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MASTER OF SCIENCE IN
FINANCE

MASTER'S FINAL WORK
PROJECT

THE EFFICIENT FRONTIER AND THE CAPITAL MARKET LINE:
THE CASE OF THE SWISS STOCK MARKET INDEX

AUTHOR

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ABSTRACT

The subprime-crisis, which arguably led investors to lose their confidence in banks, in the market, and in the US economy, had international consequences in all indices and markets. In order to analyze the consequences of a crisis in one of the most developed countries of Europe, this project studies the case of Switzerland – a country usually perceived as neutral and almost immune to crises – in particular it assesses the changes present in the Stock Market. The analysis is divided into two equal periods of time from January 1, 2001 to December 31, 2008 and from January 1, 2009 to December 31, 2016 firstly, and then the study focuses on shorter sub-periods around the crisis, to analyze the impact in more detail.

Key words: Return, Risk, Beta, Mean-Variance Theory, Efficient Frontier, Capital Market Line, CAPM, Markowitz, Swiss Market Index.

RESUMO

A crise dos créditos hipotecários de alto risco, que terá levado os investidores a perderem a sua confiança tanto nos bancos e no mercado como na economia norte-americana, trouxe consequências internacionais em todos os outros índices e mercados. Este projeto tem o objetivo estudar o impacto da crise num dos países mais desenvolvidos da Europa, o caso da Suíça - um país geralmente visto como neutro e quase imune a crises - em particular o estudo visa avaliar as mudanças presentes na bolsa. Assim, primeiramente a análise deste projeto foi dividida em dois períodos temporais de 1 de janeiro de 2001 a 31 de dezembro de 2008 e de 1 de janeiro de 2009 a 31 de dezembro de 2016. Posteriormente, o estudo foca-se em subperíodos mais curtos em torno da crise, com o intuito de analisar mais detalhadamente o seu impacto.

Palavras-Chave: Retorno, Risco, Beta, Teoria do Retorno-Variância, Fronteira Eficiente, Linha de Mercado de Capitais, CAPM, Markowitz, Índice do Mercado da Suíça.

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1. INTRODUCTION

This project has as main objective the study of the impact of the 2008 crisis in the Swiss stock market. In other words, this project intends to assess the impact of the crisis in the stock market of one of the most developed countries of Europe.

To reach a conclusion, it is necessary to start by reviewing certain theories and concepts. Hence, firstly I will describe basic concepts that are needed to understand modern financial theory.

This study starts with the developments of Markowitz (1959), usually referred to as Modern Portfolio Theory, that consists in a trade-off between return and risk (Mean-Variance Frontier), allowing to select efficient portfolios through the idea that greater return for the same risk or less risk for the same return are the main principles for investment decision. Hence, Markowitz (1987) identifies a frontier of efficient portfolios to invest in.

Tobin (1958) added to Markowitz's theories the consideration of risk-free assets, and subsequently new concepts were derived, such as the Security Market Line, the Capital Allocation Line and the Capital Market Line. The initial set of efficient portfolios identified by Markowitz is replaced by the Capital Allocation Line as the new efficient set of investments. In this Capital Market Line all investors will choose to invest part of their budget in the risk-free asset and the remainder of their budget in one (“unique”) portfolio of risky assets, known as the tangency portfolio. This new Capital Allocation Line combines the optimal portfolio of risky assets to invest in with lending or borrowing at the risk-free rate.

Thereafter, Sharpe (1964), Mossin (1966) and Lintner (1965) made even more contributions through the CAPM - Capital Asset Pricing Model, which identifies the tangency portfolio as the “Market” portfolio, and the Capital Market Line becomes the new set of efficient investment portfolios. The market portfolio is the portfolio of risky assets with the best combination (trade-off) of risk and return, for a given risk-free interest rate. Hence, all individual risky assets are then analyzed in terms of their contribution to this Market portfolio.

These theories will contribute to analyze the Swiss Market during the time of the subprime crisis, this being a subject that belongs to the recent past, but emphasizing that it may occur again. Since crises tend to be cyclical, with periods of expansion followed by periods of recession, and also since the consequences of a crisis can be amplified by several countries, it is important to understand how a market like Switzerland behaved during this period of turmoil.

Hence, my motivations in this work consists in better understating the stability over time of one of the most developed countries in Europe, and mainly understand whether Switzerland suffered with the impact of the subprime crisis

However, it is important to point out that this study has limitations, since the effect of the crisis cannot be analyzed in isolation, since there are external phenomena, such as cultural, demographic, natural, technological (advancement of technology, innovation in the companies), political and economic phenomena, which may also have an impact, could contribute for the regression of the economy or may have contributed to the development of the economy.

Another important limitation to be considered in this study is the size of the sample, since the sample was withdrawn for long-term and short-term periods, however there is notion that if the analysis was done with a sample divided by more shorter periods than what was analyzed, such as 1 year or even half-yearly, the conclusions obtained could be better substantiated.

Another consideration to be made in what concerns the limitations of this project, consists in the fact that it was used the “solver” application of Microsoft Excel software to generate efficient frontiers, i.e., although it was the only accessible tool to carry out this project, it is important to point out that it is a simple and reasonably basic tool.

Finally, it is also important to point out that this project was based on Markowitz's theories and these studies present some limitations, such as the lack of quality of asset information, that is, the variability of different assets in certain periods, or the lack of non-consideration of transaction costs. Another limitation underlies the different interpretations of the concept of risk in Markowitz's theory, the model considers the variability of historical returns and does not consider an estimate of future performance, which may bring a myopic view of reality.

However, and once this study has as principal aim to identify if there was or not an impact in the Swiss economy due to the international crisis, the present study has as contribution a perception of how similar crises can affect the more developed economies, and makes it possible to identify similar problems in advance, in order to generate the capacity to prevent the fall of more companies and to achieve faster solutions of performance, improvement or protection in companies and economies, with for example an increase equity and to generate a tolerance of credit risk.

2. THEORETICAL FRAMEWORK AND LITERATURE REVIEW

This chapter introduces fundamental concepts that are essential to understand later what characterizes an efficient investment. Hence, there is a description of what was the crisis and basic concepts, such as the rate of return of an asset, the risk of an asset, the volatility of an asset, the covariance and the correlation between the returns of a pair of assets, and the beta measure of an asset. Once these concepts are established, also for portfolios of assets, we then turn to a survey of the seminal work in modern portfolio theory, starting with portfolio selection according the Markowitz (1959), highlighting the benefits of diversification in the efficient frontier of investment possibilities.

2.1. The Subprime Crisis

The subprime-crisis had its international impact in 2007-2009 and it was triggered by an agglomeration of factors, first, due to the credit granted by institutions that presented weak regulation in the financial market and with a low level of guarantees, secondly, it was granted to creditors with difficulties in solving their liabilities, especially when there was an overvaluation of the real estate market (which aggravated interest rates on loans granted) and finally, when one of America's largest banks went bankrupt, the Lehman Brothers Bank. According to the article by Pereira (2009).

All these factors were triggered and aggravated, according to Pereira (2009), by "financial innovations" that securitized bad titles turning them into good titles, to “satisfy” customers and investors.

According to Farhi, Prates, Freitas and Cintra (2009), banks used "structured products" that are composed of a security that represents a credit and a range of financial derivatives to take the credit risks off the banks' balance sheets and to make them more liquid. This strategy was developed by Paul McCulley (CEO of Pimco) known as the Shadow Banking System and consists of other financial institutions such as hedge funds, regional banks specializing in mortgage credit, and government-sponsored agencies that borrowed by banks to have a better leverage. Thus, risk rating agencies would rank better.

On the other hand, and to make the scenario even worse, these institutions issued short-term commercial papers to acquire the securities of the banks. So, the risks were sharply compounded. In this way, the banks were able to create about $ 700 billion worth of assets to consider "toxic waste."

However, the situation has reached a limit and when the US Treasury is not able to save the Lehman Brothers bank, this demonstrates that government action against financial markets is inefficient and therefore investors have no confidence in banks, in the market and in the US economy, which led to the fall of one of the main indicators of the US market, the Dow Jones index.

Therefore, investors will always balance the return and risk on their investments and in order to develop this project according to the Markowitz's theories, this project will be based on the rational and risk-averse investor assumption, as Markowitz (1952 and 1959) defended. The rational investor will use the principle of diversification in order to optimize his or her investment portfolios, i.e., usually not investing all money in a single or a few assets, but rather in a broader set of assets of various industry sectors. The risk-averse investor prefers to take less risk in order to get a given level of return, since investors always intend to maximize their return with the least risk possible.

2.2. Basic Concepts

2.2.1. Rate of Return of an Asset

Return of a financial security, such as a stock, is the rate that describes the security's performance, which the investor receives in a given date. In mathematical terms, return can be described as the variation of the price of asset i, in an interval of time (from time t-1 to time t), plus the cash paid out by the security during that period (for example, a dividend in the case of a stock), divided by the initial price of the asset at time t-1, which gives in percentage terms the gain or loss occurred during the period of analysis. Formalizing:

$$Rate\ of\ Return\ of\ Asset\ X_{t-1,t} = R_{X,t} = \left(\frac{V_{X,t} - V_{X,t-1}}{V_{X,t-1}} + \frac{D_{X,t}}{V_{X,t-1}}\right) x\ 100 \qquad (1)$$

where Rx,t represents the percentage return of Asset X at time t, Vx,t is the value (price) of asset X at time t, and Dx,t is the cash flow paid out by asset X at time t.

The return takes two factors into consideration, first the price evolution (first part of the equation) or capital gain rate, and the cash flows that can be generated by the asset during that period (for example, it could be a dividend in the case of a stock or a coupon payment in the case of a bond).

It is important to note the difference between the historical mean return and expected mean return. The historical mean return ($\bar{R}_X, \bar{R}_{GX}$) is calculated through past information, so it just can inform what actually was earned in past investments, while the expected return should be based on a forecast of future rates of return. Often times, though, investors assume that the past behavior of financial assets (the historical observations of the realized returns) is a good predictor of their future behavior, and in such cases the expected returns end up being represented by the mean (historical) returns of those assets.

However, formally, the expected return is represented by:

$E(R_X) = \sum_{i=1}^{N}(P_i \times R_{X,i})$ (2)

where Rx represents the return forecasted of Asset x, i represents the different scenarios, being Pi the probability of each scenario and $R_{X,i}$ represents the return of asset x considering each scenario. Hence, $E(R_X)$ represents the sum of the returns of each scenario.

2.2.2. Risk and Volatility of an Asset – Variance and Standard Deviation

According Holton (2004) risk is associated with exposure and uncertainty which create a possibility of loss/gain and it is measured by the variance or the standard deviation. The volatility represents the variation around the expected return. Formalizing:

$$Variance\ of\ Asset\ X = \sigma_X^2 = \sum_{i=1}^{N} P_{it}[{R_{it}}^X - E(\overline{R}_X)]^2 \qquad (3)$$

where Pi,t represents the probability of state i occurring at time t, ${R_{it}}^X$represents the return of the Asset X in state i at time t, and E(Rx) represents the expected return of the asset X.

It is impossible to collect data from the entire population. Therefore, it becomes more correct to use the expression of sample variance returns, a specific period available, to not undervalue the variance. Many times, because it is hard to forecast returns for different scenarios in the future, investors assume that future scenarios are similar to the past (historical) data. In this case the N scenarios for the future would be similar to the past T observations of returns. In that case equation (5) above would simplify to:

$$Sample\ Variance\ of\ Asset\ X = s_X^2 = \frac{\sum_{t=1}^{T}\ ({R_{it}}^X - \overline{R}_X)^2}{T-1} \qquad (4)$$

where $\overline{R}_x$ represents the mean return of asset X and s_i^2 represents the sample variance of asset X, based on the last T observations of returns of the asset.

The standard deviation or the volatility adds to the aforementioned formulas the square root. Formalizing:

$$Sample\ Standard\ Deviation\ of\ Asset\ X = s_X = \sqrt{\frac{\sum_{t=1}^{T} ({R_{it}}^X - \bar{R}_X)^2}{T-1}} \quad (5)$$

$$Standard\ Deviation\ of\ Asset\ X = \sigma_X = \sqrt{\frac{\sum_{t=1}^{T} ({R_{it}}^X - \bar{R}_X)^2}{T}} \quad (6)$$

2.2.3. *Covariance and Correlation*

Covariance ("Cov") is a measure that defines the degree of interdependence or the interrelation between returns. Hence, if the covariance value is zero, it represents the independence between two variables. When returns move in the same direction, they have positive covariance and when returns move in opposite ways, the covariance is negative. Representing:

$$Covariance = Cov\ (R_X, R_Y) = E[(R_X - \bar{R}_X)(R_Y - \bar{R}_Y\ )] = \sigma_{X,Y} \quad (7)$$

where $\mathrm{Cov}\ (\mathrm{R_X}, \mathrm{R_Y})$ represents the covariance between two assets returns $\mathrm{R_X}$ and $\mathrm{R_Y}$, being $\mathrm{R_X}$ the return of Asset X and $\mathrm{R_Y}$ the return of asset Y, $\bar{R}_X$ and $\bar{R}_Y$ represent the mean returns of asset X and asset Y respectively, and σ_X e σ_Y represent the standard deviation of asset X and consecutively asset Y.

When the covariance is normalized, we obtain the correlation coefficient (ρ) which indicates the "degree" of portfolio diversification, since when correlation is -1 (perfect negative correlation) it means that the returns move in perfectly opposite ways. As the returns goes in different direction the probability of loss/risk is reduced, hence the portfolio is well diversified, so the risk associated is less. Comparing with the correlation of 1 (perfect positive correlation), when one asset falls another falls too in the exact same dimension – in this case the benefit of diversification for risk reduction is not achieved. Formalizing:

$$\rho_{XY} = Corr\ (R_X\ , R_Y) = \frac{Cov\ (R_X\ ,R_Y)}{\sqrt{Var(R_X)}\sqrt{Var(R_Y)}} = \frac{\sigma_{XY}}{\sigma_X \sigma_Y} \quad (8)$$

where ρ_{XY} or $Corr\ (R_X\ , R_Y)$ represents the correlation between two assets returns R_X and R_Y, being R_X the return of Asset X and R_Y the return of asset Y, $Cov\ (R_X\ , R_Y)$ or σ_{XY} represents the covariance between the returns of assets X and Y, $\sqrt{Var(R_X)}$ or σ_X represents the standard deviation of asset X and $\sqrt{Var(R_Y)}$ or σ_Y represents the standard deviation of asset Y.

2.3. Modern Portfolio Theory (MPT) and the CAPM

In the investment analysis above, investors made an evaluation considering only the performance of each security, whereas Modern Portfolio Theory consists in returns' maximization through the combination of securities, according to Bhardwaj, (2016). Modern Portfolio Theory has its origin in the work of prominent author Markowitz (1959) who created an organized vision of the portfolios (a set of securities) available to invest. Basically, the issue in this theory consists in creating a securities' combination which promotes a diversified portfolio in order to reduce the risk of investing for a given level of return. Hence, Markowitz (1959) created the efficient frontier that identifies the best portfolios to invest in: by recognizing that investors can allocate their money in more than one security and that statistically there is a reduction in the risk (variance) of a well-diversified portfolio.

In this sense, once it is about finding the best combination of securities, the issue of portfolio measures will be introduced, and later theories associated with modern portfolio theory will be developed. We start with fundamental concepts about portfolios.

2.3.1. Portfolio Return

The portfolio return is an aggregation of single securities and it's composed by the weighted average of the returns of the different securities, which is determined by multiplying their weight in the portfolio by their return. Representing:

$$Portfolio\ Return = Rp = \sum_{X=1}^{N} w_X R_X,\ with\ \sum_{X=1}^{N} w_X = 1 \qquad (9)$$

where Rp represents the return of the portfolio, R_X represents the return of Asset X and w_X represents the weight of asset X in the portfolio.[1]

2.3.2. *Portfolio's Variance and Portfolio's Standard Deviation*

The variance of a portfolio of assets is a generalization of what we saw for a single asset. The portfolio's variance is defined by:

$$Portfolio's\ Variance = \sigma_p^2 = \sum_{X=1}^{N} w_X^2 Var(R_X) + \sum_{X,Y=1,X\neq Y}^{N} w_X w_Y Cov(R_X, R_Y) \quad (10)$$

where σ_p^2 represents the variance of the portfolio, w_X represents the weight of asset X in the portfolio, w_Y represents the weight of asset Y in the portfolio, $Var(R_X)$ represents the variance of the return of the asset X and $Cov(R_X, R_Y)$ represents the covariance between the return of asset X and the return of asset Y.

The portfolio's standard deviation is, then, the square root of the portfolio's variance. Formalizing:

$$Portfolio's\ standard\ deviation\ \sigma_p = \sqrt{\sum_{X=1}^{N} w_X^2 \sigma_X^2 + \sum_{X,Y=1,X\neq Y}^{N} w_X w_Y Cov(R_X, R_Y)} \quad (11)$$

When the portfolio is extended to a large number of assets (i.e., N is large), it is possible to simplify these two equations above, if we make the important assumptions of an equal weight (1/N) for all N assets, and take the $\lim_{n\to\infty} \sigma_p^2$:

$$\sigma_p^2 = \frac{\bar{\sigma}^2}{N} + \frac{(N-1)}{N}\overline{Cov} \quad (12)$$

where σ_p^2represents the variance of the portfolio, $\bar{\sigma}^2$ represent the average variance, N represents the total assets, and $\overline{Cov}$ represents the average covariance.

[1] We can talk about portfolio return in terms of realized returns for a given date, in terms of average realized returns, or in terms of the expected returns.

2.3.3. <u>Mean-Variance Theory</u>

Mean-Variance Theory underlies Modern Portfolio Theory, by assuming that risk averse investors have a preference for high expected returns but also for low risk – i.e., investors counterbalance returns and risk, in order to identify a set of efficient portfolios Markowitz (1987).

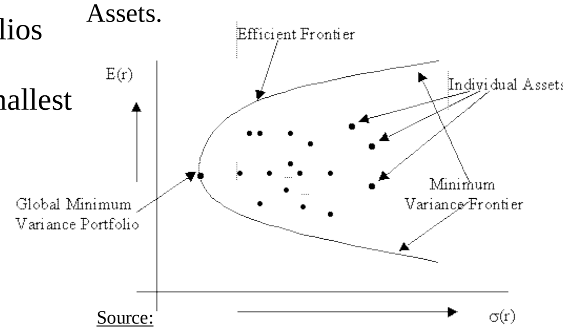
Efficient portfolios consist of those investments with the lowest possible risk for a given level of expected return (or, equivalently, portfolios with the highest expected return for a given level of risk.)

Hence, Markowitz (1959) argued that it is possible to build a diversified portfolio, by investing in assets that are not perfectly positively correlated, hence reducing portfolio variance (and standard deviation.

2.3.3.1. <u>The Efficient Frontier</u>

The Efficient Frontier (in Markowitz's sense) is the curve that contains all the efficient portfolios, portfolios with the highest return for a given risk (or with the smallest risk for a given return). It corresponds to the upper "half" of the investment opportunity curve of Figure 1.

<u>Figure 1:</u> The Efficient Frontier of Risky Assets.

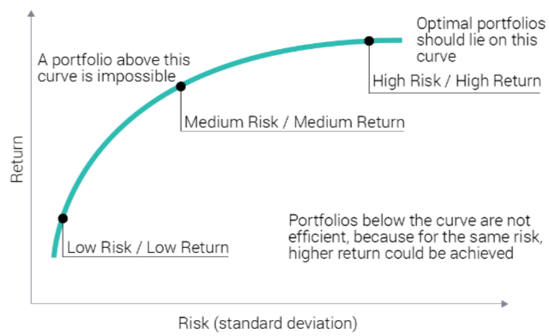


<u>Source:</u> http://webpage.pace.edu/pviswanath/notes/investments/assetalloc.html

The Global Minimum-Variance Portfolio is a portfolio that stays on the minimum-variance frontier with less volatility, being the lowest risk efficient portfolio of the whole set.

To be more accurate, Reilly and Norton (2003) describe the efficient frontier as the aggregation portfolio composed with the maximum return possible for a given level of risk or the minimum risk possible for a given level of return, this being a line created by several points represented by $\left(\sigma_{p,} \overline{R_p}\right)$.

Figure 2: Markowitz Efficient Frontier.



Source: https://uk.scalable.capital/research/why-modern-portfolio-needs-modernisation/.

Hence, the efficient frontier is the curve that starts above and the right to the global minimum-variance portfolio, being also called the Markowitz Efficient Frontier, as represented in Figure 2.

The efficient frontier's slope demonstrates that when the risk of an investment increases, there are diminishing increases in the rate of return.

2.3.3.2. *Capital Allocation Line and Capital Market Line*

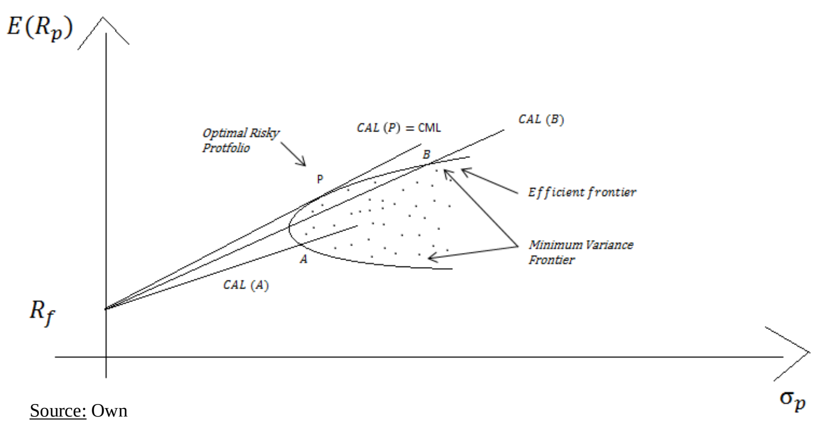
According to Markowitz's efficient frontier we would not be able to identify one universally better portfolio for all investors. Depending on the degree of risk aversion of an investor, he or she would choose a portfolio more to the left or to the right of the efficient frontier of Figure 2. An important contribution was made when a risk-free asset – an asset that promises to pay a fixed return, uncorrelated with all other assets – was also considered in this investment opportunity set.

The Capital Allocation Line (CAL) is a line which intercepts the risk-free asset on the Y-axis (Figure 3 below) and a risky asset (or portfolio of assets) that belongs to the efficient frontier. The CAL represents also an investment opportunity set for investors, one in which they allocate some money in risk assets and some money in the risk-free rate. Given that investors want to maximize expected return and minimize risk (the famous trade-off between risk and return) it is possible to identify the tangency portfolio, the one that delivers the "best" CAL in terms of the risk-return trade-off – this is known as the capital market line.

The Capital Market Line (CML) corresponds to the Capital Allocation Line, since the new efficient frontier is created when it is included a risk-free asset in the portfolio (e.g., the inclusion of a government bond in the portfolio). According to Tobin (1958) this new Efficient Frontier (CML) is a straight line that crosses the RF asset to the tangency of the old Efficient Frontier and follows forward. The tangency portfolio is recognized as the market portfolio.

However, the CML and CAL uses the total risk, hence they have to be applied with efficient portfolios, since in these cases the total risk is equal to the systematic risk, being no diversifiable risk remaining. The difference between this two is, the CAL is a combination that varies across individuals and CML imposes CAL conditions as homogeneous expectations in relation to the expected return, as if all investors had the same preference.

Figure 3: Optimal Risky Portfolio.



Source: Own

2.3.3.3. *Separation Theorem*

The Separation Theorem developed by Tobin (1958), takes into consideration the CML frontier and divided by two parts, the investment decision and the financing decision. The separation point between these two divisions is the tangency point between the Efficient Frontier and the CML (with investors of homogeneous preferences), the market portfolio. At this point of the CML nothing is invested in the RF asset.

However, if investors invest below this point, they are investing their money in a combination of the RF asset and the remaining in the market portfolio. Otherwise, above this point they are borrowing money at the risk-free rate to invest in the market portfolio at RF rate, according Engels (2004). [2]

2.3.4. Capital Asset Pricing Model (CAPM)

The Capital Asset Pricing Model (CAPM) was developed through studies conducted independently by Sharpe (1964), Mossin (1968) and Lintner (1965), based on Markowitz (1952) and the concept of the diversification.

The model permits to find an equilibrium expected return, taking into consideration the fact that there is only one tangency/market portfolio. The risk associated with that portfolio (which investors, even if well diversified, have to bear) is considered to be systematic or market risk. Hence, for any individual asset, the risk premium it "deserves" in equilibrium will reward that component of risk that persists in the well-diversified investor's portfolio. Thus, the equilibrium return for an asset is not directly related to its total risk (variance), but rather with that part of the risk that correlates with the market portfolio. According to the CAPM, the expected return of an asset i will vary according its beta parameter – where this beta is the measure of systematic risk of the asset. Formalizing:

$$E(R_X) = R_f + \beta_X\left[E(R_m) - R_f\right] \quad (13)$$

[2] The rate of return in these two cases could be the same and in this project, to simplify the calculations, it was also considered only the same rate for both cases, however it is important to emphasize that in a more precise view it would be used different risk-free rates, since for loans it is logical to pay more than the free-rate, because the ability to pay is not so certain as the risk-free government rate.

where $E(R_X)$ represents the expected return of asset X, β_X represents the beta of asset X, $E(R_m)$ represents the expected return of the market portfolio and R_f represents the risk-free.

Specifying, the (total) risk an asset is justified by two main components: systematic risk and non-systematic risk, according to the CAPM. The systematic risk corresponds to variations that affect the entire market, an entire industry and consequently the economy. Hence, this risk cannot be avoided through a diversified portfolio. The non-systematic risk component of an asset corresponds to specific risk of that asset that is essentially uncorrelated with the overall market. For an investor that holds a well-diversified portfolio this idiosyncratic or non-systematic risk of individual assets will lose statistical relevance.

Hence, beta is the measure of systematic risk. This measure estimated the sensitivity of variation of an asset to variations in the well diversified market portfolio. Formalizing:

$$\beta_X = \frac{Cov\,(R_X\,,R_m)}{\sigma_m^2} = \frac{\rho_{X,m}\sigma_X\sigma_m}{\sigma_m^2} = \frac{\rho_{X,m}\sigma_X}{\sigma_m} \quad (14)$$

where β_X represents the beta of asset X, $Cov\,(R_X\,, R_m)$ represents the covariance between the return of asset X and the return of the market, σ_m^2 represents the variance of the market, σ_m represents the standard deviation of the market, $\rho_{X,m}$ represents the correlation between the asset X and the market, σ_X represents the standard deviation of asset X and σ_m represents the standard deviation of the market.

A zero beta indicates the presence of a risk-free asset whose covariance with the market portfolio is zero, and a beta equal to 1 indicates that the asset behaves just like the market behaves, meaning that the portfolio is well diversified, since it only has systematic risk. Basically, betas whose values vary between 0 and 1 mean the asset tends to react less than the average stock in the market comparing to the market movements, values of beta above 1 mean that the asset tends to amplify market movements – it has more risk than the market has, according to the Beattie (2017), whereas betas whose values are inferior to 0 means that there would be an increase of the risk due to the incorporation of assets in a well-diversified portfolio, according to Damodaran (2009).

The CAPM equation can also be viewed as the equity cost of capital (for the owners of those shares) or the return required by the (well diversified) investors due to the systematic risk taken, once the expected return depends on the price of time (Rf), price of risk $[E(R_m) - R_f]$ and the amount of risk β_i.

However, it is important to be aware of some assumptions taken into account when using CAPM, such as:

- All investors are risk averse and rational, which means that investors make their own choices in order to maximize their utility. (Assumption described in the beginning of the project).
- Investors invest for a single period rather than several periods;
- There are no transaction costs and taxes associated;
- The risk-return is not affected by the number of transactions;
- All investor will settle the same risk-free rate for lending and another risk-free rate for borrowing;
- All investors have the same preferences and expectations.
- Investors can invest in small sizes to an infinitely small value in order to make plausible the study of a continuous function rather than a discrete function.
- The quantity of trades made by the investors does not influence the prices, being the investor’s price takers.

2.4. Portfolio Performance Evaluation

It is important to evaluate the portfolio's performance relative to other portfolios. Hence, some ratios based only the CAPM and the technique to rank the best portfolios will be introduced.

2.4.1. Sharpe Ratio

Sharpe (1966, 1994) developed a ratio that takes in consideration the two components risk and return. Hence, this measure contemplates the risk premium in the numerator, being the excess of the expected return compared to the risk-free rate and in the denominator, contemplates the risk, which means that the excess of expected return is compared to a unit of total risk. Formalizing:

$$Sharpe\ Ratio = \frac{R_p - R_f}{\sigma_p} \qquad (15)$$

where R_p represents the return of the portfolio, R_f represents the risk-free and σ_p represents the standard deviation of the portfolio.

The Sharpe Ratio visually corresponds to the slope of the CAL and, thus, the higher the slope the best performance the asset or the portfolio has, according to Sharpe (1994).

Although this ratio is easy to calculate, it has a limitation. This ratio takes into account the total risk, instead of only the systematic risk, which permits to conclude, according to Levisauskait (2010) that this measure is only a good measure when the portfolios are all perfect diversified (beta equal to one), since it is only the systemic risk that determines the price in a CAPM setting.

2.4.2. Treynor Ratio

Treynor (1965) presented a ratio that complies with the existing limitation of the Sharpe Ratio, considering the systematic risk, by replacing portfolio risk with portfolio beta. Once again, the higher the result, the better the performance of the asset is, also. Formalizing:

$$Treynor\ Ratio = \frac{R_p - R_f}{\beta_p} \quad (16)$$

where R_p represents the return of the portfolio, R_f represents the risk-free and β_p represents the beta of the portfolio.

2.4.3. Jensen's Alpha

Jensen (1968) introduced a measure that allows evaluating the performance of assets through the deviation between the excess return and the benchmark, i.e., this measure compares the excess of the actual return with the required return and the excess of the actual risk premium with required risk premium. Formalizing:

$$\alpha_p = R_p - \left[R_f + \beta_p\left(R_m - R_f\right)\right] \quad (17)$$

where α_p represents the performance of the portfolio, R_p represents the return of the portfolio, R_f represents the risk-free and R_m represents the return of the market.

So, when $\alpha_p > 0$ it means that the portfolio has a better performance when compared with the market's performance, otherwise it means that the portfolio has an underperformance in relation to the market. Hence, when the Jensen's Alpha is zero this means the performance of the portfolio is equal to the market's.

This measure also takes into consideration the systematic risk and permits ranking the portfolios through the evaluation of performance, as it becomes possible to compare portfolios.

2.5. The Single Index Model and The Formation of Optimal Portfolios

According to Levisauskait (2010), when the portfolios are not perfectly diversified, it is necessary to evaluate them through the Treynor's and Jensen's measures and rank the portfolio according to the Single Index Model, an asset pricing model, in order to select the best ones.

Hence, the Single Index Model was the technique used in this work and it was created by Sharpe (1963), Elton, Gruber, Das and Hlavka (1993).

This model incorporates several phases. Initially, it orders the assets that incorporate the portfolio in descending order according to the performance evaluation, that is, according to the values obtained through the Treynor Ratio (the measure implemented in practice in this stage, since it is a measure that apparently does not present limitations and it is the simplest of the three presented above. Still, it would be possible to have used the other measures that allow evaluating the performances). Thereafter, the excess return of an asset per unit of non-diversifiable risk is compared to the cut-off rate, represented below:

$$C^* = \frac{\sigma_m^2 \sum_{X=1}^{X} \frac{(R_X - R_f)\beta_X}{\sigma_{eX}^2}}{1+\sigma_m^2 \sum_{X=1}^{X} \frac{\beta_X^2}{\sigma_{eX}^2}} \quad (18)$$

Where σ_m^2 represents the variance in the market index and σ_{eX}^2 represents the variance of an asset's movement, associated only with the movement of unsystematic risk and not with the movement of the market index.

Hence, if the Treynor Ratio has values above the cut-off rate, these assets are considered the efficient portfolios and then interesting to invest, otherwise, assets with lower values are left out. Later, it is important to discover the proportion to invest in each asset. To find the solution is necessary to use two equations:

$$Z_X = \frac{\beta_X}{\sigma_{eX}^2}\left(\frac{\overline{R_X}-R_f}{\beta_X} - C^*\right) \quad (19)$$

where C^* represents the cut-off rate and the Z_X represents an auxiliary measure to determine the proposition to invest in each stock.

$$x_i = \frac{Z_i}{\sum_{i=1}^{n} Z_i} \quad (20)$$

where x_i represents, in percentage, the proportion that the investor must distribute its wealth, according to the different assets that decompose the portfolio.

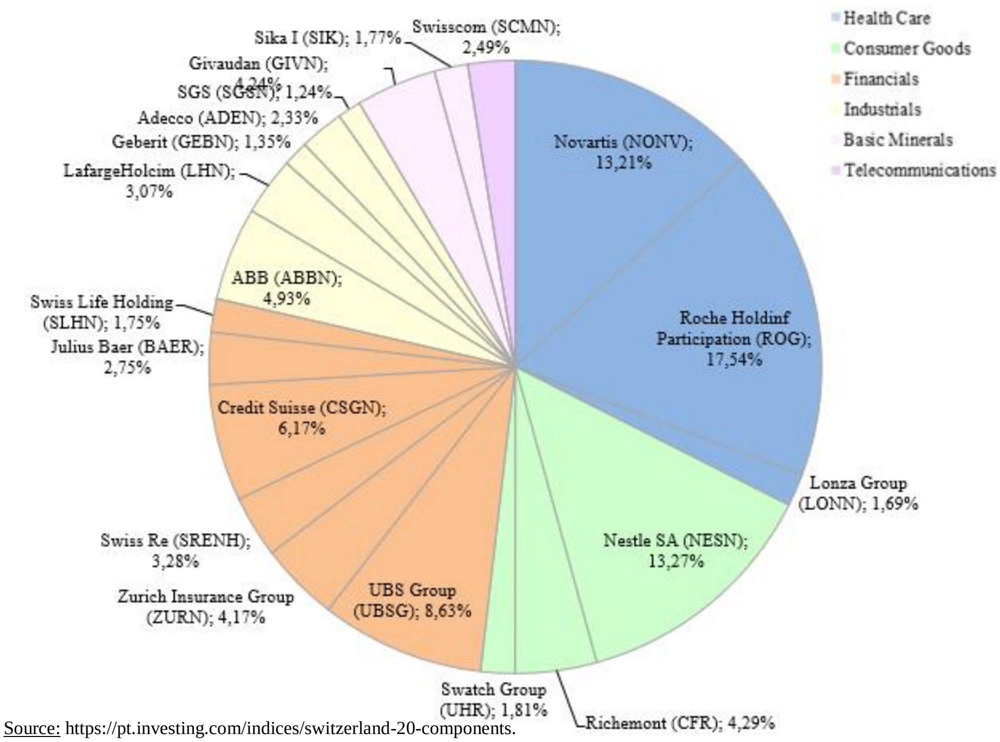
In conclusion, this model permits to rank assets and find out the optimum portfolio with the assumption that short sales are not allowed, i.e., the equation 20 must be greater than zero, $x_i \geq 0, \mathrm{i} = 1, \dots, \mathrm{n}$.

3. Analysis of Swiss Market Index

The Swiss Market Index (SMI) is listed on the Zurich stock exchange and represents a stock market index that includes 20 of the largest companies in the Swiss economy. It constitutes 90% of the Swiss market capitalization (data from 2009). For this reason, the index or the benchmark represents the development of the country.

As it is possible to see in the table below, the index is well diversified, incorporating six different sectors: health care, costumer goods, financial services, industrial services, basic minerals and telecommunications. It is possible also to conclude that the three largest companies with the highest market capitalization value are Novartis, Roche Holding Participation and Nestle SA.

The index initially contained 17 companies and three companies were subsequently incorporated, Julius Baer Gruppe AG (BAER) on October 4, 2009, UBS Group AG (UBSG) on November 1, 2009 and Givaudan SA (GIVN) on July 3, 2016.



Source: https://pt.investing.com/indices/switzerland-20-components.
Author: Own.

Table 1: The Composition of the Swiss Market Index, on July 14, 2017.

The evolution in price of the Swiss Stock Market Index, during almost thirty years, is represented below, where one can visualize the turmoil period after 2007:

Figure 4: Switzerland Stock Market (SMI).

Source: https://tradingeconomics.com/switzerland/stock-market

4. Data Set and Methodology

The historical data inherent to the companies' stocks prices, index and the risk-free rate was gathered through the "investing.com" site and it is all treated in euros.

The weekly prices were collected to cover two periods of study, from January 1, 2001 to December 31, 2008 and from January 1, 2009 to 31 Of December 2016. This division was made with the objective of realizing if there was any impact of the crisis on the economy of one of the most developed countries of Europe. Thus, the study was divided in two periods of 8 years each.

Hence, in the first period the sample has 420 weekly observations, that is, 420 prices were withdrawn for each company belonging to the first period of analysis, 420 Swiss index prices and 420 rates relative to the risk free. After the weekly prices were collected, the weekly returns are calculated according to equation (1). However, in this step we multiplied the weekly return by 52 to convert to annual values. The same happened to determine the annual variance, where equation (3) was considered, to then proceed with the multiplication by 52 weeks. Finally, in order to determine the annual standard deviation, equation (6) was followed, and then it was multiplied by the square root of 52 weeks. However, in order to determine the rate's average of the risk-free rate, it was not necessary to apply this conversion, since the rates gathered were relative to the Switzerland 1-Year Bond Yield. Nevertheless, it has not been taken into consideration the rate's average, but instead the minimum value of each periods of analysis.

It should also be noted that in the first sub-period 17 companies were taken into account, as mentioned in the previous chapter, since the remainder 3 entered after that period of analysis.

For the second sub-period, from January 1, 2009 to 31 Of December 2016, the sample has 422 weekly observations and the procedure and need for annual conversion was exactly the same as explained above. However, in this period 19 companies were taken into account since Julius Baer Gruppe AG (BAER) entered the index on October 4, 2009 and UBS Group AG (UBSG) entered the index on November 1, 2009.[3]

In order to carry out a more complete and in-depth study several divisions of periods of analysis were carried out, with the aim of accompanying the evolution of Swiss companies in the stock market in short-term periods of 2 years. Thus, it several efficient frontiers and several capital market lines were built, not only for those two large periods (01-01-2001 - 31-12-2008) and (01-01-2009 - 31-12-2016), but also for the years (01-01-2001 - 31-12-2002), for the years (01-01-2003 - 31-12-2004), for the years (01-01-2005 - 31-12-2006), for the years (01-01-2007 - 31-12-2008), for the years (01-01-2009 - 31-12-2010), for the years (01-01-2011 - 31-12-2012), for the years (01-01-2013 - 31-12-2014) for the years (01-01-2015 - 31-12-2016). The two additional companies, Julius Baer Gruppe AG (BAER) and

3 The last company Givaudan SA (GIVN) entered on July 3, 2016, but it was not considered for the study, because it entered very recently and the company obtained average values of 2016 quite different from the average of the remaining companies, with an expected annual return of (-17,04%) and an annual standard deviation of 13%.

UBS Group AG (UBSG), were considered from the range of (01-01-2011 - 31-12-2012), and on subsequent dates, since they already had the same number of observations as the other companies.

4.1. Calculation of the Efficient Frontier

The efficient frontier concept was explained, theoretically, in section 2.3.3.1. It is the curve which limits and identifies the efficient portfolios in the line or inside the curve, portfolios with the highest return for a given risk, or the lowest risk for a given return.

To do build the efficient frontier, it is necessary to minimize the total risk of the portfolio, that is, minimize the risk associated with equation (10), the variance portfolio, considering all the weights that compose the portfolio. To do that, and then to proceed with the explanation given in section 2.3, it is necessary to consider one important assumption, that short-selling is not by the investors is not allowed.

Then, following the procedures described in section 2.3, the information was sorted in descending order according to the maximization of the Treynor Ratio (equation (16)), that is, according to the excess return of an asset compared to the risk-free rate, only the efficient portfolios were selected through the cut-off (equation (18)). Thereafter, and still in the same section, equations (19) and (20) define the requirements that make it possible to determine the percentage of the wealth to invest in each asset.

In sum, it was necessary to use the “solver” application of Microsoft Excel software in order to generate an efficient frontier that encompasses all the assets, that is, a border that indicates the weights of each asset in which to invest, bearing in mind the two variables: for a given return, the minimum possible risk.

4.2. Calculation of the Capital Market Line

The Capital Market Line (CML) as described also in theory in section 2.3.3.2, is a line – or the new efficient frontier in the presence of a risk-free asset – which intercepts the risk-free asset on the Y-axis and a portfolio of risky assets that belongs to the "old" efficient frontier. The slope of this Capital Market Line corresponds to the definition of the Sharpe Ratio (equation (15)) in its best possible combination of the binomial risk-return: taking into account the risk-free interest rate, it is possible to identify a tangency portfolio in the "old" efficient frontier that maximizes the Sharpe Ratio. This tangency portfolio is then defined as the market portfolio, with expected return of the market $E(R_m)$ and standard deviation of the market portfolio σ_m. Finally, along the Capital Market Line, efficient portfolios earn an expected return equal to the risk-free interest rate plus the slope of the Sharpe Ratio multiplied by the standard deviation of the portfolio. Formalizing:

$$E(R_p) = R_f + \frac{E(R_m) - R_f}{\sigma_m}\sigma_p \qquad (21)$$

Hence, in practice, the line crosses the risk-free interest rate value in the y-axis and is tangent to the risky assets portfolio with the maximum value of the Sharpe Ratio present in the efficient frontier.

5. RESULTS

Based on the analysis made between the two long periods, from January 2001 until December 2008 (01-01-2001 - 31-12-2008) and from January 2009 until December 2016 (01-01-2009 - 31-12-2016), it is noticeable that there is no obvious negative impact of the crisis in the long-run, since in general all the different assets showed an improvement regarding the average annual return when comparing the total period 2009-2016 to 2001-

2008. There was only an insignificant decline in the annual average returns of three assets, SGSN (from 15.72% to 10.38%), ABBN (from 15.66% to 8.48%), and CSGN (from -1.07% to -1.45%).

However, when analyzing the Single Index Model and the formation of Optimal Portfolios, the number of assets to be included in the tangency portfolio in the first period (2001-2008) would be much smaller than in the second period of analysis (2009-2016), with only 10 companies to incorporate. (See table XI, in Appendix).

In the next period of the analysis, January 2009-December 2016, investment should be made in a portfolio with all companies, that is, the optimal portfolio of these periods should be more diversified, including stocks of 19 companies. (See table XII, in Appendix).

In terms of overall performance, the annual average return of the portfolio in the first period was 10.51% and after the crisis is 12.84%, i.e. it improved, whereas the standard deviation or the risk associated with the portfolio was initially of 19.52% and after the crisis is 50.13%, that is, it has worsened considerably.

In view of this analysis, the ratios that determine the performance of the portfolios indicate that despite the annual average return having improved, the risk factor has deteriorated considerably, which leads to an evaluation with lower values. According to the Sharpe Ratio of our Tangency portfolio, before the crisis the values were 0.54 and then the values are of 0.26, according to the Jensen's Alpha before the crisis the values were 0.12 and after the crisis they are 0.07 and according to the Treynor Ratio before the crisis it had values of 0.134 and then it has a value of 0.128 - that is to say, the values have worsened. (See table I, II, XI, XII, XIII and XIV and Figure 1 and 2, in Appendix).

When the analysis is performed for shorter sub-periods (every two years) we see quite a few variations. In the interval between (01-01-2001 - 12-31-2002), it is verified that company SGSN would present itself as the only efficient asset and therefore an efficient investment in this period would invest only the wealth in 100% in this asset, with an annual average return of only 3.82%. However, with such a short horizon of time and so few observations, it is natural that this academic exercise is biasing the result of this short period after the “dot.com bubble” towards a portfolio that is not really diversified. The weak ratios show the same weakness in the portfolio, with a Sharpe Ratio of 0.01, a Treynor Ratio of 0.03 and a Jensen's Alpha of 0.28. (See table III, XV and XVI and Figure 3, in Appendix).

In the years (01-01-2003 - 12-31-2004), all companies presented improvements, with 15 out of the 17 stocks available selected for the tangency portfolio. Despite that, only one company worsened in terms of the annual average return, and that was LONN with a variation of -3.51% to -10.42%, whereas all other 16 companies had some improvements or no significant change, since the annual average return of the assets varied between 42.81% (GEBN) and -4.64% (SRENH, even though it improved compared to the previous period). This led to an annual return of 25% (before it had been 4%) and a risk of 62% (before it had been over 100%). The ratios were also better, in general, with the Sharpe Ratio of 0.40 (before it was 0.01), Treynor Ratio is 0.28 (before it was 0.03) and Jensen's Alpha is 0.17 (before it was 0.28). (See table IV, XVII and XVIII and Figure 4, in Appendix).

Regarding the years (01-01-2005 - 12-31-2006), most of companies showed improvements, with the exception of four companies, GEBN, SGSN, SCMN and SLHN (See table V, XIX and XX and Figure 5, in Appendix). Hence, of the 17 stocks, 14 were considered assets to be invested and included in the efficient portfolio. In fact, the efficient frontier was created based on the optimization of the Sharpe Ratio, so it had not considered the Swiss index but rather the composition of the tangency portfolio (considered efficient). Thus, this portfolio led to an annual average return of 33% (before it had been 25%) and a risk of 52% (before it had been over 62%). The ratios are also better with the Sharpe Ratio of 0.62 (before it was 0.40) and Jensen's Alpha is of 0.28 (before it was 0.17). The Treynor Ratio is 1.85 (before was 0.28).

In the years (01-01-2007 - 12-31-2008), the fall of the annual average return of all the companies that compose the index is obvious. The annual average return of the portfolio shows the lowest value of all the periods of analysis with 1.82% (before was 33%) and the risk exceed 100% (before was 52%). The performance ratios are also weak with a Sharpe Ratio of 0.01 (before it was 0.62), Treynor Ratio with 0.03 (before it was 1.85), and Jensen's Alpha with 0.14 (before it was 0.28). It is still important to mention that even so, the portfolio to be invested in (tangency) should have been only composed by company NESN, since the return is superior to the risk-free rate, with 1.82%. However, it would still not be very rewarding, as all values indicate, especially the risk, since the portfolio is not diversified, which was infeasible during this period. (See table VI, XXI and XXII and Figure 6, in Appendix).

In the years (01-01-2009 - 12-31-2010), there was a very positive improvement, with maximum annual average return of 59.33% by UHR company and incorporating 15 companies into the efficient portfolio. The two assets excluded are the only ones with negative returns; ROG presented -5.54% and LONN -7.15%. As a result, the annual expected average return of the portfolio is 33.84% (before it was 1.82%) and the risk is 71.77% (before it was higher than 100%). The ratios also showed a positive evolution, with the Sharpe Ratio of 0.47 (before it was 0.01), the Treynor Ratio of 0.32 (before was 0.03) and the Jensen's Alpha of 0.24 (before was 0.14). (See table VII, XXIII and XXIV and Figure 7, in Appendix).

In the years (01-01-2011 - 12-31-2012), this period already contemplates 19 companies in the index. Once again there was a decrease relative to the annual expected average return in most companies, and only in only 2 there was an increase in its return, ROG with 18.23% and NOVN with 5.59%. However, even with the decrease of returns, a maximum return of the CFR is recorded with 21.43%, and it is fair to say that this was not the worst period comparing with all periods in analysis, since the portfolio as a whole made it possible to invest in 15 companies. The remaining 4 companies present negative values. (See table VIII, XXV and XXVI and Figure 8, in Appendix). Hence, the annual expected average return of the portfolio is 13.82% (before it was 33.84%) and the risk in this period is 56.84% (before it was 71.77%). Regarding the evaluation measures, they experience a small decrease, with a Sharpe Ratio of 0.24 (before was 0.47), Treynor Ratio with 0.13 (before was 0.32) and the Jensen Alpha with 0.076 (before was 0.24).

Subsequently, in the period (01-01-2013 - 12-31-2014), most of companies returned to improve annual average return, with the maximum being LONN with 41.65% and with only 4 companies decreasing their return (SRENH with 12.09%, SFR with 10.95%, SGSN with 0.58% and UHR with -2.97%.) Of the 19 companies, 18 enter into the efficient portfolio, leaving only UHR outside due to negative rate of return and for being lower than the risk-free rate. Hence, the portfolio's expected average return is 20.68% (before 13.82%) and the risk is 36.16% (before it was 56.84%), while performance ratios also improved with Sharpe Ratio of 0.57 (before was 0.24), Treynor Ratio is 0.21 (before it was 0.13) and Jensen Alpha's is 0.078 (before it was 0.076). (See table IX, XXVII and XXVIII and Figure 9, in Appendix).

Lastly, in the period (01-01-2015 - 12-31-2016), there was still a drop for the majority of companies, leaving only two companies to improve their annual expected average return (SIK with 28.07%, also being the group's highest return, and SGSN with 3.38%). In the construction of the efficient portfolio, 11 companies were allowed to join, thus registering a portfolio's average return of 16.02% (previously 20.68%) and a risk of 66.95% (before it was 36.16%). Thereafter, the performance ratios show the reduction, in general, of the values; Sharpe Ratio drops to 0.24% (before it was 0.57%) the Treynor Ratio of 0.17% (before was 0.21%) and the Jensen Alpha of 0.19 (before was 0.078). (See table X, XXIX and XXX and Figure 10, in Appendix).

6. CONCLUSIONS

In terms of general conclusions, with the analysis between the two major periods (2001-2008, and 2009-2016), we can say that there was a recovery after the crisis. Indeed, there was an improvement in the annual average return of the assets that make up the portfolios, even if volatility increased in some of the years under analysis. The fact that the market has become more volatile leads to a worse assessment of some performance ratios.

As was mentioned above, when the analysis is done every two years, we can see more effects in the economy and draw more conclusions. Hence, as the results show the short period of 2001-2002 was unfavorable, with only one efficient asset and still with a very small return, due to external effects that affected many economies and companies (in the year 2001 another crisis known as "The Internet Bubble" or the "Dot Com Bubble" burst, Ljungqvist and Wilhelm, 2003).

Over the next four years, 2003-2006, it was possible to see the development and the stability of the economy and its companies, both in the increase of the annual expected average return and of the performance ratios, as well as in the reduction of risk over time.

During the short period 2007-2008, the years of the subprime-crisis, the impact of the crisis is evident, with all the companies lowering their returns and not having an efficient portfolio of risky assets in which to invest in this period. Thus, this analysis suggests that there was no long-term impact (when we talk about the 8-year period after the sub-prime crisis), but rather that the crisis was momentarily felt very strongly in the Swiss market.

In the next two years 2009-2010 there was an improvement that reached levels considered stable in relation to the historical data. In the years 2011-2012, there was again a decrease in the annual average returns which led to the decline in the average portfolio return, but on the other hand, it led to a decrease in the percentage of risk and the number of companies also remained stable. Although there is some evidence that this was again a more fragile period, it did not reach the proportions of what was felt in 2007-2008. In 2010-2011 the overall worse performance of companies might be explained by the regulations required in Europe to ensure stability of the countries. In this sense, the Financial Stability Board (FSB) has implemented requirements in 2011 for Systemically Important Financial Institutions (SIFIs) which later creates a stumbling block in company performance, which many claim has consequences, such as the reduction of consumption and consequently the decrease of the performance of some companies.

Thereafter, in the next two years 2013-2014, there was an improvement again that reached levels considered stable, being the 2-year period with lower risk. In 2015-2016 it is possible again to identify a decline in returns for the majority of companies, but of a much smaller dimension than what was seen in the sub-prime crisis. This drop most likely had origin principally in 2015 when the Swiss franc reached historically high values in relation to the euro currency, and not only that, the Swiss franc also had large price swings, which lead to the loss of confidence of companies to invest and to create development strategies. Specifying better, the high Swiss franc reduces exports, and this led to lower profit margins, which in turn leads to the creation of cost reduction strategies, such as job cuts, creating a regression in the development of companies and in the Swiss economy, according to Mombelli and Rossi (2016).

In conclusion, the Swiss stock market is clearly affected by international affairs and market swings. With the sub-prime crisis of 2008, the performance of Swiss stocks deteriorated considerably. However, when considering longer-term effects, analyzing data from 2009 until 2016, it becomes apparent that the Swiss market recovered its spirits, and went back to levels of performance similar to what investors were used too many years before.

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Appendixes

Table I – Data from the period between January 1, 2001 and December 31, 2008.

The Efficient Frontier													
	Rank	E(Rx)	$E(R_X) - R_f$	βx	σ^2_{eX}	$\frac{E(R_X) - R_f}{\beta}$	$\frac{(E(R_X) - R_f)\beta_X}{\sigma^2_{eX}}$	$\frac{\beta_i^2}{\sigma^2_{ei}}$	$\sum_{X=1}^{17} \frac{(E(R_X) - R_f)\beta_X}{\sigma^2_{eX}}$	$\sum_{X=1}^{17} \frac{\beta_X^2}{\sigma^2_{eX}}$	Cx	Zi	% to Invest
GEBN	1	17,15%	16,87%	0,57	7,67	0,2935	0,01	0,04	0,01	0,04	0,0000001	0,02199642	**18,85%**
SIK	2	13,74%	13,46%	0,64	7,96	0,2118	0,01	0,05	0,02	0,09	0,0000001	0,0169213	**14,50%**
SGSN	3	15,72%	15,44%	0,84	8,57	0,1829	0,02	0,08	0,04	0,18	0,0000002	0,01801056	**15,43%**
ABBN	4	15,66%	15,38%	1,55	38,66	0,0995	0,01	0,06	0,04	0,24	0,0000002	0,00397816	**3,41%**
CFR	5	9,01%	8,73%	1,08	7,37	0,0807	0,01	0,16	0,06	0,40	0,0000003	0,01184681	**10,15%**
LONN	6	3,47%	3,19%	0,55	4,49	0,0580	0,00	0,07	0,06	0,47	0,0000003	0,0071008	**6,08%**
NESN	7	4,16%	3,88%	0,67	2,10	0,0576	0,01	0,21	0,07	0,68	0,0000004	0,01841637	**15,78%**
ROG	8	3,71%	3,43%	0,93	2,99	0,0369	0,01	0,29	0,08	0,97	0,0000004	0,01144759	**9,81%**
LHN	9	3,65%	3,37%	0,98	7,12	0,0345	0,00	0,13	0,09	1,10	0,0000004	0,004736	**4,06%**
UHR	10	1,70%	1,42%	0,95	6,27	0,0149	0,00	0,14	0,09	1,25	0,0000004	0,00226659	**1,94%**
NOVN	11	-0,149%	-0,43%	0,85	2,76	-0,0050	0,00	0,26	0,09	1,51	0,0000004	-0,00155594	**100,00%**
CSGN	12	-1,07%	-1,35%	1,69	6,57	-0,0080	0,00	0,43	0,09	1,94	0,0000004	-0,00205266	
SCMN	13	-0,38%	-0,66%	0,44	2,37	-0,0150	0,00	0,08	0,09	2,02	0,0000004	-0,00276943	
ZURN	14	-5,02%	-5,30%	1,45	8,06	-0,0367	-0,01	0,26	0,08	2,28	0,0000004	-0,00657774	
ADEN	15	-3,96%	-4,24%	1,13	11,94	-0,0377	0,00	0,11	0,07	2,39	0,0000003	-0,00355248	
SRENH	16	-10,02%	-10,30%	1,23	5,40	-0,0836	-0,02	0,28	0,05	2,67	0,0000002	-0,01905568	
SLHN	17	-16,90%	-17,18%	1,31	15,79	-0,1312	-0,01	0,11	0,03	2,78	0,0000002	-0,01088384	
												0,1167206	

Figure 1 – The Efficient Frontier and the CML from the period between January 1, 2001 and December 31, 2008.

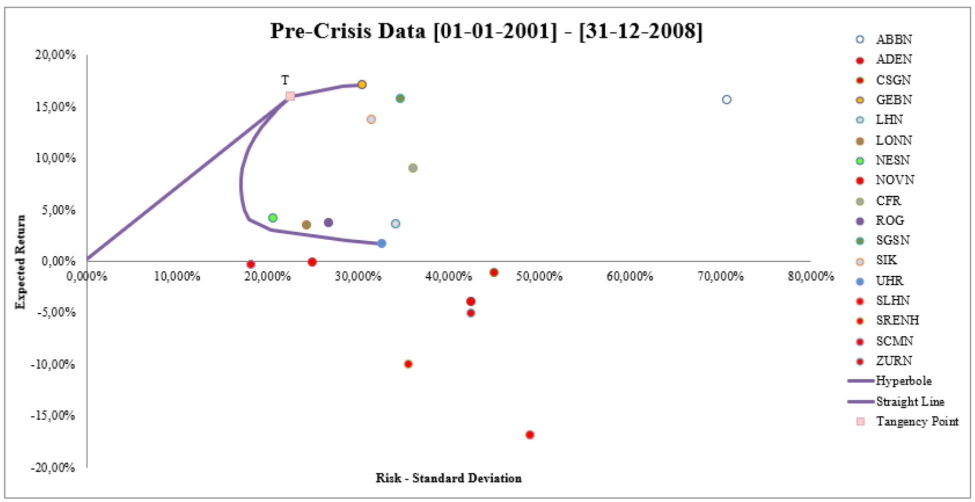


Table II – Data from the period between January 1, 2009 and December 31, 2016.

The Efficient Frontier													
	Rank	E(Rx)	$E(R_X) - R_f$	βx	σ^2_{eX}	$\frac{E(R_X) - R_f}{\beta}$	$\frac{(E(R_X) - R_f)\beta_X}{\sigma^2_{eX}}$	$\frac{\beta_i^2}{\sigma^2_{ei}}$	$\sum_{X=1}^{19} \frac{(E(R_X) - R_f)\beta_X}{\sigma^2_{eX}}$	$\sum_{X=1}^{19} \frac{\beta_X^2}{\sigma^2_{eX}}$	Cx	Zi	Percentage to Invest
BAER	1	5,42%	0,070	0,07	8,26	0,9707	0,00	0,00	0,00	0,00	0,0000000	0,008418	**1,32%**
SIK	2	25,30%	0,268	1,06	5,11	0,2535	0,06	0,22	0,06	0,22	0,0000001	0,052561	**8,24%**
GEBN	3	18,70%	0,202	0,97	2,66	0,2085	0,07	0,35	0,13	0,57	0,0000003	0,076012	**11,91%**
SLHN	4	23,89%	0,254	1,30	6,29	0,1963	0,05	0,27	0,18	0,84	0,0000005	0,040426	**6,34%**
CFR	5	19,85%	0,214	1,32	5,06	0,1615	0,06	0,35	0,24	1,19	0,0000006	0,042213	**6,62%**
SGSN	6	10,38%	0,119	0,78	2,53	0,1529	0,04	0,24	0,27	1,43	0,0000007	0,047084	**7,38%**
NESN	7	8,28%	0,098	0,66	1,37	0,1482	0,05	0,32	0,32	1,75	0,0000008	0,071881	**11,27%**
UHR	8	14,59%	0,161	1,14	6,41	0,1412	0,03	0,20	0,35	1,95	0,0000009	0,025139	**3,94%**
SCMN	9	4,82%	0,063	0,50	1,61	0,1269	0,02	0,16	0,37	2,11	0,0000010	0,039494	**6,19%**
SRENH	10	16,68%	0,182	1,45	10,46	0,1252	0,03	0,20	0,40	2,31	0,0000010	0,017415	**2,73%**
LONN	11	11,25%	0,128	1,02	6,58	0,1248	0,02	0,16	0,42	2,47	0,0000011	0,019436	**3,05%**
ADEN	12	12,61%	0,141	1,30	5,23	0,1085	0,04	0,33	0,45	2,79	0,0000012	0,027065	**4,24%**
ROG	13	6,60%	0,081	0,95	1,91	0,0856	0,04	0,47	0,49	3,26	0,0000013	0,042491	**6,66%**
NOVN	14	6,09%	0,076	0,90	1,52	0,0846	0,05	0,53	0,54	3,80	0,0000014	0,050002	**7,84%**
ABBN	15	8,48%	0,100	1,28	3,34	0,0783	0,04	0,49	0,58	4,28	0,0000015	0,029944	**4,69%**
ZURN	16	6,33%	0,079	1,22	3,42	0,0646	0,03	0,43	0,60	4,72	0,0000016	0,022987	**3,60%**
LHN	17	4,80%	0,063	1,41	5,01	0,0450	0,02	0,40	0,62	5,11	0,0000016	0,012631	**1,98%**
UBSG	18	4,12%	0,056	1,44	4,42	0,0391	0,02	0,47	0,64	5,58	0,0000017	0,012769	**2,00%**
CSGN	19	-1,45%	0,001	1,58	7,33	0,0005	0,00	0,34	0,64	5,92	0,0000017	0,000115	**0,02%**
												0,63808	**100,00%**

Figure 2 – The Efficient Frontier and the CML from the period between January 1, 2009 and December 31, 2016.

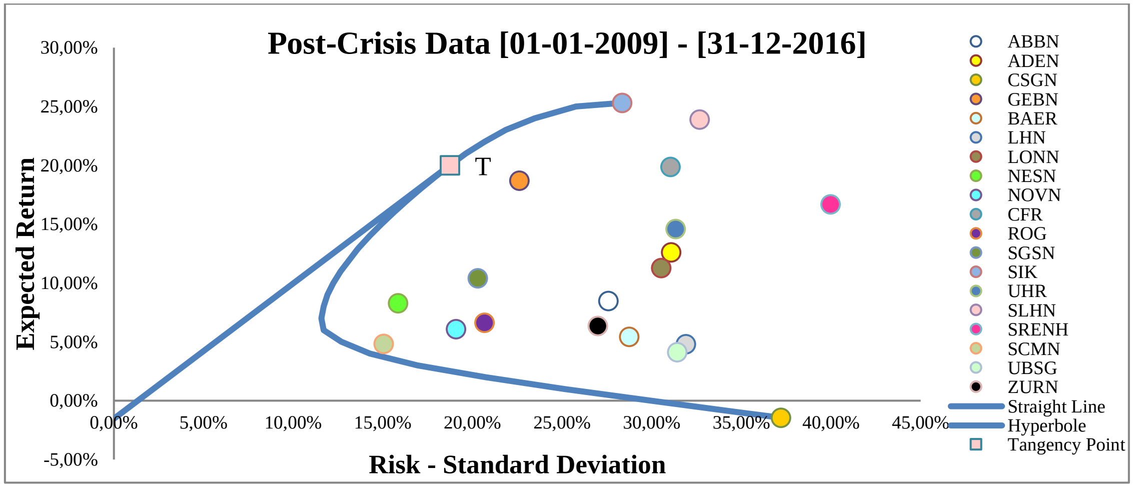


Table III – Data from the period between January 1, 2001 and December 31, 2002.

EFFICIENT FRONTIER													
	Rank	E(Rx)	$E(R_X) - R_f$	βx	σ^2_{eX}	$\frac{E(R_X) - R_f}{\beta}$	$\frac{(E(R_X) - R_f)\beta_X}{\sigma^2_{eX}}$	$\frac{\beta_i^2}{\sigma^2_{ei}}$	$\sum_{X=1}^{17} \frac{(E(R_X) - R_f)\beta_X}{\sigma^2_{eX}}$	$\sum_{X=1}^{17} \frac{\beta_X^2}{\sigma^2_{eX}}$	Cx	Zi	Percentage to Invest
SGSN	1	3,82%	3,23%	1,15	16,54	0,0282	0,00	0,08	0,00	0,08	0,0000	0,001955	100,00%
GEBN	2	0,26%	-0,33%	0,28	9,43	-0,01	0,00	0,01	0,00	0,09	1,49766E-08	-0,00035	
SCMN	3	-0,02%	-0,61%	0,26	3,75	-0,02	0,00	0,02	0,00	0,11	0,0000000	-0,00162	
LONN	4	-3,51%	-4,10%	0,43	2,50	-0,09	-0,01	0,08	-0,01	0,18	0,0000000	-0,01643	
NESN	5	-4,85%	-5,44%	0,60	2,68	-0,09	-0,01	0,13	-0,02	0,31	-0,0000001	-0,02032	
NOVN	6	-7,411%	-8,00%	0,83	4,56	-0,10	-0,01	0,15	-0,03	0,47	-0,0000002	-0,01753	
ADEN	7	-13,67%	-14,26%	1,33	21,60	-0,11	-0,01	0,08	-0,04	0,55	-0,0000003	-0,0066	
LHN	8	-12,15%	-12,74%	0,94	6,17	-0,14	-0,02	0,14	-0,06	0,69	-0,0000004	-0,02064	
UHR	9	-16,34%	-16,93%	1,10	10,91	-0,15	-0,02	0,11	-0,08	0,80	-0,0000005	-0,01552	
SIK	10	-7,49%	-8,08%	0,46	9,86	-0,18	0,00	0,02	-0,08	0,82	-0,0000006	-0,0082	
ROG	11	-17,89%	-18,48%	1,07	3,31	-0,17	-0,06	0,34	-0,14	1,17	-0,0000010	-0,05589	
CSGN	12	-26,84%	-27,43%	1,48	9,88	-0,18	-0,04	0,22	-0,18	1,39	-0,0000013	-0,02776	
SRENH	13	-24,66%	-25,25%	1,20	6,84	-0,21	-0,04	0,21	-0,23	1,60	-0,0000016	-0,03693	
ABBN	14	-46,48%	-47,07%	1,63	111,76	-0,29	-0,01	0,02	-0,23	1,63	-0,0000016	-0,00421	
ZURN	15	-62,14%	-62,73%	1,72	20,56	-0,36	-0,05	0,14	-0,29	1,77	-0,0000020	-0,03052	
SLHN	16	-85,06%	-85,65%	1,54	22,40	-0,56	-0,06	0,11	-0,34	1,88	-0,0000024	-0,03824	
CFR	17	-21,86%	-22,45%	0,18	18,65	-1,25	0,00	0,00	-0,35	1,88	-0,0000024	-0,01204	
												0,001955	

Figure 3 – The Efficient Frontier and the CML from the period between January 1, 2001 and December 31, 2002.

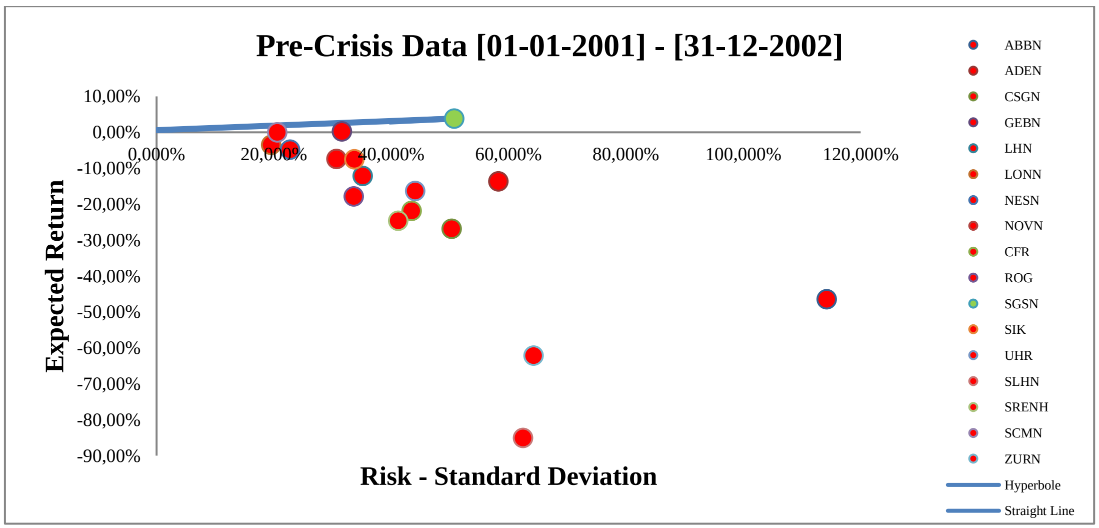


Table IV – Data from the period between January 1, 2003 and December 31, 2004.

EFFICIENT FRONTIER													
	Rank	E(Rx)	$E(R_X) - R_f$	βx	σ_{eX}^2	$\frac{E(R_X) - R_f}{\beta}$	$\frac{(E(R_X) - R_f)\beta_X}{\sigma_{eX}^2}$	$\frac{\beta_i^2}{\sigma_{ei}^2}$	$\sum_{X=1}^{17} \frac{(E(R_X) - R_f)\beta_X}{\sigma_{eX}^2}$	$\sum_{X=1}^{17} \frac{\beta_X^2}{\sigma_{eX}^2}$	Cx	Zi	Percentage to Invest
GEBN	1	42,81%	0,428	0,52	5,51	0,8268	0,04	0,05	0,04	0,05	0,0000001	0,077681	**11,39%**
SIK	2	35,28%	0,353	0,54	4,25	0,6565	0,04	0,07	0,08	0,12	0,0000002	0,083102	**12,19%**
SGSN	3	33,58%	0,336	0,62	4,62	0,5391	0,05	0,08	0,13	0,20	0,0000003	0,072702	**10,66%**
SLHN	4	37,09%	0,371	1,42	23,04	0,2612	0,02	0,09	0,15	0,29	0,0000004	0,016102	**2,36%**
ABBN	5	47,06%	0,471	1,85	29,24	0,2541	0,03	0,12	0,18	0,41	0,0000005	0,016097	**2,36%**
UHR	6	21,55%	0,216	0,91	4,60	0,2368	0,04	0,18	0,23	0,59	0,0000006	0,046841	**6,87%**
SCMN	7	8,13%	0,081	0,39	1,16	0,2092	0,03	0,13	0,25	0,72	0,0000007	0,069935	**10,26%**
CSGN	8	24,30%	0,243	1,28	3,95	0,1891	0,08	0,42	0,33	1,13	0,0000009	0,061496	**9,02%**
ROG	9	15,58%	0,156	0,84	2,95	0,1844	0,04	0,24	0,38	1,38	0,0000010	0,052783	**7,74%**
CFR	10	19,55%	0,196	1,07	5,50	0,1821	0,04	0,21	0,41	1,58	0,0000011	0,035527	**5,21%**
LHN	11	19,53%	0,195	1,32	3,52	0,1478	0,07	0,50	0,49	2,08	0,0000013	0,055455	**8,13%**
ZURN	12	20,98%	0,210	1,56	4,22	0,1344	0,08	0,58	0,57	2,66	0,0000015	0,049738	**7,30%**
ADEN	13	12,83%	0,128	1,39	16,88	0,0920	0,01	0,12	0,58	2,77	0,0000015	0,007602	**1,12%**
NOVN	14	4,935%	0,049	0,90	1,45	0,0547	0,03	0,56	0,61	3,33	0,0000016	0,033945	**4,98%**
NESN	15	0,57%	0,006	0,86	2,06	0,0066	0,00	0,36	0,61	3,69	0,0000016	0,002757	**0,40%**
SRENH	16	-4,64%	-0,046	1,34	5,92	-0,0347	-0,01	0,30	0,60	3,99	0,0000016	-0,00783	**100,00%**
LONN	17	-10,42%	-0,104	0,63	5,98	-0,1666	-0,01	0,07	0,59	4,06	0,0000015	-0,01741	
												0,681764	

Figure 4 – The Efficient Frontier and the CML from the period between January 1, 2003 and December 31, 2004.

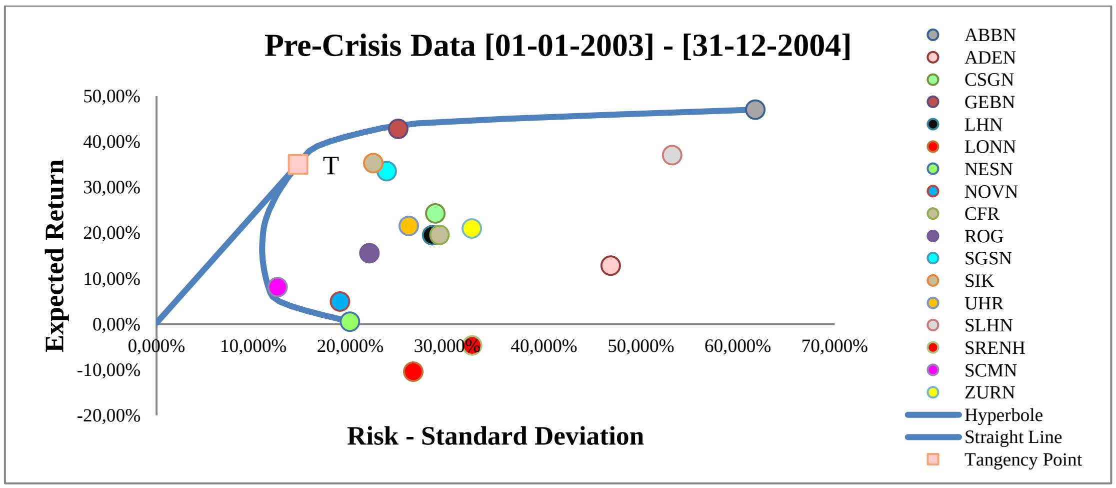


Table V – Data from the period between January 1, 2005 and December 31, 2006.

EFFICIENT FRONTIER													
	Rank	E(Rx)	$E(R_X) - R_f$	βx	σ^2_{eX}	$\frac{E(R_X) - R_f}{\beta}$	$\frac{(E(R_X) - R_f)\beta_X}{\sigma^2_{eX}}$	$\frac{\beta_i^2}{\sigma^2_{ei}}$	$\sum_{X=1}^{17} \frac{(E(R_X) - R_f)\beta_X}{\sigma^2_{eX}}$	$\sum_{X=1}^{17} \frac{\beta_X^2}{\sigma^2_{eX}}$	Cx	Zi	Percentage to Invest
NESN	1	18,82%	18,12%	0,02	1,48	8,1601	0,00	0,00	0,00	0,00	0,0000000	0,122046	**10,39%**
ABBN	2	62,48%	61,78%	0,08	6,14	7,7896	0,01	0,00	0,01	0,00	0,0000000	0,100681	**8,57%**
NOVN	3	12,819%	12,12%	0,02	1,63	6,5714	0,00	0,00	0,01	0,00	0,0000000	0,074541	**6,34%**
GEBN	4	42,16%	41,46%	0,11	4,31	3,9250	0,01	0,00	0,02	0,00	0,0000000	0,096159	**8,18%**
CSGN	5	30,55%	29,85%	0,12	3,97	2,5340	0,01	0,00	0,03	0,01	0,0000000	0,075113	**6,39%**
ROG	6	28,71%	28,01%	0,12	2,17	2,2541	0,02	0,01	0,05	0,01	0,0000000	0,129122	**10,99%**
ADEN	7	20,78%	20,08%	0,09	4,63	2,1620	0,00	0,00	0,05	0,02	0,0000001	0,043361	**3,69%**
CFR	8	33,58%	32,88%	0,22	5,40	1,5091	0,01	0,01	0,06	0,03	0,0000001	0,060878	**5,18%**
UHR	9	25,09%	24,39%	0,16	3,14	1,4813	0,01	0,01	0,08	0,03	0,0000001	0,077656	**6,61%**
SIK	10	55,24%	54,54%	0,44	5,01	1,2351	0,05	0,04	0,13	0,07	0,0000001	0,10894	**9,27%**
ZURN	11	31,75%	31,05%	0,28	3,56	1,1026	0,02	0,02	0,15	0,10	0,0000001	0,087192	**7,42%**
SGSN	12	29,55%	28,85%	0,29	4,09	0,9907	0,02	0,02	0,17	0,12	0,0000002	0,070452	**6,00%**
LHN	13	26,99%	26,29%	0,32	2,55	0,8156	0,03	0,04	0,20	0,16	0,0000002	0,10308	**8,77%**
SCMN	14	3,67%	2,97%	0,10	1,15	0,2838	0,00	0,01	0,21	0,17	0,0000002	0,0258	**2,20%**
SRENH	15	13,70%	13,00%	-0,01	3,13	-10,2192	0,00	0,00	0,21	0,17	0,0000002	0,041585	**100,00%**
SLHN	16	35,44%	34,74%	-0,018	4,82	-18,8839	0,00	0,00	0,20	0,17	0,0000002	0,072066	
LONN	17	26,55%	25,85%	-0,007	2,55	-37,6222	0,00	0,00	0,20	0,17	0,0000002	0,101267	
												1,17502	

Figure 5 – The Efficient Frontier and the CML from the period between January 1, 2005 and December 31, 2006.

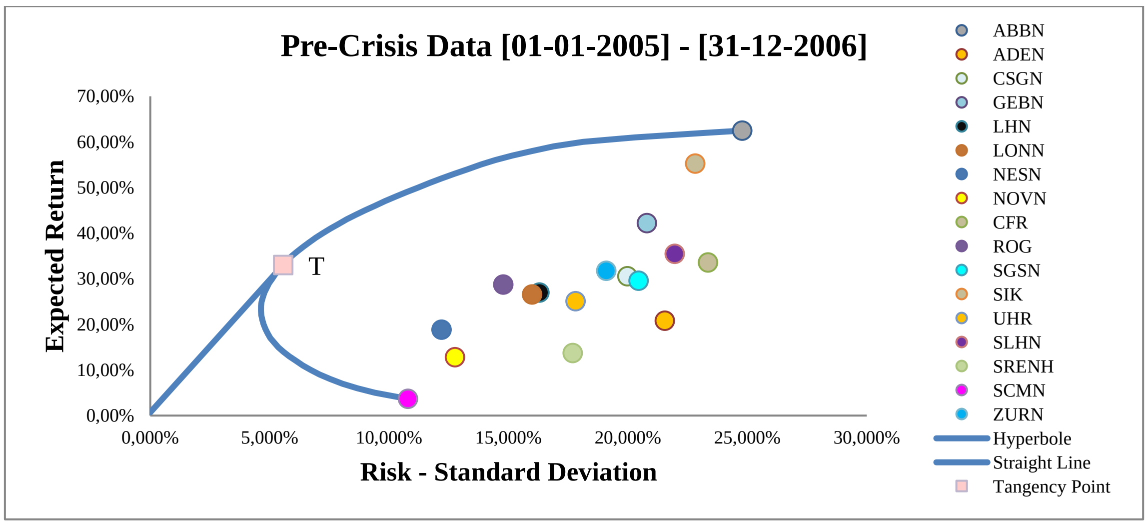


Table VI – Data from the period between January 1, 2007 and December 31, 2008.

EFFICIENT FRONTIER													
	Rank	E(Rx)	$E(R_X)-R_f$	βx	σ^2_{eX}	$\frac{E(R_X)-R_f}{\beta}$	$\frac{(E(R_X)-R_f)\beta_X}{\sigma^2_{eX}}$	$\frac{\beta_i^2}{\sigma^2_{ei}}$	$\sum_{X=1}^{17}\frac{(E(R_X)-R_f)\beta_X}{\sigma^2_{eX}}$	$\sum_{X=1}^{17}\frac{\beta_X^2}{\sigma^2_{eX}}$	Cx	Zi	Percentage to Invest
NESN	1	1,82%	0,89%	0,68	2,58	0,0132	0,00	0,18	0,00	0,18	0,0000000	0,003471	100,00%
LONN	2	0,84%	-0,09%	0,62	7,07	-0,0015	0,00	0,05	0,00	0,23	0,0000000	-0,00013	
ABBN	3	-1,16%	-2,09%	1,36	9,86	-0,0153	0,00	0,19	0,00	0,42	0,0000000	-0,00212	
SGSN	4	-4,14%	-5,07%	0,63	9,02	-0,0802	0,00	0,04	0,00	0,47	0,0000000	-0,00562	
ZURN	5	-11,33%	-12,26%	1,20	4,14	-0,1023	-0,04	0,35	-0,04	0,81	-0,0000003	-0,02963	
CFR	6	-10,03%	-10,96%	0,88	12,69	-0,1243	-0,01	0,06	-0,05	0,87	-0,0000004	-0,00864	
NOVN	7	-11,086%	-12,02%	0,87	3,98	-0,1382	-0,03	0,19	-0,07	1,06	-0,0000006	-0,03018	
ROG	8	-11,90%	-12,83%	0,88	3,52	-0,1450	-0,03	0,22	-0,11	1,29	-0,0000009	-0,03649	
CSGN	9	-32,59%	-33,52%	2,02	8,88	-0,1660	-0,08	0,46	-0,18	1,75	-0,0000015	-0,03776	
SRENH	10	-24,77%	-25,70%	1,26	6,61	-0,2034	-0,05	0,24	-0,23	1,99	-0,0000019	-0,03886	
SCMN	11	-13,24%	-14,17%	0,61	3,06	-0,2315	-0,03	0,12	-0,26	2,11	-0,0000022	-0,0463	
LHN	12	-19,99%	-20,92%	0,92	16,47	-0,2279	-0,01	0,05	-0,27	2,16	-0,0000023	-0,0127	
GEBN	13	-16,80%	-17,73%	0,76	11,23	-0,2347	-0,01	0,05	-0,28	2,21	-0,0000024	-0,01579	
UHR	14	-23,71%	-24,64%	0,81	7,41	-0,3052	-0,03	0,09	-0,31	2,30	-0,0000026	-0,03326	
SIK	15	-28,46%	-29,39%	0,73	12,77	-0,4040	-0,02	0,04	-0,33	2,34	-0,0000027	-0,02302	
ADEN	16	-35,97%	-36,90%	0,88	5,16	-0,4217	-0,06	0,15	-0,39	2,49	-0,0000033	-0,07154	
SLHN	17	-55,73%	-56,66%	1,05	12,93	-0,5410	-0,05	0,08	-0,44	2,58	-0,0000036	-0,04381	
												0,003471	

Figure 6 – The Efficient Frontier and the CML from the period between January 1, 2007 and December 31, 2008.

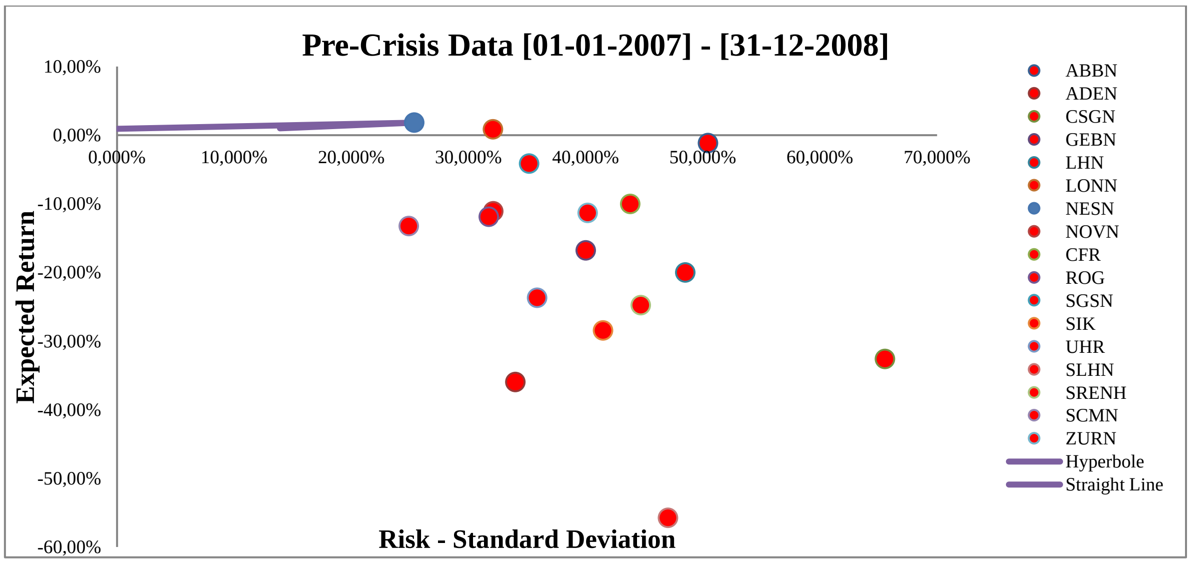


Table VII – Data from the period between January 1, 2009 and December 31, 2010.

EFFICIENT FRONTIER													
	Rank	E(Rx)	$E(R_X) - R_f$	βx	σ^2_{eX}	$\frac{E(R_X) - R_f}{\beta}$	$\frac{(E(R_X) - R_f)\beta_X}{\sigma^2_{eX}}$	$\frac{\beta_i^2}{\sigma^2_{ei}}$	$\sum_{X=1}^{17} \frac{(E(R_X) - R_f)\beta_X}{\sigma^2_{eX}}$	$\sum_{X=1}^{17} \frac{\beta_X^2}{\sigma^2_{eX}}$	Cx	Zi	Percentage to Invest
UHR	1	59,33%	0,59	1,12	9,38	0,5261	0,07	0,13	0,07	0,13	0,0000002	0,063029	**8,98%**
SGSN	2	21,49%	0,21	0,47	3,49	0,4529	0,03	0,06	0,10	0,20	0,0000003	0,06098	**8,69%**
CFR	3	56,01%	0,56	1,39	5,92	0,4012	0,13	0,33	0,23	0,52	0,0000007	0,094206	**13,42%**
GEBN	4	36,18%	0,36	0,99	3,77	0,3636	0,09	0,26	0,32	0,78	0,0000010	0,095418	**13,60%**
SIK	5	47,55%	0,47	1,34	6,82	0,3524	0,09	0,26	0,42	1,05	0,0000013	0,069417	**9,89%**
SLHN	6	44,56%	0,44	1,46	12,96	0,3027	0,05	0,17	0,47	1,21	0,0000015	0,034217	**4,88%**
NESN	7	15,54%	0,15	0,53	2,73	0,2911	0,03	0,10	0,50	1,32	0,0000016	0,056155	**8,00%**
SCMN	8	10,64%	0,10	0,39	1,62	0,2685	0,02	0,09	0,52	1,41	0,0000016	0,064282	**9,16%**
ADEN	9	33,12%	0,33	1,23	7,66	0,2679	0,05	0,20	0,58	1,61	0,0000018	0,042968	**6,12%**
ABBN	10	23,10%	0,23	1,39	5,96	0,1650	0,05	0,32	0,63	1,93	0,0000020	0,038381	**5,47%**
CSGN	11	21,23%	0,21	1,64	9,34	0,1283	0,04	0,29	0,67	2,21	0,0000021	0,022488	**3,20%**
LHN	12	18,33%	0,18	1,57	8,81	0,1153	0,03	0,28	0,70	2,49	0,0000022	0,020545	**2,93%**
SRENH	13	23,74%	0,24	2,60	27,06	0,0903	0,02	0,25	0,72	2,74	0,0000022	0,008691	**1,24%**
ZURN	14	10,22%	0,10	1,51	6,47	0,0663	0,02	0,35	0,74	3,10	0,0000023	0,01546	**2,20%**
NOVN	15	3,97%	0,04	0,65	2,41	0,0578	0,01	0,17	0,75	3,27	0,0000024	0,01556	**2,22%**
ROG	16	-5,54%	-0,06	0,95	3,22	-0,0605	-0,02	0,28	0,74	3,55	0,0000023	-0,01791	**100,00%**
LONN	17	-7,15%	-0,07	0,60	10,16	-0,1228	0,00	0,04	0,73	3,59	0,0000023	-0,00725	
												0,701796	

Figure 7 – The Efficient Frontier and the CML from the period between January 1, 2009 and December 31, 2010.

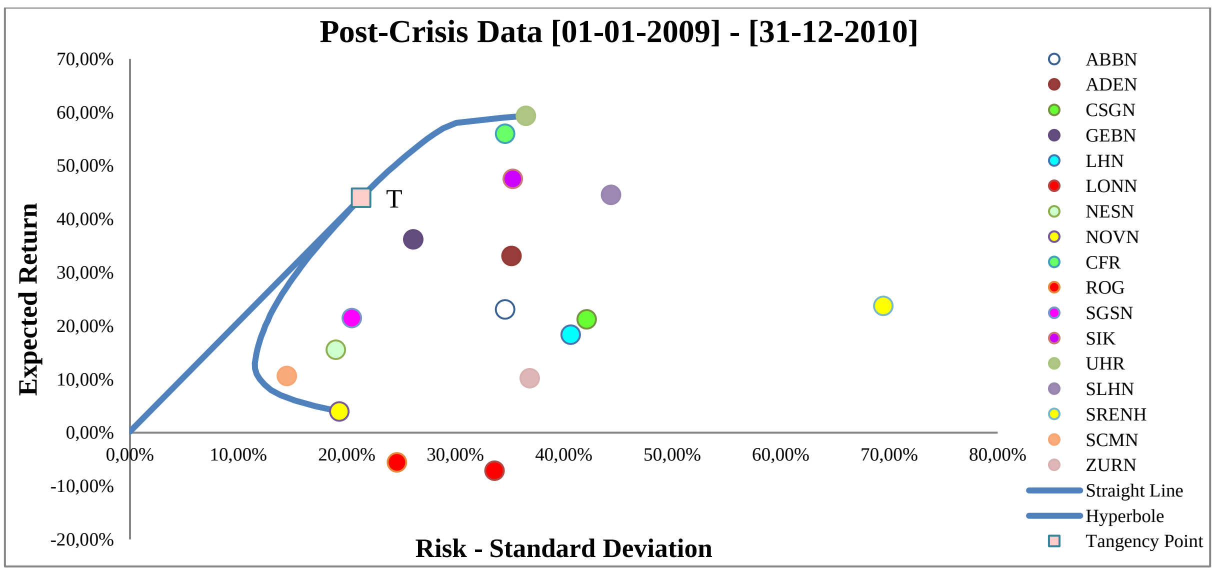


Table VIII – Data from the period between January 1, 2011 and December 31, 2012.

EFFICIENT FRONTIER													
	Rank	E(Rx)	$E(R_X) - R_f$	βx	σ^2_{eX}	$\frac{E(R_X) - R_f}{\beta}$	$\frac{(E(R_X) - R_f)\beta_X}{\sigma^2_{eX}}$	$\frac{\beta_i^2}{\sigma^2_{ei}}$	$\sum_{X=1}^{19} \frac{(E(R_X) - R_f)\beta_X}{\sigma^2_{eX}}$	$\sum_{X=1}^{19} \frac{\beta_X^2}{\sigma^2_{eX}}$	Cx	Zi	Percentage to Invest
ROG	1	18,23%	18,22%	0,89	1,87	0,2043	0,09	0,43	0,09	0,43	0,0000002	0,097394	**20,81%**
SRENH	2	21,45%	21,44%	1,25	3,80	0,1716	0,07	0,41	0,16	0,84	0,0000004	0,056437	**12,06%**
SGSN	3	16,03%	16,02%	0,99	1,59	0,1623	0,10	0,61	0,26	1,45	0,0000007	0,100593	**21,49%**
CFR	4	21,43%	21,42%	1,47	6,40	0,1460	0,05	0,34	0,31	1,78	0,0000008	0,03344	**7,14%**
UHR	5	13,54%	13,53%	1,22	6,80	0,1111	0,02	0,22	0,33	2,00	0,0000009	0,019885	**4,25%**
NESN	6	6,40%	6,39%	0,56	1,29	0,1150	0,03	0,24	0,36	2,24	0,0000009	0,049649	**10,61%**
NOVN	7	5,59%	5,58%	0,88	1,42	0,0635	0,03	0,54	0,39	2,78	0,0000010	0,039164	**8,37%**
SIK	8	7,04%	7,03%	1,17	3,49	0,0600	0,02	0,39	0,42	3,18	0,0000011	0,020163	**4,31%**
ZURN	9	4,64%	4,63%	1,32	2,03	0,0350	0,03	0,86	0,45	4,04	0,0000012	0,022809	**4,87%**
SLHN	10	4,69%	4,68%	1,69	5,47	0,0277	0,01	0,52	0,46	4,56	0,0000012	0,008563	**1,83%**
UBSG	11	3,81%	3,80%	1,55	5,61	0,0244	0,01	0,43	0,47	4,99	0,0000012	0,006765	**1,45%**
LHN	12	3,24%	3,23%	1,39	3,37	0,0233	0,01	0,57	0,48	5,56	0,0000013	0,009578	**2,05%**
GEBN	13	0,30%	0,29%	0,95	2,12	0,0031	0,00	0,42	0,49	5,98	0,0000013	0,001378	**0,29%**
ABBN	14	0,37%	0,36%	1,42	2,30	0,0025	0,00	0,88	0,49	6,86	0,0000013	0,001554	**0,33%**
SCMN	15	0,11%	0,10%	0,54	1,35	0,0018	0,00	0,21	0,49	7,08	0,0000013	0,000702	**0,15%**
ADEN	16	-3,63%	-3,64%	1,66	6,16	-0,02	-0,01	0,45	0,48	7,52	0,0000012	-0,0059	**100,00%**
CSGN	17	-16,49%	-16,50%	1,78	7,51	-0,09	-0,04	0,42	0,44	7,95	0,0000011	-0,02197	
LONN	18	-15,96%	-15,97%	1,28	8,14	-0,13	-0,03	0,20	0,41	8,15	0,0000011	-0,01962	
BAER	19	-7,70%	-7,71%	0,10	7,69	-0,77	0,00	0,00	0,41	8,15	0,0000011	-0,01002	
												0,468074	

Figure 8 – The Efficient Frontier and the CML from the period between January 1, 2011 and December 31, 2012.

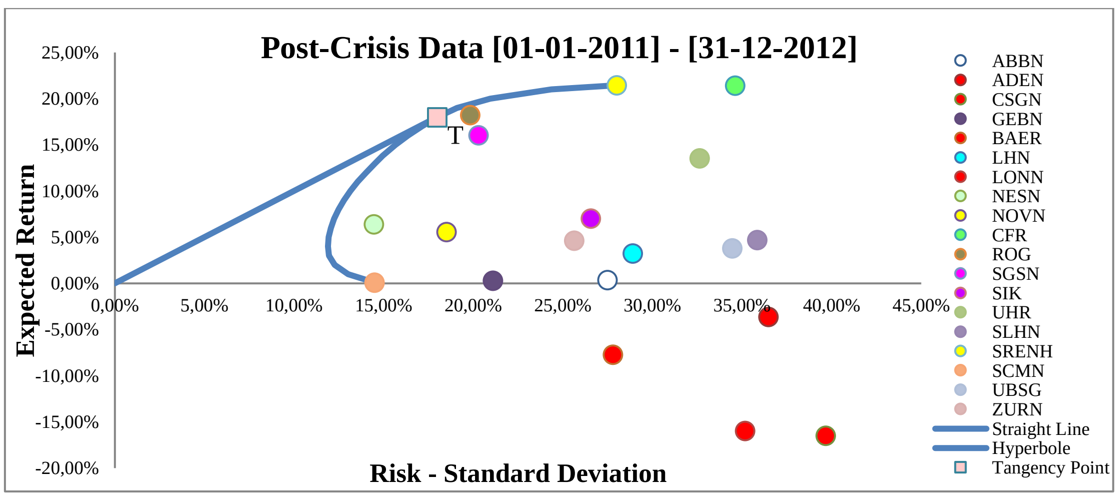


Table IX – Data from the period between January 1, 2013 and December 31, 2014.

EFFICIENT FRONTIER													
	Rank	E(Rx)	$E(R_X) - R_f$	βx	σ^2_{eX}	$\frac{E(R_X) - R_f}{\beta}$	$\frac{(E(R_X) - R_f)\beta_X}{\sigma^2_{eX}}$	$\frac{\beta_i^2}{\sigma^2_{ei}}$	$\sum_{X=1}^{19} \frac{(E(R_X) - R_f)\beta_X}{\sigma^2_{eX}}$	$\sum_{X=1}^{19} \frac{\beta_X^2}{\sigma^2_{eX}}$	Cx	Zi	Percentage to Invest
LONN	1	41,65%	0,419	1,14	3,41	0,3668	0,14	0,38	0,14	0,38	0,0000000	0,1228642	**7,67%**
SLHN	2	33,75%	0,340	0,94	3,03	0,3630	0,11	0,29	0,25	0,67	0,0000000	0,1121233	**7,00%**
GEBN	3	26,25%	0,265	1,03	1,98	0,2570	0,14	0,54	0,38	1,21	0,0000000	0,133973	**8,36%**
NOVN	4	23,21%	0,235	1,04	0,58	0,2265	0,42	1,84	0,80	3,05	0,0000000	0,4027849	**25,14%**
SCMN	5	14,12%	0,144	0,70	1,57	0,2051	0,06	0,31	0,87	3,37	0,0000000	0,0916341	**5,72%**
BAER	6	17,41%	0,177	0,90	3,34	0,1965	0,05	0,24	0,91	3,61	0,0000000	0,0529939	**3,31%**
ROG	7	18,97%	0,192	1,00	1,38	0,1932	0,14	0,72	1,05	4,33	0,0000000	0,1392777	**8,69%**
SIK	8	18,73%	0,190	1,12	5,62	0,1699	0,04	0,22	1,09	4,55	0,0000000	0,0338307	**2,11%**
SRENH	9	12,09%	0,124	0,79	2,53	0,1561	0,04	0,25	1,13	4,80	0,0000000	0,0489252	**3,05%**
ADEN	10	18,62%	0,189	1,26	2,29	0,1505	0,10	0,69	1,23	5,49	0,0000000	0,0826142	**5,16%**
ZURN	11	12,52%	0,128	0,87	1,37	0,1468	0,08	0,55	1,31	6,04	0,0000000	0,093124	**5,81%**
NESN	12	9,78%	0,100	0,77	0,76	0,1303	0,10	0,78	1,42	6,82	0,0000000	0,132588	**8,28%**
CFR	13	10,95%	0,112	1,24	2,73	0,0901	0,05	0,57	1,47	7,39	0,0000000	0,0411101	**2,57%**
UBSG	14	10,10%	0,104	1,31	2,69	0,0790	0,05	0,64	1,52	8,03	0,0000000	0,0385424	**2,41%**
CSGN	15	6,88%	0,072	1,23	3,27	0,0580	0,03	0,46	1,54	8,50	0,0000000	0,021836	**1,36%**
ABBN	16	6,41%	0,067	1,28	1,94	0,0523	0,04	0,84	1,59	9,34	0,0000000	0,0344536	**2,15%**
LHN	17	4,29%	0,046	1,33	3,02	0,0344	0,02	0,58	1,61	9,92	0,0000000	0,0151148	**0,94%**
SGSN	18	0,58%	0,008	0,72	2,03	0,0118	0,00	0,26	1,61	10,18	0,0000000	0,0041879	**0,26%**
UHR	19	-2,97%	-0,027	1,00	2,65	-0,027	-0,01	0,37	1,60	10,55	0,0000000	1,601978	**100,00%**

Figure 9 – The Efficient Frontier and the CML from the period between January 1, 2013 and December 31, 2014.

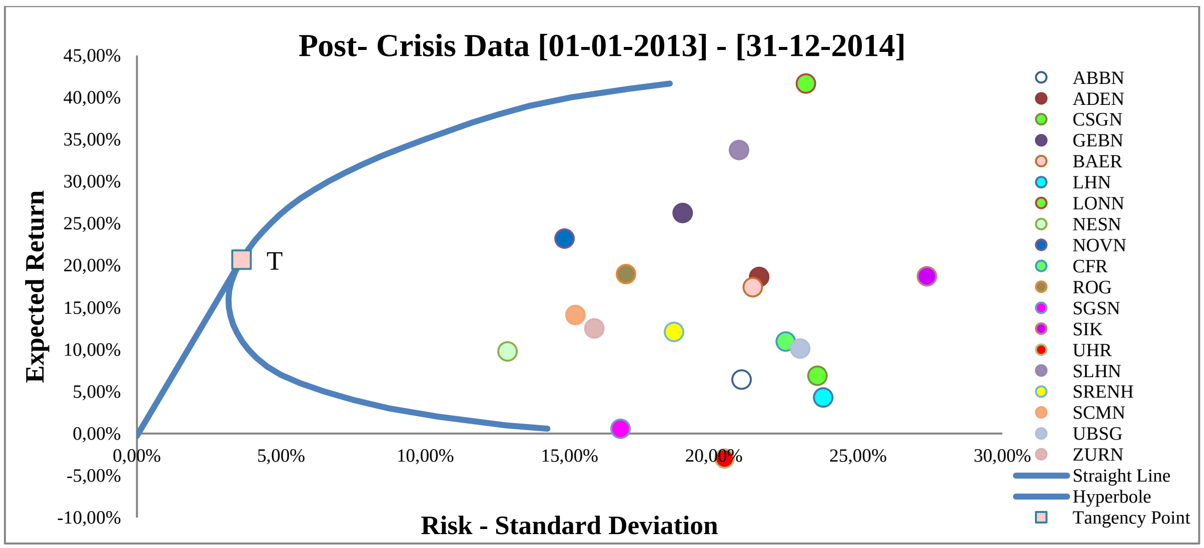
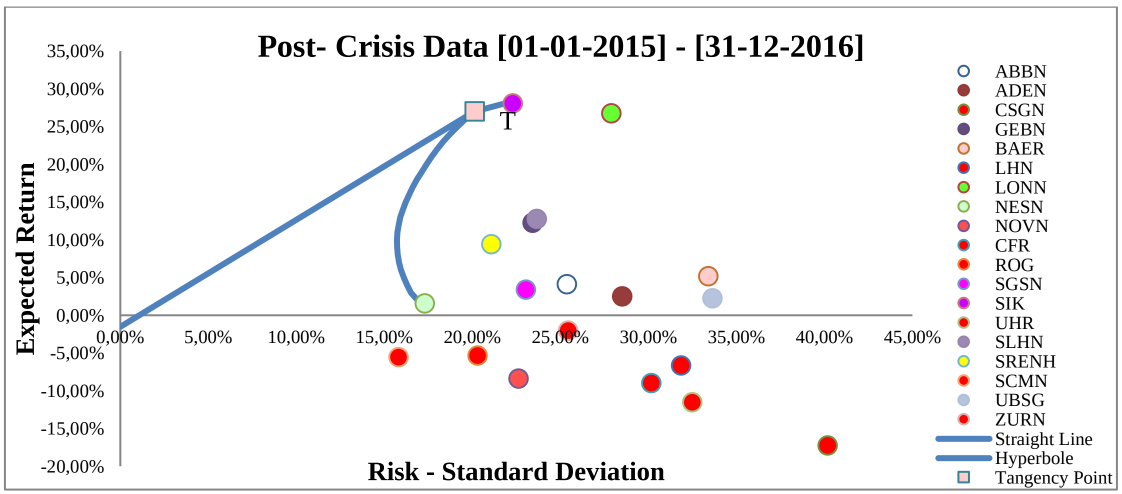


Table X – Data from the period between January 1, 2015 and December 31, 2016.

EFFICIENT FRONTIER													
	Rank	E(Rx)	$E(R_X)-R_f$	βx	σ^2_{eX}	$\frac{E(R_X)-R_f}{\beta}$	$\frac{(E(R_X)-R_f)\beta_X}{\sigma^2_{eX}}$	$\frac{\beta_i^2}{\sigma^2_{ei}}$	$\sum_{X=1}^{19}\frac{(E(R_X)-R_f)\beta_X}{\sigma^2_{eX}}$	$\sum_{X=1}^{19}\frac{\beta_X^2}{\sigma^2_{eX}}$	Cx	Zi	Percentage to Invest
SIK	1	28,07%	0,30	0,67	3,54	0,44	0,06	0,13	0,06	0,13	0,0000002	0,08365663	**20,02%**
LONN	2	26,73%	0,28	1,18	3,30	0,24	0,10	0,42	0,16	0,55	0,0000005	0,0855532	**20,47%**
SLHN	3	12,76%	0,14	0,97	2,56	0,15	0,05	0,37	0,21	0,92	0,0000007	0,05571471	**13,33%**
GEBN	4	12,23%	0,14	0,94	2,66	0,15	0,05	0,33	0,26	1,25	0,0000008	0,05169941	**12,37%**
SRENH	5	9,40%	0,11	0,82	2,28	0,13	0,04	0,30	0,30	1,55	0,0000010	0,04789538	**11,46%**
ABBN	6	4,11%	0,06	1,06	2,86	0,05	0,02	0,39	0,32	1,94	0,0000010	0,01971027	**4,72%**
SGSN	7	3,38%	0,05	0,94	2,46	0,05	0,02	0,36	0,34	2,30	0,0000011	0,01999546	**4,78%**
BAER	8	5,15%	0,07	1,48	11,15	0,05	0,01	0,20	0,35	2,50	0,0000011	0,00599352	**1,43%**
ADEN	9	2,49%	0,04	1,11	4,21	0,04	0,01	0,29	0,36	2,79	0,0000011	0,00955601	**2,29%**
NESN	10	1,58%	0,03	0,79	1,00	0,04	0,02	0,63	0,38	3,41	0,0000012	0,03123676	**7,47%**
UBSG	11	2,26%	0,04	1,35	5,47	0,03	0,01	0,33	0,39	3,75	0,0000013	0,00691938	**1,66%**
ZURN	12	-2,04%	-0,01	1,01	3,21	-0,01	0,00	0,32	0,39	4,06	0,0000012	0,41793073	**100,00%**
LHN	13	-6,64%	-0,05	1,31	4,70	-0,04	-0,01	0,36	0,38	4,43	0,00000120		
ROG	14	-5,36%	-0,04	0,97	1,10	-0,04	-0,03	0,86	0,34	5,29	0,00000109		
NOVN	15	-8,41%	-0,07	1,09	1,30	-0,06	-0,06	0,92	0,28	6,21	0,00000091		
CFR	16	-9,01%	-0,07	1,17	4,72	-0,06	-0,02	0,29	0,27	6,50	0,00000085		
UHR	17	-11,53%	-0,10	1,16	6,26	-0,09	-0,02	0,21	0,25	6,72	0,00000079		
CSGN	18	-17,26%	-0,16	1,52	8,78	-0,10	-0,03	0,26	0,22	6,98	0,00000070		
SCMN	19	-5,54%	-0,04	0,48	1,76	-0,08	-0,01	0,13	0,21	7,11	0,00000067		

Figure 10 – The Efficient Frontier and the CML from the period between January 1, 2015 and December 31, 2016.



[01-01-2001]-[31-12-2008]		
	E(Rx)	Percentage to Invest
GEBN	17,15%	**18,85%**
SIK	13,74%	**14,50%**
SGSN	15,72%	**15,43%**
ABBN	15,66%	**3,41%**
CFR	9,01%	**10,15%**
LONN	3,47%	**6,08%**
NESN	4,16%	**15,78%**
ROG	3,71%	**9,81%**
LHN	3,65%	**4,06%**
UHR	1,70%	**1,94%**
NOVN	-0,15%	
CSGN	-1,07%	
SCMN	-0,38%	
ZURN	-5,02%	
ADEN	-3,96%	
SRENH	-10,02%	
SLHN	-16,90%	
RF	0,28%	
Index	-2,16%	21,90%
		100,00%

Table XI – The annual expected average return and the percentage to invest, in order to create a portfolio efficient, period between January 1, 2001 and December 31, 2008.

E(Rp)	10,51%
σp	19,52%

SR	0,54
TR	0,134
J	0,12

Table XII – The portfolio data and performance appraisal ratios, period between January 1, 2001 and December 31, 2008.

[01-01-2009]-[31-12-2016]		
	E(Rx)	Percentage to Invest
BAER	5,42%	**1,32%**
SIK	25,30%	**8,24%**
GEBN	18,70%	**11,91%**
SLHN	23,89%	**6,34%**
CFR	19,85%	**6,62%**
SGSN	10,38%	**7,38%**
NESN	8,28%	**11,27%**
UHR	14,59%	**3,94%**
SCMN	4,82%	**6,19%**
SRENH	16,68%	**2,73%**
LONN	11,25%	**3,05%**
ADEN	12,61%	**4,24%**
ROG	6,60%	**6,66%**
NOVN	6,09%	**7,84%**
ABBN	8,48%	**4,69%**
ZURN	6,33%	**3,60%**
LHN	4,80%	**1,98%**
UBSG	4,12%	**2,00%**
CSGN	-1,45%	**0,02%**
RF	-1,53%	
Index	6,26%	16,15%
		100,00%

Table XIII – The annual expected average return and the percentage to invest, in order to create a portfolio efficient, period between January 1, 2009 and December 31, 2016.

E(Rp)	12,84%
σp	50,13%

SR	0,26
TR	0,128
J	0,07

Table XIV – The portfolio data and performance appraisal ratios, period between January 1, 2009 and December 31, 2016.

[01-01-2001]-[31-12-2002]		
	E(Rx)	Percentage to Invest
SGSN	3,82%	100,00%
GEBN	0,26%	
SCMN	-0,02%	
LONN	-3,51%	
NESN	-4,85%	
NOVN	-7,41%	
ADEN	-13,67%	
LHN	-12,15%	
UHR	-16,34%	
SIK	-7,49%	
ROG	-17,89%	
CSGN	-26,84%	
SRENH	-24,66%	
ABBN	-46,48%	
ZURN	-62,14%	
SLHN	-85,06%	
CFR	-21,86%	
RF	0,590%	
Index	-21,14%	26,43%
		100,00%

Table XV – The annual expected average return and the percentage to invest, in order to create a portfolio efficient, period between January 1, 2001 and December 31, 2002.

E(Rp)	4%
σp	408%

SR	0,01
TR	0,03
J	0,28

Table XVI – The portfolio data and performance appraisal ratios, period between January 1, 2001 and December 31, 2002.

[01-01-2003]-[31-12-2004]		
	E(Rx)	Percentage to Invest
GEBN	42,81%	11,39%
SIK	35,28%	12,19%
SGSN	33,58%	10,66%
SLHN	37,09%	2,36%
ABBN	47,06%	2,36%
UHR	21,55%	6,87%
SCMN	8,13%	10,26%
CSGN	24,30%	9,02%
ROG	15,58%	7,74%
CFR	19,55%	5,21%
LHN	19,53%	8,13%
ZURN	20,98%	7,30%
ADEN	12,83%	1,12%
NOVN	4,94%	4,98%
NESN	0,57%	0,40%
SRENH	-4,64%	
LONN	-10,42%	
RF	0,28%	
Index	8,88%	16,16%
		100,00%

Table XVII – The annual expected average return and the percentage to invest, in order to create a portfolio efficient, period between January 1, 2003 and December 31, 2004.

E(Rp)	25%
σp	62%

SR	0,40
TR	0,28
J	0,17

Table XVIII – The portfolio data and performance appraisal ratios, period between January 1, 2003 and December 31, 2004.

[01-01-2005]-[31-12-2006]		
	E(Rx)	Percentage to Invest
NESN	18,82%	**10,39%**
ABBN	62,48%	**8,57%**
NOVN	12,82%	**6,34%**
GEBN	42,16%	**8,18%**
CSGN	30,55%	**6,39%**
ROG	28,71%	**10,99%**
ADEN	20,78%	**3,69%**
CFR	33,58%	**5,18%**
UHR	25,09%	**6,61%**
SIK	55,24%	**9,27%**
ZURN	31,75%	**7,42%**
SGSN	29,55%	**6,00%**
LHN	26,99%	**8,77%**
SCMN	3,67%	**2,20%**
SRENH	13,70%	
SLHN	35,44%	
LONN	26,55%	
RF	0,70%	
Index	22,01%	9,99%
		100,00%

Table XIX – The annual expected average return and the percentage to invest, in order to create a portfolio efficient, period between January 1, 2005 and December 31, 2006.

E(Rp)	33%
σp	52%

SR	0,62
TR	1,85
J	0,28

Table XX – The portfolio data and performance appraisal ratios, period between January 1, 2005 and December 31, 2006.

[01-01-2007]-[31-12-2008]		
	E(Rx)	Percentage to Invest
NESN	1,82%	**100,00%**
LONN	0,84%	
ABBN	-1,16%	
SGSN	-4,14%	
ZURN	-11,33%	
CFR	-10,03%	
NOVN	-11,09%	
ROG	-11,90%	
CSGN	-32,59%	
SRENH	-24,77%	
SCMN	-13,24%	
LHN	-19,99%	
GEBN	-16,80%	
UHR	-23,71%	
SIK	-28,46%	
ADEN	-35,97%	
SLHN	-55,73%	
RF	0,93%	
Index	-19,35%	28,92%
		100,00%

Table XXI – The annual expected average return and the percentage to invest, in order to create a portfolio efficient, period between January 1, 2007 and December 31, 2008.

E(Rp)	1,82%
σp	161,7%

SR	0,01
TR	0,03
J	0,15

Table XXII – The portfolio data and performance appraisal ratios, period between January 1, 2007 and December 31, 2008.

[01-01-2009]-[31-12-2010]		
	E(Rx)	Percentage to Invest
UHR	59,33%	8,98%
SGSN	21,49%	8,69%
CFR	56,01%	13,42%
GEBN	36,18%	13,60%
SIK	47,55%	9,89%
SLHN	44,56%	4,88%
NESN	15,54%	8,00%
SCMN	10,64%	9,16%
ADEN	33,12%	6,12%
ABBN	23,10%	5,47%
CSGN	21,23%	3,20%
LHN	18,33%	2,93%
SRENH	23,74%	1,24%
ZURN	10,22%	2,20%
NOVN	3,97%	2,22%
ROG	-5,54%	
LONN	-7,15%	
RF	0,22%	
Index	9,11%	17,66%
		100,00%

Table XXIII – The annual expected average return and the percentage to invest, in order to create a portfolio efficient, period between January 1, 2009 and December 31, 2010.

E(Rp)	33,84%
σp	71,77%

SR	0,47
TR	0,32
J	0,24

Table XXIV – The portfolio data and performance appraisal ratios, period between January 1, 2009 and December 31, 2010.

[01-01-2011]-[31-12-2012]		
	E(Rx)	Percentage to Invest
ROG	18,23%	20,81%
SRENH	21,45%	12,06%
SGSN	16,03%	21,49%
CFR	21,43%	7,14%
UHR	13,54%	4,25%
NESN	6,40%	10,61%
NOVN	5,59%	8,37%
SIK	7,04%	4,31%
ZURN	4,64%	4,87%
SLHN	4,69%	1,83%
UBSG	3,81%	1,45%
LHN	3,24%	2,05%
GEBN	0,30%	0,29%
ABBN	0,37%	0,33%
SCMN	0,11%	0,15%
ADEN	-3,63%	
CSGN	-16,49%	
LONN	-15,96%	
BAER	-7,70%	
RF	0,01%	
Index	5,89%	16,09%
		100,00%

Table XXV – The annual expected average return and the percentage to invest, in order to create a portfolio efficient, period between January 1, 2011 and December 31, 2012.

E(Rp)	13,82%
σp	56,84%

SR	0,24
TR	0,13
J	0,07678

Table XXVI – The portfolio data and performance appraisal ratios, period between January 1, 2011 and December 31, 2012.

[01-01-2013]-[31-12-2014]		
	E(Rx)	Percentage to Invest
LONN	41,65%	**7,67%**
SLHN	33,75%	**7,00%**
GEBN	26,25%	**8,36%**
NOVN	23,21%	**25,14%**
SCMN	14,12%	**5,72%**
BAER	17,41%	**3,31%**
ROG	18,97%	**8,69%**
SIK	18,73%	**2,11%**
SRENH	12,09%	**3,05%**
ADEN	18,62%	**5,16%**
ZURN	12,52%	**5,81%**
NESN	9,78%	**8,28%**
CFR	10,95%	**2,57%**
UBSG	10,10%	**2,41%**
CSGN	6,88%	**1,36%**
ABBN	6,41%	**2,15%**
LHN	4,29%	**0,94%**
SGSN	0,58%	**0,26%**
UHR	-2,97%	
RF	-0,27%	
Index	12,82%	0,12%
		100,00%

Table XXVII – The annual expected average return and the percentage to invest, in order to create a portfolio efficient, period between January 1, 2013 and December 31, 2014.

E(Rp)	20,68%
σp	36,16%

SR	0,57
TR	0,21
J	0,0778

Table XXVIII – The portfolio data and performance appraisal ratios, period between January 1, 2013 and December 31, 2014.

[01-01-2015]-[31-12-2016]		
	E(Rx)	Percentage to Invest
SIK	28,07%	**20,02%**
LONN	26,73%	**20,47%**
SLHN	12,76%	**13,33%**
GEBN	12,23%	**12,37%**
SRENH	9,40%	**11,46%**
ABBN	4,11%	**4,72%**
SGSN	3,38%	**4,78%**
BAER	5,15%	**1,43%**
ADEN	2,49%	**2,29%**
NESN	1,58%	**7,47%**
UBSG	2,26%	**1,66%**
ZURN	-2,04%	
LHN	-6,64%	
ROG	-5,36%	
NOVN	-8,41%	
CFR	-9,01%	
UHR	-11,53%	
CSGN	-17,26%	
SCMN	-5,54%	
RF	-1,53%	
Index	-2,79%	17,88%
		100,00%

Table XXIX – The annual expected average return and the percentage to invest, in order to create a portfolio efficient, period between January 1, 2015 and December 31, 2016.

E(Rp)	16,02%
σp	66,95%

SR	0,24
TR	0,17
J	0,19

Table XXX – The portfolio data and performance appraisal ratios, period between January 1, 2015 and December 31, 2016.