

# **Methods to minimize the risks in international portfolio investing**

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<p>The purpose of this thesis is to understand the portfolio investment decision-making process and learn how to minimize the risks involved in pursuing the true value of the portfolio by internationalizing the domestic portfolio and selecting the right portfolio policies. This research's content will offer an overview of security market by illustrating the relation between portfolio risks and returns and probing the proper ways to make the right investment. The handful techniques like diversification and market models, especially CAPM—the capital asset pricing model, will be introduced. Furthermore, the study renders basic finance knowledge, theories and practices in capital market and economic elements affecting the investment decision.</p> <p>This paper is primarily the result of quantitative means. The actual data will be collected from NYSE, Nasdaq Composite, S&amp;P 500 and OMX Helsinki 25. Additional ratios and figures will be obtained from Bloomberg for further analysis.</p> <p>By using of certain portfolios in one-year period, the portfolio theories will go through re-examination and testing. The research will also reveal the empirical problems found in theories. The follow-up solutions for empirical problems can be regarded as contribution of this study. The author makes sure all the results and findings are trustworthy and valid.</p>	
<b>Keywords</b> Risk, Return, Portfolio, Diversification, Capital Asset Pricing Model, Equity Evaluation	

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# 1 Introduction

This thesis aims to give brief introduction to portfolio, followed by analysis on variable methods to minimize the risks involved in portfolio investing.

## 1.1 Background

It's interesting how particular years acquire historical significance: 1914 (outbreak of the first world war); 1929 (the Wall Street crash); 1983 (switching on of the internet). And of course 2016, the year of Brexit and Trump, the implications of which are, as yet, unknown.

(The guardian 2016.)

The 2016 Brexit event brings anxiety of global financial market. The stock market stumbled after the voting result was published. Investors were also in shadow of the triumph of Trump. Those political issues make investment more complicated and hard. On the other hand, the globalization and technology make investment on portfolio easier and faster. There are advantages and disadvantages. Fisher (2003, 180) indicates the first dimension of a conservative investment is in five golden principles: Low-cost production, strong marketing organization, outstanding research, technical effort and financial skills (these are the focus of this study).

The idea to write about portfolio investment started when author got acquaintance with Finnish stock market. As a new investor, the author wish to have a thorough study on portfolio management concerning to risk reduction. As Pearson (2002, 24) said, "risk is inherently a probabilistic or statistical concept, and there are various notions and measures of risk." There is the risk management for banks, such as the calculation of Value at risk. While for the individual investors, international portfolio diversification had been proved to be useful in reducing risk in investment. In addition, accounting understanding of the company performance and sound valuation of the company and careful comparison with other companies and average rate in industry was proved useful.

## 1.2 Benefit

Writing this paper enables author to have a better understanding the portfolio investment theories and offer a general knowledge base for investors who long for reducing risks in portfolio purchases.

### 1.3 Thesis objectives and research questions

The study aims to identify the basic concept in portfolio investment. Exercising methods to gain maximum profit and minimum risk in portfolio by analysing capital asset pricing model and diversifying invests.

The research questions go through different perspectives.

- What are the portfolio theories?
- What risks are involved in portfolio investment?
- What are methods to reduce the risks and enhance rate of returns?
- What is diversification?

Ultimately, the author is expected to apply theories into reality and give advices on the topic.

### 1.4 Research methods and data collection

Research is based on quatitative methods. Content analysis would help this study to have a good explain on the current situation of the portfolio market and development on risk management on portfolio. All the data will be collected from books and updated actual market lists.

Table 1 presents the theoretical framework, research methods and results chapters for each investigative question.

**Table 1. Overlay matrix**

Investigative question	Theoretical Framework*	Research Methods	Results
IQ 1.What are the portfolio theories?	Harry Markowitz, Sharpe	Hypothesis, observation (gaining of first and second hand material) and inductive ways (produce generalized theories and conclusions)	Provide basic academic knowledge on portfolio knowledge
IQ 2. What risks are involved?	Systematic and un-systematic risks	Data collection	How to calculate systematic and unsystematic risks
IQ 3. How to reduce	Diversification, Capi-	Quantitative methods col-	Find the

risks and enhance rate of returns	tal Asset Pricing Model, Equity valuation (key financial ratio analysis), the dividend pricing approach, forecasting future dividends	laborated with scientific data analysis (numerical), documentary analysis and statistic analysis (sample selection)	market portfolio and use risk-free rate of interest and risk premium properly
IQ 4. What is diversification?	Various financial assets	Comparison	Diversified portfolio performs better or not

### 1.5 Demarkation

The research will focus on the methods to reduce risks involved in portfolio investment. Since the unsystematic risk can be decreased or even eliminated through low cost diversification, more focus will be casted on systematic risk.

### 1.6 International Aspect

The research will be carried out in form of evaluating securities both domestic and international. All the selected data come from global Stock Markets, such as National Association of Securities Dealers Automated Quote System (NASDAQ).



## 2 Portfolio analysis

### 2.1 Portfolio opportunity set

Considering the market risk elements, investors should cast net wide. In the market, real estate, stock, bond, U.S. Treasury government bills, options, forward and fund. Portfolio is a pool of different assets that investors hold in hope of getting returns. However, the investment on portfolio involves great risks.

The existence of risk means that the investor can no longer associate a single number or payoff with investment in any asset. The payoff must be described by a set of outcomes and each of their associated probability of occurrence, called a frequency function or return distribution.

(Elton, Gruber, Brown & Goetzmann 2003, 44.)

This distribution consists the expected return and the standard deviation (Elton et al. 2003, 44). These two items help investors to compare the rate of the return and measure the risks involved in portfolio investment.

#### 2.1.1 The return on individual security

Security refers to the financial instrument, which stands for future value of those assets. Equities, bonds, options, futures and funds all belong to security. Other instruments can be market transactions of interest such as those where currencies are exchanged or where instruments whose value depends on other financial variables are traded (Murphy 2008, 7).

In terms of the return, the income stream and changes in the value of the asset should be closely checked:

$$R1=(P1-P0)/P0+C1/P0=(P1-P0+C1)/P0$$

Where R1 is the return on a financial asset at the end of period 1; P1 is the price of a financial asset at the end of period 1; P0 is the price of a financial asset at the beginning of period 1; and C1 is the income received on the asset at the end of period 1.

(Pilbeam 2010,154.)

For example, at the beginning of 2015 the Nordea share's price was 8,52 €. The client bought 1000 shares. At the end of 2015, the value of the asset had risen to 9,44 €. Thus the percentage return on this asset is:

$$(9,44-8,52)/8,52 =11\%.$$

If the income on the share of 30 € was made for the period of whole year). The rate of return on this equity would be:

$$(9440-8520)/8520+30/8520=0,11$$

Usually the rate of return is on an annual base. Therefore, the investor would gain 11% return on this equity investment. (Bloomberg markets 2016.)

### 2.1.2 The expected return and dividends

The rate of return can be calculated from the current security price minus original price and then divided by the original price. Due to the fact that future market trend is hard to predict and investors expect returns for their investments, only expected return is reasonable to reach. Investors do not get return on daily basis. As stated by Keown, Martin & Petty (2011, 172.),

The probability of the future price of stock can be gained from equation:

$$f(P) = \frac{1}{sP\sqrt{2\pi T}} e^{-\frac{[\log(\frac{P}{P_0}) - (r-s^2/2)T]^2}{2Ts^2}}$$

The Probability of achieving a price P is calculated in four years' period on weekly basis. T = 10 weeks.

(Price probability 2016.)

Many short-term investors would pledge on trading-offs. As a result, long-term dividend yields are usually been neglected. In financial security investment, the dividend risk is also a crucial part of portfolio risk. The dividend policy is firmly akin to shareholders and managements' policy. The argument now for paying small rather than liberal dividends is not that the company "needs" money, bit rather that it can use it to the shareholders direct and immediate advantage by retaining the funds for profitable expansion. (Graham 1973, 489) It is also basic knowledge to separate dividend from stock split. The latter refers to the common-stock structure –issuing two or three shares for one (Graham 1973, 492). Investors gain income from cash flow through two methods: (1) Dividend payment; (2) increase in security's price. A dividend is the percentage of company's profit ained by its shareholders. DDM is commonly used method to get dividend.

# Dividend Discount Models: General Model

$$V_0 = \sum_{t=1}^{\infty} \frac{D_t}{(1+k)^t}$$

$V_0$  = Value of Stock

$D_t$  = Dividend

$k$  = required return

Figure1: Dividend discount general model (Slideplayer 2015.)

One-year holding period DDM example:

## One-year Holding Period DDM

$$V_0 = \frac{D_1}{(1+k_e)} + \frac{P_1}{(1+k_e)}$$

Last year's dividend	\$10
Next year's dividend	10% more
Stock price after 1 year	\$110
Required rate of return	15%

$$V_0 = \frac{11}{(1+0.15)} + \frac{110}{(1+0.15)} = \$105.22$$



Figure 2: One-year holding period DDM (Youtube 2012.)

Due to the fact that dividend payments and discount rate of return would not be the same, another model called as Gordon was very popular. Deriving from the core formula, the further equations (Khan 2015.) are listed as below:

If the current value of the dividend is  $D_0$ , then assuming a constant dividend growth rate of  $g$ , the dividend in year  $n$  will be  $D_n = D_0 * (1+g)^n$

Assuming we require a compound rate of return of  $r$ , the present value of the dividend in year  $n$  is  $P_n = D_0 * (1+g)^n / (1+r)^n$

This is a geometric series that gives a remarkably simple formula for the intrinsic value of a stock:  $P = D_0 (1+g) / (r-g)$

If the expected dividend in year 1 is  $D_1$ , then the equation can be further simplified to  $P = D_1 / (r-g)$

The Required Rate of Return

The Capital Asset Pricing Model is often used to estimate  $r$ .

The formula is  $R = R_f + (R_m - R_f) * \beta$

Where

$r_f$  is the risk-free rate

$r_m$  is the market risk premium

$\beta$  is the stock beta relative to a benchmark

Risk-free rate of discount is used for the bond, in Stock Market. Risk-free rate of return especially means there is no risk at all. U.S. Government Treasury bills for certain period are often used for risk-free rate. Another symbol-beta is useful in indicating the return of investment with the market return. The market risk premium is the extra return investor can gain from whopping increased risk.

The Gordon Growth Model lets you strip away any and all current market factors to give you an estimate of the intrinsic value of a company. However, by only capturing the effect of dividends, the model excludes all other factors – such as branding or a unique product

The model assumes that a company pays dividends (however, variants of the model route around this assumption by estimating what the dividend would be if it were paid).

The required rate of return must be larger than the expected dividend growth rate (otherwise, the intrinsic value would be negative).

The dividend growth rate must be estimated. This is speculative and risky, especially given the fact the intrinsic value can vary widely given small changes in the dividend growth rate.

The dividend growth rate is assumed to be constant in perpetuity.

The valuation is very sensitive to the difference between the required rate of return and the dividend growth rate. A small change in the difference can lead to a very different valuation.

## Gordon Growth Model in Excel

This Excel spread sheet helps you value a company using the Gordon Growth Model, using the CAPM approach for the required rate of return.

	A	B	C	D
1	<b>Gordon Growth Model</b>			
2	<a href="http://investexcel.net">http://investexcel.net</a>			
3				
4	<b>Parameters</b>			
5	Beta	1.15		
6	Dividend Growth Rate	0.064		
7	Dividends Paid in Year 0	2.7		
8	Risk-free rate	0.0235		
9	Market risk premium	0.1		
10				
11	<b>Intermediate Calculations</b>			
12	Required Rate of Return	0.11148		
13				
14	<b>Results</b>			
15	Valuation	60.5118		

Figure 3: Gordon growth model in excel (Investexcel 2015)

It's already populated with the data for Exxon Mobil.

30-year dividend growth rate: 0.064

3-year beta VS S&P 500: 1.15

Risk-free rate of 0.0235 (daily Treasury long term rate on 14 April 2015)

Market risk premium of 0.1

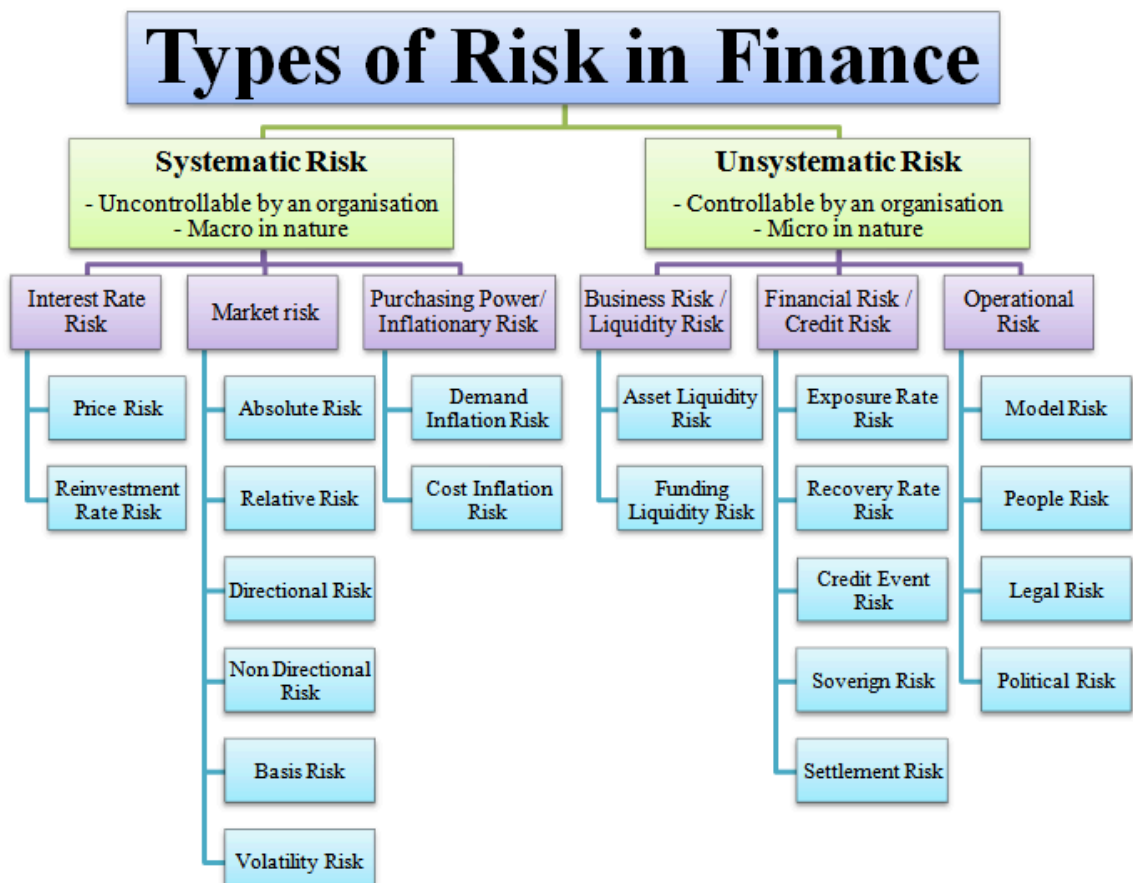
Total dividends paid out of 2.7 per share in 2014

## 2.2 Portfolio risk

### 2.2.1 The portfolio risk types

The portfolio risks can be defined as the possibilities of loss on investment. "The risk of a portfolio is measured by the ratio of the variance of the portfolio's return relative to the variance of the market return" (Eiteman, Stonehill & Moffett 2013, 440). In addition, risk

means for a particular client (Haslet & CFA 2010, 29). There are two types of risk in portfolio investment — systematic risk and unsystematic risk. The unsystematic risk can be reduced or eliminated through diversification. The unsystematic risk usually contains company or organisation issues, while the systematic risk is the market risk, which can not be foreseen and reduced. Generally speaking holding 20 pieces of assets is the maximum in diversifying away the unsystematic risk. Generally speaking, systematic risk is caused by macroeconomic issues, such as changes in interest rate, inflation rate and market risk. Among them, market risk can include absolute risk, relative risk, directional risk, non-directional risk, basis risk and volatility risk. On the other hand, unsystematic risk pertains to micro level, which means that internal factors prevailing within an organization affects the assets' value. It consists of business risk or liquidity risk, financial or credit risk, operational risk. Liquidity risk can be defined as asset liquidity risk and funding liquidity risk. Financial risk refers to exchange rate risk, recovery rate risk, credit event risk, non-directional risk, sovereign risk and settlement risk. Operational risk comprises model risk, people risk, legal risk and political risk. (Akrani 2012.)



**Figure 4: Types of financial risk (Akrani 2012.)**

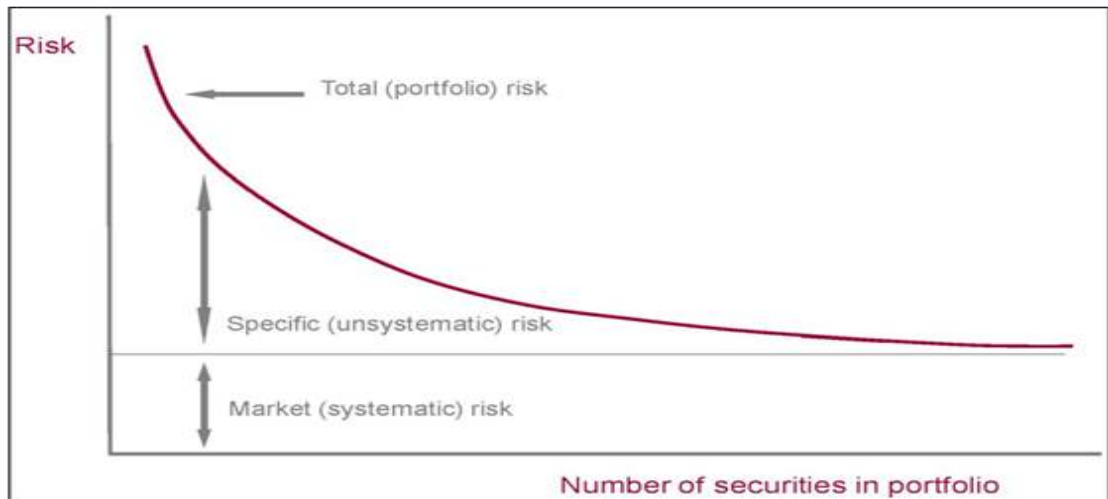


Figure 5: Risk (Academlib 2016.)

### 2.2.2 The Standard deviation and variance

The mostly used way to measure the risk in portfolio is to calculate the variance and standard deviation. Variance gauges the difference (both positive and negative) of random outcome from its mean (volatility) and use probability to get security value. Standard deviation  $\sigma$  (sigma) (squaring variance) manifests the dispersion of probability distribution around the mean. Theoretically, the dispersion of the standard deviation appears in bell shape around the mean expected return. The normal distribution example will be given in Figure 6.

#### NORMAL DISTRIBUTION EXAMPLE Mean = 10%; Standard Deviation = 5%



Figure 6: The normal distribution (Slideshare 2015.)

In this case, horizontal line stands for return and vertical line represents probability. The mean expected return is 10% and standard deviation is 5%. Due to the fact that this curve is symmetric, therefore, the chances of above and below of the mean is half-half. As the figure shows, 68,26% probability of actual return will fall into 1 standard deviation, while, 99,74% lies within two standard deviations of the expected return. This can be explained with example. According to figure 3, there is a 99,74% probability that the expected return will lie within the range 10% plus or minus twice of standard deviation. As a result, it would be the range among  $10\% \pm (2*5)=0\%$  to 20% and 68,26% probability that will lie in region of  $10\% \pm (1*5)=5\%$  to 15%.

Two measures of how the returns on a pair of stocks vary together are the covariance and the correlation coefficient.

(Business Finance Online 2016.)

Covariance shows whether investment sets have similar movement or not and what is the dependence degree. The more similar trend two variables have, the higher correlation they have.

The Covariance between the returns on two stocks can be calculated using the following equation:  $\text{Cov}(R_1, R_2) = \sigma_{12} = \text{Sum of } (R_{1i} - E(R_1)) * (R_{2i} - E(R_2))$

Where

$s_{12}$  = the covariance between the returns on stocks 1 and 2,

$R_{1i}$  = the return on stock 1 in state  $i$ ,

$E[R_1]$  = the expected return on stock 1,

$R_{2i}$  = the return on stock 2 in state  $i$ , and

$E[R_2]$  = the expected return on stock 2.

(Business Finance Online 2016.)

The Correlation Coefficient between the returns on two stocks can be calculated using the following equation:

$\text{Corr}(R_1, R_2) = \beta_{12} = \text{COV}(R_1, R_2) / \text{SD}(R_1) \text{SD}(R_2)$

Where

$r_{12}$  = the correlation coefficient between the returns on stocks 1 and 2,

$s_{12}$  = the covariance between the returns on stocks 1 and 2,

$s_1$  = the standard deviation on stock 1, and

$s_2$  = the standard deviation on stock 2.

(Business Finance Online 2016.)



### Covariance and Correlation Coefficient between the Returns on Stocks A and B

Note:  $E[RA] = 12.5\%$ ,  $E[RB] = 20\%$ ,  $s_A = 5.12\%$ , and  $s_B = 20.49\%$ .

$$\sigma_{AB} = .2(.05 - .125)(.5 - .2) + .3(.1 - .125)(.3 - .2) + .2(.15 - .125)(.1 - .2) + .2(.2$$

$$\sigma_{AB} = -.0105$$

$$\rho_{AB} = \frac{-.0105}{(.0512)(.2049)} = -1$$

**Figure 7: Covariance and correlation coefficient (Business Finance Online 2016.)**

Using either the correlation coefficient or the covariance, the Variance on a Two-Asset Portfolio (Business Finance Online 2016.) can be calculated as follows:

$$\begin{aligned}\sigma_P^2 &= (w_1)^2 \sigma_1^2 + (1 - w_1)^2 \sigma_2^2 + 2w_1(1 - w_1)\rho_{12}\sigma_1\sigma_2 \\ &= (w_1)^2 \sigma_1^2 + (1 - w_1)^2 \sigma_2^2 + 2w_1(1 - w_1)\sigma_{12}\end{aligned}$$

Where

W=Weighted average of asset

$\sigma$ =The standard deviation on the portfolio equals the positive square root of the the variance.

### Variance and Standard Deviation on a Portfolio of Stocks A and B

Note:  $E[RA] = 12.5\%$ ,  $E[RB] = 20\%$ ,  $s_A = 5.12\%$ ,  $s_B = 20.49\%$ , and  $r_{AB} = -1$ .

Portfolio consisting of 50% Stock A and 50% Stock B

$$\sigma_P^2 = (.5)^2 (.0512)^2 + (1 - .5)^2 (.2049)^2 + 2(.5)(1 - .5)(-1)(.0512)(.2049) = .00591$$

$$\sigma_P = \sqrt{.00591} = .0768 = 7.68\%$$

Portfolio consisting of 75% Stock A and 25% Stock B

$$\sigma_P^2 = (.75)^2 (.0512)^2 + (1 - .75)^2 (.2049)^2 + 2(.75)(1 - .75)(-1)(.0512)(.2049) = .00016$$

$$\sigma_P = \sqrt{.00016} = .0128 = 1.28\%$$

**Figure 8: Variance and standard derivation (Business Finance Online 2016.)**

Notice that the portfolio formed by investing 75% in Stock A and 25% in Stock B has a lower variance and standard deviation than either Stocks A or B and the portfolio has a higher expected return than Stock A. This is the essence of Diversification, by

forming portfolios some of the risk inherent in the individual stocks can be eliminated.

**Example Problems**

	Stock 1	Stock 2	
Ex-pected Return:	<input style="width: 80%;" type="text" value="12.5"/> %	<input style="width: 80%;" type="text" value="20"/> %	
Standard Devia-tion:	<input style="width: 80%;" type="text" value="5.12"/> %	<input style="width: 80%;" type="text" value="20.49"/> %	
Correlation Coefficient:		<input style="width: 80%;" type="text" value="-1"/>	
<input style="width: 150px; height: 25px;" type="button" value="New Problem"/> <input style="width: 150px; height: 25px;" type="button" value="Calculate"/> <input style="width: 80px; height: 25px;" type="button" value="Help"/> <input style="width: 100px; height: 25px;" type="button" value="Clear"/>			
<b>Portfolio</b>			
Weight	Expected Return	Variance	Standard Deviation
1			
<input style="width: 60px; height: 25px;" type="text" value="50"/> %	<input style="width: 80px; height: 25px;" type="text"/>	<input style="width: 80px; height: 25px;" type="text"/>	<input style="width: 80px; height: 25px;" type="text"/> %

**Figure 9: Portfolio variance and correlation coefficient (Business Finance Online 2016.)**

### 2.3 Investor's risk aversion

There are three types of investors, to name, risk –averse, risk indifferent and risk-seeking investors.

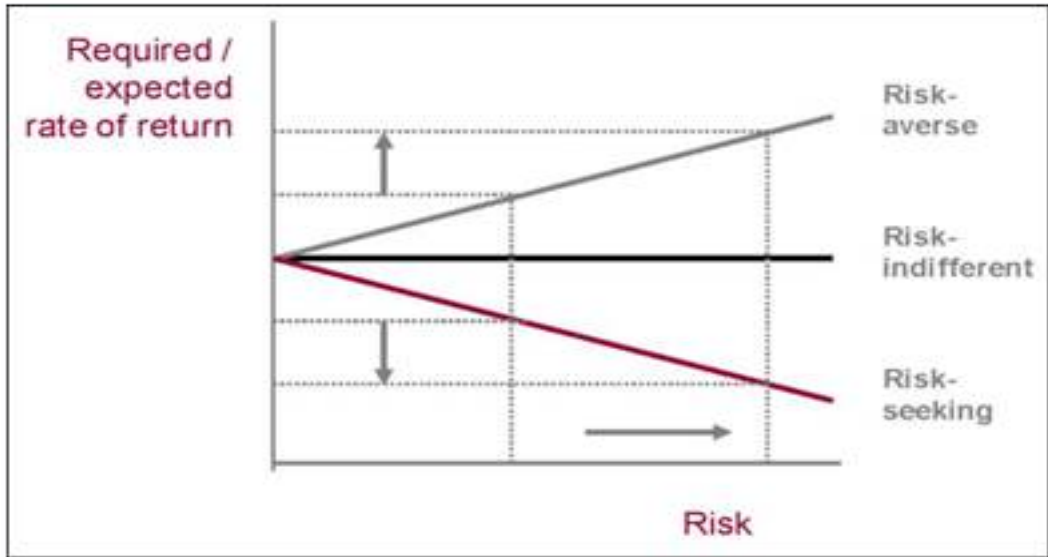
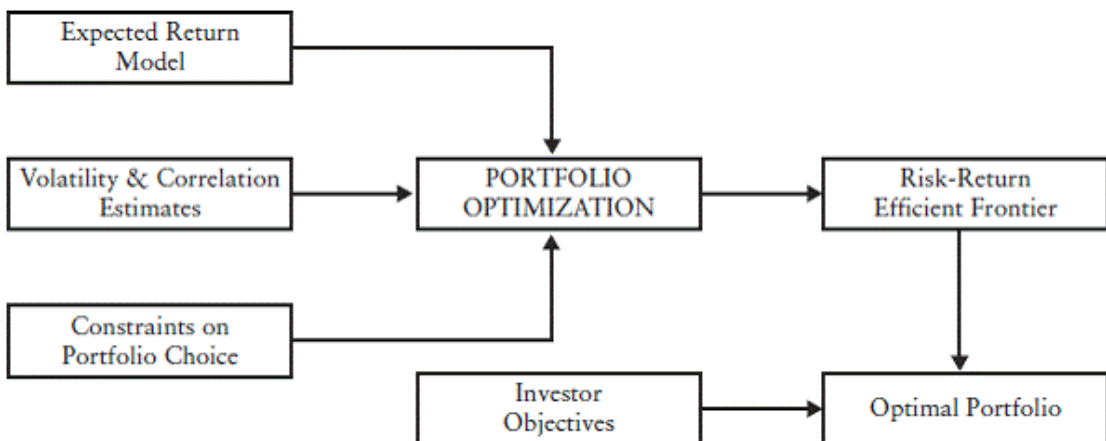


Figure 10: Risk profile (Academlib 2016.)

## 2.4 The portfolio theories

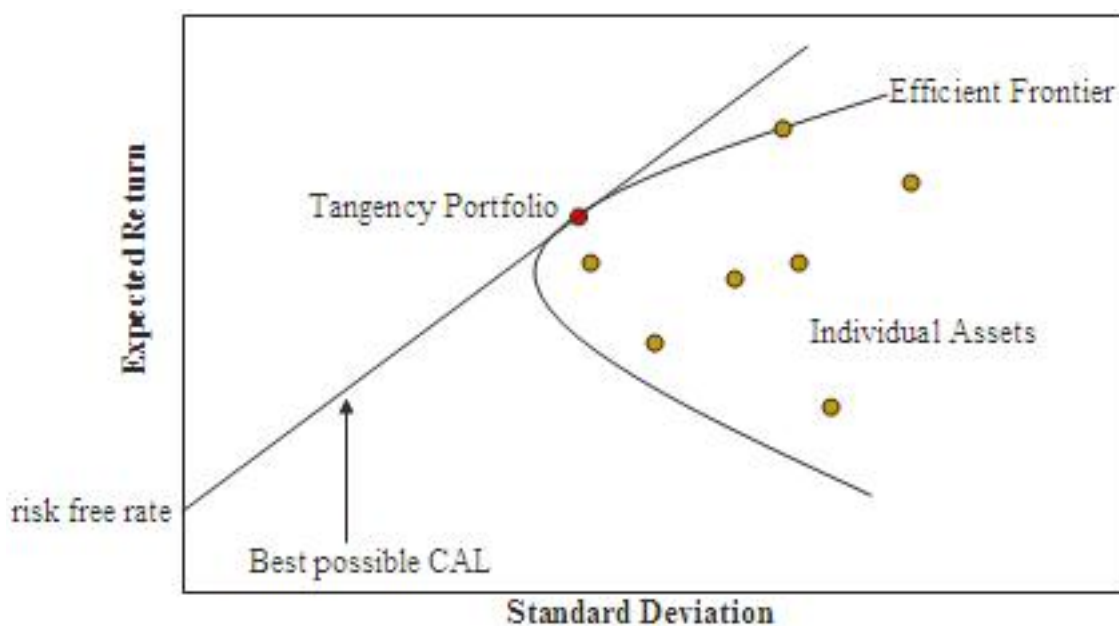
### 2.4.1 Harry Markowitz portfolio theory

The Nobel Prize winner Harry Markowitz published Portfolio Selection, which constituted the major part of mean-variance analysis, mean-variance optimization and Modern portfolio theory (MPT). Mean-variance portfolio optimization is largely used for quantitative aims. Portfolio Selection is a normative theory comparing to positive theory such as capital asset pricing model. Normative theories focus on establishing a standard for investors to pursue in forming portfolio. On the other hand, positive theories derive the implications of hypothesized investor behaviour. As a result, the positive theory depends on the idealized assumptions. (Fabozzi, Kolm, Pachamano & Focardi 2007, 17.)



**Figure 11: The MPT investment process (Fabozzi, → & al.)**

The two main idea of Markowitz theory are: (1) Diversification is the ideal way of managing risk. (2) Investors act, when allocate wealth, in a two- dimensional space (Braga 2016, 4). Harry Markowitz brought up the concept of the efficient frontier. It is the mixed sets of portfolios each with the feature that no other portfolio exists with a higher expected return but with the same standard deviation of return. In other word, one portfolio might overcome another portfolio by rendering either a higher expected rate of return (assuming same standard deviation) or a lower standard deviation (assuming the rate of return stays the same). The so-called “efficient” here refers to the assets, which has the best possible expected level of return for its level of risk. Definitely, the higher rate of return and lower risk provides better return. Therefore, investors should focus only the upper part of the curve. The risk is measured by the standard deviation of the portfolio’s return. As shown in figure 12, when the investors buy non risk-free assets, then the efficient frontier can be drawn in upward sloped portion. By contrast, in the case of risk-free assets, the efficient frontier is shown in straight line. (Wikipedia 2016.)



**Figure 12: The Markovitz Efficient Frontier (Euronomist 2013.)**

#### **2.4.2 Eugene Fama portfolio theory**

Another Nobel Prize winner Eugene Fama had developed the efficient-market hypothesis (EMH). The highlight of Fama’s theory is the efficient that is the price of the asset is the mirror of the all combined information on its future value. Informational efficiency means

one and only one thing: prices reflect available information. (Cochrane 2014.) Fama insists that there is no way investor can obtain high profit without taking high risk or chances. Three main variances constitute his theory. Weak-form efficiency means that future prices cannot be predicted by analysing past prices or past returns. Semi-strong form efficiency, as name indicates, presents that share prices adjust to publicly available new information very quickly and in an unbiased fashion, such that no excess returns can be earned by trading on that information. Last but not least, strong-form efficiency added more values to the above two points that share prices reflect all information, public and private, and no one can earn excess returns. (Euronomist 2013.) Although Fama's theory demonstrated many stock events, however, capital asset pricing model (CAPM) had explained some neglected stocks high return phenomenon (Wikipedia 2016.)

In the journal of testing the weak-form efficiency of Finnish and Swedish stock markets by Shaker (2013, a serial correlation test, an Augmented Dicky-Fuller (ADF) test and variance ratio test were applied to find out the efficiency form of these two Nordic countries. The tests were performed under ten years' daily the OMX Helsinki and OMX Stockholm indices data from 2003 to 2012. In general, the results pointed to the fact that prices and returns do not follow random walks in any of the two countries. Thus the conclusion that both two countries' stock market are not weak from efficient were drawn. (European Journal of Business and Social Sciences 2013, 176.) Instead, Finnish stock market tends to be semi-strong form efficiency.

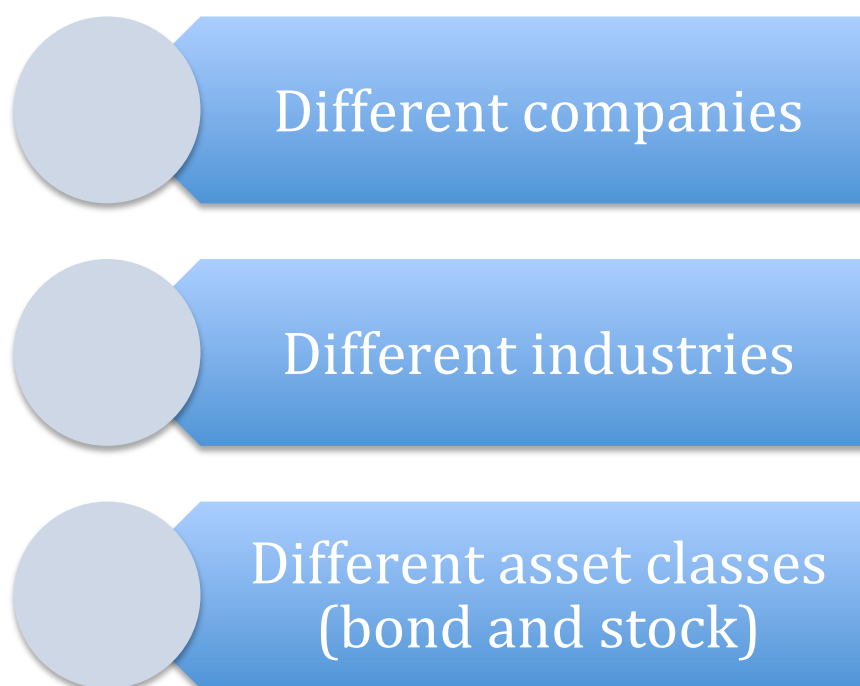
Finnish share market is just one small part of Nordic countries reflection. Comparing with USA's stock market, it is as tiny as its population. However, the relation with Nasdaq and Helsinki Nasdaq is close. When there was financial crisis, the big wave involved all other international markets. The empirical findings relating to the level of segmentation of the Finnish stock market to Swedish and U.S. stock markets was discovered in the report written by Martikainen, Virtanen and Yli-Olli. The report's model reveals that many Finnish securities have significant Swedish risk components from, while the later-relation between Finnish and American stock markets is relevantly lower. The model also illustrates that cross-sectional variation in systematic risk components can largely be appointed to industry differences across firms, which explains the international systematic risk components' influences on Finnish stock markets. (Martikainen, Virtanen & Yli-Olli 1991, 2.)

### 3 Portfolio risk management

#### 3.1 International diversification

Usually, the international diversification of portfolio consist of two parts: (!) holding international securities and (2) added foreign exchange risk. (Eiteman, Stonehill & Moffett 2013, 440.) The key of this study is on the international side. The research will expand from domestic share into international shares. To start with, this paper will integrate two fundamental components into diversification theory, to say, solving the specific risk by combing two financial assets so as to manifest diversification theory and finding the efficient set exposed under the market risk by measuring with riskless security and the market portfolio.

Broadly, there are many types of diversification.

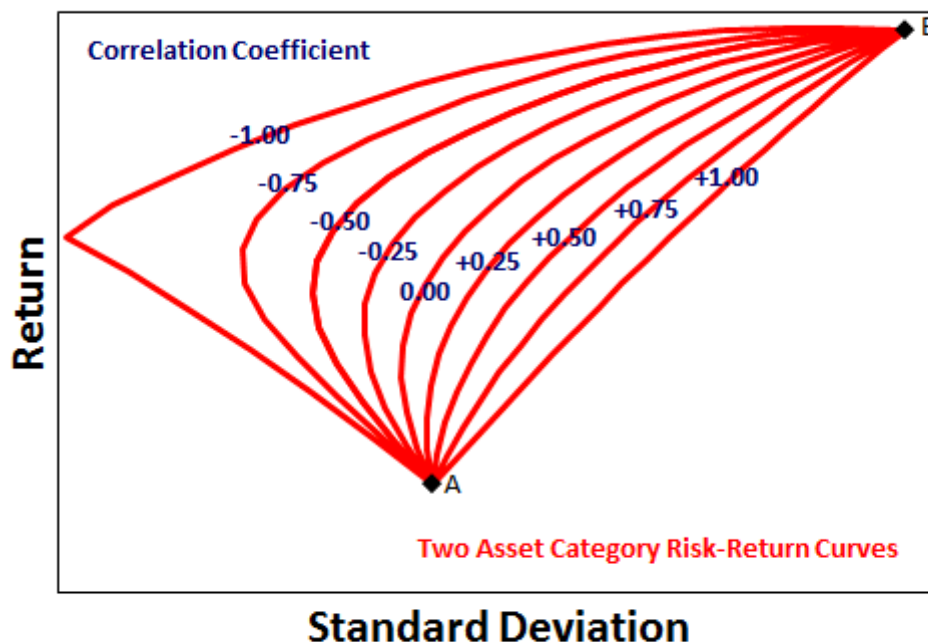


**Figure 13: Diversification types**

##### 3.1.1 The two-asset efficiency frontier and the minimum variance

Portfolio specific risk can be reduced or even eliminated through low-cost diversification. The common practice among investors is to find the efficiency frontier for the mix of two assets (asset A and asset B). The efficiency frontier as depicted in Figure 12 is the optimal rate of return gained from portfolio for a certain level of risk or smallest risk for a given rate of return. Total portfolio risk is represented by square of standard deviation, consider-

ing the possibility of both negative and positive result. There are millions of ways to combine two assets. The experienced investors choose efficiency frontier to locate the optimized return of the unit of two assets. The efficient frontier gives all the possibilities of efficient portfolios.

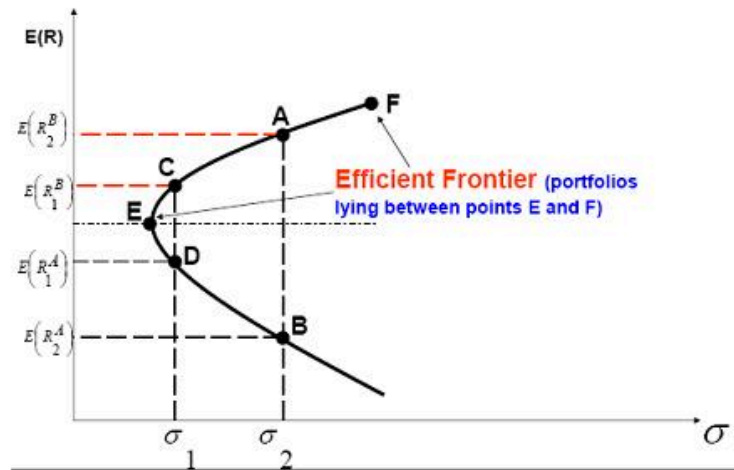


**Figure 14: The mean – standard deviation frontier for different values of the correlation coefficient (Emarotta 2016.)**

As we can see from Figure 13, if the correlation is negative, then the portfolio combination provides best diversification value. The more positive it goes, the less worth the diversification value is.

### 3.1.2 The efficiency frontier with N securities and its variance

This is just the theory when there are only two securities, but in reality portfolio usually includes N number of securities. The following figure represents the portfolio efficiency frontier when there is more than two assets in portfolio.



**Figure 15: The portfolio efficiency frontier with N securities (Analystnotes 2016.)**

The portfolio weights are given in an N vector ( $w$ ) where  $w_i$  is the percentage holding of asset class  $i$ .  $E(R_p)$  is the expected rate of return.  $\sigma$  is the covariance. (Braga 2016, 23.)

$$E(R_p) = \sum_{i=1}^N w_i E(R_i)$$

$$\text{Variance of portfolio } \sigma_p^2 = \sum_{i=1}^N w_i (1-w_i) \sigma_{ij}$$

It would be worthwhile to see the optimum portfolio, in other words, maximum expected return for a given level of risk or minimum risk for a given rate of return.



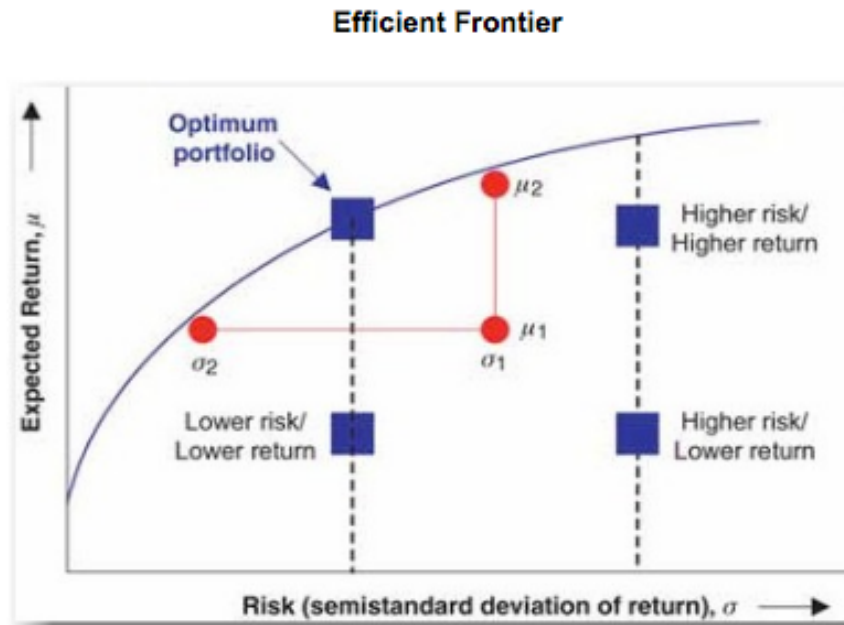


Figure 16: Efficient frontier with optimum portfolio (Mhj3 2016.)

### 3.1.3 The efficient set with riskless security

So far, the theories brought out are limited in the selection of the efficient portfolio set. James Tobin (1958) extended Markowitz's analysis by allowing riskless security to be included. With riskless security, the investor can both lent and borrowed at the same risk-free rate of interest.

## Portfolio Possibilities Combining the Risk-Free Asset and Risky Portfolios on the Efficient Frontier

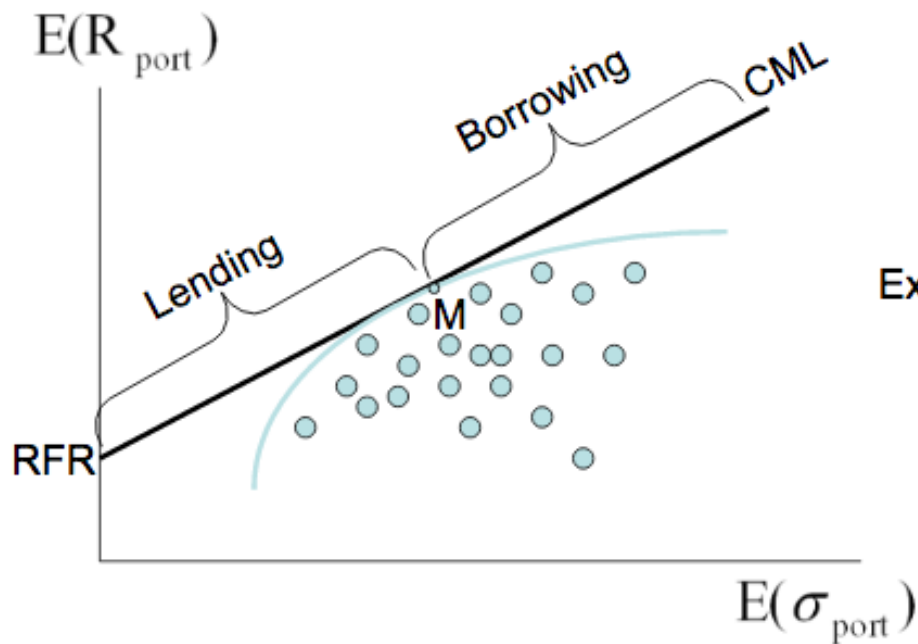


Exhibit 8.2

**Figure 17: Risk-return possibilities with leverage (Slideplayer 2016.)**

Figure 16 suggests that investor borrow from risk-free rate asset to invest on more risky asset M. With growing risk, investors are looking for bigger return.

### 3.1.4 The market portfolio

From Figure 17, M is the market portfolio. It is said to be the portfolios' value similar to the market real value. Most security purchaser use it to get trade-off in return and risk. The idea behind is that to use difference between risk-free rate of return and the market portfolio to be divided by the standard deviation of the market rate of return. Therefore, the expected rate of return on portfolio can be related to the CML. In form of equation:

$$E(R) = R_f + \sigma^* [(R_m - R_f) / \sigma_m]$$

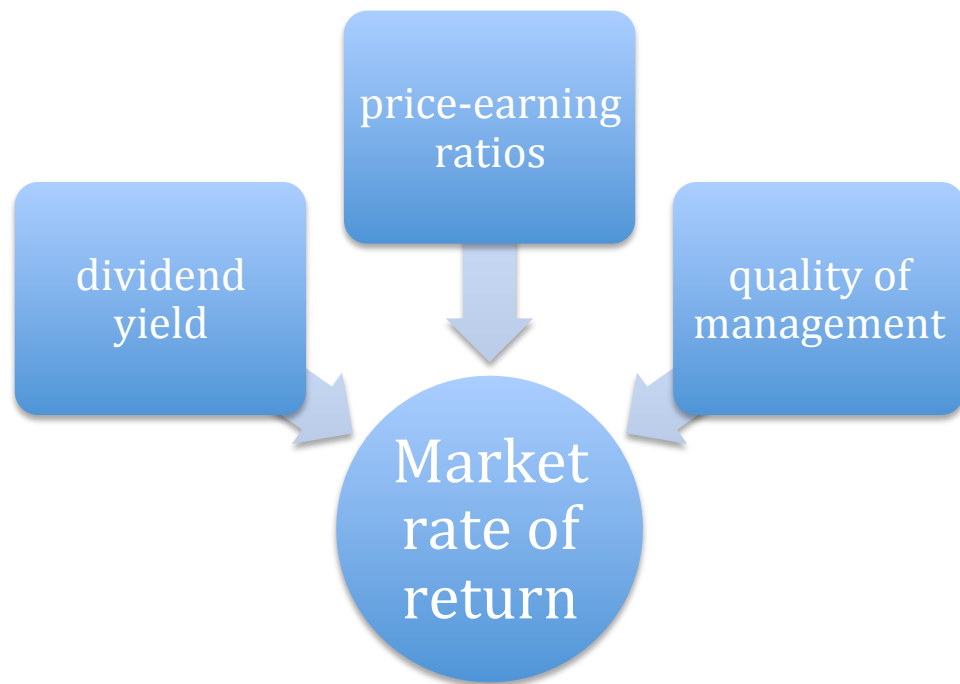
### 3.2 The market Models

The Markowitz model may offers solution for portfolio with two securities. Other theories, such as, William F. Sharpe (1963) includes more securities, which represents as benchmark on rating the percentage of excess return gained from excess risk per unit of total risk. (Diderich 2009, 164.)

Sharpe ratio  $r = (\text{expected portfolio return} - \text{risk-free rate of return}) / \text{portfolio standard deviation}$ .

The Sharpe's market model can be understood as if a share has a beta equal to one happens to have similar movement as the whole market. If  $\beta > 1$ , then the share is more volatile than the market and vice versa.

Influences in Sharpe's model:



**Figure 18: Sharpe's model influence factors**

### 3.2.1 The capital asset pricing model theory

The CAPM fixes the dispute that Sharpe's model lacks theoretical base. Since all the investors want to gain a rate of return from the difference between expected future cash flow and current low price of share. The capital asset pricing model is commonly used to get required rate of return. The basic idea underpins the CAPM is that investors receive risk premium for the systematic risk beside of risk-free of interest.

Considering there are both risk-free asset and risky asset and the risk-free asset does not produce risk, so only the systematic risk left for the market to place a price on it. In return, the expected return gives hint on the price of security. The key assumptions in the CAPM:

- 1: In the marketplace, the securities are traded highly efficiently, which means that the price of portfolio reflects all the available information on the publicity of Stock Market;
- 2:

The CAPM assumes that all the trades happen in a perfect market. In other words, all

information is available to investors in nominal cost; security can be divided and sold and all investors are price takers. (Keown, Martin & Petty 2011, 177.)

## CAPM formula

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

$E(R_i)$  = expected return on an asset i

$R_f$  = risk-free rate

$\beta_i$  = beta of asset i; a measure of systematic risk

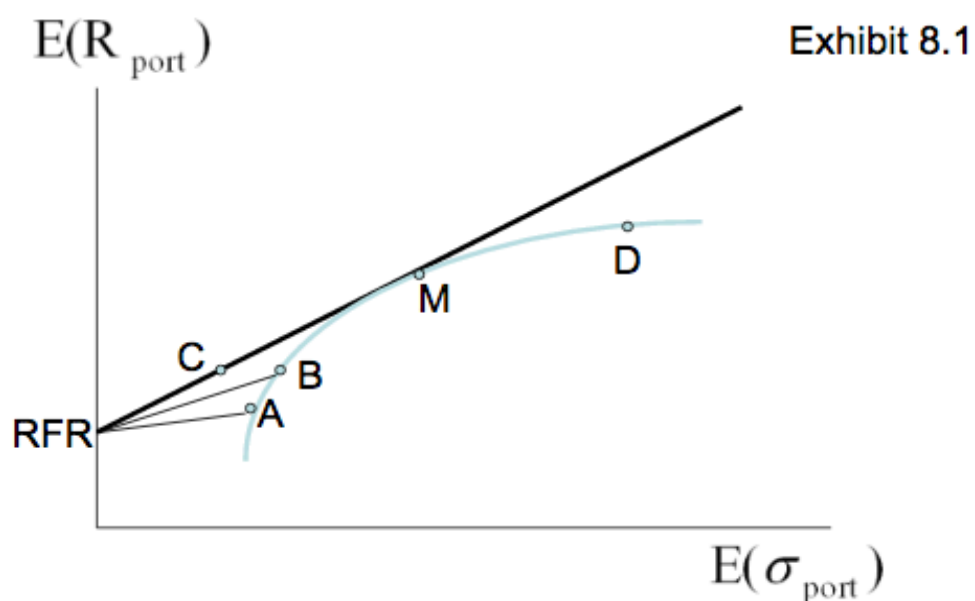
$E(R_M)$  = expected return on the market portfolio that contains all assets

$E(R_M) - R_f$

= Market risk premium, a measure of the excess return of the market portfolio over the risk-free rate

Figure 19: CAPM formula ( Slideplayer 2016.)

## Portfolio Possibilities Combining the Risk-Free Asset and Risky Portfolios on the Efficient Frontier



**Figure 20: Portfolio possibilities (Slideplayer 2016.)**

The straight line is known as the capital market line. From this line, we can defer the trade-off between risk and return occurred in investment. The capital market line supplies with pricing method for efficient portfolio by associating the market portfolio with the risk-free security. The securities market line (SML) offers wider purpose on securities which are exclusive from CML. SML is the light tower for investors to value the minimum return on basis of market reflected systematic risk. Here beta works wonder. Beta is the slope of the line to see how is the return on portfolio compared to the market value.

The capital asset pricing model in equation:

Expected rate of return = risk-free rate of return + risk premium

Or

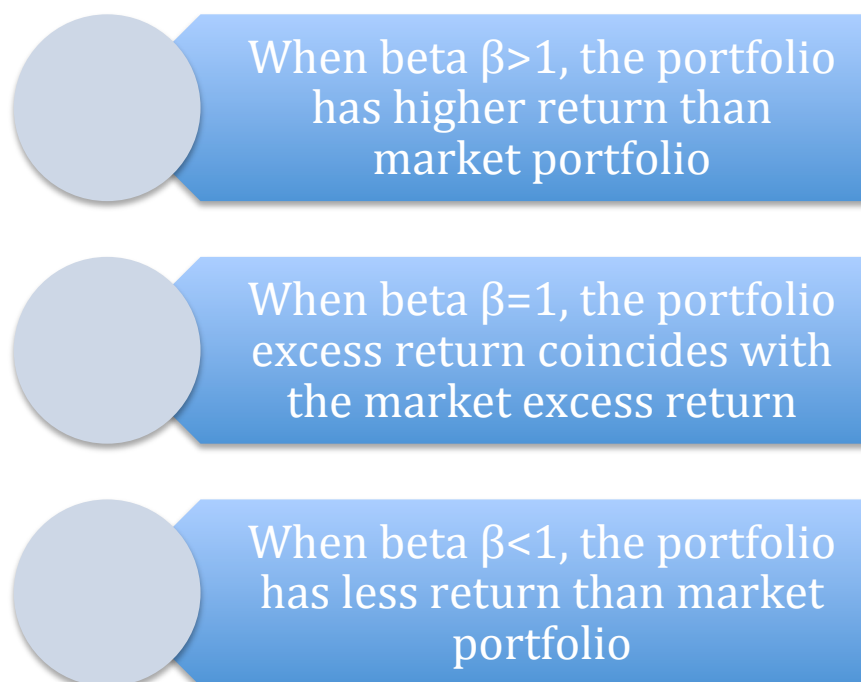
Expected rate of return = risk-free rate of return + beta for individual security \* ( Expected rate of return on the market portfolio – risk-free rate of return)

(Where the beta for individual security equals standard deviation of individual security / standard deviation of the market portfolio)

**Table 2: Beta decides security type**

$\beta_{im} < 1$	$\sigma_i^* \beta_{im} < \sigma_m$	Defensive securities
$\beta_{im} > 1$	$\sigma_i^* \beta_{im} > \sigma_m$	Aggressive securities

The CAPM equation tells that the excess return above the risk-free rate of interest on a portfolio is a function of the beta of the portfolio and the difference between the market rate of return and the risk-free rate of interest.



**Figure 21: The beta reflection on excess return of portfolio and market**

**Table 3: Regression analysis of five shares A-E**

Share	Beta	Specific risk $e_i$	Annual return (%)
A	0,6	0,25	20
B	0,8	0,35	15
C	0,7	0,55	7
D	1,1	0,30	18
E	0,9	0,4	10

### 3.2.2 Empirical testing of CAPM

A typical empirical estimation of the CAPM involves looking at portfolio betas.

$$E(R_p) = \beta_p * E(R_{Pm})$$

Then empirically a regression would be run such that:

$$R_p = a + b(R_{Pm}) + e_p$$

Where  $R_{Pp}$  is the excess return on the portfolio above the risk-free rate of interest;  $R_{Pm}$  is the market risk premium (excess return on the market over risk-free return); and  $e_p$  is the specific (unsystematic risk) risk on the portfolio. The intercept term is captured by the parameter  $a$ , and the empirical estimate of beta by  $b$ .

The CAPM makes the following five key predictions:

- 1: The intercept term  $a$  should be equal to zero; if it were non-zero then it would mean that the CAPM model is missing something as a complete explanation of a portfolio's excess return.
- 2: The beta coefficient should be the sole explanation of the rate of return on the risky portfolio. The estimated slope  $b$  should be positive and not differ significantly from the risk premium on the market portfolio,  $R_{Pm} = R_m - R^*$ .
- 3: There should be a linear relationship given by beta between the average portfolio risk premium and the average market risk premium.
- 4: Over time,  $R_m$  should  $> R^*$ , since a market portfolio is riskier than the risk-free asset.
- 5: Other explanatory variables such as dividend yield, firm size and price-earnings ratios should not prove to be statistically significant in predicting the required rate of return.

(Pilbeam 2010, 195.)

Bunch of empirical studies on the CAPM show the following results:

- 1: The estimated intercept term,  $a$ , tends to be significantly different from zero, contrary to prediction 1.
- 2: The estimated slope  $b$ , while positive tends to be less than the difference between the market rate of return and the risk-free rate of interest, contrary to prediction 2.
- 3: Prediction 3 & 4 seem valid.
- 4: Contrary to prediction 5, it is possible to find other factors that can explain a portfolio's excess return.

(Pilbeam 2010, 191.)

### 3.2.3 The arbitrage pricing theory and critique of CAPM

Pilbeam (2010, 197) points out that the main challenge from the arbitrage pricing theory (APT) is that the only beta is not enough to reflect the market risk as stated in the CAPM. The APT put forward K as numbers of other systematic factors, which affect the market risk. The APT also believes that those factors are in linear relationship with the rate of return, though the content of those factors were not mentioned.

$$E(R_i) = R^* + \beta_{i1} E(RP_{f1}) + \beta_{i2} E(RP_{f2}) + \dots + \beta_{ik} E(RP_{fk})$$

Where  $E(R_i)$  is the expected return on security I;  $R^*$  is the risk-free rate of interest;  $\beta_{ik}$  is the sensitivity of security I to the k factors;  $E(RP_{fk})$  is the risk premium associated with each of the systematic k factors.

Those factors can be exchange - rate and interest-rate risk those economical things.

Another arbitrage theory is linear programming put forward by Scherer and Martin (2005, 1). This theory aims for checking for arbitrage in security returns using linear programming techniques. Assuming all assets for trading cost one monetary unit, but expected rate of return in different states of the world differ.

Matrix S of gross returns =  $1 + R_{mn}$

Where m is the states around the world and n is the number of assets.

## 4 Portfolio development

The portfolio theories provide explanation for minimizing risks on portfolios from those comprise with two assets to those postulated by N securities. Diversification means that investors have more than just one security. When the separate security moves in different directions, in this case the diversification works, then investors can reduce or eliminate the unsystematic risk. The measure of the rest systematic risk can be shown in beta. Beta exhibits the connection of portfolio return and market return.

### 4.1 Problems and goal

Although both diversification and the CAPM are handy in solving some issues, diversification can't diversify away the systematic risk and the CAPM can't include other factors. Meanwhile, the CAPM requires standard deviation and the market index, so the APT comes up. The goal is to find ways fix the insufficient in former theories and find the best way to decrease the risk in portfolio investing.



## **4.2 Methodological choices and project plan**

The methodology used for thesis is quantitative methods. This entails documentary analysis. The data necessary are picked from existing history of stock trading market and Bloomberg. Empirical studies are extra bonus.

## **4.3 Data and analysis methods**

Data is analyzed in quantitative methods. Besides, scientific data analysis method (numerical), documentary analysis and statistic analysis method (sample selection) also equip the study.

## **4.4 Chosen stocks and findings**

The theory of diversification and risk measurement is tested by selected different securities in the same sectors. The data are extracted from historical record from Bloomberg terminal in the past five-year's period and monthly basis. What's more, corporation's investor page and multi stock exchange market were reached for further information. The stocks were chosen from energy oil section. Portfolio A is Wärtsilä OYJ Abp listed on OXM Helsinki Stock Market. Portfolio B is CGG. CGG ordinary shares are available from both the Euronext (compartment A) Paris Stock Market and CGG American Depositary shares (ADSs/ADR) are listed on the New York Stock Exchange Market (NYSE). 1 ADR = 1 share of common stock. Portfolio C is ExxonMobil, which includes XOM:US NEW YORK, XONA:GR XETRA STARS and EXXO34:BZ BM&FBOVESPA. ExxonMobil common stock is listed on the New York Stock Exchange (NYSE).

**Table 4: Security and Stock market listed**

Portfolio A		Portfolio B		Portfolio C	
Wärtsilä OYJ	OXM Helsinki Stock Mar- ket	CGG France	Euronext Paris Stock Market	ExxonMobil XOM US	New York Stock Ex- change Market (NYSE)
		CGG Amer- ican De- pository shares (ADSs)	New York Stock Ex- change Market (NYSE)	ExxonMobil XONA:GR XETRA STARS	New York Stock Ex- change Market (NYSE)
				ExxonMobil EXXO34:BZ BM&FBOVESPA	New York Stock Ex- change Market (NYSE)

**Table 5: Weighted average of security in portfolio**

Portfolio A		Portfolio B		Portfolio C	
Stock	Weight	Stock	Weight	Stock	Weight
WÄRTSILÄ	100%	CGG:FR	50%	XOM:US NEW YORK	33,3%
		CGG:NY	50%	XONA:GR XETRA STARS	33,3%
				EXXO34:BZ BM&FBOVESPA	33,3%

Table 6 shows the return of two securities in different region. The source of data is from Bloomberg terminal and Nasdaq stock market.

**Table 6: Monthly holding-period returns and standard deviation Portfolio A and B**

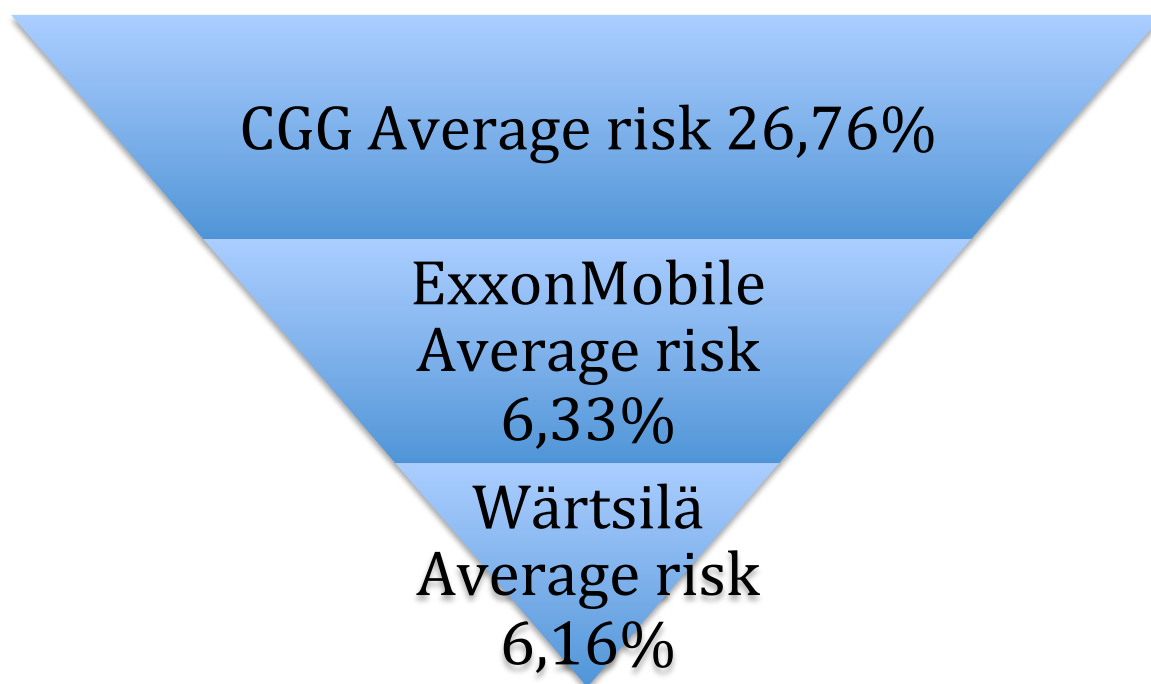
Monthly holding-period returns, Wätsilä versus CGG Nov 2014-Nov 2015						
Month and year	Wätsilä		CGG		ADSS	
	Price (euro)	Returns %	Price (euro)	Returns%	Price (dollar)	Returns%
2014						
Nov	38,41		81,96		211,52	
Dec	36,76	-4,30%	130,22	58,88%	320,64	52%
2015						
Jan	42,15	14,66%	77,85	-40,22%	185,28	-42%
Feb	39,8	-5,58%	92,37	18,65%	214,72	16%
Mar	38,63	-8,35%	98,69	26,77%	217,6	17%
Apr	39,38	1,94%	87,02	-11,82%	192,64	-11%
May	36,34	-5,93%	101,98	3,33%	231,36	6%
Jun	38,31	5,42%	95,53	-6,32%	216	-7%
July	38,01	4,60%	77,52	-23,99%	282,72	22%
Aug	38,06	0,13%	64,15	-17,25%	146,24	-48%
Sep	37,41	-1,58%	62,65	-19,18%	141,12	-50%
Oct	40,62	8,58%	49,06	-21,69%	151,04	7%
Nov	38,24	2,22%	53,17	-15,13%	117,76	-17%
<b>Average return</b>		0,99%		-4,00%		-4,56%
<b>Standard deviation</b>		6,16%		24,94%		28,58%
Covariance of CGG and ADSS						0,0570

Note: we assume that these two securities have same probability due to the fact that all the data used are based on historical record.

**Table 7: Monthly holding-period returns and standard deviation Portfolio C**

Monthly holding-period returns, ExxonMobil Nov 2014-Nov 2015						
Month and year	XOM		XONA		EXXO34	
	Price(dollar)	Returns %	Price(dollar)	Returns%	Price(dollar)	Returns%
2014						
Nov	96,59		77,82		61,35	
Dec	93,82	-2,87%	76,45	-1,76%	61,6	0,41%
2015						
Jan	92,83	-1,06%	77,05	0,78%	61,19	-0,67%
Feb	91,5	-1,43%	80,75	4,80%	63,2	3,28%
Mar	85,63	-7,76%	79,3	2,92%	65,86	7,63%
Apr	84,3	-1,55%	77,5	-2,27%	66,36	0,76%
May	88,85	3,76%	79,29	-0,01%	66,59	1,11%
Jun	84,28	-5,14%	75,78	-4,43%	66,87	0,42%
July	83,14	-6,43%	74,7	-5,79%	65,09	-2,25%
Aug	76,83	-7,59%	70	-6,29%	67,91	4,33%
Sep	72,46	-12,85%	65,03	-12,95%	69,86	7,33%
Oct	75,88	4,72%	71,84	10,47%	74,82	7,10%
Nov	84,47	16,57%	77,87	19,74%	79,2	13,37%
<b>Average return</b>		-1,80%		0,44%		3,57%
<b>Standard deviation</b>		7,00%		7,83%		4,16%
Covariance XOM & XONA						0,0053
Covariance XOM & EXXO						0,0013
Covariance EXXO & XONA						0,0020

From Table 6 and table 7, standard deviations of each security are given. Since the standard deviation represents as the risk of the portfolio. Thus, the order of the risk can be arranged as follow:



**Figure 22: Risk order of three portfolios**

Therefore, here are the findings:

1: Standard deviation is closely related to the monthly returns. Especially, the figure of standard deviation varies as the chosen period for calculation differs. CGG France and CGG US covariance is 57%, however any combination of two securities from ExxonMobil is lower than 57%. Hence, it can be concluded that ExxonMobil portfolio combination has better diversification result than CGG, though CGG is more internationally diversified. In this case, it suggests that ExxonMobil has less risk than CGG in the one- year period from November 2014 to November 2015. As for the risk, the standard deviation measures volatility of the return on portfolio. So ExxonMobil has more frequent move and more risky for investors. Considering the fact that during 2014 to 2015, ExxonMobil has higher average return than CGG. Due to the fact that standard deviation is gained by measuring the difference of every month return with average return. Therefore, ExxonMobil has lower standard deviation naturally. In order to demonstrate this, when looking into period November of 2012 to November of 2013, CGG has higher average return, then the standard deviation will be the other way around. It is interesting to see that Wärtsilä has the lowest risk. That is because Wärtsilä has rather high average return during November of 2014 to November of 2015. This helps lower the standard deviation.

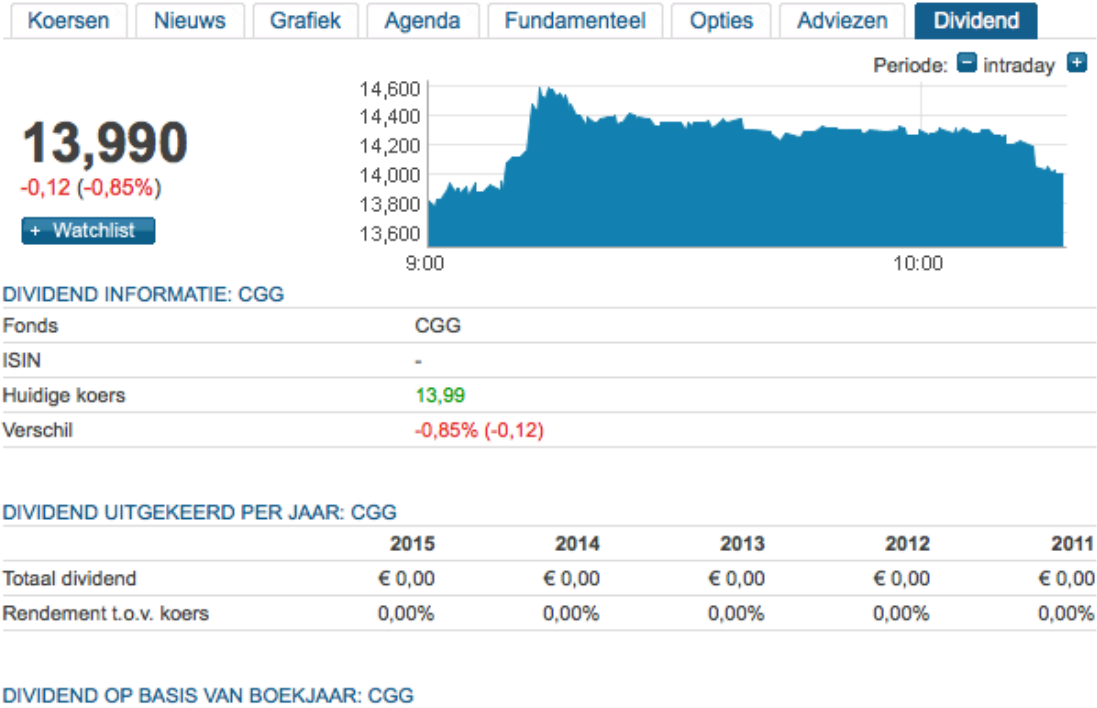
2: It is also important to bear in mind that the average return is highly connected to the dividend policy. The order of average dividend paid during November 2014 to November 2015 is CGG 0 € < Wärtsilä 1,18 < ExxonMobil 2,79 €. CGG did not pay dividend, instead the corporation use this retained earning for future investment. In long term, the dividend profit from CGG would be higher. This would lead to the false image that CGG is more risky for shareholders. On contradictory, ExxonMobil paid highest dividend. This would reward investors and give good impression among shareholders on the company's risk assessment.

According to Gordon growth model, the dividend effect can be discovered.

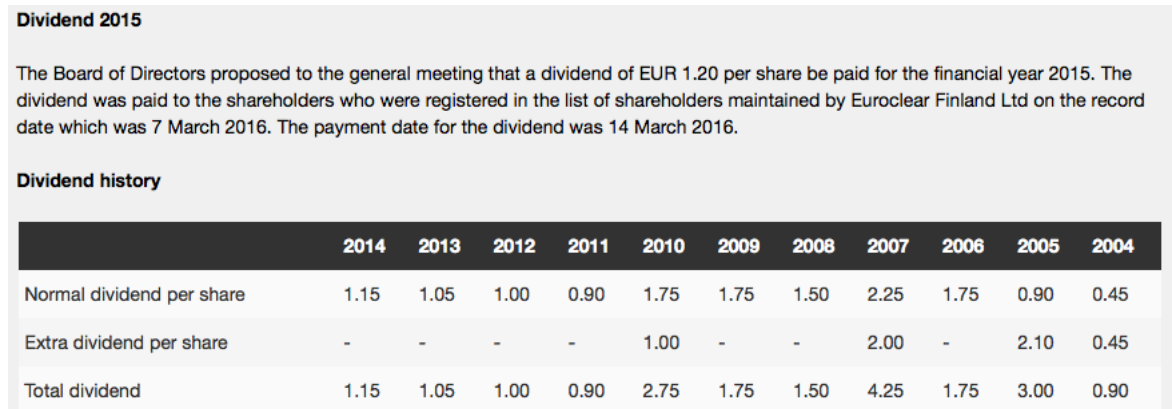
The growth rate of ExxonMobil over the last 34 years is 6,40%. Average rate of return is 10,14%. So  $P = D1 / (R - g) = 2,88 / (10,14\% - 6,40\%) = 77$  euro. The expected value of the ExxonMobil stock is 77 euro. The diversification provides close result.

ExxonMobil dividends per common share									
	2016	2015	2014	2013	2012	2011	2010	2009	2008
1st Quarter	\$0.73	\$0.69	\$0.63	\$0.57	\$0.47	\$0.44	\$0.42	\$0.40	\$0.35
2nd Quarter	\$0.75	\$0.73	\$0.69	\$0.63	\$0.57	\$0.47	\$0.44	\$0.42	\$0.40
3rd Quarter	\$0.75	\$0.73	\$0.69	\$0.63	\$0.57	\$0.47	\$0.44	\$0.42	\$0.40
4th Quarter	\$0.75	\$0.73	\$0.69	\$0.63	\$0.57	\$0.47	\$0.44	\$0.42	\$0.40
<b>Total</b>	<b>\$2.98</b>	<b>\$2.88</b>	<b>\$2.70</b>	<b>\$2.46</b>	<b>\$2.18</b>	<b>\$1.85</b>	<b>\$1.74</b>	<b>\$1.66</b>	<b>\$1.55</b>

**Figure 23: ExxonMobil dividend payment 2008-2016 (Exxonmobil 2016.)**



**Figure 24: CGG dividend payment (Beleggen 2016.)**



**Figure 25: Wärtsilä Dividend payment (Wartsila 2016.)**

Judging from the covariance figures, the portfolio C demonstrates that the covariance between XONA and EXXO is the smallest. This means that these two securities tend to move in different direction. If investor chooses the combination of security XONA and EXXO, then the investor can diversify away the unsystematic risk.

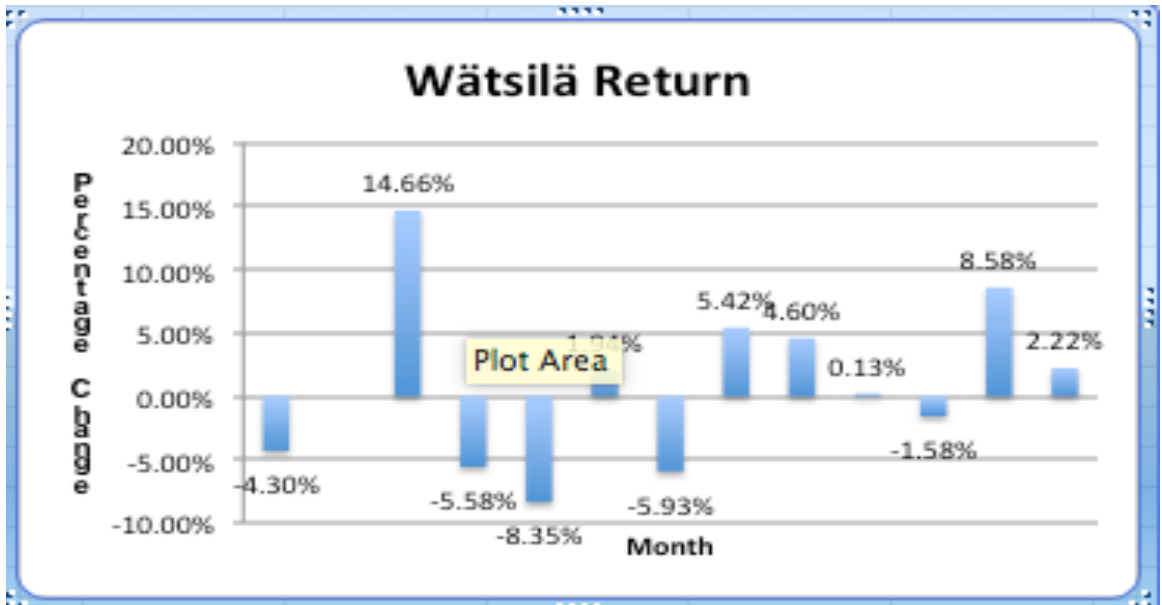


Figure 26: Wätsilä return

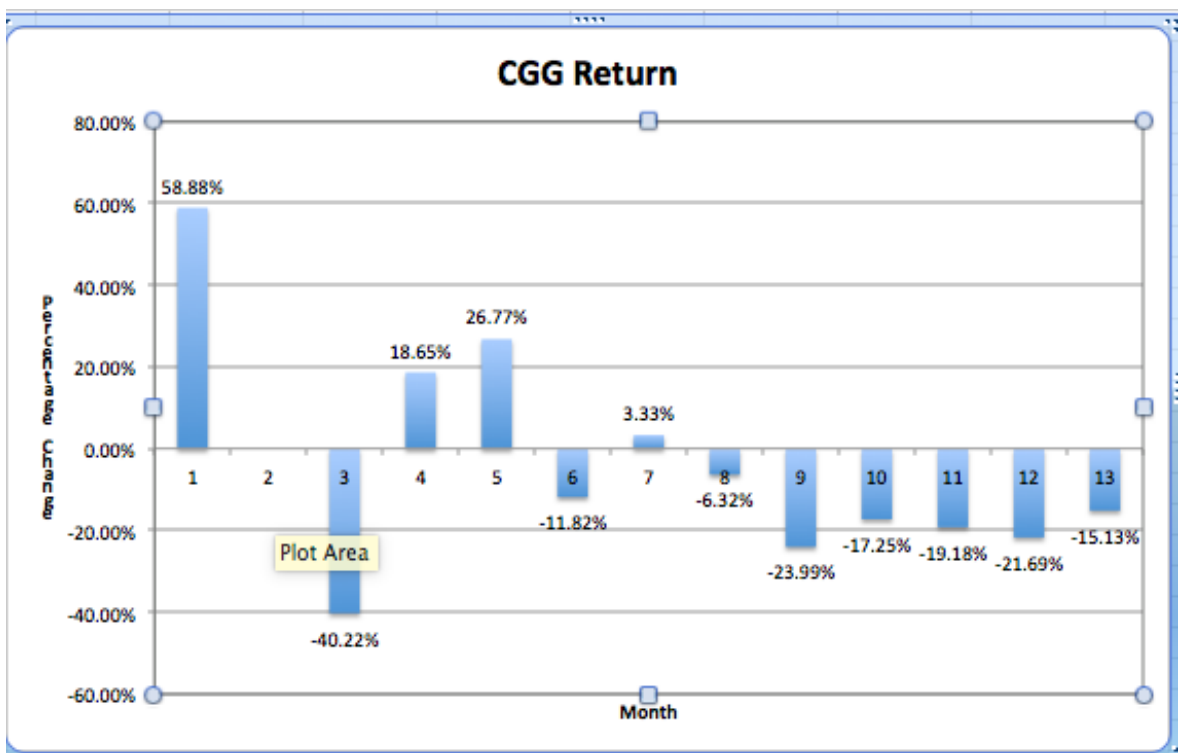
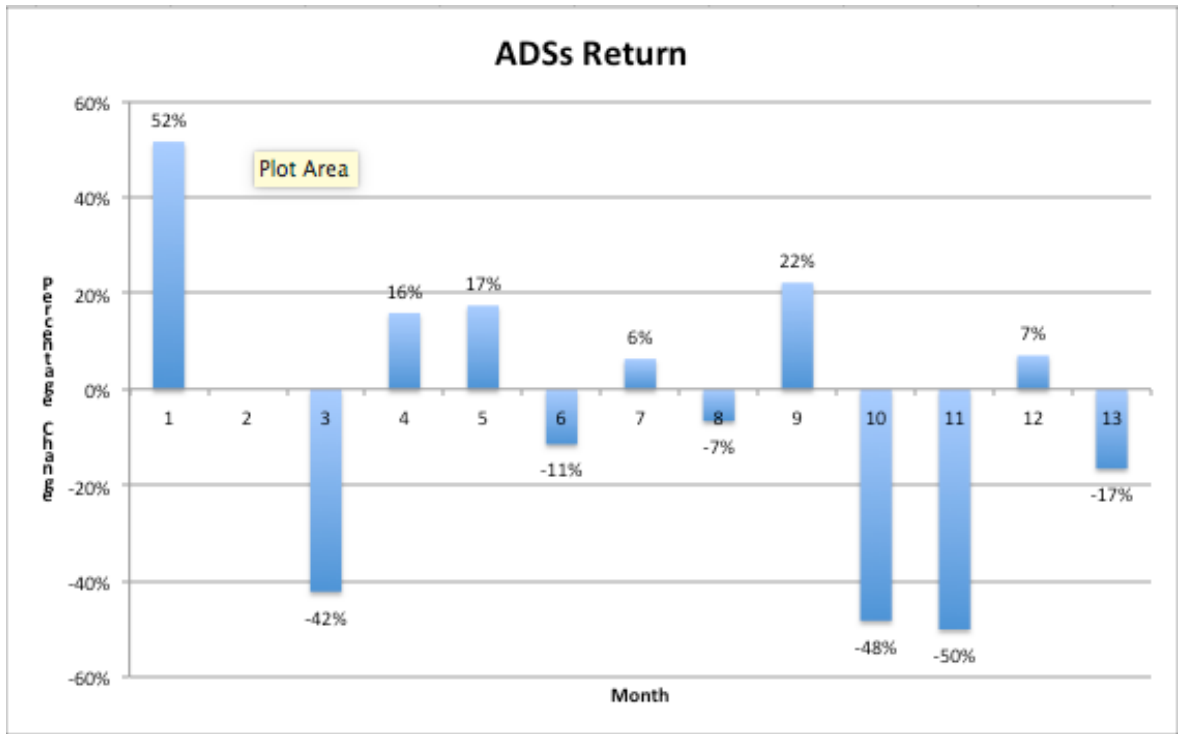


Figure 27: CGG: FR return



**Figure 28: CGG: New York return**

As can be seen from above figures, Wärtzilä's return were in negative status in the beginning of year 2015.

We can refer from table 3 that as correlation coefficient represented by beta moves towards negative values, then the diversification strategy works better, so investors gain more return.

Since the risk had been measured by the standard deviation and the trend of movement of different securities had been recovered by covariance and correlation. The application of CAPM would help to decide the required rate of return, which is the sum of risk-free rate of return and risk premium. As return, the portfolio with maximum return in given level of systematic risk will pop up in CAPM strategy. When beta is known, then the risk premium equals beta multiply required return on the market portfolio minus beta multiply risk-free of interest. The author will use CGG and ExxonMobil to compute the required rate of return for each portfolio and use Security Market Line to compare these two portfolios' value to market value. The risk-free rate of interest adopted is ten-year Treasury bond rate at 2,70%. (Risk-free rate 2016.) The market return is from two- year's historical data of ExxonMobil from November 2014 to November 2015.

In addition, the application of CAPM is similar as Eugene Fama's strong-form efficiency, where it assumes that the price of stock reflects all the available information.



**Table 8: The CAPM data**

	Portfolio B		Portfolio C		
Security	CGG FR (50%)	CGG US (50%)	XOM (33,3%)	XONA (33,3%)	EXXO (33,3%)
Beta	0,90	1,05	0,75	0,60	0,70
Mean	15,86%		11,80%		
E(Ri)	14,81%	16,90%	12,73%	10,64%	12,03%
E(Rp)	15,85%		11,79%		
the market return	16%	Risk-free rate of interest	2,30%		
<b>Note</b>					
Beta=0, stock has no systematic risk		Beta usually between 0,60 and 1,60			
Beta=1, stock has market risk		Beta>1, stock with more market risk			
Beta CGG			Return CGG		
0			2,30%		
0,90			14,81%		
1,05			16,90%		
Beta EXXONMOBIL			Return EXXONMOBIL		
0			2,30%		
0,75			12,73%		
0,6			10,64%		
0,7			12,03%		

The beta of portfolio ExxonMobil is given in Foundations of Finance written by Keown, Martin & Petty (2011, 172.) Other data is gathered from Morningstar. (Morningstar 2016.) From table 8, it can be judged that portfolio ExxonMobil has higher expected rate of return for the given level of risk. However, CGG portfolio has higher average expected rate of return than ExxonMobil. But CGG portfolio's expected rate of return as indicated 15.85% is lower than the market rate of return, which is 16%. Therefore, it is naturally to be guessed that both CGG and ExxonMobil portfolios are not good investment during holding period from November 2014 to November 2015. In spite of all speculations, it is hard to say whether the portfolio is good investment, because portfolio C has lower beta, which usually means less risk, but it has lower return. Rather contradictory, portfolio B has another result. So it is depends on the investors preference on risk and rate to decide whether it is good investment or not.

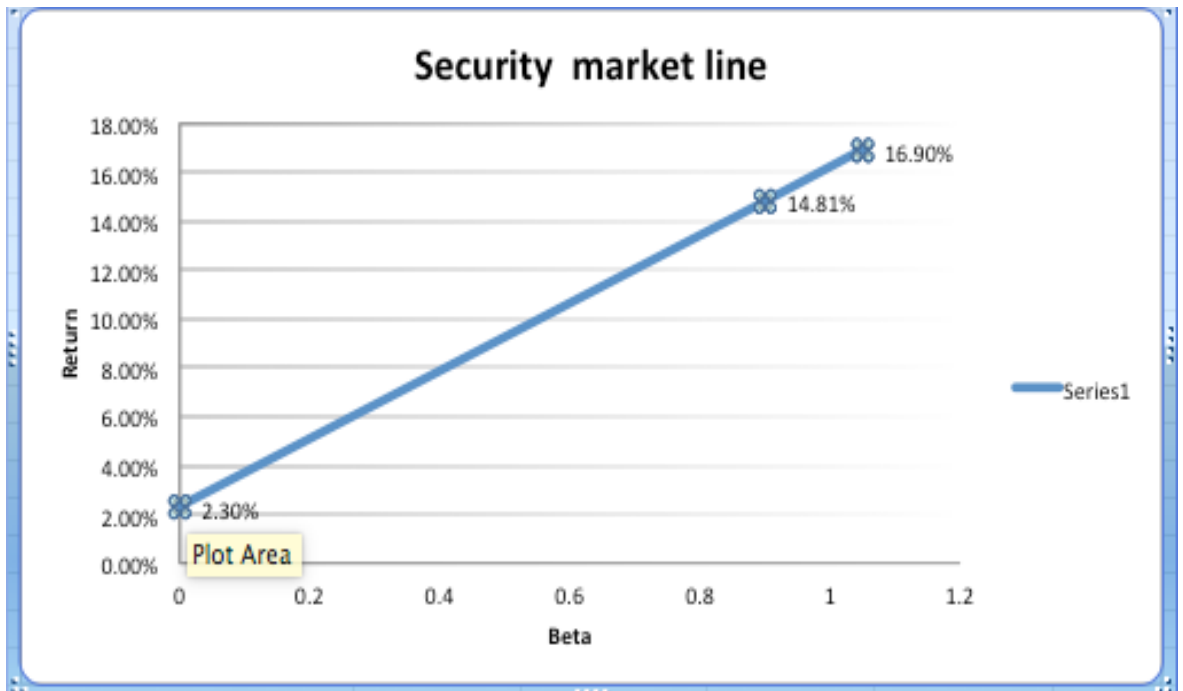


Figure 29: Security market line for CGG

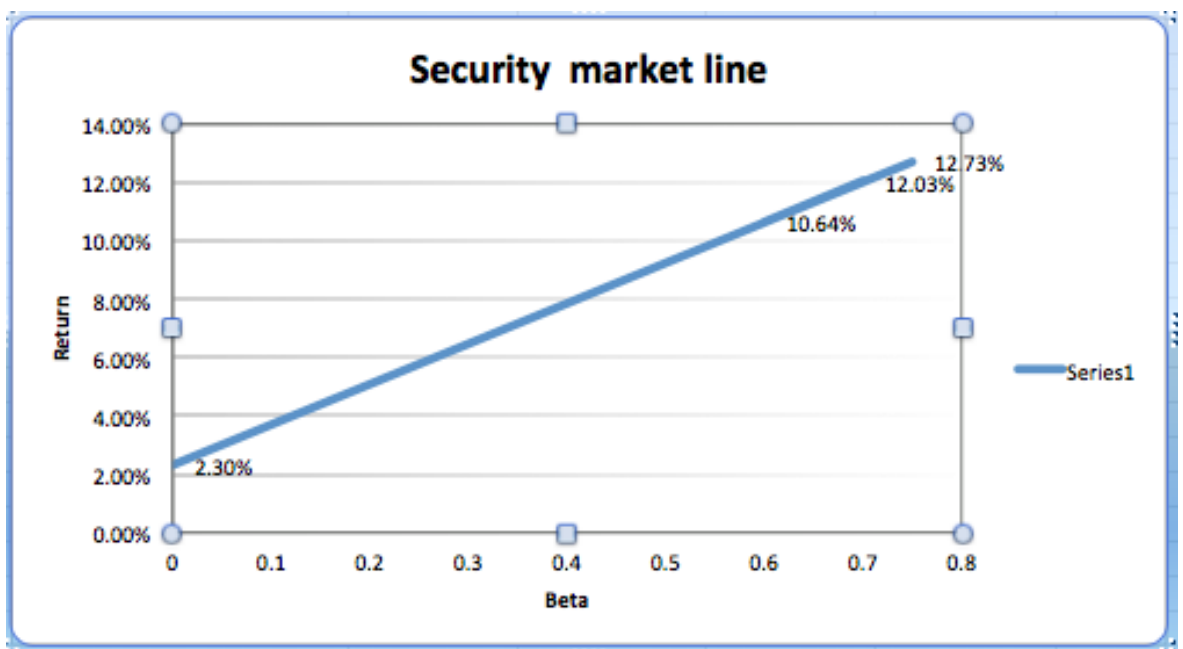


Figure 30: Security market line for ExxonMobil

The security market line graphically represents for the CAMP of these two portfolios. SML helps to understand the risk and return trade-off, where the risk is generally measured by beta.

## 4.5 Testing findings

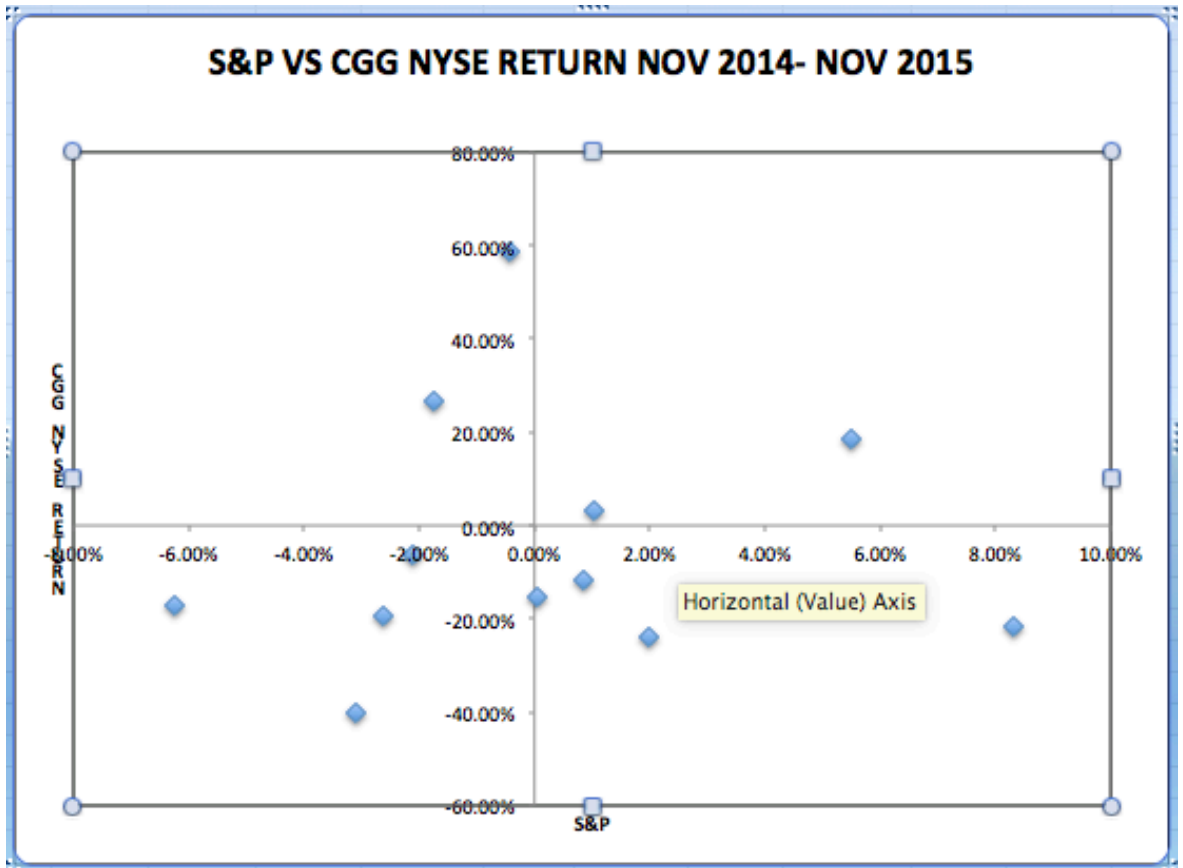
In order to gain a better view of the study, the author will compare the selected portfolio return with the S & P 500 return from November 2014 to November 2015. (Ycharts 2016.)

**Table 9: Returns of portfolios selected and S & P 500**

	S&P		CGG		ADSs		XOM		XONA		EXXO34	
Month&year	Price (\$)	Returns	Price (€)	Returns%	Price (\$)	Returns%	Price (\$)	Returns %	Price (\$)	Returns%	Price (\$)	Returns%
2014												
Nov			81,96		211,52		96,59		77,82		61,35	
Dec		-0,42%	130,2	58,88%	320,64	52%	93,82	-2,87%	76,45	-1,76%	61,6	0,41%
2015												
Jan		-3,10%	77,85	-40,22%	185,28	-42%	92,83	-1,06%	77,05	0,78%	61,19	-0,67%
Feb		5,49%	92,37	18,65%	214,72	16%	91,5	-1,43%	80,75	4,80%	63,2	3,28%
Mar		-1,74%	98,69	26,77%	217,6	17%	85,63	-7,76%	79,3	2,92%	65,86	7,63%
Apr		0,85%	87,02	-11,82%	192,64	-11%	84,3	-1,55%	77,5	-2,27%	66,36	0,76%
May		1,05%	102	3,33%	231,36	6%	88,85	3,76%	79,29	-0,01%	66,59	1,11%
Jun		-2,10%	95,53	-6,32%	216	-7%	84,28	-5,14%	75,78	-4,43%	66,87	0,42%
July		1,97%	77,52	-23,99%	282,72	22%	83,14	-6,43%	74,7	-5,79%	65,09	-2,25%
Aug		-6,25%	64,15	-17,25%	146,24	-48%	76,83	-7,59%	70	-6,29%	67,91	4,33%
Sep		-2,64%	62,65	-19,18%	141,12	-50%	72,46	-12,85%	65,03	-12,95%	69,86	7,33%
Oct		8,30%	49,06	-21,69%	151,04	7%	75,88	4,72%	71,84	10,47%	74,82	7,10%
Nov		0,05%	53,17	-15,13%	117,76	-17%	84,47	16,57%	77,87	19,74%	79,2	13,37%
<b>Average return</b>		0,12%		-4,00%		-4,56%		-1,80%		0,44%		3,57%
<b>Standard deviation</b>		3,59%		24,94%		28,58%		7,00%		7,83%		4,16%
<b>Covariance</b>												

From the table 9, it is clear to see that S & P 500 has lower standard deviation for certain level of rate of return. It suggests that both CGG and ExxonMobil are volatile during holding period from November 2014 to November 2015.

As an example, according to table 9, figure 28 represents returns of CGG NYSE and S & P 500, where the beta can be deferred. One line can be drawn to divide the display of returns of CGG NYSE and S & P 500. The slope of this line is beta, in this case, beta equals to 0,60%. This implies that CGG's stock prices increase and decrease 0,60% when S & P 500 prices increase and decrease 1,00%.



**Figure 31: S&P and CGG NYSE returns November 2014 to November 2015**

#### 4.6 Summary

In this study, a closer view had been posed to check the relationship of risk and return and the measurement of risk. Risk can be obtained by calculating standard deviation. International diversification is the common method to reduce the risk in investing portfolios. The return is based on expected rate of return, stemming from the fact that the real world can't offer perfect market. The expected rate of return is the sum of risk-free rate of interest and risk premium. Risk premium is the extra return investors can get from increased risk. The CAPM is widely used to get the expected rate of return. However, there are still other elements have not been included, such as inflation, the holding-time difference, interest rate change, and that will be the focus in the following development of this research. The important factor – Beta, the symbol will be seen in most papers, indicates the variability between the portfolio's return and the market return.

## **6 Discussion**

### **6.1 Consideration of results**

The study has been carried out based on two assumptions. Firstly, it is based on the fact that stocks can be traded quickly responding to all available information. Another crucial assumption is that the assets can be divided into individual securities for future trading.

The result of the analysis provides demonstration of part portfolio theory and also provides problem for future development. To put in a nutshell, it offers three findings:

1: Between individual stock in single public listed market and international diversified stock in certain holding period, the stock in simple Stock Market performs better. This challenges the international diversification theory. But the reasons such as exchange rate, issuing outstanding share amount and inflation had not been included.

2: Between the international diversified portfolio (listed on two or more international Stock Exchange market) and the internal diversified portfolio, the higher expected rate of return is followed up by higher risk. It follows the natural law in investment that the risk rewards the investors with return. Generally speaking, international diversified portfolio generates better return results.

3: The study also finds out that although CGG is well internationally diversified, however, it is not the one with highest return accompanied with lowest risk. According to the market rate of return-16%, none of the portfolio B and portfolio C is recommended. The real challenge in investment is whether to get involved despite the high risk. The solution can only be explained by the investor's preference on risk and return.

### **6.2 Trustworthiness of the research**

The best way to get the standard deviation and variance is to compare the chosen portfolio with NYSE or S & P 500. The reason is that as the biggest portfolio pool, these two can be regarded as the market portfolio. Therefore the result is more wearable.

### **6.3 Conclusions and suggestions for development**

Before investors start to dive into Stock Exchange Market or other portfolio investment, investors have to understand the risk and the return, as well as risk management.

Comparing the historical data of the invested portfolio with the market value is crucial for long-term purpose.

From bigger perspective, the analysis of different portfolio is based on the same sector securities. It would be more thoroughly demonstrated to exam other comparison between different industries (energy and manufacturing) and different securities (stock VS bond). Looking into details, the judge of probability is preferably subjective. It requires a manager to have very good knowledge of the general economy and company performance. It is advised to gain the probability from the cash flow and annual financial report of the company.

Another issue to remember is the measurement of beta. Beta often is the result of the graphical drawing result, which is the best-fit line to divulge the two portfolios' arrangement of return. Thus, it might leads to default.

#### **6.4 Evaluation of thesis process and own learning**

Concerning to the order of thesis process, the author reads related books for theories, then, the author chooses targeted portfolios from Stock Exchange Market, at last, after combining theories and application, author edits the content of objectives. From the layout of the work, it combines text, tables, figures and SmartArts.

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## Abbreviations

NASDAQ: National Association of Securities Dealers Automated Quotation System  
CAPM: Capital Asset Pricing Model  
NYSE: New York Stock Exchange  
CML: Capital Market Line  
SML: Security Market Line  
D: Dividend  
COV: Covariance  
CORR: Correlation  
E(R): Expected Rate of Return  
R: Rate of Return  
RM: Return of the Market Portfolio  
DDM: Divident Discount Model  
MPT: The Markowitz Portfolio Theory  
APT: Arbitrage Pricing Theory  
CGG: Compagnie Générale de Géophysique  
S & P: Standard & Poor 500  
FR: Future Return  
RF: Risk -Free Rate of Return