quantitative will be mainly used because of its interrelation with systematic steps of scientific methods, for example numerical. The quantitative methods will be employed through analyzing all the statistics extracted from the

BLOOMBERG terminal and Excel along with the deductive approach concept.

**1.4.3 Data collection:**

There are two main sources of data in a scientific research: primary and secondary sources. Primary source is the self-made data, which are created by author during the studying process (Walbert 2015). In opposite, the secondary source is based on the previous studies, for instance, book, newspaper and etc (Johnruss 2012). In order to elucidate this study, both of resources will be exploited. The study will be conducted as summarized in figure 2 below:

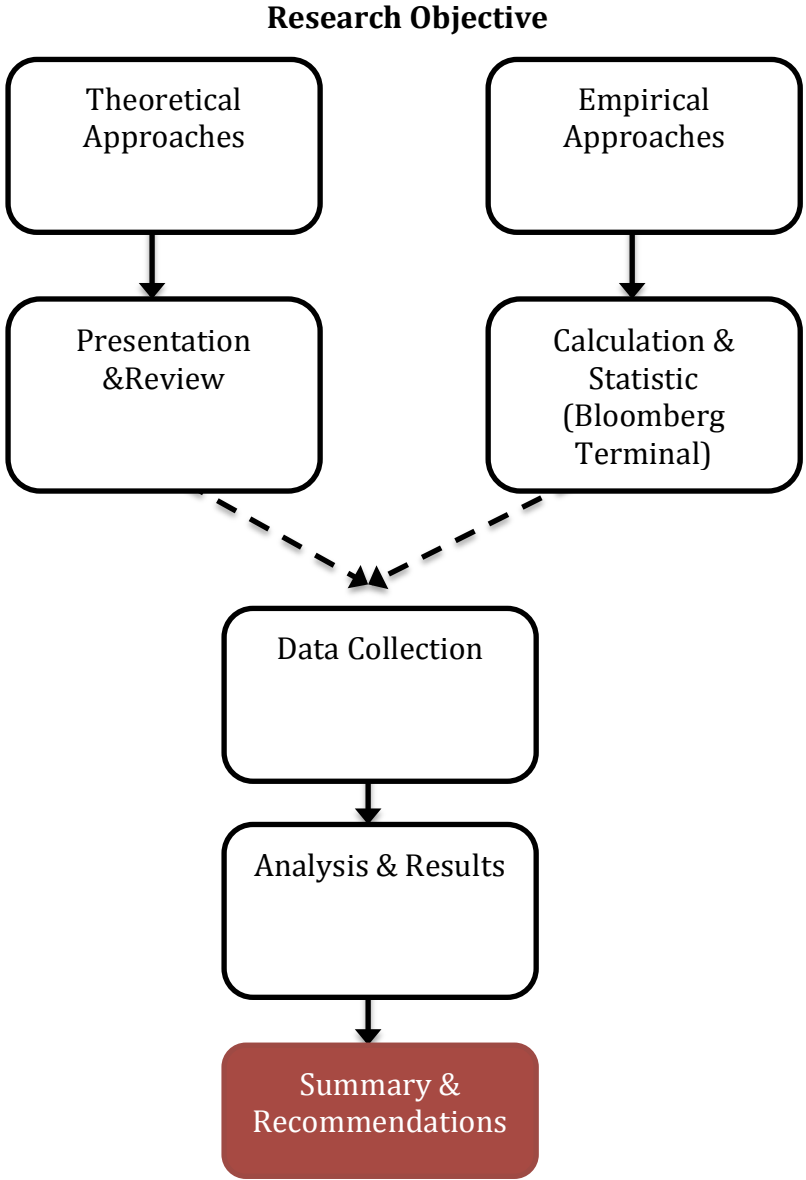


Figure 2: The thesis’s research process

## 2 INVESTMENT SETTING

Investment is the commitment among parties in a specific period of time for achieving the future earnings to investors who can be an individual, a government, a pension fund, and a corporation (Reilly & Brown 2000, 5). There are several common investment types consisting of bond, equity, money market, and derivative market. Two significant components of investment include risks and return which will be explained in the next sections.

### 2.1 Risks

There are several definitions given to this term. The first approach given by Knight (1921), he defines risk as measurable uncertainty. The other approach created by Jorion (2000) correlates risks to the financial aspects; here, risk is defined as the volatility of expected results on the value of assets and liabilities of interest. However, the most relevant and popular well-known risk definition was made by Holton (2004), stating that risk is “ the exposure to a proposition of which one is uncertain”.

In general, risk can be described as an uncertainty having the negative effect on the mean (expected return); in other words, the change of actual investment's return is not similar to the expectation at the beginning (Investopedia 2015). There are many types of risk, namely credit risks, market risks, liquidity risks, operational risk, etc. These types of risk can be broken down into the 2 main categorizes: systematic risk and unsystematic risk.

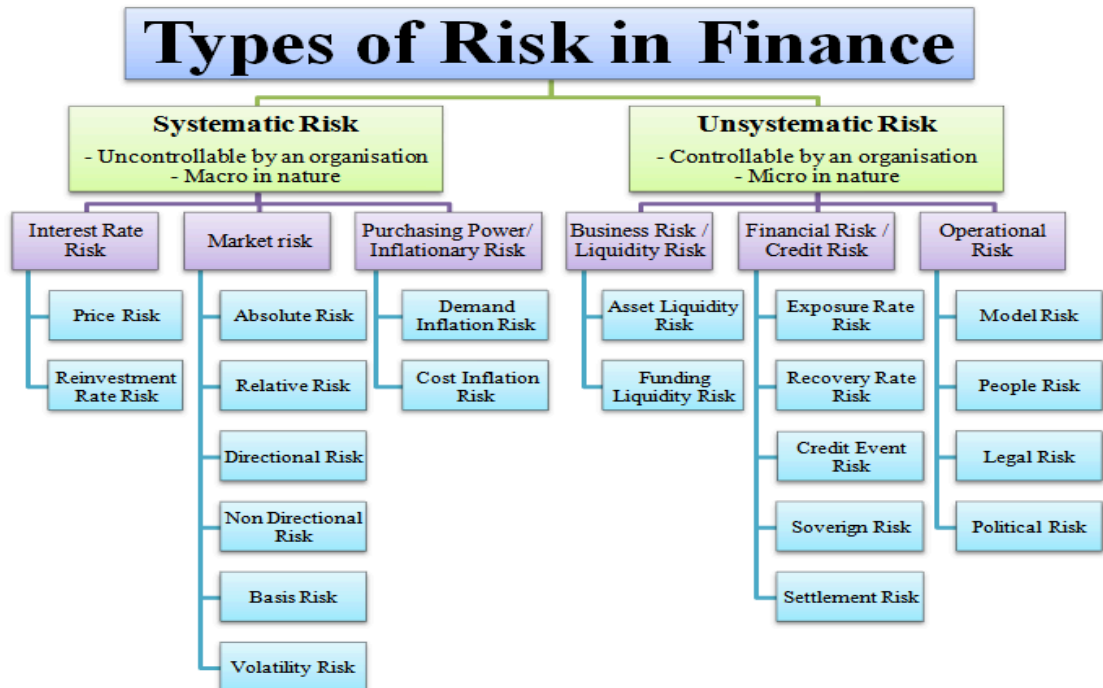


Figure 3: Types of financial risk (Source: Gaurav Akrani, 2012)

### 2.1.1 Systematic risk

Systematic risk can be understood generally through some mainly features: the risks causing economic shock such as market or institution failure trigger, failure of the chain market or institution, chain of losses to financial institution, the outcome of cost capital increasing and availability decreasing (Schwarcz 2008). In details, systematic risk (denoted as beta) can be known as the “undiversifiable risk”, volatility, or market risk; it has wide range effect on the whole market, not only on some specific aspects, for examples, war, recession, or interest rate.

There are 3 classes of systematic risk comprising of interest rate risk, market risk and inflationary risk.

- Interest rate risk is about the alternation of interest rate from time to time, which will affect the security’s fixed rate of return.
- Market risk occurs due to the fluctuation or volatility of market price. Particularly, it is the fall or rise in trading price of securities in the stock market. This type of risk will be focused throughout this study.

- Inflationary risk is the kind of risk in which the purchasing power is affected adversely. Specifically, it is about the increasing in price happened from the imbalance between supply and demand of market that leads to the loss in currency value generally.

It is necessary to understand the role of systematic risk in order to give the suitable investment decisions. There are several reasons explaining how important systematic risk is to investor's decision making.

Firstly, it has a plenty of negative effects on every market area. As its name, "system" means that the legitimate and complicated structure work together in non-isolation. Hence, one strong-adequate effect will lead to the "domino phenomenon" which causes the unpredictable outcome from every aspect of economic, and the investment outcome is not the exception in this case either. There are many market indexes that can be influenced by a number of factors for example interest rate, currency exchange, credit, etc.

Secondly, the systematic risk cannot be diversified. Unlike unsystematic risk, systematic risk cannot be eliminated. The only way to reduce the exposure of systematic risk is to compromise with future return, which should be carefully considered by investors when starting their investment.

Needless to say, investors also need to take into account the effect of systematic risk in every single investment decision they make and always bear in mind about its compensation to acquire the proper expected return.

### **2.1.2 Unsystematic risks**

In contrast, unsystematic risk is called as diversified risk, residual risk or specific risk; it is the specific hazard of company or industry and notably, it does not affect to the entire market when occurred (Investopedia 2015). Unsystematic risks arise



due to the factors that disturb the internal sustainability of business. This type of risk consists of business risk, financial risk and operational risk.

- Business risk, known as the liquidity risk, is the possibility of lowering company's profit originated from internal and external factors. This kind of risk has significant influence on firm's income and the dividend variability of the firm.
- Financial risk or credit risk stems from the alteration in capital structure of the firm correlated with the company's financing activities.
- Operational risk is emanated from the internal management of company, and it is the result from breaking down in operating process, e.g. internal procedure, people, policy, and system.

Unsystematic risks can be reduced through diversification, and they are diversified right away in the large portfolio. Surprisingly, there is a link between systematic risk and unsystematic risk. That is to say, the market measurement of risk is reflected through the risk of individual asset. For instance, the company with high business risk and financial risk is expected to derive the higher beta than the average beta of market risk. (Reilly & Brown 2000, 22.).

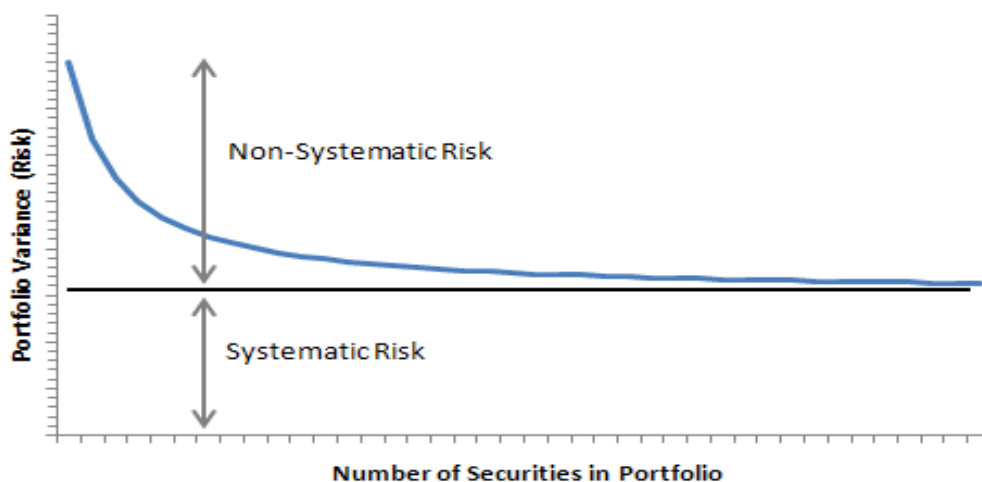


Figure 4: Systematic and unsystematic risk

## 2.1.3 Risk Measurement

### 2.1.3.1 Historical volatility

Historical volatility (risk measurement for historical return) is the uncertainty or the risk measured by the dispersion of the return around its average value. In order to measure the risk of the historical return, we need to consider the historical holding period yield (HPY) as following:

$$\sigma^2 = \sum_{i=1}^n \frac{[HPY_i - E(HPY)]^2}{n}$$

Where:

$\sigma^2$  is the variance of the series

$HPY_i$  is the holding period yield during period i

$E(HPY)$  is the expected value of the holding period yield that is equal to the arithmetic mean of the series

n is the number of observations

The square root of variance is standard deviation (historical volatility). It refers:

$$Stdv(R) = \sigma$$

### 2.1.3.2 Ex-ante risk

Ex-ante risk (risk measurement of expected return) is evaluated by the dispersion of the return around expected return ( $E[R]$ ) in the assumption that asset has n possible return  $R_i$  with probability  $p_i$ . This dispersion called variance:

$$\begin{aligned} Var(R) = \sigma^2 &= \sum_{i=1}^n p_i (R_i - E[R])^2 \\ &= E[R^2] - E[R]^2 \end{aligned}$$

The square root of the variance is the standard deviation or it can be called volatility.

$$Stdv(R) = \sigma$$

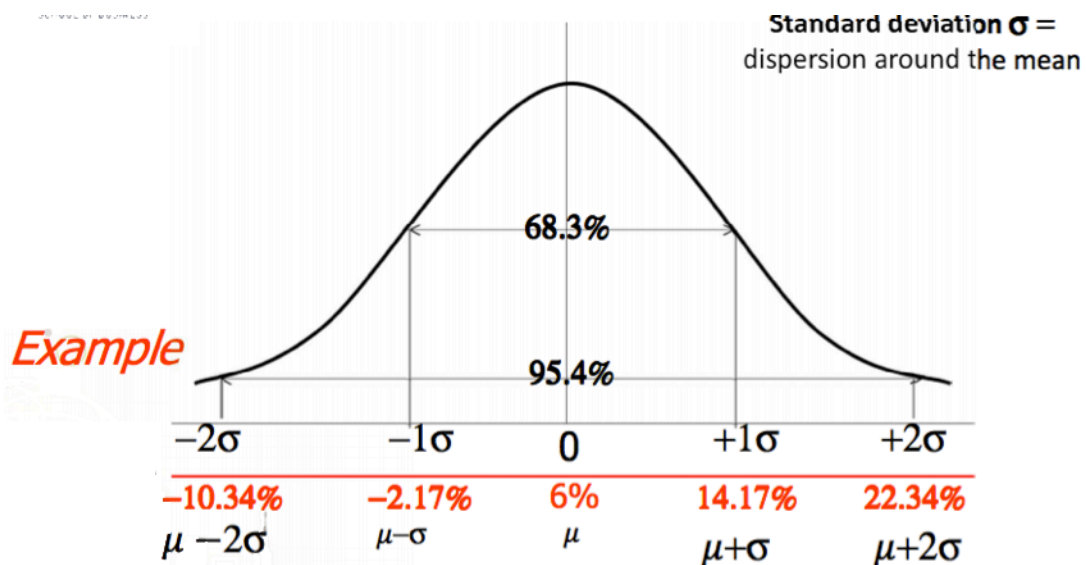


Figure 5: Standard deviation demonstrating (Peri 2015)

## 2.2 Return

As opposed to risk, the return reflects the earning gained through investment. The stock investment generated normally comes from 2 main sources including capital gain and dividend paid. The capital gain can be described as the increasing value of capital assets comparing to its initial purchasing value. Besides, dividend is the subsidiary yield of return on the asset, and it can be paid or not based on the company regulation. To evaluate the profitability of specific investment, investors usually use capital gain as their base of estimation. There are several types of rate of return including ex-post (actual return), and ex-ante return (expected return), required rate of return that will be explained clearly in this section.

### 2.2.1 Ex-post Return (historical return)

Ex-post return, also known as historical return or actual return, is the return of investment from the past up to the concerned time, and it is used for comparing and evaluating investment performance during the certain periods (Reilly & Brown 2009, 6). It can include the dividend paid or not as mentioned before based on the company rules.

The ex-post return can be negative, or positive results that reflect the gain or loss of investment. It can be calculated by:

$$R_t = \frac{P_t - P_{t-1} + D}{P_{t-1}}$$

Where:

$R_t$  = Return of time t

$P_t$  = Price of stock at time t

$P_{t-1}$  = Price of stock at time t-1

D = Dividend between t-1 and t

For example, A month ago you bought the share A for 100\$, now you sell it for 110\$ with dividend 5\$. So, the return at the time of selling will be:

$$\frac{110 - 100 + 5}{100} = 15\%$$

So, the investor will receive 15% of return on the original investment.

### 2.2.2 Ex-ante return (expected return)

Ex-ante return demonstrates how much investors want to derive in the future return. To do this, investor needs to assign the probability value to all possible returns. The probability will be computed on the basis of the historical performance or similar investment modified by investor's expectation in the future. (Reilly & Brow 2009, 11). It will be defined as:

$$E(R) = \sum_{i=1}^n (\text{Probability of return}) \times (\text{Possible Return})$$

$$E(R_i) = \sum_{i=1}^n (P_i)(R_i)$$

Let's analysis how the probability on the expected return works with example in which the alternative scenario will be taken into account.

Table 3: probability and return sample

<b>Probability</b>	<b>Return</b>
<b>0.05</b>	+40%
<b>0.25</b>	+20%
<b>0.4</b>	+10%
<b>0.25</b>	-10%
<b>0.05</b>	-30%

The expected return can be calculated as following:

$$0.05 \times 0.4 + 0.25 \times 0.2 + 0.4 \times 0.1 + 0.25 \times (-0.1) + 0.05 \times (-0.3) = 0.07$$

With different scenarios, the return varies as showed in the table. The probabilities depend on the variety of economic factors concerned by investor. As we can see, the expected return is 7% by summing all possible returns.

### 2.2.3 Required rate of return

Required rate of return is the minimum rate of return needed to compensate you for the time value of money during the periods of investment, the expected rate of inflation during the period, and the risks involved (Reilly & Brown 2009, 22). The procedure to evaluate the required rate of return is very complex that is heavily influenced by the behaviors of market over time for following reasons.

Firstly, the return of particular asset is frequently changed. Secondly, there is a lot of available rates for alternative investment selection at anytime. Thirdly, the spread of each asset is also altered over time so it is not easy to set a base for evaluation of specific assets.

In general, the required rate of return can be determined by 3 factors: the real risk free rate, which is the long-term real growth rate of economic; factors influencing

the nominal risk free rate, which consists of the short term effects in the capital market and the expected rate of inflation; and the risk premium in investment.

### 2.3 Relationship between risk and return

Previously, we have already distinguished clearly risk and return, the different types of risk and return and the way to measure both of them. This section will find out the relationship between risk and return.

Apparently, “the more risk is taken, the more return is gained” is the basic financial principle in every investor’s mindset. The changes in risk obviously affect the alteration of return. By using Security Market Line (SML), which shows the linear relationship of risk and return, we can understand how it affects each other.

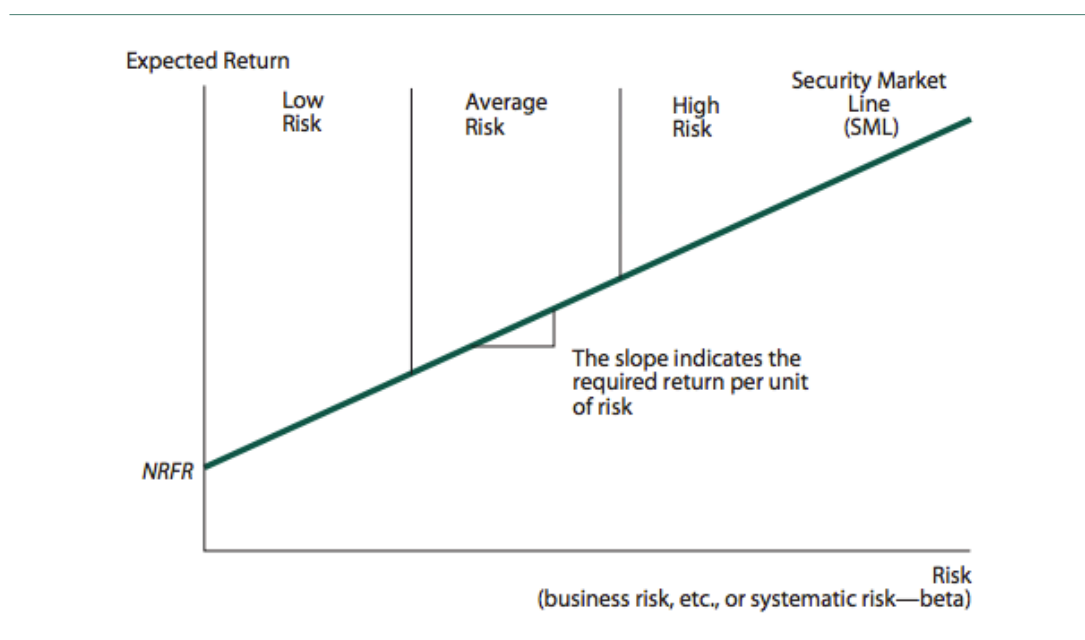


Figure 6: Relationship Between Risk and Return (Source: Brown & Reilly 2009, 23)

- ❖ The relationship between risk and return can be changed in 3 ways:

Firstly, the movement along the Security Market Line explains that the increasing or decreasing of risk will lead to the up trend or down trend of expected return. The Security Market Line generally demonstrates the combination of risk and return

available on alternative investment. Depending on the risk preference of investor, the expected return will be decided.

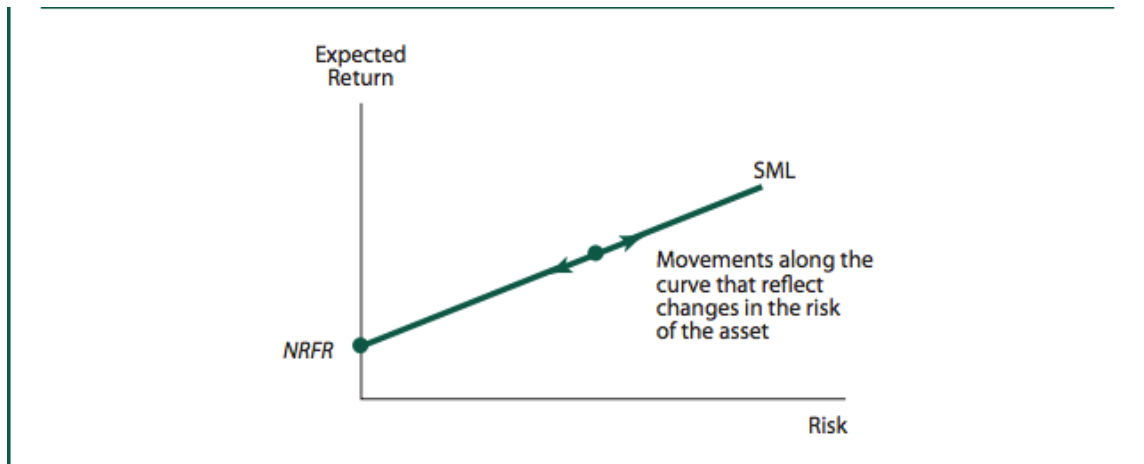


Figure 7: Movement Along SML (Source: Brown & Reilly 2009, 23)

Secondly, the slope adjustment of SML reflects investor's attitude toward risk and the change in risk premium. Such a change in investor's attitude demonstrates that investors want to higher or lower return at the same risk rate. Consequently, the market risk will be altered, affecting backward to the degree slope of Security Market Line and leading to change the relationship between risk and return.

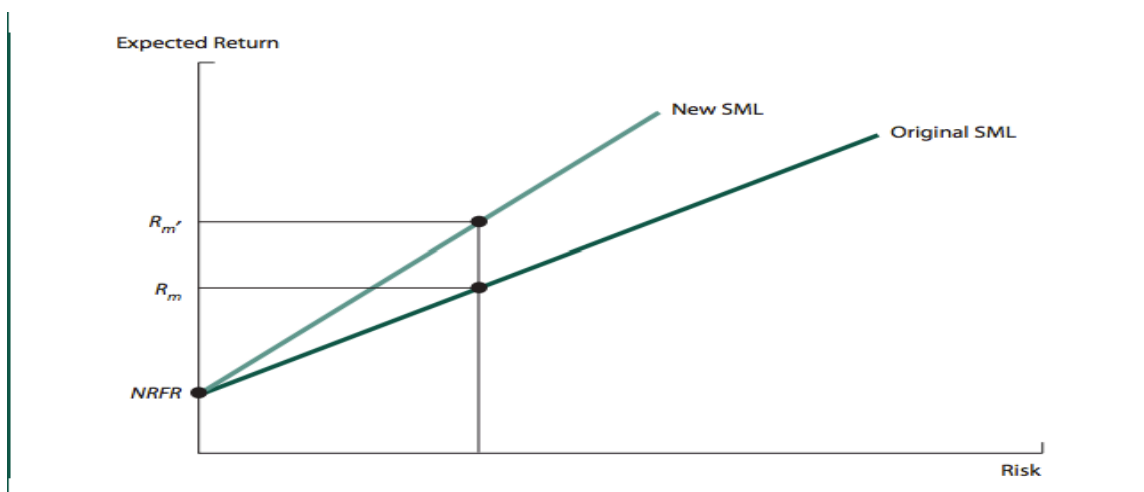


Figure 8: Change in market Risk premium (Source: Brown, Reilly 2009, 23)

Thirdly, the change in nominal risk free rate leads to the shift of SML reflecting the change in expected real growth. Such a change again will affect all investments. Hence, the expected return and risk will be influenced as a certain result, and with

the same risk we will have higher return in this case.

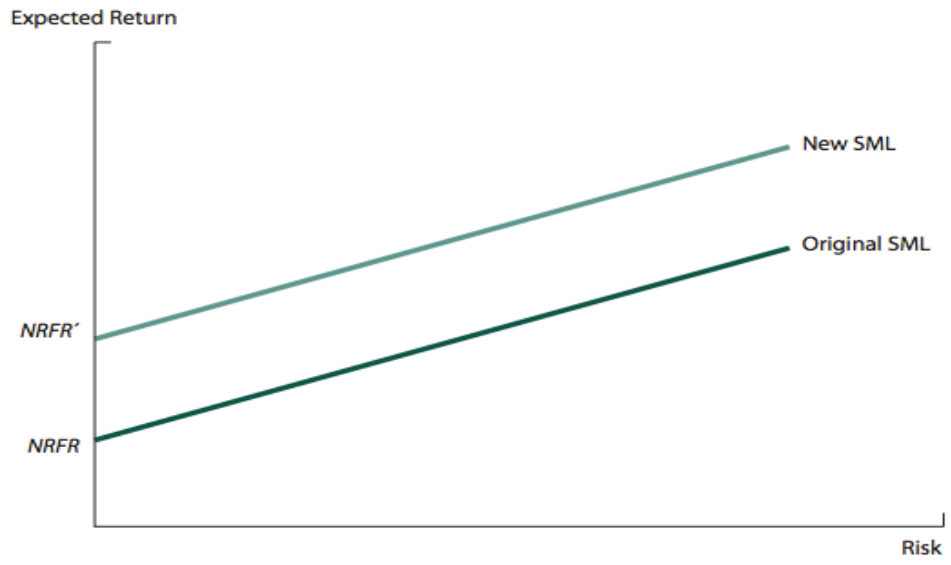


Figure 9: The shifting of SML (Brown & Reilly, 2009, 23)



## 3 PORTFOLIO RISK MANAGEMENT

### 3.1 Diversification

The purpose of setting up portfolio is to make the investment more diverse, or to reduce the loss possibilities. As stated earlier in the chapter 1, diversification is about varying the options and spreading risk in the purpose of balancing portfolio and reducing the unsystematic risk in portfolio. It has the significant meaning in portfolio risk management, in particular, reducing the risk and hedging.

It needs to be reminded that the diversification technique can apply only to un-systematic risk and portfolio manager cannot absolutely diversify the portfolio with zero risk. For non-institutional investors, it is quite expensive for them to optimize diversifying portfolio because of limited personal budget. This is the reason why financial intermediates are existed.

According to Gray and Harvey (1997), there are some common senses of diversification, which can be used to construct a diversified portfolio:

- Diversify across the industries: Investing in different stocks in the same industry will not reduce the risk better than investing in the stocks from different industries.
- Diversify across the industries group: there are some industries correlating to many other industries so choosing stock from the ones having little correlation will maximize the benefit of diversification.
- Diversify across geographic regions: the portfolio in which stocks selected are in the same country is less diversified than the portfolio having stocks from across countries.
- Diversify across asset classes: Investing in variety of asset will produce more diversified portfolio than investing in one single asset.

One of these assumptions will be proven in this thesis to clarify the important application of diversification technique in reality.

## 3.2 Portfolio Return and Risk

### 3.2.1 Portfolio Return

The return of portfolio is the sum of individual stock's return with random weights depending on the investor's selection. Once more again reminding, the stock rate of return mentioned previously consists of ex-post return (historical rate of return) and ex-ante return (expected return). According to which kind of return is concerned, the portfolio rate of return can be computed as describes:

$$\text{Ex - post return of Portfolio: } R_p = \sum_{i=1}^N x_i R_i$$

$$\text{Ex - ante return of Portfolio: } E [R_p] = \sum_{i=1}^N x_i E [R_i]$$

Where:

$R_i$  is ex - post rate of return

$E[R_i]$  is ex - ante rate of return

$x_i$  is the weights of stock in portfolio

Noticed that:

$$\boxed{\sum_{i=1}^N x_i = 1}$$

For instance, the expect return on stock A is 17%, and the expected return on stock B is 7%. The portfolio is made up of 70% of stock A and 30% of stock B. Therefore, the portfolio rate of return is:

$$E(R_p) = 17\% \times 70\% + 7\% \times 30\% = 11.9\% + 2.1\% = 14\%$$

So, the expected return of the portfolio obtaining 70% investment in stock A and 30% investment in stock B is 14%.

### 3.2.2 Portfolio Risk

Coming along with return of portfolio, it will be a big mistake without mentioning portfolio's risk. Portfolio risk can be described as the variance of portfolio that refers to the possibility of loss or the percentage in which investor tolerates to compensate for their higher return. In the purpose of diversification, the risk of portfolio is significantly taken into consideration. Additionally, it is the only factor used currently to explain the superior benefit of portfolio compared to individual stock.

To understand how to calculate the portfolio variance with n assets, we initially need to get familiar with computation of the portfolio with 2 assets. The fractions of capital invested in asset A, B are denoted as  $x_1$  and  $x_2$ ; the variance of stock A, B is noted as  $\sigma_A, \sigma_B$  and co-variance of 2 stocks is  $\sigma_{AB}$ . Thereof, the calculation of portfolio's variance is:

$$\sigma_p^2 = x_1^2 \sigma_A^2 + x_2^2 \sigma_B^2 + 2 x_1 x_2 \sigma_{AB}$$

$$\sigma_{AB} = \rho x \sigma_A x \sigma_B \text{ with } \rho \text{ is the co-relation of stock A and B.}$$

Variance (risk) of portfolio with N assets:

$$\sigma_p^2 = \sum_{j=1}^N \sum_{i=1}^N x_i x_j \sigma_{ij} = \sum_{j=1}^N \sum_{i=1}^N x_i x_j \sigma_j \sigma_i = x^T V x$$

V var -covariance matrix

$$\text{V example with 3 stocks: } V = \begin{bmatrix} \sigma_{11} & \sigma_{12} & \sigma_{13} \\ \sigma_{21} & \sigma_{22} & \sigma_{23} \\ \sigma_{31} & \sigma_{32} & \sigma_{33} \end{bmatrix}$$

- Example:

Table 4: Portfolio sample index

	E (R)	$\sigma$	Portfolio
Stock A	12%	7%	25%
Stock B	18%	3%	75%
$\sigma_{AB}$	-0.105%		

Supposing that we have 2 stocks A, B as demonstrated above, the portfolio variance will be computed as coming after:

$$\sigma_p^2 = 0,12^2 \times 0,07^2 + 0,18^2 \times 0,03^2 + 2 \times 0,12 \times 0,18 \times 0,04 = 0,00041875$$

$$\Rightarrow \sigma = 2,05\%$$

As the result, the portfolio's variance is 2,05%. Furthermore, the diversification of portfolio is proved through this result when the risk of portfolio is lower than risk of individual stock as can be seen.

### 3.3 Co-variance and Correlation

Covariance is the absolute measurement of how much return of 2 assets move in tandem. In details, it reflects the association between the return of 2 assets that is given by:

- Historical co-variance: the past link in alteration of 2 stock's return.

$$Cov = \sigma_{AB} = \frac{\sum_{t=1}^T (R_{A,t} - \bar{R}_A) \times (R_{B,t} - \bar{R}_B)}{T}$$

where:

$\bar{R}_A, \bar{R}_B$  are the average return over the period T.

$R_{A,t}, R_{B,t}$  are the return of stock A and stock B in the time t.

- Expected co-variance: the expected link (future prediction) related to the fluctuation in return of 2 stocks. (the formula for discrete distribution)

$$Cov = \sigma_{AB} = \sum_{i=1}^n p_i (R_{A,i} - E(R_A)) \times (R_{B,i} - E(R_B))$$

where:

$R_{A,i}, R_{B,i}$  are the return of A,B in scenario i and  $p_i$  is the probability of scenario i.

$E(R_A), E(R_B)$  are the expected return of stock A and B (calculated basing on probability  $p_i$ )

If the covariance is positive, it means that the assets returned move in the same direction. Otherwise, it moves in the opposite direction. There is no co-variance in case of zero.

Normally, the co-variance number is not easy to be interpreted so it can be normalized into correlation, which is not complicated to explain. The significant difference between co-variance and correlation is “ the co-variance is an absolute measure showing association between security return while the correlation coefficient is relative measure showing association between security return”.

The correlation describes deeply the independence of 2 assets, which covers wide range from negative correlation -1 to positive correlation 1. It is denoted  $\rho_{AB}$  and defined as:

$$\rho_{AB} = \frac{\sigma_{AB}}{\sigma_A \sigma_B}$$

where:

$\sigma_A, \sigma_B$  are the standard deviation of stock A and B.

By construction  $-1 \leq \rho_{AB} \leq 1$ :

- 1: monotone evolution
- 0: no (linear) dependence
- -1: countermonotone evolution

It is worthy of noting that there is a strong relationship between co-variance, correlation to diversification of portfolio. With the perfect negative correlation, portfolio will be absolutely diversified. In contrary, with the perfect positive correlation, portfolio will be less diversified as showed in table below:

Table 5: diversification criticized by correlation range (Anke 2015)

Asset's Correlation Range	Diversification Value in Portfolio
Negative	Outstanding
0.0 to 0.5	Excellent
0.5 to 0.6	Very Good
0.6 to 0.7	Good
0.7 to 0.8	Ok to poor
0.8 to 0.9	Poor to bad
0.9 to 1	Worthless

### 3.4 Portfolio Optimal Allocation

#### 3.4.1 Risky assets (Mean-variance portfolio allocation)

The mean-variance allocation can be also called as Markowitz optimization, which is used for setting up the investment strategy. The assumption is that the objective of rational investor is to build a portfolio with minimum diversifiable risk that gives the highest return.

In order to make that portfolio, all feasible portfolios need to be determined and thereof, efficient frontier is graphed. Based on efficient frontier, the portfolio with minimum risk will be figured out from which we can find the portfolios having highest return for the same level of risk. After that, investor can choose their optimal portfolio relying on their risk preference. The process will be explain as bellows.

- Step 1: *Building Frontier of feasible portfolios, those minimize the risk for given level of expected return.* Plotting all the possible portfolios that minimize the risk for different levels of expected return, we will get the frontier of all feasible portfolios. In the figure 10, we can see that all upper part and the part below Pmin of the efficient frontier including all feasible portfolios. Noted that in first step, the portfolio with minimum variance is not discovered yet.

- Step 2: *By using the financial calculator to find the portfolio with minimum variance ( $P_{min}$ ). We can see that the upper part from point  $P_{min}$  on efficient frontier including all of feasible portfolios with minimum risk and highest return for that level or risk.*

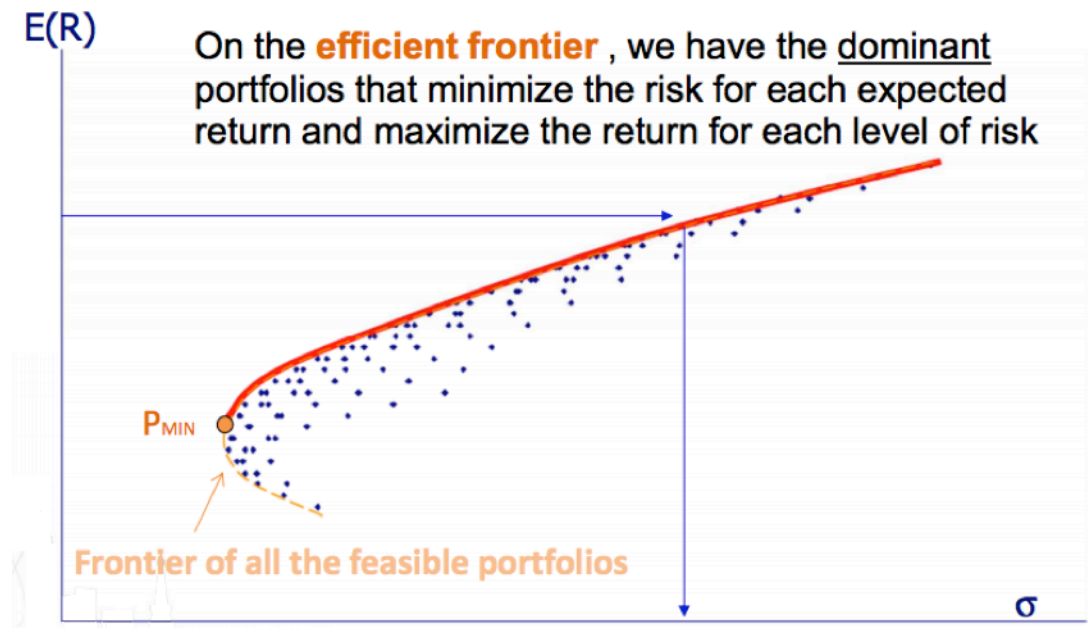


Figure 10: Efficient Frontier (Peri 2015)

- Step 3: *The investor can select the best optimal portfolio according to their risk preference in order to make the best trade-off decision. The crossover point of utility curve (indifference curve) and efficient frontier are the preferred portfolio of investor. Finally, we can find the optimal portfolio, which consists of risky assets only.*

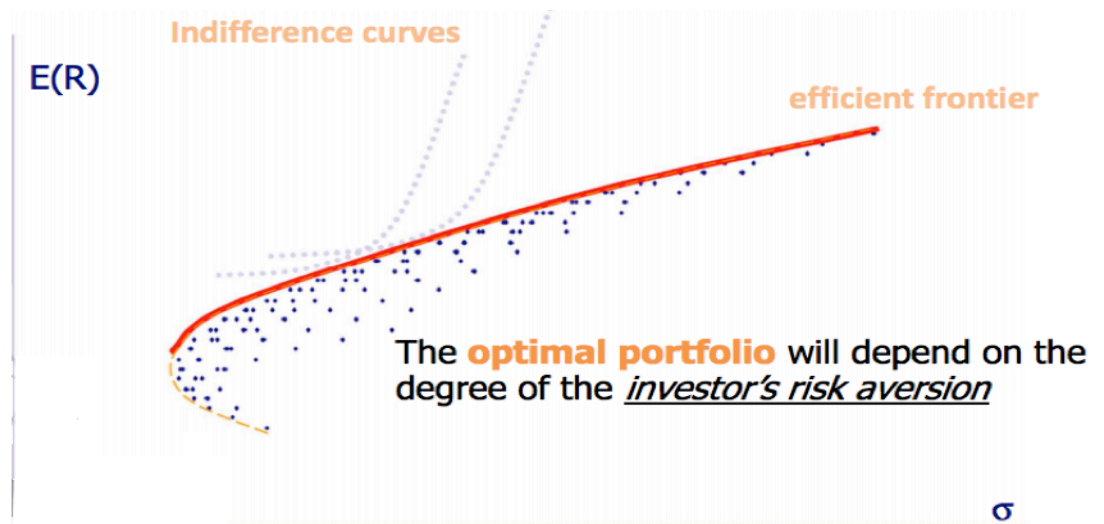


Figure 11: Optimal Portfolio (Peri 2015)

According to the process, the optimal portfolio can be found easily, but the question arises that how the efficient frontier looks like in the case of portfolio that consists not only the risky assets but also the riskless ones. The answer will be found in the next section.

### 3.4.2 Risky and risk free assets

Up to this point, we already know how to curve the efficient frontier with risky assets and select the optimal portfolio also. However, there are some assets that is called riskless assets or risk free assets for example, the money market T-bills, LT fixed income, Euro-Dollar options. As can be guessed from the name, these assets give no risk at all, so it will offer extra return to the portfolio without adding risks. Consequently, the efficient frontier including risky assets and risk free assets will be called as new efficient frontier or "Markowitz Bullet". The efficient frontier will be altered and the author will show how it looks like.

Firstly, we need to get familiar with Capital Allocation Line (CAL). Capital Allocation Line is the line in which all feasible portfolios obtaining riskless assets and risky asset are allocated. The understanding of CAL is of relative importance in finding the new efficient frontier. The CAL can be graphed by using the formula below:



$$E(R_p) = R_f + \frac{\sigma_p}{\sigma_r} (E(R_r) - R_f)$$

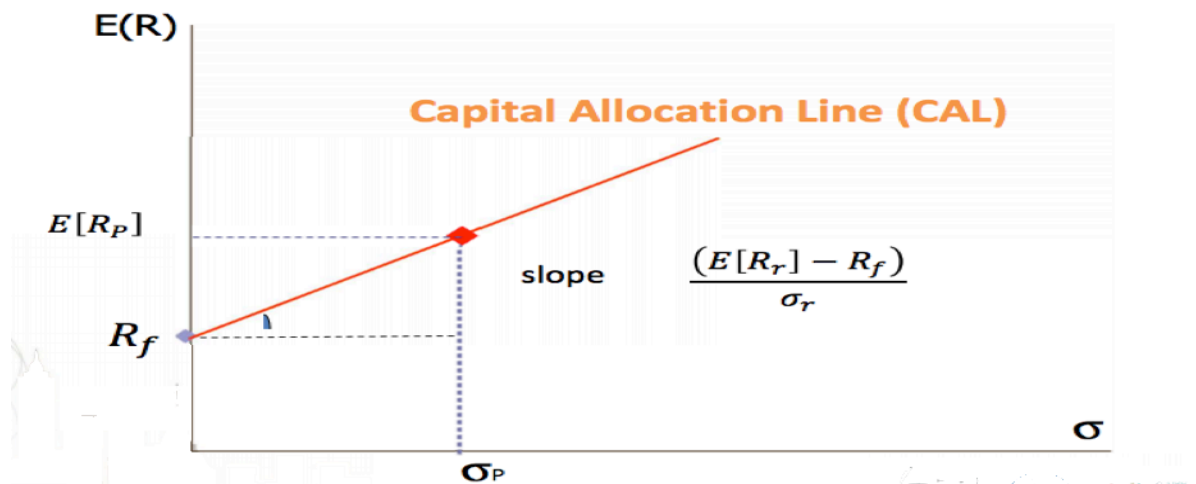


Figure 12: Capital Allocation Line (Peri 2015)

Secondly, the other significant concept must be taken into account also is Capital Market Line. The capital market line describes the risk/return relationship for efficient portfolio, which includes a mix of market portfolio and a riskless asset. (Eugene, Louis & Michael 1999, 226). It is the implementation for Markowitz's ideas of the efficient frontier, which does not consider the risk free asset but CML does. By maximizing the slope of CAL, CML can be figured out. The CML is also known as new efficient frontier.

Thirdly, the new efficient frontier can be formed in 2 possible ways that depend on borrowing at risk free rate is allowed or not. In case the investors are allowed to borrow at risk free rate, the new efficient frontier is the straight line starting at the risk free rate on vertical axis.

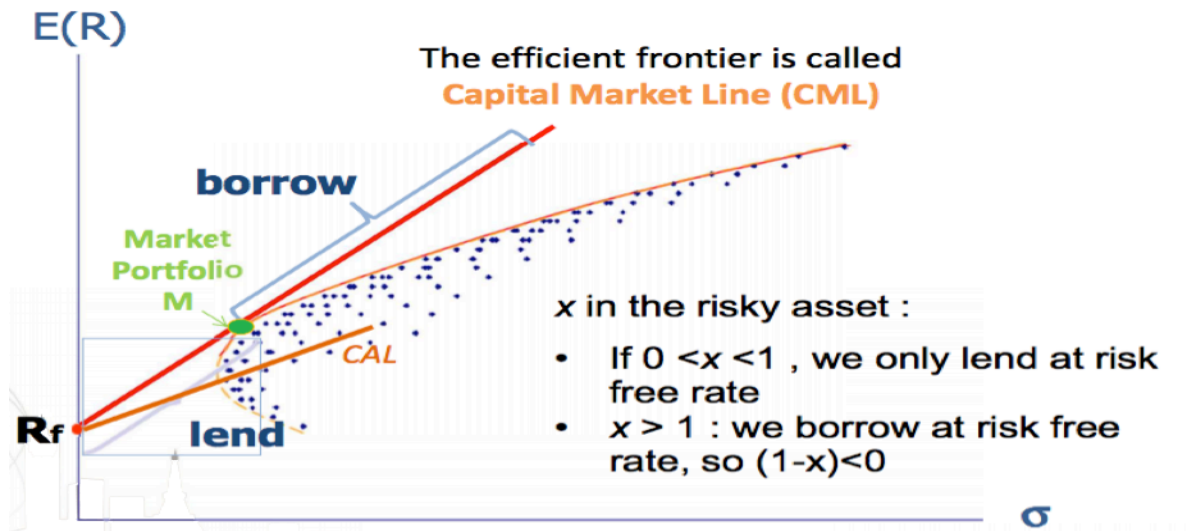


Figure 13: Efficient frontier in 1<sup>st</sup> case (allowing to borrow risk free asset)

If investors are not allowed to borrow at risk free rate and they can only lend the amount of riskless asset in their portfolio, or convert the weights of riskless assets to other risky assets, the new efficient frontier is not the straight line after point M any more.

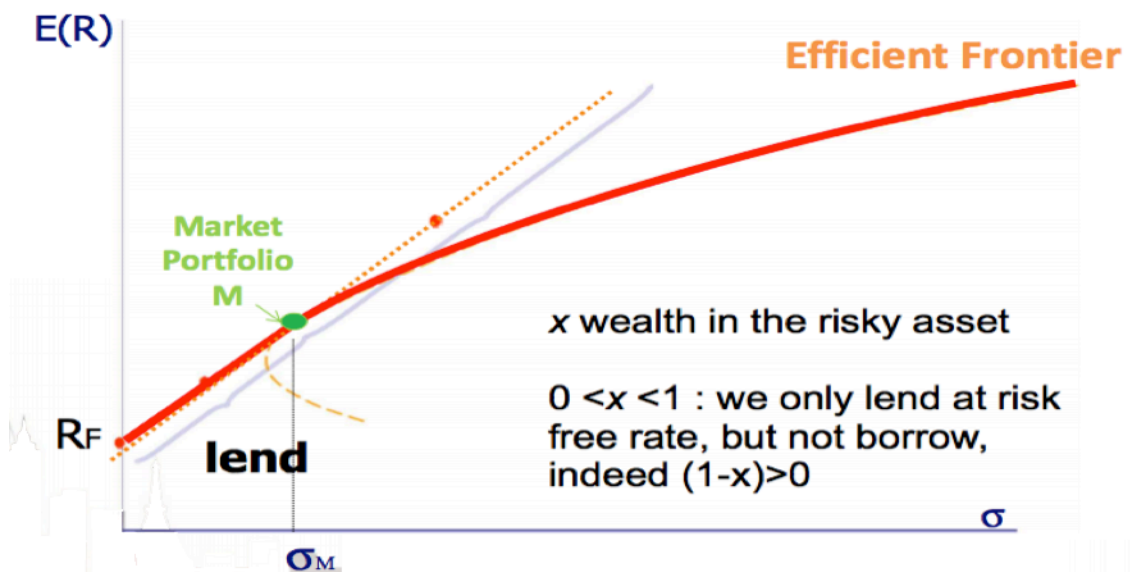


Figure 14: Efficient Frontier in 2<sup>nd</sup> case (without borrowing riskless asset)

Since investors are probable to put their money in riskless assets, as a rational decision, they will obviously invest into the portfolio called as “market portfolio”. The market portfolio is the crossover point or tangency point between new efficient frontier and original efficient frontier in which it gives the best risk and return trade-

off. Therefore, the optimal allocation among risky assets and riskless assets is in market portfolio. The market portfolio (point M) can also be changed based on investor's risk preference.

### 3.5 Portfolio Measurement

The manager's objectives are to diversify the portfolio and derive above-average performance for the given risk class. To do so, portfolio measurement is employed as the method that will assist managers in evaluating the performance of certain assets (Investopedia 2015). There are 3 common sets of tool used to estimate the asset's performance that are Jensen, Treynor, and Sharpe ratios.

#### 3.5.1 Systematic group

##### **Jensen Ratio:**

Jensen Ratio describes the attribution amount of return to manager ability in order to obtain the expected return (which is lied on the SML)(Jensen 1968). It can be claimed that the higher the ratio is, the better the risk-adjusted return is (Investopedia 2015). The formula will be broken down as following:

$$Jensen\ Ratio = R_p - E(R_p)$$

Where:

$R_p$  = Portfolio Return

$E(R_p)$  = Benchmark portfolio Return (CAPM)

$$E(R_p) = R_f + \beta_p(R_M - R_f)$$

##### **Treynor Ratio:**

Treynor ratio of portfolio means the approximate return per unit of systematic risk (Beta) (Treynor1996). In addition, it reflects the slope of ex-post ( $\beta_p, R_p$ ) expressed the correlation between portfolio return and systematic risk. The higher Treynor ratio, the larger slope is indicated. If the Treynor ratio of specific porfffolio is higher than Treynor ratio of market It means that the portfolio chosen performs better than

market's performance and this specific portfolio should be considered by investors. It will be showed hereafter:

$$\text{Treynor Ratio} = \frac{R_p - R_f}{\beta_p}$$

Where:

$R_p$  is portfolio Return

$R_f$  is risk free rate

$\beta_p$  is systematic Risk of portfolio

### 3.5.2 Global risks

#### Sharpe Ratio (Global Risk):

Sharpe Ratio is related to global risks and it demonstrates risks premium earned per unit of total risks (Sharpe 1996). With the higher Sharpe Ratio, the slope will be bigger demonstrating that the return will be higher at the certain point of risk.

### Sharpe's ratio

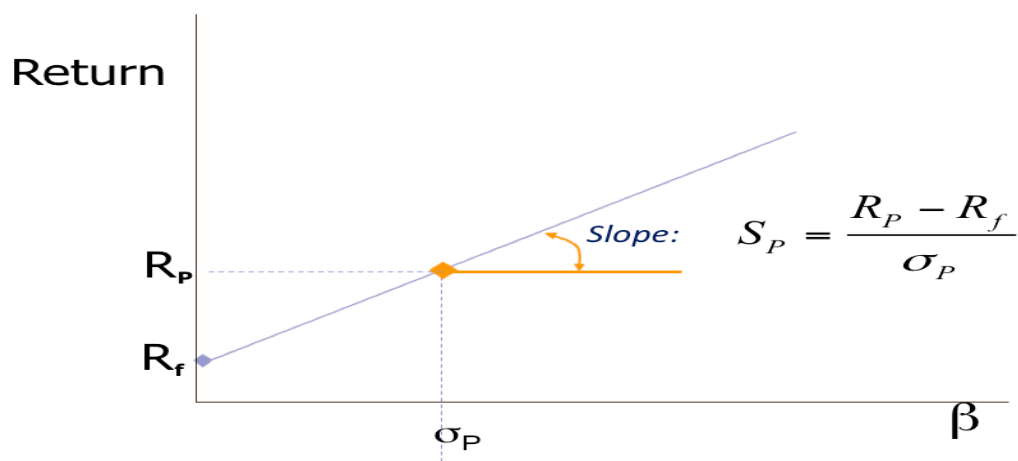


Figure 15: Sharpe's ratio (Peri 2015)

As following the formula:

$$\text{Sharpe Ratio} = \frac{R_p - R_f}{\sigma_p}$$

$R_p$  is Portfolio Return

$R_f$  is Risk free rate

$\sigma_p$  is Systematic Risk of portfolio

## 4 CAPITAL ASSET PRICING MODEL

CAPM is built on the model of portfolio created by Harry Markowitz (1959). The model of Markowitz presumes that the investor is risk averse and they want to look for the “mean-variance efficient portfolio”. In such a portfolio, the risk will be minimized for given expected return or the expected return will be maximized for the given level of risk. Later, this model is contributed by Sharpe (1964) and Lintner (1965) who identify the portfolio that must be mean-variance efficient in the condition that 2 more assumptions are added in Markowitz’s assumptions. CAPM has the vast meaning in practical application such as estimating the cost of capital of firm, evaluating performance of managed portfolio. In this chapter, the author will give more details about this model of portfolio to help investor have overall understanding.

### 4.1 CAPM Assumption

In order to make a valid measurement of portfolio risk, there is a set of assumptions needed to be acknowledged. Once again, it should be emphasized that the assumptions of this model is the implementation of previous one of Martkowitz. These assumptions will be reviewed as following.

- Investors are rational and risk averse. They all aim at achieving the target point on efficient frontier at which the return will be maximized for the same level of risk. In other words, the risk can reach to the “bottom” for the specific expected return.
- It is possible for the investors to lend or borrow unlimited amount of money at the risk free rate of return. The nominal risk free rate can be collected through buying stability security such as government T-Bills.
- Capital markets are in equilibrium. The initial investment is priced in line with their risk level.

- It is the perfect market with no taxes or transaction costs, no barriers, and no inflation. In case of changes in inflation and interest rate, these adjustments will be not fully anticipated.
- All investment can be absolutely divisible. It can be understood that there is no barriers to prevent investors from buying or selling fractional shares of asset or portfolio.
- All information is available at the same time to all investors, so they have the same expectation in terms of risk/return.
- Investors have homogeneous expectation in which the identical probability distributions for future rates of return will be estimated by investors.
- Investors are price takers. All investors assume that their own buying and selling activities will not affect the stock price.

#### 4.2 Formula

The calculation used in CAPM can be described as following:

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

where:

$E(R_i)$  is expected Return computed according to CAPM

$R_f$  is Riskless Rate of Return

$\beta_i$  is Beta ( Systematic risks)

$R_m$  is Expected market return

Beginning with consideration about riskless return in this formula, the 10- year US government bond is normally used in order to calculate expected return of individual stock or portfolio according to CAPM. The next formula's component is Beta, which stands for the systematic risk or can be understood as the response of stock to market risks as mentioned later in this section. Moreover, the expected return of market can be computed based on investor's preference. There are some common indexes can be utilized to find the average return of market (expected

return of market) including FTSE100 (London Stock Exchange Market), S&P 500 (New York Stock Exchange Market), etc. The special element of the CAPM computation is risk premium ( $R_m - R_f$ ), which refers to the advance risk tolerated to compensate for the extra return in market equilibrium.

### 4.3 Systematic risk (beta)

Systematic risk is known as beta (mentioned previously in Chapter 1), which is sensitivity of security's return to the alteration in returns on the market portfolio. Beta of individual stock can be described as equation listed hereafter:

$$\beta_i = \frac{\sigma_{i,M}}{\sigma_M^2}$$

Where:

$\beta_i$  is beta of stock  $i$

$\sigma_{i,M}$  is co – variance between stock  $i$  and market portfolio

$\sigma_M$  is variance of stock  $i$

As indicated in the figure below, beta is simply known as the slope (i.e., the change in the excess return on the stock over the change in excess return on the market portfolio) of the characteristic line. (James & John 1998, 101). If the slope is 1.0, the stock will have the same systematic risk as the market. In case of the market going up, the excess return of the stocks will be altered which has better return. Hence, the slope is now in upward movement, and it reflects the systematic risk of stock is higher than systematic risk of market portfolio. This type of stock is called “aggressive” investment. In the other way around, the slope is lower than 1.0, or can say that it's in downward movement. In this situation, the systematic risk is less than systematic risk market portfolio.



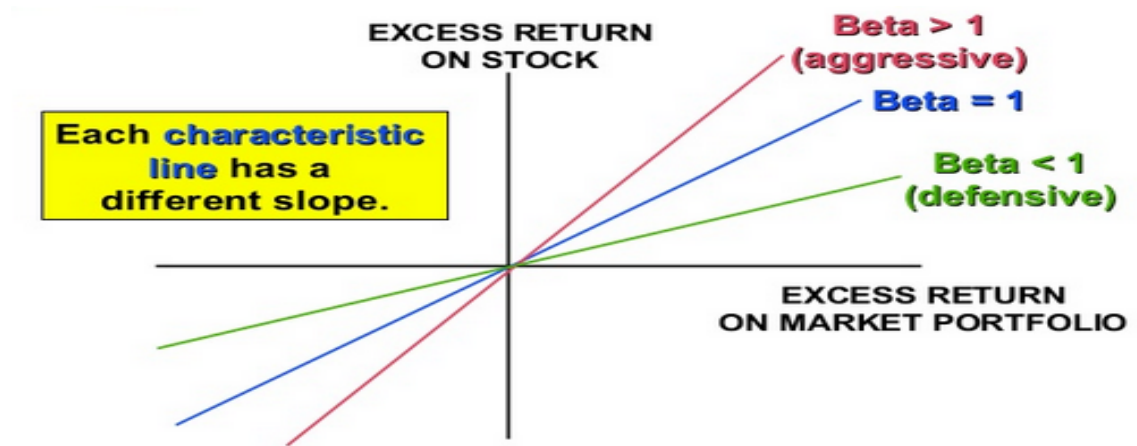


Figure 16: The change of beta comparing to market's beta

Table 6: The range of Beta reflection

Beta	
$\beta < 1$	The stock is less volatile than market as a whole
$\beta > 1$	The stock is more volatile than the market as a whole
$\beta < 0$	The stock is losing money while market as a whole is gaining

Additionally, the portfolio's beta can be calculated by a weighted average of individual stock's beta in the portfolio.

$$\beta_P = \sum_{i=1}^n w_i \beta_i$$

$\beta_P$  = Portfolio's beta

$w_i$  = stock's weight

#### 4.4 Security Market Line

Security Market Line illustrates the linear relationship between security's expected return and its systematic risk which is measured as beta. (James & John 1998, 102-103). If the CAPM holds to the truth, all assets will lie on SML. To plot the

assets on SML, two factors must be computed comprising of beta and asset's expected return as following formula:

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

With beta =1, the expected return of asset will be the expected return of market portfolio.

The question arisen is what happens when the stock will not lie on the security market line. By answering this question, the other use of SML is additionally figured out. Especially, in the "CAPM world", there is no such thing called underpricing or overpricing; but in reality, it is not the case. If the security is not lie on the SML, it can be below or above the SML; or one can say that it is underpriced or overpriced. In case of underpricing, the stock gives the expected return higher than required return in equilibrium market according to CAPM, so it is better to buy this stock. Otherwise, it could be possible to obtain the higher expected return in the case of overpricing so the short in position can be a good option. This will be demonstrated graphically hereafter in figure 17.

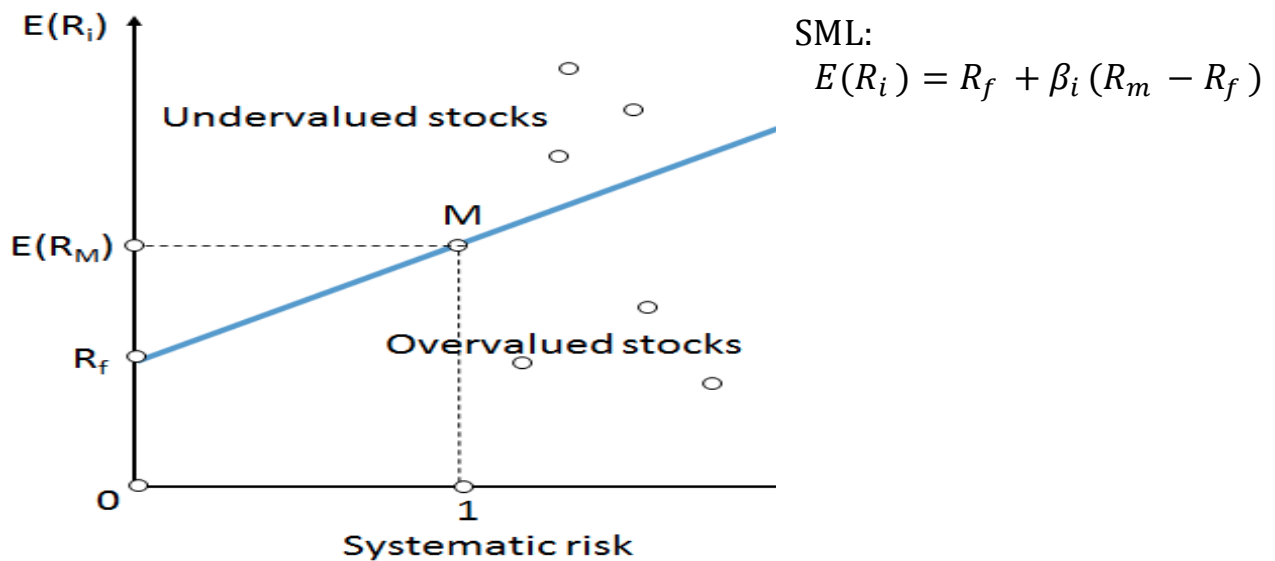


Figure 17: Securities Market Line (Investopedia 2015)

#### 4.5 Critics

As mentioned earlier, CAPM is constructed based on some basic assumptions. These assumptions may not be correct in some specific cases. For example, the SML will not work accurately in case of (1) the portfolio is not diversified completely

so the beta isn't adequate measure of risks (2) the required rate of return set is not fully explained by SML. For listed reasons, probably CAPM needs to be implemented a lot in order to be more valid in practical application. There are some empirical test of CAPM have been done and they found some interesting results as listed below:

- Test of the Stability of Beta Coefficients (Robert A. Levy & E. Blume, 1971):  
Based on the measurement of the beta stability in debt, it concludes that the beta of individual stock is not stable enough to be used in predicting the future risk; otherwise, the past beta of portfolio is quite stable to be used for estimating the future portfolio volatility. CAPM is better for structuring investment portfolio than being used for estimating the cost of capital for single securities.
- Test of the CAPM based on the slope of SML: (Roll 1977)  
Using the past data to predict for the thing happening in the future does not make sense in reality. This study found out that (1) the relationship between risk and return seems to be linear;(2) the CAPM should be applied for whatever assets existed, and bond is not an exception. However, Bond is not plotted on SML in CAPM;(3) the slope of SML predicted is less than the theoretical showed.
- The Fama-French Study:  
The Fama- French study reveals that there is no relationship between historical betas and historical returns, low beta gives the same rate of return as high beta. This result is contrary to the CAPM indicating that high beta stock give higher return than low beta stock.

However, CAPM is a useful conceptual tool up to now being exploited to evaluate and predict the future investment (ex ante). In majority, investors still accept it without questions currently. Although the questions still arise when thinking about the assumption, some empirical results will fill in this gap and implement for more perfect future CAPM model.

## 5 CASE ANALYSIS

As mentioned in the beginning, the research goal is to build the optimal portfolio with minimum risk based on Capital Asset Pricing Model and the applicable significant value of diversification principle. In details, this research will indicate the following points:

- + Building the optimal portfolio with minimum risk
- + Checking the reliability of diversification principles
- + Selecting the portfolio basing on using CAPM and other supportive benchmarks

All the objectives above will be done by both theoretical and empirical approaches. The further approach of this thesis aims at checking the reliability of theory in practice nowadays. Hereafter, the specific tasks and framework of case analysis will be broken down:

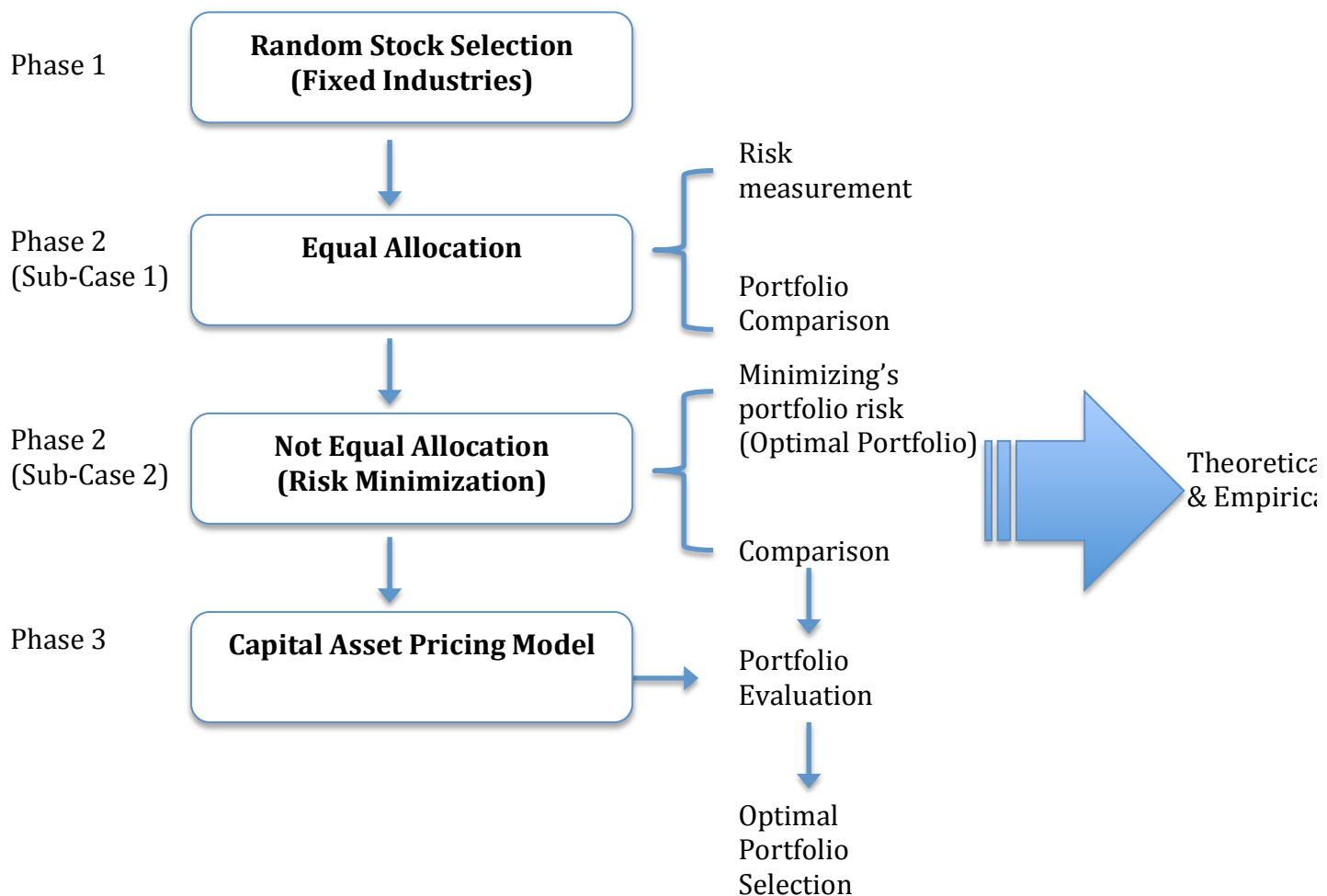


Figure 18: Empirical research Structure

## 5.1 Stock Selection

In the first stage of process, the stocks are randomly collected. Notably, these chosen stocks have to be in the same industry; in other words, the sector must be fixed in advance. Consequently, the sector fixed is “financial and banking”. Afterwards, they will be categorized into 2 portfolios as listed below:

The first portfolio (Portfolio A) consists of all the stocks in United Kingdom (London Stock Exchange Market) including: Lloyds Banking Group PLC (LLOY LN), Barclays (BARC LN), Royal Bank of Scotland (RBS LN).

The second portfolio (portfolio B) consists of the stocks in different regions and stock exchange markets including United Kingdom (LDSE), United State (NYSE), and Germany (Frankfurt Stock Exchange Market) which will be listed in order: Lloyds Banking Group PLC in United Kingdom (LLOY LN), J.P Morgan Chase & Co in United State (JPM US), Deutsche Bank AG in Germany (DBK GR).

Table 7: Stock Selection in each Portfolio

Portfolio A		Portfolio B	
Lloyds Banking Group PLC (LLOY LN)	United Kingdom (London Stock Exchange Market)	Lloyds Banking Group PLC (LLOY LN)	United Kingdom (London Stock Exchange Market)
Barclays (BARC LN)		J.P Morgan Chase & Co in United State (JPM US)	United States (New York Stock Exchange Market)
Royal Bank of Scotland (RBS LN).		Deutsche Bank AG (DBK GR)	Germany (Frankfurt Stock Exchange Market)

The reason why these stocks must be in the same sector or fixed industry is to measure the reliability of diversification's assumption. In details, if the securities collected are from different industries or sectors, the portfolio itself will be diversified immediately. Hence, the comparison cannot be made among these diversified portfolios to prove for the diversification assumption that is one of the study's objectives.

## 5.2 Sub-case 1

In sub-case 1, the diversification principle will be clarified through comparison between portfolio A and B with the same amount of allocation. The total holding of each portfolio are 100 percent of investment (weight) equivalent to 100 shares that will be divided equally to its carried stocks. There are 2 hypotheses in this stage 2 which will be distinguished after this first sub-case 1:

Hypothesis 1: The Portfolio A's risk is less than the risk of portfolio B.

Hypothesis 2: The Portfolio A's risk is higher than the risk in portfolio B.

Table 8: Equal allocation in each portfolio

<b>Portfolio A</b>		<b>Portfolio B</b>	
Stocks	Weight (%)	Stocks	Weight (%)
Lloyds Banking Group PLC (LLOY LN)	33,3%	Lloyds Banking Group PLC (LLOY LN)	33,3%
Barclays (BARC LN)	33,3%	J.P Morgan Chase & Co in United State (JPM US)	33,3%
Royal Bank of Scotland (RBS LN).	33,3%	Deutsche Bank AG (DBK GR)	33,3%

First of all, the data of historical price of each stock is gathered in the periods of 3 years from 24<sup>th</sup> March 2012 to 13<sup>rd</sup> March 2015 by utilizing the Bloomberg terminal.

The time horizon selected is weekly. The author will compute all figures of each portfolio relying on the historical performance including the ex-post return (mean); risk (standard deviation, variance); co-relation, co-variance as following:

### 5.2.1 Calculation

#### **Portfolio A figures:**

Table 9: Individual Stock Figure

	Mean	Variance	Standard Deviation
LLOY LN	35.04%	0.00142518	0.037752
BARC LN	9.294%	0.00209275	0.045747
RBS LN	14.921%	0.00228746	0.047827

As can be seen in the table 5, stock's means are computed basing on the week's last price of stock in the periods of 3-year. According to the stock's mean, variance, and standard deviation are functioned also.

Table 10: Correlation & Co-Variance Matrix

		LLOY LN	BARC LN	RBS LN
LLOY LN	Co-variance	0.00142518	0.00104484	0.00122252
	Correlation	1	0.60500195	0.67708556
BARC LN	Co-Variance	0.00104484	0.00209275	0.0015835
	Correlation	0.60500195	1	0.72374121
RBS LN	Co-variance	0.00122252	0.0015835	0.00228746
	Correlation	0.67708556	0.72374121	1

The correlation of each stock is quite high from the range 0.60500195-0.72374121 that shows the diversification value in portfolio from poor to good (Table 5). This number means that the stocks in this portfolio move in the same direction more

than 75% of the time. Therefore, it proves for the less diversified of this portfolio also.

Table 11: Descriptive statistic

	Portfolio A
Standard Deviation	0.03874004
Variance	0.00150079

We can see that the portfolio's risk is almost less than the risk of each stock in the portfolio because of diversification effect. The portfolio A indirectly shows its internal diversification through correlation index, and the result from comparing with its stock's risk.

**Portfolio B figures:**

Table 12: Individual Stock Figure

	Mean	Variance	Standard Deviation
LLOY LN	35.04%	0.00142518	0.037752
JPM US	13.43%	0.00096705	0.031097
DBK GR	-2.45%	0.0015521	0.039397

The stock's mean, variance and standard deviation in this portfolio are calculated in same way as the previous one.

Table 13: Co-relation & Co-Variance Matrix

		LLOY LN	JPM US	DBK GR
LLOY LN	Co-variance	0.00142518	0.00055842	0.00075324
	Correlation	1	0.47566875	0.50645309
JPM US	Co-variance	0.00055842	0.00096705	0.00062389
	Correlation	0.47566875	1	0.50923728
DBK GR	Co-variance	0.00075324	0.00062389	0.0015521
	Correlation	0.50645309	0.50923728	1



The correlation of each stock is in the range 0.47566875-0.50923728, so there are some following points that can be given according to this range:

The portfolio B is more diversification comparing to portfolio A because the range of correlation coefficient of portfolio B is smaller and narrower than the range in portfolio A. In addition, the portfolio B is classified as excellent diversification even though the range is not quite perfect in general.

Table 14: Descriptive statistic

	Portfolio B
Standard Deviation	0.02946831
Variance	0.00086838

The portfolio's B standard deviation is less than the same index of all its stocks as presented. It can be understood that this portfolio breaks the risk's concentration better than the portfolio A or we can say that the internal diversification of portfolio B is better. The table hereafter will show the comparison between portfolio A and B:

Table 15: Risk of Portfolio A & B

	Portfolio A	Portfolio B
Standard Deviation	0.03874004	0.02946831
Variance	0.00150079	0.00086838

The standard deviation of portfolio A is greater than portfolio B, meaning that the risk in portfolio B is less than the risk in portfolio A. Moreover, portfolio B consists of the stocks from different countries with the purpose mentioned previously, so the distance is definitely involved in portfolio's evaluation. Therefore, the assumption about the role of distance in diversification makes sense in this calculation.

### 5.2.2 Observation

The author tries to observe deeply the diversification of portfolios with equal allocation by using the risk measurement of Bloomberg terminal in 25<sup>th</sup> March 2015.



Figure 19: Portfolio A's risk (Source: Bloomberg)

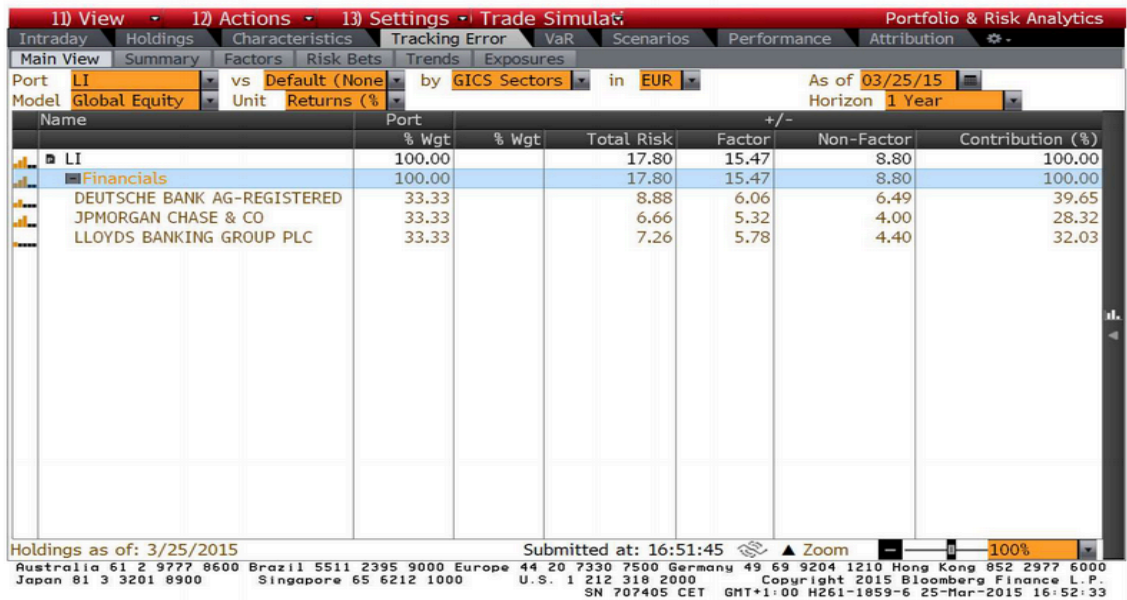


Figure 20: Portfolio B's risk (Source: Bloomberg)

The figure shows that the portfolio B contains less risk than portfolio A or it is more diversified than portfolio A. The theoretical calculation result is matching with observation.

As a result, the hypothesis 2 is accepted.

### 5.3 Sub-case 2

In this sub-case, the diversification of both portfolios will be checked again in the same approach with the aid of risk minimization methods. As same as sub-case 1, there are 2 hypotheses coming along with this testing also:

Hypothesis 1': The portfolio A's risk is less than the risk of portfolio B.

Hypothesis 2': The portfolio A's risk is greater than the risk of portfolio B

#### 5.3.1 Calculation

Table 16: Weight of portfolio with minimum risk

Portfolio A		Portfolio B	
Stocks	Weight (%)	Stocks	Weight (%)
Lloyds Banking Group PLC (LLOY LN)	73,084229	Lloyds Banking Group PLC (LLOY LN)	25,141619
Barclays (BARC LN)	26,321176	J.P Morgan Chase & Co in United State (JPM US)	58,505384
Royal Bank of Scotland (RBS LN).	0.594595	Deutsche Bank AG (DBK GR)	16,352997

After minimizing the risk of portfolio, the weight of stocks in each portfolio will be altered accordingly with amount of risk reduction in each portfolio.

Table 17: Risk of Portfolio A & B

	Portfolio A	Portfolio B
Variance	0.00132387	0.0008082
Standard Deviation	0.036385497	0.02842884

If comparing the standard deviation of each portfolio in sub-case 2 to the same index in sub-case 1, we can see that the risk of each portfolio is completely decreased. In particular, the portfolio A's risk is reduced from 0.038 to 0.036, and portfolio B's risk in sub-case 2 is lower than risk of the same portfolio in sub-case 1 about 0.002.

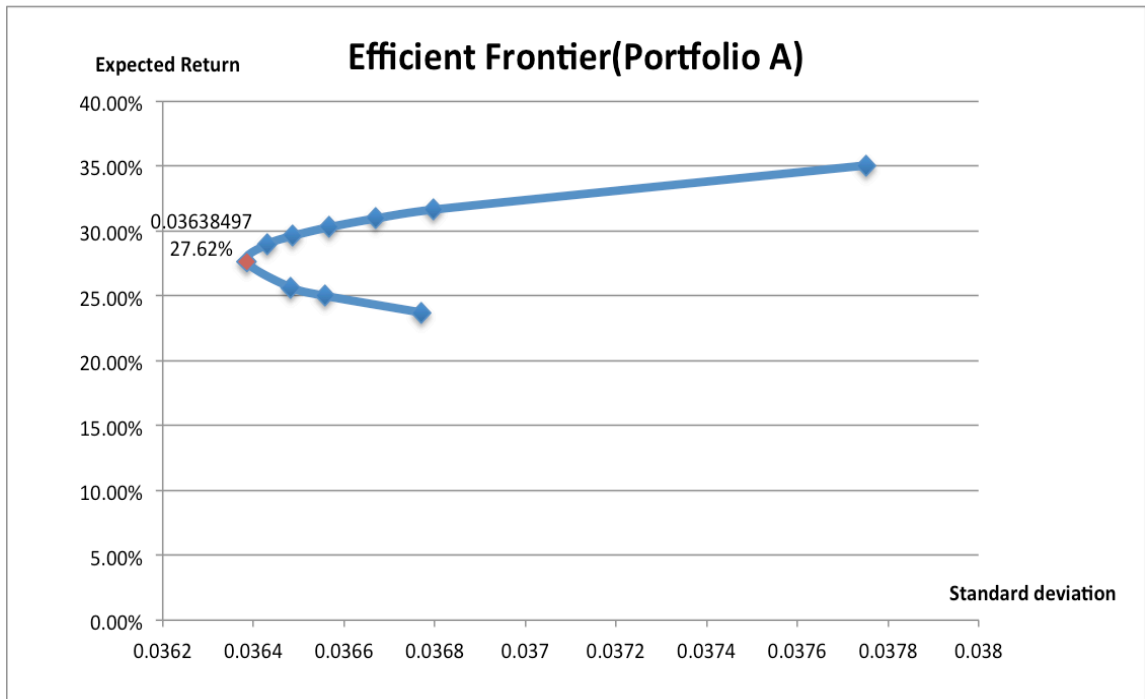


Figure 21: Efficient Frontier (Portfolio A) and Portfolio with minimum risk

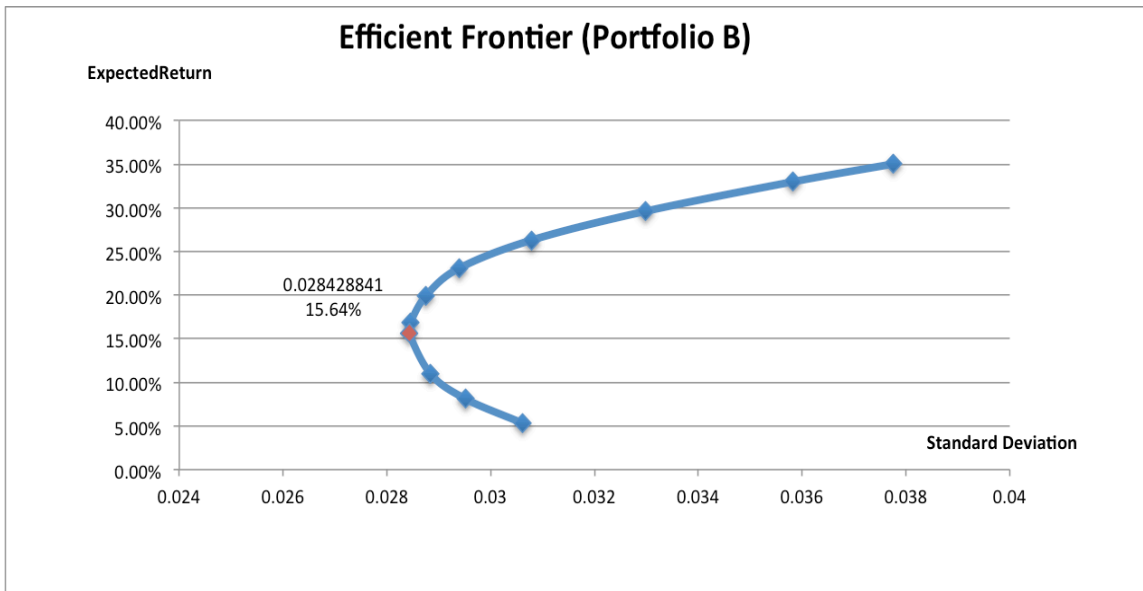


Figure 22: Efficient Frontier (Portfolio B) and Portfolio with minimum risk

The efficient frontiers listed describe all the possibilities of portfolio A, B by combining the weight of their stocks and the red dot is the portfolio with minimum risk. Evidently, the standard deviation of portfolio A is still higher than in portfolio B.

### 5.3.2 Observation

Using the same approaches, the author inputs all the weights of the portfolio with minimum standard deviation to check the results on Bloomberg terminal.

1) View - 2) Actions - 3) Settings - Trade Simulat - Portfolio & Risk Analytics							
Main View Summary Factors Risk Bets Trends Exposures							
Port LL vs Default (None) by GICS Sectors in EUR As of 03/25/15							
Model Global Equity Unit Returns (%) Horizon 1 Year							
Name	Port	% Wgt	% Wgt	Total Risk	Factor	Non-Factor	Contribution (%)
LL		100.00		20.62	17.61	10.73	100.00
Financials		100.00		20.62	17.61	10.73	100.00
BARCLAYS PLC		26.32		6.76	4.86	4.71	25.23
LLOYDS BANKING GROUP PLC		73.08		15.93	12.68	9.64	74.32
ROYAL BANK OF SCOTLAND GROUP		0.59		0.17	0.11	0.13	0.45

Holdings as of: 3/25/2015 Submitted at: 16:55:29

Australia 61 2 9777 8600 Brazil 5511 2395 9000 Europe 44 20 7330 7500 Germany 49 69 9204 1210 Hong Kong 852 2977 6000 Japan 81 3 3201 8900 Singapore 65 6212 1000 U.S. 1 212 318 2000 Copyright 2015 Bloomberg Finance L.P. SN 707405 CET GMT+1:00 H261-1859-6 25-Mar-2015 16:55:33

Figure 23: The Portfolio A with Minimum risk

Name	% Wgt	Total Risk	Factor	Non-Factor	Contribution (%)
LI	100.00	17.44	15.29	8.40	100.00
Financials	100.00	17.44	15.29	8.40	100.00
DEUTSCHE BANK AG-REGISTERED	16.35	4.36	2.97	3.18	15.43
JPMORGAN CHASE & CO	58.51	11.69	9.34	7.03	61.36
LLOYDS BANKING GROUP PLC	25.14	5.48	4.36	3.32	23.21

Figure 24: The Portfolio B with Minimum risk

After applying the weight as shown in table 16, the Bloomberg gives the result as expected. The total risk of portfolio A in sub-case 2 is higher than in sub-case 1, and it is the same in portfolio B. In details, the portfolio A's risk is reduced 0.15% and it is about 0.36% in portfolio B.

In this observation, the total risk of portfolio A is definitely greater than in portfolio B so the hypothesis 2' is accepted.

#### 5.4 Portfolio Evaluation with CAPM (Phase 3)

In the aim of selecting the more profitable portfolio with less risk between 2 researched portfolio, the author will compute the expected return of each portfolio based on CAPM, and then draw the Securities Market Line (SML) to know the 2 portfolios with lowest risk whether it is overvalued or undervalued compared to market value. In the next step, the new efficient frontier will be created and used to make trade-off decision in investment between these portfolios.

To compute the portfolio's expected return based on CAPM, the risk free asset will be considered as 10 years United State Government Bond (2,20%), and the

market return is calculated by using the 3 years historical return of S&P 500 from 24<sup>th</sup> March 2012 to 13<sup>th</sup> March 2015.

Table 18: Descriptive Statistic

	Portfolio A			Portfolio B		
Stocks	LLOY LN	BARC LN	RBS LN	LLOY LN	JPM US	DBK GR
Beta	0.985	1.189	1.251	0.985	1.146	1.057
Mean	27.62%			15.64%		
E(R <sub>i</sub> )	14.33%	16.84%	17.60%	14.32%	16.31%	15.21%
E(R <sub>p</sub> )	15.005%			15.629%		

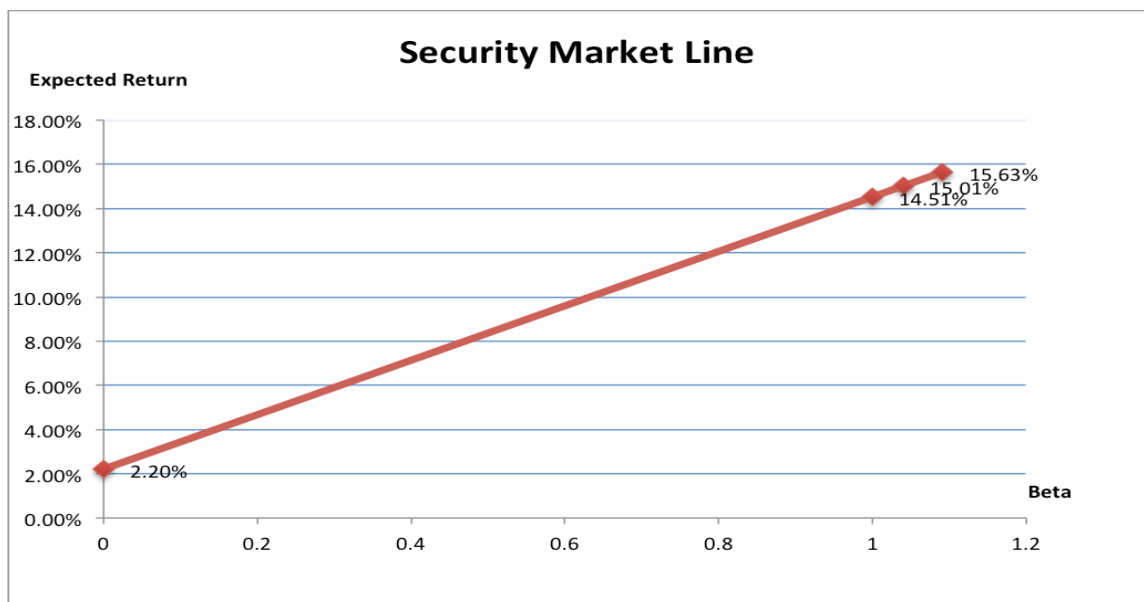


Figure 25: Security Market Line

The portfolio A and B with lowest risk have better performance than the market. In specific, the portfolio A's mean is 27.62% which is higher than expected return of its on SML (calculated basing on CAPM); the portfolio B is derived the higher position, it is also greater than the expected return of it according to CAPM about 0.02%. Hence, these portfolios are undervalued and they are good to be invested in. However, the question is which one is superior the other. The answer will be

given and explained according to the following convincing argument and observation.

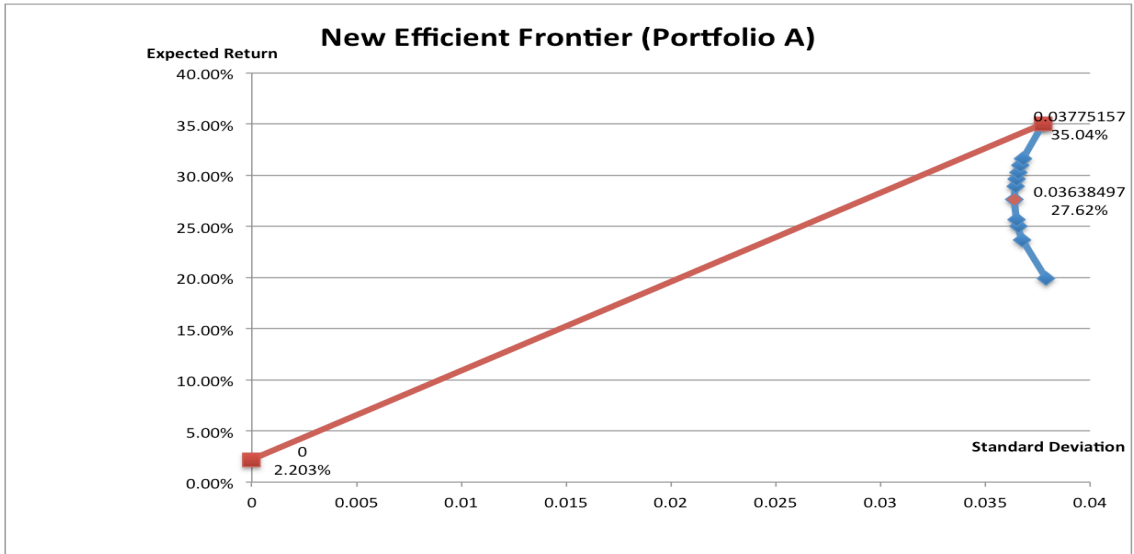


Figure 26: New Efficient Frontier of Portfolio A

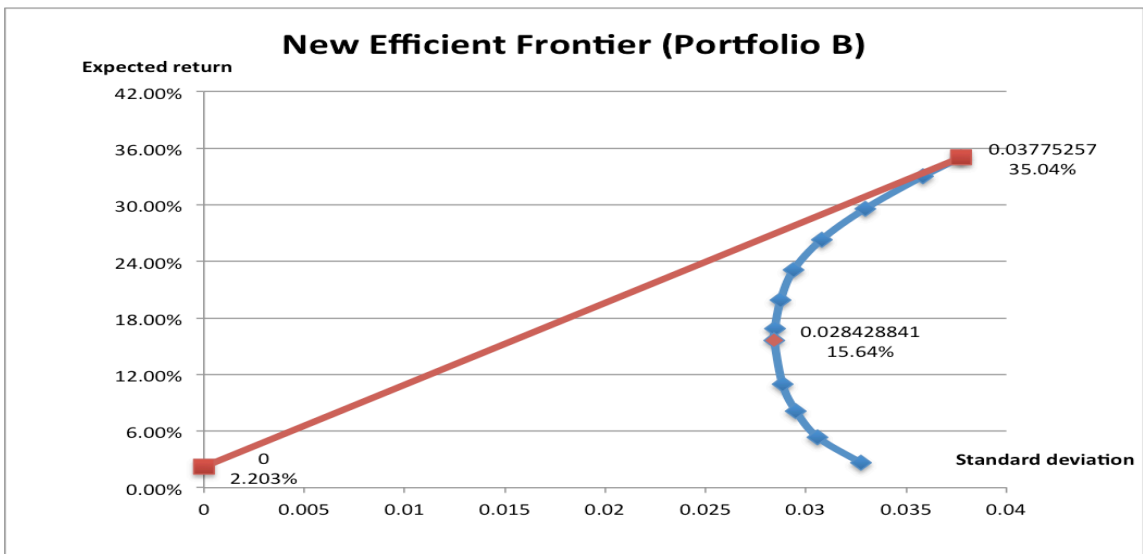


Figure 27: New Efficient Frontier of Portfolio B

The author finds the tangent between Capital Market Line and Efficient frontier (New Efficient Frontier) by maximizing the Sharpe ratio. The tangent point demonstrates the risk and return possibility with leverage. Luckily, we can see that the tangent point is the same in two portfolios; therefore, it will be easy in sorting



the investment position. It will be discovered when merging two portfolios together into 1 chart as below.

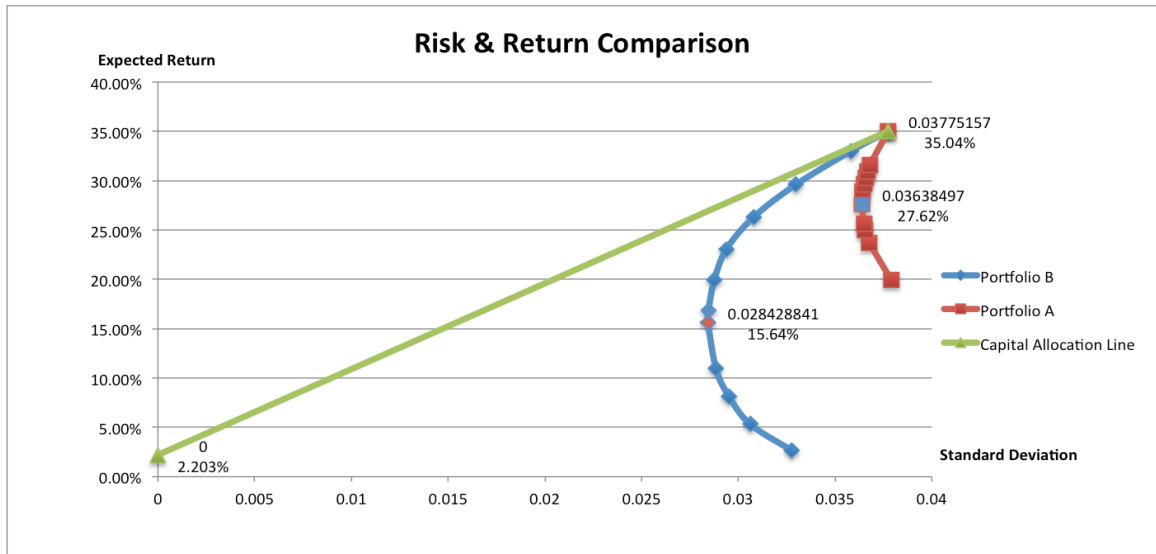


Figure 28: Risk & Return Comparison

As noted earlier, with the same tangent point, it is not difficult to distinguish which portfolio has better performance. According to the figure 28, the portfolio B has better "risk & return trade-off" than portfolio A. With the same return, we can find that the standard deviation or risk is lower in the portfolio B. As a result, the portfolio B is chosen.

**Observation:**

The data is collected from Bloomberg in the periods of 28 days from 25<sup>th</sup> March to 22<sup>th</sup> April 2015.



Figure 29: Profit & Loss Attribution of Portfolio A



Figure 30: Profit & Loss Attribution of Portfolio B

As can be seen, the total return of portfolio B is 5.25% in the period of 28 days, and it performs better than the portfolio A in this period. In addition, the portfolio B's companies make the profit of about 5.161.715 Euros. In contrast, performance of portfolio A is worse with the profit in the 28-day period of about 1.970.996 Euros. Therefore, the outcome is of expectation and the portfolio B is the ideal portfolio to be invested in.

## 5.5 Results & Finding

There are several finding and results collected through the research of this study, which will be included hereafter:

Firstly, by collecting the stocks from different regions, the portfolio risks will be reduced better than in the case of portfolio picking the stocks in the same region. Also, the portfolio including stocks of varied regions is more diversified.

Secondly, the portfolio risk is smaller than that of its stocks. It is the reason why we need to diversify investment rather than invest only in single stock.

Thirdly, optimizing portfolio by minimizing the risk plays an important role in investment decision. It will help to clarify the optimal portfolio in which the expected return will be maximized for the same level of risk.

Fourthly, with the same tangent point, the investment decision can be made easily based on the comparison of risk and return among portfolios. In contrary, if two portfolios do not have same tangent point, the portfolio will be evaluated and chosen on the ground of past performance and investor's risk preference.

Finally, the CAPM is still valuable to be utilized nowadays as proven in this research. By using this model, investor will have the good benchmark to find the appropriate investment.

## 6 DISCUSSION

### 6.1 Summary

To answer the research questions, the thesis is divided into 2 ways of approach including theoretical and empirical approach. All fundamental information is given in theoretical part and these basic literal concepts are proven by the research in order to build deep understanding about the content of this thesis. The answers for research questions will be shown as follows:

- **What is the component of investment?**

In the perspective of investor, the investment's component consists risk and return. These components are the basic or fundamental index that the investors always bear in mind before making any the investment decisions. Through these components, investor can know how much they are able to get in the fixed periods or in the future and the level possibility of loss by uncertainty effects. Return includes historical return (ex-post) and expected return (ex-ante) and these types of return can be utilized depending on the purpose of user. There are variety of risks categorized into 2 main types regarding of systematic risks and unsystematic risk. The systematic risk is not affected by diversification but the unsystematic risk can be diversified. Due to the nature of this thesis, these kinds of risk are not fully captured.

- **What are the diversification and its contribution?**

Diversification is about varying the options and spreading risks in the portfolio aiming at balancing and reducing the overall risk in portfolio. The more assets in one "basket" we have, the more risks that can be reduced. This reduction of risk will lead to the high return possibility. Diversification has the huge meaning of support in portfolio management.

Firstly, through clear understanding of diversification, investor can make their wise strategy adjustment in selecting the portfolio's assets with the purpose of gaining profit.

Secondly, investor is not only aiming at gaining profit but also limiting the leaking out of money in investor's portfolio. The diversification gives investors the idea to reduce the loss probability.

Furthermore, it has significant contribution in term of literal study.

- **What are the portfolio setting and the way to manage portfolio risks?**

Similar to single assets, the portfolio has the same components including return and risk, but the way to calculate is completely different. Besides, the single assets in portfolio have the relation with each other, and this relation can be evaluated by 2 variables including co-variance and correlation.

In order to manage portfolio risk, there are 2 methods that can be used based on the application of diversification, and the alteration in weight allocation of each asset in portfolio. It is noted that these methods are created on ground of knowledge conducted in this paper only.

- **What is Capital Asset Pricing Model?**

Capital Asset Pricing Model is the model reflecting the relationship between risk and return; and this model is used for pricing of securities for investment purposes. Furthermore, it has the vast meaning in estimating the cost of firm's capital and evaluating performance of managed portfolio.

According to CAPM, there are some important elements that should be taken into account consisting of systematic risk, risk premium, security market line and risk free rate (riskless assets). Having a good comprehension these elements, it is not too challenging for investors using practical application of CAPM in reality.

In this study, the author meets some disadvantages about the time, and information collected. Firstly, the time for observation is quite short, so it can't show all the possibilities of the outcome in case of longer period. Due to the short time observation, It is also the limitation in the number of stocks selected in each portfolio. Secondly, there is not much information published on Bloomberg, so it

takes time to find the stock's information as well as get familiar with the Bloomberg system.

Last but not least, the content of this paper gives the investor general basic knowledge related to investment and its sample application in real market. There is still a pyramid of models and pricing methods employed nowadays in which many other factors are considered. To have the accurate investment decision, the best option is to combine all possible methods or models as suggested. Once more again, it needs to emphasize that this thesis only provides the overview on investment along with concerned factors.

## 6.2 Validity & Reliability

The use of validity and reliability is quite common in the quantitative research. The purpose of discussing about these terms is to support reader's comprehension about the use of this thesis's results. Firstly, the validity of the study indicates whether the results of measurement are accurate and whether the researchers are measuring what they want to measure. Secondly, the reliability shows whether the result is replicable. (Golafshani 2003).

With regard to validity, author follows the deductive approach mentioned at the beginning of this thesis. It is logical theoretical and empirical presentation according to the structure constructed in chapter 1. In theoretical part, author captures fully the knowledge in logical way starting from investment's components and portfolio setting to Capital asset pricing model. Moreover, these info are collected from trusted sources including university electric library, books, and well known website. In the empirical section, the data is collected from Bloomberg terminal and all the calculations are made by using Excel. Hence, the input and output of this thesis is highly valid.

In terms of reliability, author believes that in the certain situation, the results given will be the same as this study using a similar methodology. In addition, the

reliability is additionally proven by the trusted statistic data in Bloomberg, which is collected in the period of 3 years from 24<sup>th</sup> March 2012 to 13<sup>rd</sup> March 2015 and the time horizon is weekly. Overall, the content of this thesis is reliable.

### **6.3 Recommendation for further study**

Firstly, diversification has a crucial role to play in choosing and managing the portfolio as shown in this thesis. Thus, it is strongly advised to all investors to concern about varying their portfolio components before heading to any investment decision.

Secondly, CAPM is basic benchmark to evaluate portfolio according to some unreal assumptions. Additionally, the economic is always changing and so unpredicted that there are some unexpected situations that can break the reliability of this theory. Hence, the market is not always giving the expected results. Author recommends investor to not only to pay attention in single method but also take into consideration about combining different methods in selecting securities for profitability.

Thirdly, security Market Line is another useful tool for investor in evaluating the price of stock to decide whether to buy stock, besides some traditional methods used regularly in fundamental financial analysis, for instance, Dividend Discount Model.

Finally, as studied, in case of two portfolios with the same tangent point, the investment decision can be made easily based on the comparison of risk and return among portfolios. In contrast, if two portfolios do not have same tangent point, the portfolio will be evaluated relying on its past performance and investor's risk preference. Therefore, investor should carefully set their investment strategy in advance to know which level of risk or expected return they prefer.

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**APPENDICES**

10 Year Treasury Rate Historical Data

Appendix 1

## 10 Year Treasury Rate Historical Data

## Appendix 1

## Data for this Date Range

May 6, 2015	2.25%	April 1, 2015	1.87%
May 5, 2015	2.19%	March 31, 2015	1.94%
May 4, 2015	2.16%	March 30, 2015	1.96%
May 1, 2015	2.12%	March 27, 2015	1.95%
April 30, 2015	2.05%	March 26, 2015	2.01%
April 29, 2015	2.06%	March 25, 2015	1.93%
April 28, 2015	2.00%	March 24, 2015	1.88%
April 27, 2015	1.94%	March 23, 2015	1.92%
April 24, 2015	1.93%	March 20, 2015	1.93%
April 23, 2015	1.96%	March 19, 2015	1.98%
April 22, 2015	1.99%	March 18, 2015	1.93%
April 21, 2015	1.92%	March 17, 2015	2.06%
April 20, 2015	1.90%	March 16, 2015	2.10%
April 17, 2015	1.87%	March 13, 2015	2.13%
April 16, 2015	1.90%	March 12, 2015	2.10%
April 15, 2015	1.91%	March 11, 2015	2.11%
April 14, 2015	1.90%	March 10, 2015	2.14%
April 13, 2015	1.94%	March 9, 2015	2.20%
April 10, 2015	1.96%	March 6, 2015	2.24%
April 9, 2015	1.97%	March 5, 2015	2.11%
April 8, 2015	1.92%	March 4, 2015	2.12%
April 7, 2015	1.89%	March 3, 2015	2.12%
April 6, 2015	1.92%	March 2, 2015	2.08%
April 3, 2015	1.85%	Feb. 27, 2015	2.00%
April 2, 2015	1.92%	Feb. 26, 2015	2.03%