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ATHENS UNIVERSITY OF ECONOMICS AND BUSINESS

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SCHOOL OF ECONOMIC SCIENCES

ΤΜΗΜΑ ΔΙΕΘΝΩΝ & ΕΥΡΩΠΑΪΚΩΝ ΟΙΚΟΝΟΜΙΚΩΝ ΣΠΟΥΔΩΝ
DEPARTMENT OF INTERNATIONAL & EUROPEAN ECONOMIC STUDIES

MSc in International Economics and Finance

MSc Dissertation: Alternative Methods of Portfolio Management

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Athens, 2019

Copyright Statement

Abstract

The present dissertation intends to summarize and analyze some significant factors that affect the portfolio management and also, to simulate some common investing strategies. The theoretical part of this research is the interpretation of the concept of risk in portfolio management and the analytical presentation of the most important risk types such as market risk, credit risk, operational risk, and liquidity risk. Also, at the theoretical part of this dissertation, we examine the most important risk measurement models which are: Variance, Value-at-Risk (VaR), Conditional Value-at-Risk (CVaR) and Mean Absolute Deviation MAD). The final theme of the theoretical part is an extensive presentation of the strategies that are going to be simulated at the empirical part of this dissertation. More specifically, these strategies are the Equally Weighted Portfolio, Momentum, Contrarian, Equity Market-Neutral, and Risk-on/Risk-off.

For the empirical part of this dissertation, we use twenty companies that are components of the Standard & Poor's 500 (S&P 500) in order to construct a portfolio for every strategy that we mentioned above and to observe the range of its return for the period 31/01/2007 to 30/11/2018. Also, we will present comparison charts among those methods. Finally, this study provides conclusions for the results of the simulated strategies.

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1 Introduction

1.1 Object and Motive of this Research

The object of this dissertation is to provide an extensive portfolio management theory in international level and taking this into account, to construct a portfolio for some popular investment methods and to determine the return of these methods through backtesting.

The financial sector has been developed extremely fast in recent years. There are many individuals and entities that they try to decode these developments by analyzing stock markets. At these attempts, they use terminology which includes words such as “momentum,” “risk,” “return,” “strategy” and “performance”. So, the motive behind this research is the better understanding of this terminology, not only with a theoretical but also, a technical approach by using numerical analysis, that clarifies the big picture behind the investment strategies, and real-data simulation in order to understand better the philosophy of these strategies and the philosophy of the investors who apply them.

1.2 Research Questions

The primary purpose of this research is to provide the theoretical framework of the portfolio management and the simulation some of the most recognizable investing strategies. At this point, we present some tips with question form in order to achieve the best possible outcome of this dissertation. These questions are:

1) What is risk and what is return?
2) What is financial risk, and which types of risk comprise it?
3) What is business risk, and which models are used to measure risk?
4) What strategies are going to be examined, and what do they represent?

5) How will we simulate these strategies, and what results will we receive?
6) What conclusions arise from these simulations?

1.3 Importance of the Study

Nowadays, we are in the middle of an economic and financial crisis all over the world. This crisis affects everyone's lives and it is crucial for everyone to get familiar with the consequences and the ways to overcome them. This story cannot be different for investors, even if they are corporate investors or individual investors. Investors face new challenges every day and it is essential for them to create new strategies or to be able to adapt to new strategies. The major concern that investors have is the creation of a portfolio that it will be able to make profits for them at every period, including the period of crisis. Investors have already developed tools and strategies. So, the contribution of this dissertation is to use these strategies for real historical data over an extensive period (11 years) which includes several phases of the economic cycle (including the American financial crisis at the September of 2008).

1.4 Structure and Methodology of the Research

This dissertation consists of six chapters.

The first chapter is the **introduction** and contains the object and the motive of this research, the questions that have been used as guidelines to this study, and finally, the importance of this study to the scientific field. In other words, this chapter shows the main theme of this research.

The second and the third chapter are detailed analyzes of the **literature review** that get us deeper into the subject. The second chapter is an extensive presentation of the concepts of return, risk, financial risk and the types of financial risk. The third chapter has to do with the concept of business risk and the detailed presentation of the most important risk measurement models.

The fourth chapter is a thorough description of the research **strategies** used in this dissertation. Also, this chapter includes a discussion about the investing strategies that are commonly used at these days.

The fifth chapter describes step by step the process of the simulation of the above strategies, the procedure of the data selection and the **results** of these simulations.

Finally, in the sixth chapter, we discuss the **conclusions** of this study and we provide recommendations for a further study.

2 Portfolio Risk

2.1 Risk, Return and Financial Risk

In the field of finance, the concept of risk has been strongly developed in recent years. It has been crucial for all the actors of the global finance and economy sector (e.g., individual investors, mutual funds, companies, governments, international organizations) to identify and categorize the risk that lurks in an investment, and also, to measure it. The process of risk measurement has been evolved through various models in order to achieve a more significant and more completed risk analysis (Jorion, 2007; Coleman, 2011).

The most common explanation on what we mean with the notion of risk and which notion is closely related to this, is the uncertainty. The point of this statement is that any investor that participates in a financial transaction cannot precisely predict the outcome, at least in cases that there is no full information. So, having this in mind, it is safe to say that almost all financial transactions involve risk. Also, the concept of uncertainty arises from the concept of variation (or volatility) (Jorion, 2007; Coleman, 2011; Levisauskaite, 2010).

The variation appears in the future prices and the expected prices of assets. This sequence leads investors to figure out how risky is an investment. Uncertainty is more obvious in the stock market where the future price of a stock is unknown in advance and is determined by various factors through the day. So, it is safe to say that these type of transactions are described by uncertainty for the prices and anyone who attempts transactions with stocks operates in an uncertain environment. Variation in prices also appears in money markets and foreign exchange markets via interest rates and exchange rates, respectively. Central banks are responsible for delineating interest rates, but this action is considered unstable because of the various reasons that finally affect it. A similar process describes the level of the exchange and also, the fact that an exchange rate describes the relation of two different currencies leads to a more uncertain environment (Jorion, 2007; Coleman, 2011; Capinski & Kopp, 2014).

The prices of the different assets are very important for the international financial system because they represent the level that these assets are finally bought and sold and they determine the outcome of an investment (profit or loss) through the comparison of the purchase price and the selling price. The profit or loss from an investment is called return and it is evident that variations in different markets cause variations in returns. So, we conclude that risk affects the outcome of the returns through the level of the prices (Capinski & Kopp, 2014).

Many investors consider risk as a single concept in risk assessment and they estimate it as the potential losses from investment through the volatility in prices (the so-called downside risk). Also, there are other investors associate the concept of risk with the possible outcome of an investment (whether it will be profit or loss). They categorize risk in downside risk and upside risk, which is the potential profit from an investment (Jorion, 2007; Elton, Gruber, Brown & Goetzmann, 2014).

The key to achieve a sufficient risk management is an analytical risk assessment. It is not only about the creation of models which manage the risk. An investor has to categorize risks and find an effective way to measure them before he/she tries to handle them. This is a very important task for investors and it has been fundamental for the modern risk analysis (Jorion, 2007; Elton, Gruber, Brown & Goetzmann, 2014).

Risk measurement cannot occur without the knowledge of what type of risk lurks in an investment. Categorization of risk has to be precise, even if there are more than one types of risk in single investment (Jorion, 2007; Dowd, 2002).

In the financial sector, investors deal with financial risks which they have to do with the instability of different financial markets, such as bond markets, stock markets, foreign exchange markets, money markets, etc. Financial risks affect banks, insurance companies, investment institutions, and as a result, everyone who makes transactions with these institutions. Having in mind that the financial system has been developed to a great extent and it has a very complicated form, financial risks can be categorized as:

- Market risk

- Credit risk
- Operational risk
- Liquidity risk

(Jorion, 2007; Dowd, 2002)

2.2 Market Risk

Market risk is the risk of adverse changes in the market price of various assets due to the various changes taking place in the market where various assets are traded. Market risk is also known as systematic risk, non-diversifiable risk, and risk volatility and affects the entire market (or a great part of this) and cannot be dealt with the diversification approach. Market risk can be expressed in an absolute form which is the risk in currency terms, or in a relative form which is the relation of risk with a benchmark (Jorion, 2007; Dowd, 2002).

Many investors simply settle the market risk issue if the liquidation period is short, by selling their assets in order to avoid losses from a possible decline in assets price. If the process of liquidation cannot be completed before the prices reduction, investors use more complicated financial instruments (such as derivatives) so that they can hedge their investments (Jorion, 2007; Dowd, 2002).

The most widespread measuring method of market risk is the Value at Risk (VaR). VaR is a method which measures the downside risk of the investment by estimating the maximum possible losses that might occur at a particular time horizon, for a given level probability of occurrence (usually, 95% or 99%) (Jorion, 2007; Dowd, 2002).

Also, market risk includes some other types of risk that are highly related to the market. The main types are:

- Interest rate risk
- Stock market risk

- Currency risk

Interest rate risk is considered to be the risk of an investment due to interest rate changes in an economy. So, interest rate risk reflects the relation of some assets with the movements of interest rate price. Supply and demand are the factors that determine interest rates (which are also known as the price of money) and their movements are reflected on the daily level of interest rates. Consequently, interest rates are not single-handled by monetary authorities (such as the Federal Reserve System and European Central Bank) (Jorion, 2007; Basle Committee on Banking Supervision, 1997).

However, interest rate changes are not the only cause of the market risk. Another main source of market risk is a change in the price index of a stock market. This means that the value of stocks of an investor can be change due to an overall movement of the stock market (e.g., negative/positive financial shock). So, if these price changes proceed from a global economic crisis, investors cannot adopt the diversification approach and the alternative strategy that they can follow is hedging, in order to offset the stock market risk (Dowd, 2002; Whitelaw, 2000).

Last but not least, the concept of market risk includes currency risk. Currency risk is the reduction in the value of an asset due to movements in exchange rates. This type of risk can be noticed in assets that are assessed and traded in foreign currency terms. Again, the main currency risk reduction approach is hedging, because portfolio diversification is not an option in an environment of systematic risk (Jorion, 2007).

2.3 Credit Risk

Another type of financial risk is the credit risk. Credit risk is the risk of a probable loss of an investor resulting from the inability of a borrower to repay a debt or to fulfill a predetermined enforceable agreement. So, the relation between credit risk and interest rates is proportional. If credit risk is more substantive in an investment than another investment, the borrower has to

repay higher interest rates. Consequently, the interest rate is the hedging tool of an investor in order to protect his/her investment from collapse as a result of credit risk (Van Gestel & Baesens, 2009; Jorion 2007).

Credit risk can be divided into three other subcategories:

- Default risk
- Exposure risk
- Loss risk

Default risk is the probability that companies or individual investors will not be able to repay their required obligations to the issuer of their debt. More specifically, the most remarkable form of debt is a bond. Bonds are categorized into sovereign and commercial bonds. Bonds that have been issued by the government are considered to have zero risks because the probability of country to bankrupt is extremely low (even though, a government has the ability to print money to fulfill its needs). In the opposite direction, commercial bonds are considered to be riskier. So, investors require interest proportionate to the risk of the investment, in order to hedge it. There are some credit rating agencies, in order to evaluate the level of the default risk (Van Gestel & Baesens, 2009; Jorion 2007).

Exposure risk is considered as a degree of assessment in which an investor or an institute (e.g., bank) might be exposed to a counterparty in time and amount of money at the time of default. Exposure risk depends on the features of the borrower and on the general state of the economy and is used mainly in the banking sector. The exposure risk is typically expressed in the currency of the bank. Foundations (in general) approach to measure the exposure risk is ruled over by regulatory authorities. In contrast, banks use a different method for different types of transactions to calculate the exposure risk (Van Gestel & Baesens, 2009; Jorion 2007).

Finally, loss risk is what part of the amount owed at the time of default, is able to recover from the borrower. The amount that investors finally rescue from default (in terms of overall debt) is called recovery rate and the other part that they have failed to rescue (also in terms of overall

debt) is called “Loss Given Default” (Basel II). It is obvious that both the loss given default and the recovery rate sum up to one (Van Gestel & Baesens, 2009; Jorion 2007).

2.4 Operational Risk

Operational risk is called the risk of direct or indirect loss through a not sufficient or failed internal processes, people and systems, or from external events. The definition of operational risk also includes legal risks resulting from regulatory actions and private settlements (Girling, 2013; Jorion, 2007).

New technologies and innovations in the financial and economic sector have rendered essential the study and the estimation of operational risk. The operational risk measurement is very beneficial and aims to evaluate the probability of an unfavorable situation and the losses that are going to bring upon (Girling, 2013; Jorion, 2007).

2.5 Liquidity Risk

The final component of market risk and consequently, the financial risk is the liquidity risk and is related to the difficulties that investors (or institutions) face in order to raise funds (Andersen, Bollerslev, Christoffersen & Diebold, 2011; Dowd, 2002; Jorion, 2007).

For example, an investor who needs to raise funds, he/she must have creditworthiness and it is complicated for someone who has not good credit to absorb these funds. So, it is fair to say that liquidity risk has a significant effect on the cost of raising capital, setting obstacles to an investor’s plans for profitability (Andersen, Bollerslev, Christoffersen & Diebold, 2011; Dowd, 2002; Jorion, 2007).

Liquidity risk, also, affects the transactions of an asset. There is a relation between the liquidity of the market, that an asset is traded and how easy it is to buy or sell this asset. Also, the frequency of these transactions (buying or selling) has to do with the liquidity risk of a market,

pointing out that liquidity risk has a significant effect on the cost of raising capital, as we mentioned before (Andersen, Bollerslev, Christoffersen & Diebold, 2011; Dowd, 2002; Jorion, 2007).

Finally, it is very important for an investor to achieve extensive liquidity risk management. Liquidity risk can be managed with the application of management to assets and liabilities where the most appropriate assets are selected concerning their time structure and liquidity (Andersen, Bollerslev, Christoffersen & Diebold, 2011; Dowd, 2002; Jorion, 2007).

3 Portfolio Optimization Models

3.1 The Significance of Risk Measurement and Business Risk

Over time, models which attempt to measure the uncertainty on the investment, have been developed. After the investor identifies the type of risk that he/she is dealing with, he/she uses these models to measure the risk and consequently, the expected return of the investment (Capinski & Kopp, 2014).

On a business level, these methods can be very advantageous in order to help with the elimination of business risks. Business risks have to do with the ability of a business to generate profits, revenues and cash flows. Also, business risks are about the efficient operation of a business. Business risk may occur from reckless entrepreneurship with high resulting fixed costs exceeding income. Every company operates in a market that has many risks at market level (also at an individual business level). The variability of cash flows is considered as business risk (Andersen, Bollerslev, Christoffersen & Diebold, 2011; Van Gestel & Baesens, 2009).

In order to depict the risk, optimization models use scenarios. Every scenario describes the future value of all parameters affecting the performance of the examined portfolio. Also, these scenarios are able to detect different sources of risk and provide different approaching methods for all these sources (Capinski & Kopp, 2014).

Most of these models are based on a mathematical formula. The most popular methods that they are going to be presented here are:

- Variance
- Value at Risk (VaR)
- Conditional Value at Risk (CVaR)
- Mean Absolute Deviation (MAD)

(Capinski & Kopp, 2014)

3.2 Variance

Variance, in financial analysis, is a measurement of the spread between prices or returns of a stock at a specific data set. The variance measures how far each price of the data set is from the mean and it is calculated by taking the differences between each number in the set and the mean, squaring the differences and dividing the sum of the squares by the number of values in the set (Copeland, 2005).

$$\mathbf{Var(X)} = \frac{1}{n}\sum_{i=1}^{n}(\mathbf{x_i} - \boldsymbol{\mu})^2$$

Where Var(X) is the variance of asset X, n is the total number of the data set, x_i is the price of the stock at the period i and μ is the mean of the price (Copeland, 2005).

Variance can help an investor to determine the risk of an investment because variance measures the volatility from a mean value. It is safe to say that a large variance value signifies high deviation of a stock price of a data set, in contrast with a low variance value, which shows the relatively state stock price (Copeland, 2005).

The variance of stock returns helps investors to improve their optimal portfolios by optimizing the return-variance trade-off in investment portfolios (Copeland, 2005).

Also, the variance has been very helpful in mean-variance analysis. Mean-variance analysis is the method of weighing risk, expressed as variance, against expected return. Investors apply the mean-variance analysis to decide about which financial instruments to invest in, based on how much risk they are willing to take on in exchange for different levels of reward (Agarwal, 2015).

3.3 Value at Risk (VaR)

The method of Value-at-Risk (VaR) is a percentage unit of measurement which is the principle for risk measurement purposes. VaR is defined as the maximum expected loss that an investor might

be adversely affected in a specific period of time and a given level of confidence (Consiglio, Nielsen & Zenios, 2009).

VaR is the worst return of a portfolio for a preselected level of confidence α*100% and the mathematical formula of this method is:

$$\mathbf{VaR}(\mathbf{x}, \boldsymbol{\alpha}) = \mathbf{min}\{\mathbf{u}: \mathbf{F}(\mathbf{x}, \mathbf{u}) \geq \mathbf{1} - \boldsymbol{\alpha}\} = \mathbf{min}\{\mathbf{u}: \mathbf{P}\{\mathbf{R}(\mathbf{x}, \tilde{\mathbf{r}}) \leq \mathbf{u}\} \geq \mathbf{1} - \boldsymbol{\alpha}\}$$

Where VaR(x,α) is the (1-α)*100% percentage of the distribution of portfolio returns, $\tilde{r}$ is the random variable of asset returns which are unknown in the selection of the portfolio and R is a function of the portfolio x and random variables of portfolio returns which shows the performance of the portfolio (Consiglio, Nielsen & Zenios, 2009).

VaR is a very commonly used tool to measure risk, but it is not used in mathematical models to choose the optimal portfolio. This calculation reveals that the performance of the portfolio will be under VaR(x,α) with probability (1-α)*100%, but it does not provide information about the extent of the tail of the distribution. So, it is possible that the performance of the portfolio might take lower prices than the VaR and leads to significant losses (Zenios & Markowitz, 2008).

This leads to the conclusion that VaR is difficult to be optimized. When the returns of the assets are specified in terms of scenarios function, the VaR function is eventful and concave in comparison with the portfolio and demonstrates multiple local extremes. Thus, efficient algorithms for solving problems with corresponding objective functions do not exist (Zenios & Markowitz, 2008).

3.4 Conditional Value at Risk (CVaR)

Conditional Value at Risk is a relative measure of risk and it is defined as the conditional expectation of losses exceeding the VaR in a certain level of confidence. VaR and CVaR are similar, but CVaR is more popular and more effective in risk measurement. Also, CVaR can be defined as

the conditional expectation of the returns of the portfolio to be lower than the performance of VaR (Zenios & Markowitz, 2008).

For continuous distributions, CVaR is defined as:

$$\mathbf{CVaR(x,a) = E[R(x,\tilde{r})|R(x,\tilde{r}) \leq VaR(x,a)]}$$

CVaR measures the expected value of (1-a)*100% lower returns for the portfolio x (Zenios & Markowitz, 2008).

The creation and the use of CVaR have led to the issue of which of the methods of VaR and CVaR is more efficient and more appropriate risk measurement. CVaR has received credits from the insurance and the financial sectors, while VaR is an industry standard for measuring risk. But, the most significant advantage that CVaR has over VaR is that it can be easily used to optimization portfolio problems and it can reduce the tail of the distribution (Zenios & Markowitz, 2008).

Finally, it is noteworthy that in the case where CVaR and VaR are not significantly different, losses will not surpass the boundary line that has been determined by VaR. In contrast, when CVaR is significantly higher than VaR, the results that have been defined by the VaR approach have to be revised (Zenios & Markowitz, 2008).

3.5 Mean Absolute Deviation (MAD)

In Mean Absolute Deviation (MAD) model, which also is a risk measurement method, the risk is defined as the mean absolute deviation of the real portfolio return from its expected return. The mathematical formula of MAD is:

$$\mathbf{MAD(x) = E\ [\ |R(\ x,\tilde{r}\ ) - R(\ x,\ \bar{r}\ )|\ ]}$$

where

$\tilde{r} = (r_1, r_2, \ldots, r_n)^T$ are the assets generate returns,

$\bar{r}$ = E(r) = $(r_1, r_2, \ldots, r_n)^T$ are the assets average return and

X = $(X_1, X_2, \ldots, X_n)^T$ is the weight of each asset that we include in the portfolio (Konno & Yamazaki, 1991).

But at this case, the returns of the assets in period t are unknown, investors forecast these returns by estimating the return of these assets in the next period by using probabilities (p) (Konno & Yamazaki, 1991).

So, the mathematical formula of MAD transformed into:

$$\mathbf{MAD(x)} = \sum_{s=1}^{S} \boldsymbol{p}_s \left| \mathbf{x}^T \mathbf{r}_s - \mathbf{x}^T \bar{\boldsymbol{r}} \right|$$

Consequently, the MAD model minimizes the following cumulative formula:

$$\sum_{s=1}^{S} \boldsymbol{p}_s \mathbf{y}_s$$

Subject to the following limitations:

1. xϵX
2. $y_s \geq x^T(r_s - \bar{r})$ for s= 1,2,…, S
3. $y_s \geq x^T(\bar{r} - r_s)$ for s= 1,2,…, S
4. $y_s \geq 0$, for s = 1,2,…, S

y_s is a random variable which is used to linearize the expression of absolute return (Konno & Yamazaki, 1991).

4 Alternative Investing Methods

In this chapter, we are going to present some of the most noted strategies with an extensive description. These strategies are the pillars of this study because they will be the formulas for the empirical part. The strategies that we will discuss are:

1) Equal-Weighted Portfolio
2) Momentum Strategy
3) Contrarian Strategy
4) Equity Market-Neutral Strategy
5) Risk-on, Risk-off Strategy

4.1 Equally Weighted Portfolio

Equally weighted portfolio is an investing strategy where the investor constructs a portfolio where every asset which is included in this, has the same weight with every other asset regardless of other factors, such as their price or their market capitalization. Equally weighted portfolio gives the same importance to each stock, from a small company with limited financial activities to a gigantic company with financial transactions all over the world. This weighting method is not commonly used in real life. For example, funds prefer to weigh their holding stocks subject to specific criteria. These criteria could be the market capitalization of a stock or the price that the stock is traded at the markets. When an investor has in his/her portfolio more stocks which are traded in high price and less that are traded at a lower price, he/she manages the portfolio with a price-weighted strategy. On the other hand, when an investor owns a portfolio with more stocks of large companies and fewer stocks of smaller companies, he/she manages the portfolio with a market capitalization weighted strategy (Ernst, Thompson & Miao, 2017; DeMiguel, Garlappi & Uppal, 2006).

Equally weighted portfolio is easy to be calculated. The mathematical formula of the return of this strategy is:

Equally Weighted Portfolio Return= (1/n) * ($r_1 + r_2 + … + r_n$)

Where n is the number of the assets included in the portfolio, r are the returns of these assets and (1/n) is the weight for every asset. Weights here are expressed as a rate of the overall capital.

Over the years, many types of research have been published in order to examine the performance of the equally weighted portfolio of the Standard & Poor's 500 (S&P 500) in comparison with the market capitalization weighted S&P 500. These researches have shown that over many decades, an equally weighted portfolio has been performing better than the market capitalization weighted portfolio, making significantly higher profits in total and annual rate. Also, the equal weight between small companies and large companies leads to a higher standard deviation for the equally weighted strategy. Also, in Sharpe Ratio terms, which is the return of an investment compared to its risk, equally weighted portfolio strategy has been proven more efficient than the market capitalization weighted portfolio strategy (Ernst, Thompson & Miao, 2017).

Another issue of the equally weighted portfolio strategy that concerns the researchers in the world is the performance of this strategy in comparison with the price-weighted portfolio strategy. Researches have been made for this strategies by constructing portfolios with the components of S&P 500 and weighting them by the principles of each strategy, respectively, for many decades. Even in this case, the results of these studies have shown that the equally weighted portfolio is significantly more profitable than the price-weighted (Plyakha, Uppal & Vilkov, 2012).

These researches do not conclude that it must have been a superiority of equally weight portfolio over the other weighting strategies, but that it is a durable strategy that should not be ignored by the investors (DeMiguel, Garlappi & Uppal, 2006).

4.2 Momentum Strategy

Momentum strategy is an investing method in which an investor manages his/her portfolio in a way to capitalize on the continuity of an existing market tendency, by taking long position on stocks that have been performing well over the last time period and short position on those which have been underperforming at the same period. In other words, momentum strategy is the inclination of the investments to remain into their recent performance. By this statement, investments that have performed well will continue to perform well, in contrast with the investments that have performed poorly which will continue to this poor performance. Momentum is a widespread investing strategy which is commonly used by the investors all over the world and the philosophy of this strategy has been fundamental for other investing strategies that are variations of the original momentum strategy (Antonacci, 2016; Siganos, 2010).

It is worth mentioning that momentum strategy is considered as a risky strategy and it usually offers a considerable rate of return to compensate the high-risk level. So, an investor who uses this strategy expects to have high returns in the long run, and in order to achieve this, he/she has to cautiously choose the stock market and the financial environment in which he/she applies this strategy (Antonacci, 2016).

Momentum is a long-living strategy. From the beginnings of the twentieth century, many journalists, investors, researchers, and fund managers have expressed their opinion about the momentum strategy and the importance of the further research on this field (Lefevre, 1923; Wyckoff, 1924). Also, there are many verified examples of investors which they used entirely the momentum strategy and the achieved high returns of profit and they contributed to the further development of this strategy. The person who is mostly related with the momentum investing is Richard Driehaus. Driehaus is considered to be the “father” of momentum investing, even if the strategy can be detected before his time (Antonacci, 2015).

Nowadays, momentum investing has become more technical. There are indexes associated with the momentum strategy that provides signals to investors and makes easier the understanding of the stock prices movement. These signals refer to buy and sell prices. These signals can be the

Treasury Bond yield curve and the long-term moving average of a stock. In both cases, investors check if a shorter term average is higher than the long-term average and then, the choose long positions at these stocks. Otherwise, they prefer to choose short positions or to be neutral and observe the movement of the market and wait for the right time to choose long position again (Wolf, Schumacher & Tappan, 2002).

Momentum strategy has a variety of mathematical formulas. The simplest form of the classic mathematical formula which determines the weight of each stock that is included in the portfolio is:

$$\mathbf{W_{i,t} = (1/n) * (r_{i,t-1} - r_{m,t-1})}$$

Where $w_{i,t}$ is the weight of the stock i at the t time period, n is the number of stocks that are included in the portfolio, (1/n) is the weight for every asset and weights here are expressed as a rate of the overall capital. $r_{i,t-1}$ is the return of stock i at the previous time period and $r_{m,t-1}$ is the return of the market portfolio at the same time period (Lo & MacKinlay, 1990; Conrad & Kaul, 1998).

In this dissertation, we will use only long positions. More specifically, in the portfolio will be included only stock that outperformed the market portfolio at the previous period. Also, we will not use equal weights to the portfolio components as the equation above indicates, but we will weigh the assets proportionally to their performance.

Another type of momentum investment is the earnings momentum strategy. Earnings momentum strategy can be possible when the corporate earnings per share (EPS) are increased or decreased from the previous fiscal period. Investors are in the pursuit of positive earnings momentum because it usually pushes the price of a stock to increase, depending on how expected the momentum is (Hong, Lee & Swaminathan, 2003; Chan, Jegadeesh & Lakonishok, 1995).

At this point, we have to mention some disadvantages of the momentum strategy that occur in the real world. A frequent change in the portfolio components and the weights of the stocks can

lead to extremely high transaction costs, making this strategy unaffordable. Another thing that we should take into consideration is the performance of the momentum strategy during a financial crisis. Momentum is proven to be an extremely detrimental strategy during the crisis. Also, it is more preferable to not invest during the uptick rule period than to invest. The potential loss will be significantly lower (Maheshwari & Dhankar, 2017).

4.3 Contrarian Strategy

Contrarian strategy is an investing method in which investors believe that the losers of the past are going to be the winners of the future and the winners, respectively, tend to be losers. In other words, investors buy assets that did not perform well at a previous period and sell those that had been profitable. This is a comprehensive investing behavioral approach of the portfolio management and it is wholly opposed to the momentum strategy in which winners are going to be winners again and losers will be losers. Contrarian strategy has the attention of many researchers all over the world and many studies have been made in order to get a better view of the performance of this method (Alper & Aydogan, 2017).

Contrarian strategy has some specific features that make it profitable. First of all, it is a value strategy, but not according to the traditional way. Also, it is essential for an investor to be punctual and accurate informed about the good or the bad news and act respectively if he/she wants to follow this method. Contrarian strategies are able to outperform the market because they follow the mechanism of overinvesting in underpriced stocks and underinvesting in an overpriced stock, ignoring the excitement about stocks that have been profitable in the past and vice versa. It is worth mentioning that contrarian strategies are considered to be very effective and make great profits. A probable explanation about this statement is that they are fundamental riskier and the high return that they offer is proportional to the higher risk that is included on them. Contrarian strategy has also a psychological factor. This strategy is formulated under the consumption that the stock market overreacts to the news for the movement of the stock prices. Research in experimental psychology indicates that “people tend to overreact to unexpected and

dramatic events" (Kahneman & Tversky, 1982). Having this in mind, we are able to observe many abnormal returns through the contrarian investment strategy. (Chan, 1988; Lakonishok, Shleifer & Vishny, 1993).

Many mathematical formulas have been developed in order to describe better the contrarian strategy. For the purposes of this dissertation, we will use the simplest form of these mathematical formulas which is used to determine the weights of the assets that are included in the portfolio:

$$\mathbf{W_{i,t} = - (1/n) * (r_{i,t-1} - r_{m,t-1})}$$

This is almost the same formula that we use in momentum strategy, but the minus sign at the beginning of the equation denotes the totally different approach of those two strategies. At this equation, $w_{i,t}$ is the weight of the stock i at the t time period, n is the number of stocks that are included in the portfolio, (1/n) is the weight for every asset and weights here are expressed as a rate of the overall capital. $r_{i,t-1}$ is the return of stock i at the previous time period and $r_{m,t-1}$ is the return of the market portfolio at the same period (Lo & MacKinlay, 1990; Lehmann, 1990).

In this dissertation, we will use only long positions as we will do in the momentum strategy. More specifically, in the portfolio will be included only stock that underperforms the market portfolio at the previous period. Also, we will not use equal weights to the portfolio components as the equation above indicates, but we will make the asset weighting proportionally to their performance.

Nowadays, contrarian strategy is considered to be one of the most widespread investing methods all over the world and it has been the subject of researches in order to identify the performance and the development of this strategy. Empirical applications have been made to many different stock markets. Most of these applications have shown that contrarian investing strategy is a profitable way for an investor to manage his/her portfolio, offering high returns with high standard deviation (risk) in the long run. These empirical applications have been made into some of the biggest stock markets, such as New York Stock Exchange Market and Japanese Stock

Market, but also to smaller, such as the Istanbul Stock Market with the same effective results (Lakonishok, Shleifer & Vishny, 1993; Chang, McLeavy & Rhee, 1995; Alper & Aydogan, 2017).

Finally, we have to make a brief summary of the overall contribution of the contrarian investing strategy. Contrarian can be extremely profitable in most cases where the market enlarges the impact of events that affect stock prices. Many tools and indicators have been developed to offer better information to the investors about the opportunity of applying the contrarian strategy. Unfortunately, this strategy is not perfect because many times an undervalued stock keeps falling, in contrast with the estimations of the contrarians leading to significant losses.

4.4 Equity Market-Neutral Strategy

Equity market-neutral strategy is an investing method and it is a combination of the long/short equity strategy and the market-neutral strategy. Equity market-neutral investing method requires establishment of both a long and a short position in two assets simultaneously. This strategy aims to create significant and continual returns while controlling risk by maintaining a low correlation to broader market averages. The point of this market-neutral strategy is to make profits regardless of whether stock prices rise or fall. In contrast with the classic market-neutral strategy, equity-market neutral strategy's performance is determined by the positive or negative correlation with the market, according to the volatility (Davidsson, 2012; Gibson & Ryabkov, 2014).

The concept of neutrality is related to many investors and it is critical to understand what this concept describes. In the financial sector, neutrality describes a situation where an individual investor or a fund takes a position in a market that is not favorable neither bearish and it is indifferent to the direction of a stock's or market's price. There are two main reasons why investors choose this investing behavior. First, in equity terms, investors might believe that a stock price will remain at a pretty stable level and they try to capitalize from this situation from dividends and some options that are created for these types of fluctuations. Second, market's

volatility is expected to be pretty high, leading to important market's fluctuations (e.g. crisis). So, investors prefer to be neutral at these events.

Equity market-neutral portfolios are indifferent in overwhelmingly markets good and bad performance. This strategy has a specific criterion of which of the stocks that included in the portfolio will be long and which of them will be short. In order to stabilize their returns (and also, to maximize them) through this strategy, investors should estimate the fair value of a stock and evaluate which stocks are overvalued and which are undervalued. Then, the investor chooses to hold long position on the undervalued stocks and short position on the overvalued stocks, expecting to gain profits from this strategy. This investing method is more accurate if these stocks represent companies from the same industry (Davidsson, 2012; Gibson & Ryabkov, 2014).

One of the most accurate and efficient ways for the investors to determine whether a stock is overvalued or undervalued is the Price-Earnings ratio (P/E ratio). The P/E ratio is a ratio for valuing a company and it measures the current share price of the company relative to its per-share earnings Earning per share is the rate of a company's profit which is distributed to each share of common stock and is used as an indicator of the profitability of a company. P/E ratio shows the expectations of an investor on the dollar amount that he/she should invest in order to receive one dollar of the earnings of the company. The higher the P/E ratio of a company is, the more overvalued is the stock of this company (Gottwald, 2012).

Researchers have developed many mathematical formulas in order to describe better the application of the equity market-neutral strategy. In this dissertation, we will use a formula that it is a combination of the long/short equity strategy and the dollar-neutral strategy. This formula is used to help us determine the weights of each asset and the position that we will choose to hold on each asset. It is worth mentioning that the portfolio of this strategy consists of only two stocks from the same industry and the indicator that it will determine the long or the sort position will be the P/E ratio.

In conclusion, equity market-neutral strategies are handy tool for an investor. The main advantage of this strategy is that is neutral to the movements of the market providing to the

investors an alternative behavioral approach to the classic momentum and contrarian strategies. There are two drawbacks on this strategy. First, the implementation of this strategy in the real world is characterized by high fees and borrowing costs, reducing the already low profits (low risk) from the investment. Finally, this strategy is not effective in the case of a rising market, because the investor misses the opportunity for higher returns due to neutrality (Davidsson, 2012; Gibson & Ryabkov, 2014).

4.5 Risk-on, Risk-off

Risk-on, risk-off is an investing method in which the investment decisions of an investor are determined by his/her risk tolerance and what level of risk he/she is willing to face. In other words, the concept of risk-on, risk-off refers to changes in the investment activity according to the market's movements. The period when the volatility (risk) is at a low level and the market is pretty stable, investors engage into higher risk investments in order to achieve higher returns. This period is the "risk-on" period. When markets facing high volatility issues, investors do not prefer high-return investments, but they turn to investments that they are safer, even if they do not offer high returns because investors primal intention is to avoid losses. This period is the "risk-off" period (HSBC Global Research, 2010).

This investing method, in which investors change their portfolio's construction in relation to the risk level that defines every period, has become very useful for the investors and many studies and researches have been made in order to present a better interpretation of this strategy. Researchers were able to create indexes, specially formed for this strategy, which measure the extent to which the risk-on, risk-off phenomenon drives the markets and indicates the correlations among the assets of the whole market. Also, researches have shown which type of assets are the most important investing choices for the risk-on and the risk-off period, respectively. Finally, researchers have put much effort in order to create an index that it will be able to identify whether the investigated market is in a risk-on or a risk-off period (HSBC Global Research, 2010).

Now that the meaning of the risk-on, risk-off strategy has become clear, we are able to see what these researches have shown about which type of assets is more preferable at these periods. In a risk-on environment, investors prefer riskier assets with higher returns. These assets could be the equities of the S&P 500, equities of emerging markets (e.g. Brazil, Shanghai), high yield bonds, commodities and marginally favored currencies (e.g. EUR/USD, USD/JPY). On the other hand, when investors need "safe" assets in the risk-off period, they turn to the United States Treasury Bills, Swiss Government notes, corporate bonds with high credibility ratings and marginally favored currencies that they have stable movement through the risk-off periods, such as the Japanese Yen and the Swiss Franc (HSBC Global Research, 2010; Corcoran, 2013).

To summarize, risk-on and risk-off periods depend on the volatility of a market and how investors consider this volatility. The largest options market of the world, the Chicago Board Options Exchange, created the Volatility Index (VIX) in 1993. VIX is a powerful tool for an investor because it indicates the expectations of the market about the volatility for the next 30 days. VIX derives from the price of the components of the S&P 500 index options and measures the market risk and the expectations of the investors. When the value of VIX increases, volatility moves up and vice versa. VIX was very effective at the financial crash of the United States stock market. Also, during this period, VIX set a record high value (CBOE, 2018).

In this dissertation, we will make an empirical application of an investing strategy during the risk-on and risk-off periods. The indicator which is going to determine whether we are in a risk-on or a risk-off period is going to be the VIX. When the indicator expects a risk-on period, we will construct an equally weighted portfolio compounded of twenty stocks that are components of the S&P 500. When the index expects that in the next period the volatility of the market will rise, the investing strategy that we will use is a portfolio compounded only of United States Treasury Bills, in order to try to be neutral at the fluctuations of the market. Finally, we will calculate the total return after all these periods.

Except the Volatility Index, some other indexes can be used as indicators for the risk-on and the risk-off periods. An alternative index could be the S&P Small-Cap 600 Pure value index which has a proportional movement with the expectations of investors about the market's future volatility.

Another indicator for these periods could be the high yield bonds. High yield bonds are the riskiest type of bonds, so when investors expect a future increase in market's volatility, there will be a decrease in the price of these type of bonds and vice versa.

5 Empirical Application

After the presentation of the theoretical framework and the central concept of the methodology, we proceed to the technical part of this dissertation: the simulation of the performance of the equally weighted portfolio strategy, the momentum strategy, the contrarian strategy, the equity market-neutral strategy, and the risk-on, risk-off strategy. The calculations of the returns of all these strategies have been made via Microsoft Office Excel.

5.1 Data Selection

Every single strategy that is mentioned above requires a portfolio which consists of stocks. Also, every strategy begins at 31/01/2007 and ends at 30/11/2018 and most of these strategies require monthly reallocation of the assets weights.

In order to proceed to the simulations, we need 20 stocks that are components of the S&P 500. Having the necessary data from the Thomson Reuters Datastream, we make the selection of the participant companies.

The final selection was made under the following steps:

- From these 505 companies, we chose 200 companies with the higher Sharpe Ratio for 31/01/2007 to 30/11/2018.
- From these 200 companies, we chose those which their skewness was relative close to the zero (30 companies).
- Finally, we selected 20 companies which their kurtosis was closer to 3 (0 for the Excel formula).

The companies that are used in this study are:

Table 1: The twenty companies that they will be used in this study

	Name	SECTOR	INDUSTRY
1	ADV.AUTO PARTS	CONSUMER DISCRETIONARY	Specialty Retail
2	AGILENT TECHS.	HEALTH CARE	Diagnostics & Research
3	ALASKA AIR GROUP	INDUSTRIALS	Airlines
4	ALEXION PHARMS.	HEALTH CARE	Biotechnology
5	BERKSHIRE HATHAWAY 'B'	FINANCIALS	Insurance - Diversified
6	CHIPOTLE MEXN.GRILL	CONSUMER DISCRETIONARY	Restaurants
7	CSX	INDUSTRIALS	Railroads
8	CVS HEALTH	HEALTH CARE	Health Care Plans
9	DISCOVERY SERIES A	CONSUMER DISCRETIONARY	Media - Diversified
10	EDWARDS LIFESCIENCES	HEALTH CARE	Medical Devices
11	FLIR SYSTEMS	INFORMATION TECHNOLOGY	Scientific & Technical Instruments
12	JACK HENRY & ASSOCS.	INDUSTRIALS	Business Services
13	KROGER	CONSUMER STAPLES	Grocery Stores
14	LOWE'S COMPANIES	CONSUMER DISCRETIONARY	Home Improvement Stores
15	MCDONALDS	CONSUMER DISCRETIONARY	Restaurants
16	RESMED	HEALTH CARE	Medical Instruments & Supplies
17	SOUTHWEST AIRLINES	INDUSTRIALS	Airlines
18	VARIAN MEDICAL SYSTEMS	HEALTH CARE	Medical Instruments & Supplies
19	WEC ENERGY GROUP	UTILITIES	Utilities - Regulated Electric
20	WW GRAINGER	INDUSTRIALS	Industrial Distribution

Here are also some descriptive statistics about the performance of the returns of these stocks during this period:

Table 2: Descriptive statistics for the returns of the companies' stocks

	Mean	Standard Error	Median	Standard Deviation	Sample Variance	Kurtosis	Skewness	Range	Minimum	Maximum
ADV.AUTO PARTS	0.0143	0.0065	0.0152	0.0779	0.0061	0.7723	-0.0120	0.4489	-0.2133	0.2356
AGILENT TECHS.	0.0112	0.0072	0.0081	0.0860	0.0074	0.6924	-0.0544	0.4895	-0.2519	0.2377
ALASKA AIR GROUP	0.0191	0.0084	0.0148	0.1007	0.0101	-0.1685	0.0782	0.4976	-0.2231	0.2745
ALEXION PHARMS.	0.0223	0.0081	0.0225	0.0967	0.0093	0.8377	-0.0805	0.5281	-0.2350	0.2931
BERKSHIRE HATHAWAY 'B'	0.0088	0.0041	0.0098	0.0489	0.0024	0.9367	0.0922	0.3052	-0.1422	0.1630
CHIPOTLE MEXN.GRILL	0.0207	0.0091	0.0170	0.1084	0.0118	0.2104	0.0937	0.5585	-0.2306	0.3279
CSX	0.0160	0.0065	0.0252	0.0781	0.0061	0.5479	-0.0764	0.4766	-0.1855	0.2911
CVS HEALTH	0.0087	0.0053	0.0066	0.0637	0.0041	-0.1652	-0.0966	0.3237	-0.1573	0.1664
DISCOVERY SERIES A	0.0135	0.0073	0.0118	0.0873	0.0076	0.4076	0.0969	0.5479	-0.2440	0.3039
EDWARDS LIFESCIENCES	0.0218	0.0069	0.0216	0.0820	0.0067	0.9974	-0.0957	0.4676	-0.2236	0.2440
FLIR SYSTEMS	0.0107	0.0067	0.0126	0.0807	0.0065	0.9717	-0.0516	0.4994	-0.2466	0.2528
JACK HENRY & ASSOCS.	0.0145	0.0043	0.0141	0.0519	0.0027	0.0875	0.0597	0.2813	-0.1051	0.1762
KROGER	0.0089	0.0057	0.0157	0.0679	0.0046	0.9055	-0.0018	0.4662	-0.2169	0.2493
LOWE'S COMPANIES	0.0108	0.0066	0.0059	0.0786	0.0062	-0.4191	-0.0106	0.3875	-0.1749	0.2126
MCDONALDS	0.0110	0.0035	0.0094	0.0417	0.0017	0.2926	0.0132	0.2387	-0.0994	0.1392
RESMED	0.0132	0.0061	0.0145	0.0727	0.0053	0.2845	0.0271	0.4407	-0.2033	0.2374
SOUTHWEST AIRLINES	0.0129	0.0074	0.0114	0.0890	0.0079	0.4090	-0.0951	0.5081	-0.2657	0.2424
VARIAN MEDICAL SYSTEMS	0.0098	0.0057	0.0141	0.0678	0.0046	0.8345	-0.0786	0.4245	-0.2034	0.2212
WEC ENERGY GROUP	0.0088	0.0037	0.0122	0.0446	0.0020	0.2008	-0.0961	0.2617	-0.1068	0.1549
WW GRAINGER	0.0127	0.0055	0.0069	0.0663	0.0044	0.2959	-0.0885	0.4007	-0.2055	0.1952

The final table for these stocks is the correlation matrix of their returns:

Table 3: Correlation matrix of returns of the stocks

	ADV.AUT	AGILENT	ALASKA AI	ALEXION F	BERKSHIR	CHIPOTLE	CSX	CVS HEAL	DISCOVE	EDWARD	FLIR SYST	JACK HEN	KROGER	LOWE'S C	MCDONA	RESMED	SOUTHW	VARIAN N	WEC ENE	WW GRA
ADV.AU	100.00%																			
AGILEN	16.14%	100.00%																		
ALASKA	23.58%	13.76%	100.00%																	
ALEXIO	1.32%	22.09%	25.92%	100.00%																
BERKSH	14.73%	35.72%	13.16%	9.01%	100.00%															
CHIPOT	36.11%	16.52%	16.05%	15.50%	9.67%	100.00%														
CSX	25.68%	57.85%	23.88%	20.98%	29.64%	22.37%	100.00%													
CVS HE	33.13%	40.45%	27.54%	25.26%	32.95%	34.30%	33.23%	100.00%												
DISCOV	23.45%	37.83%	5.51%	19.23%	15.25%	30.06%	32.40%	37.25%	100.00%											
EDWAR	13.11%	29.63%	9.70%	18.89%	17.40%	2.72%	23.51%	22.34%	11.75%	100.00%										
FLIR SYS	8.01%	37.94%	11.78%	6.15%	28.30%	12.78%	32.55%	18.97%	13.45%	17.77%	100.00%									
JACK HE	23.93%	35.42%	29.49%	8.61%	31.73%	26.43%	38.10%	38.74%	25.68%	23.51%	46.40%	100.00%								
KROGE	27.88%	7.33%	19.54%	6.76%	24.62%	21.59%	16.94%	39.29%	25.04%	9.49%	19.85%	37.25%	100.00%							
LOWE'S	37.00%	39.71%	33.15%	13.31%	33.12%	22.17%	35.82%	41.94%	28.34%	21.24%	18.98%	50.09%	25.19%	100.00%						
MCDON	10.32%	22.73%	9.30%	13.18%	25.02%	16.21%	22.63%	21.57%	29.05%	7.38%	25.32%	33.25%	30.44%	10.89%	100.00%					
RESME	18.35%	35.04%	19.49%	14.58%	22.02%	10.65%	23.32%	24.37%	23.67%	25.41%	4.54%	31.29%	15.18%	35.94%	19.49%	100.00%				
SOUTH	24.59%	45.95%	46.67%	24.28%	35.87%	21.50%	49.12%	32.49%	9.01%	22.51%	28.08%	33.99%	20.83%	36.70%	16.89%	18.96%	100.00%			
VARIAN	7.20%	52.79%	20.71%	13.59%	34.95%	0.21%	32.98%	19.95%	14.10%	21.76%	25.53%	27.36%	14.28%	25.63%	24.13%	36.51%	28.97%	100.00%		
WEC EN	17.44%	15.65%	29.63%	7.17%	17.53%	6.61%	14.96%	19.49%	-0.87%	7.86%	18.46%	24.27%	23.58%	9.03%	30.88%	20.30%	14.79%	19.18%	100.00%	
WW GR	40.79%	35.93%	23.52%	18.37%	39.09%	23.00%	44.64%	38.52%	23.70%	17.39%	35.43%	35.31%	21.71%	45.95%	19.64%	31.75%	36.26%	15.60%	10.56%	100.00%

This matrix shows that there is a positive correlation between the returns of these stocks.

5.2 Equally Weighted Portfolio

In order to construct this strategy and to observe its performance, we need to be specific about the calculations that have been made.

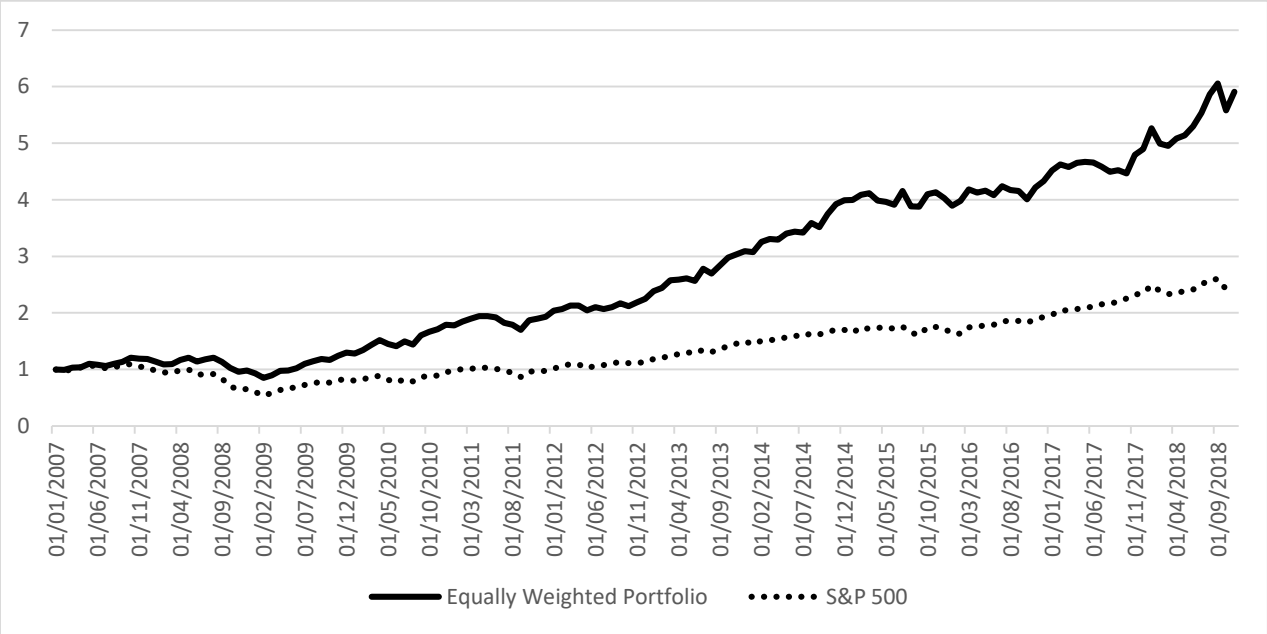
We create a portfolio that contains the same amount of every asset and we track the performance of this portfolio at the end of every month for the 12-year period of 31/01/2007 to 30/11/2018. For simplicity's sake, and in order to achieve better comparison charts, the study of the portfolio returns will begin at the 28/02/2007. So, the final number of the months where this strategy will be applied is 142. The monthly returns of the portfolio are:

Table 4: Monthly returns of the equally weighted portfolio

Date	Return	Date	Return	Date	Return	Date	Return	Date	Return	Date	Return
28/02/2007	-0.0092	31/03/2009	0.0508	29/04/2011	0.0239	31/05/2013	0.0080	30/06/2015	-0.0124	31/07/2017	-0.0161
30/03/2007	0.0416	30/04/2009	0.0874	31/05/2011	-0.0011	28/06/2013	-0.0168	31/07/2015	0.0618	31/08/2017	-0.0196
30/04/2007	0.0054	29/05/2009	0.0073	30/06/2011	-0.0111	31/07/2013	0.0827	31/08/2015	-0.0650	29/09/2017	0.0062
31/05/2007	0.0582	30/06/2009	0.0424	29/07/2011	-0.0502	30/08/2013	-0.0297	30/09/2015	-0.0020	31/10/2017	-0.0129
29/06/2007	-0.0154	31/07/2009	0.0762	31/08/2011	-0.0186	30/09/2013	0.0523	30/10/2015	0.0563	30/11/2017	0.0738
31/07/2007	-0.0195	31/08/2009	0.0405	30/09/2011	-0.0492	31/10/2013	0.0499	30/11/2015	0.0084	29/12/2017	0.0217
31/08/2007	0.0375	30/09/2009	0.0365	31/10/2011	0.0977	29/11/2013	0.0185	31/12/2015	-0.0238	31/01/2018	0.0747
28/09/2007	0.0325	30/10/2009	-0.0159	30/11/2011	0.0142	31/12/2013	0.0185	29/01/2016	-0.0346	28/02/2018	-0.0520
31/10/2007	0.0650	30/11/2009	0.0610	30/12/2011	0.0187	31/01/2014	-0.0047	29/02/2016	0.0230	30/03/2018	-0.0069
30/11/2007	-0.0165	31/12/2009	0.0472	31/01/2012	0.0567	28/02/2014	0.0593	31/03/2016	0.0508	30/04/2018	0.0253
31/12/2007	-0.0048	29/01/2010	-0.0125	29/02/2012	0.0137	31/03/2014	0.0152	29/04/2016	-0.0138	31/05/2018	0.0121
31/01/2008	-0.0387	26/02/2010	0.0499	30/03/2012	0.0300	30/04/2014	-0.0030	31/05/2016	0.0083	29/06/2018	0.0305
29/02/2008	-0.0441	31/03/2010	0.0674	30/04/2012	0.0005	30/05/2014	0.0314	30/06/2016	-0.0197	31/07/2018	0.0451
31/03/2008	0.0062	30/04/2010	0.0557	31/05/2012	-0.0414	30/06/2014	0.0110	29/07/2016	0.0400	31/08/2018	0.0586
30/04/2008	0.0690	31/05/2010	-0.0441	29/06/2012	0.0289	31/07/2014	-0.0046	31/08/2016	-0.0169	28/09/2018	0.0332
30/05/2008	0.0298	30/06/2010	-0.0251	31/07/2012	-0.0175	29/08/2014	0.0480	30/09/2016	-0.0040	31/10/2018	-0.0782
30/06/2008	-0.0560	30/07/2010	0.0598	31/08/2012	0.0184	30/09/2014	-0.0190	31/10/2016	-0.0347	30/11/2018	0.0582
31/07/2008	0.0378	31/08/2010	-0.0398	28/09/2012	0.0322	31/10/2014	0.0653	30/11/2016	0.0516		
29/08/2008	0.0220	30/09/2010	0.1143	31/10/2012	-0.0235	28/11/2014	0.0465	30/12/2016	0.0266		
30/09/2008	-0.0608	29/10/2010	0.0392	30/11/2012	0.0319	31/12/2014	0.0178	31/01/2017	0.0431		
31/10/2008	-0.0953	30/11/2010	0.0262	31/12/2012	0.0268	30/01/2015	0.0005	28/02/2017	0.0240		
28/11/2008	-0.0624	31/12/2010	0.0464	31/01/2013	0.0602	27/02/2015	0.0240	31/03/2017	-0.0093		
31/12/2008	0.0224	31/01/2011	-0.0049	28/02/2013	0.0256	31/03/2015	0.0056	28/04/2017	0.0157		
30/01/2009	-0.0530	28/02/2011	0.0379	29/03/2013	0.0542	30/04/2015	-0.0314	31/05/2017	0.0038		
27/02/2009	-0.0837	31/03/2011	0.0283	30/04/2013	0.0056	29/05/2015	-0.0052	30/06/2017	-0.0023		

Finally, for these returns, we create the performance chart of this strategy and we also intergrade the performance of the S&P 500 for further discussion in the next chapter.

Graph 1: Performance of the equally weighted portfolio and S&P 500



5.3 Momentum Strategy

In this strategy, the assets weights are reallocated according to which stock performed better than the market portfolio during the previous month. Those which offered a lower return than the market portfolio, will not be included in the portfolio because we use only long positions.

The mathematical expression for this statement is: $r_{i,t-1} - r_{m,t-1} > 0$. In this study, the return of the market portfolio will be indicated by the return of the S&P 500.

Then, we determine the weight of each stock, proportionally to the last month's return. Using Excel, this can be achieved by the formula: NORMDIST, only for those stocks that performed better than the S&P 500.

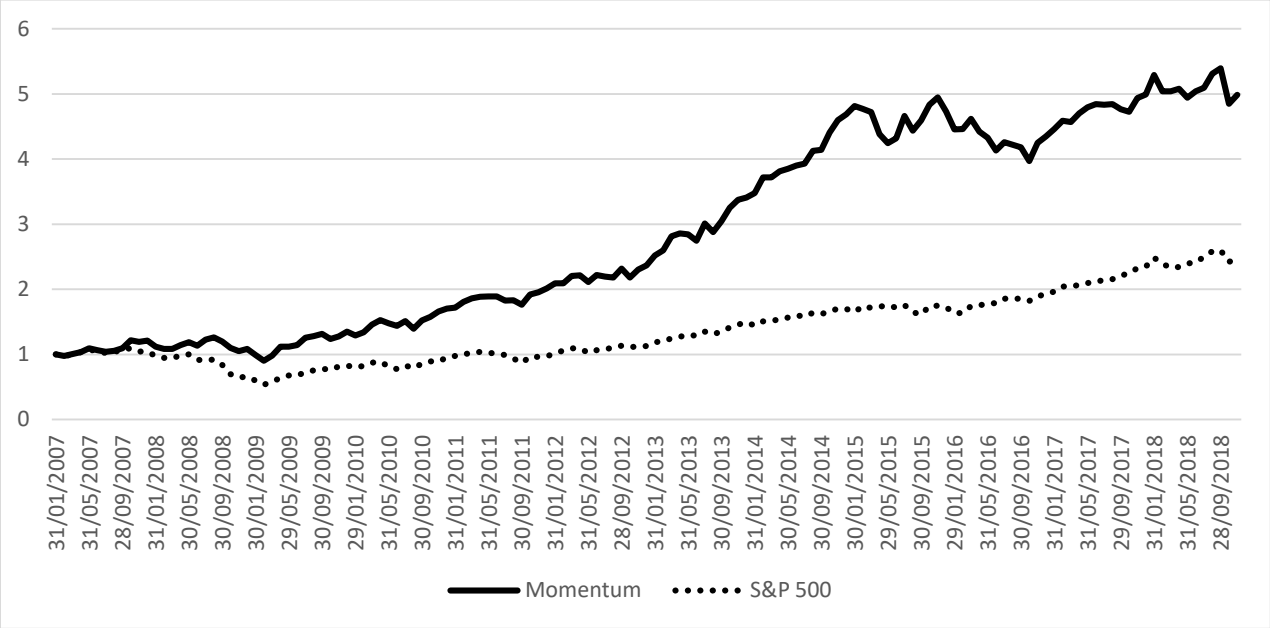
The returns of this strategy are the following:

Table 5: Monthly returns of the momentum strategy

Date	Return	Date	Return	Date	Return	Date	Return	Date	Return	Date	Return
28/02/2007	-0.0250	31/03/2009	0.0834	29/04/2011	0.0147	31/05/2013	-0.0039	30/06/2015	0.0171	31/07/2017	-0.0030
30/03/2007	0.0302	30/04/2009	0.1447	31/05/2011	0.0013	28/06/2013	-0.0342	31/07/2015	0.0800	31/08/2017	0.0027
30/04/2007	0.0294	29/05/2009	-0.0026	30/06/2011	0.0015	31/07/2013	0.0966	31/08/2015	-0.0484	29/09/2017	-0.0159
31/05/2007	0.0596	30/06/2009	0.0241	29/07/2011	-0.0348	30/08/2013	-0.0445	30/09/2015	0.0354	31/10/2017	-0.0086
29/06/2007	-0.0274	31/07/2009	0.0979	31/08/2011	0.0034	30/09/2013	0.0585	30/10/2015	0.0523	30/11/2017	0.0446
31/07/2007	-0.0238	31/08/2009	0.0196	30/09/2011	-0.0364	31/10/2013	0.0670	30/11/2015	0.0240	29/12/2017	0.0110
31/08/2007	0.0119	30/09/2009	0.0263	31/10/2011	0.0885	29/11/2013	0.0373	31/12/2015	-0.0435	31/01/2018	0.0596
28/09/2007	0.0389	30/10/2009	-0.0583	30/11/2011	0.0171	31/12/2013	0.0111	29/01/2016	-0.0588	28/02/2018	-0.0473
31/10/2007	0.1116	30/11/2009	0.0311	30/12/2011	0.0317	31/01/2014	0.0190	29/02/2016	0.0014	30/03/2018	0.0002
30/11/2007	-0.0175	31/12/2009	0.0572	31/01/2012	0.0377	28/02/2014	0.0696	31/03/2016	0.0351	30/04/2018	0.0080
31/12/2007	0.0156	29/01/2010	-0.0432	29/02/2012	-0.0007	31/03/2014	0.0007	29/04/2016	-0.0425	31/05/2018	-0.0272
31/01/2008	-0.0796	26/02/2010	0.0389	30/03/2012	0.0560	30/04/2014	0.0245	31/05/2016	-0.0209	29/06/2018	0.0194
29/02/2008	-0.0300	31/03/2010	0.0857	30/04/2012	0.0044	30/05/2014	0.0102	30/06/2016	-0.0454	31/07/2018	0.0112
31/03/2008	-0.0012	30/04/2010	0.0497	31/05/2012	-0.0479	30/06/2014	0.0128	29/07/2016	0.0305	31/08/2018	0.0427
30/04/2008	0.0571	31/05/2010	-0.0338	29/06/2012	0.0523	31/07/2014	0.0075	31/08/2016	-0.0093	28/09/2018	0.0152
30/05/2008	0.0376	30/06/2010	-0.0261	31/07/2012	-0.0123	29/08/2014	0.0509	30/09/2016	-0.0088	31/10/2018	-0.1009
30/06/2008	-0.0450	30/07/2010	0.0516	31/08/2012	-0.0061	30/09/2014	0.0036	31/10/2016	-0.0506	30/11/2018	0.0286
31/07/2008	0.0831	31/08/2010	-0.0777	28/09/2012	0.0640	31/10/2014	0.0638	30/11/2016	0.0704		
29/08/2008	0.0284	30/09/2010	0.0905	31/10/2012	-0.0597	28/11/2014	0.0436	30/12/2016	0.0226		
30/09/2008	-0.0533	29/10/2010	0.0361	30/11/2012	0.0565	31/12/2014	0.0191	31/01/2017	0.0265		
31/10/2008	-0.0800	30/11/2010	0.0529	31/12/2012	0.0281	30/01/2015	0.0275	28/02/2017	0.0288		
28/11/2008	-0.0451	31/12/2010	0.0278	31/01/2013	0.0639	27/02/2015	-0.0097	31/03/2017	-0.0046		
31/12/2008	0.0307	31/01/2011	0.0075	28/02/2013	0.0312	31/03/2015	-0.0099	28/04/2017	0.0297		
30/01/2009	-0.0859	28/02/2011	0.0522	29/03/2013	0.0831	30/04/2015	-0.0722	31/05/2017	0.0195		
27/02/2009	-0.0865	31/03/2011	0.0276	30/04/2013	0.0147	29/05/2015	-0.0314	30/06/2017	0.0107		

After the calculation of the portfolio returns, we can construct the performance chart of the momentum strategy, containing once again, the performance of the S&P 500 in the same period.

Graph 2: Performance of the momentum strategy and S&P 500



5.4 Contrarian Strategy

In this strategy, we use the same methodology with the momentum strategy but with the exact opposite criteria.

In other words, the weights of the assets are reallocated according to which stock underperformed the market portfolio the previous month. The stocks which offered a higher return than the market portfolio, will not be included in this portfolio because we use only long positions.

The mathematical expression for this statement is: $r_{i,t-1} - r_{m,t-1} < 0$. In this study, the return of the market portfolio will be indicated by the return of the S&P 500.

Then, the determination of the stock weighting is proportional to the last month's return. Using Excel, this can be achieved by the formula: NORMDIST, only for those stocks that underperformed better than the S&P 500.

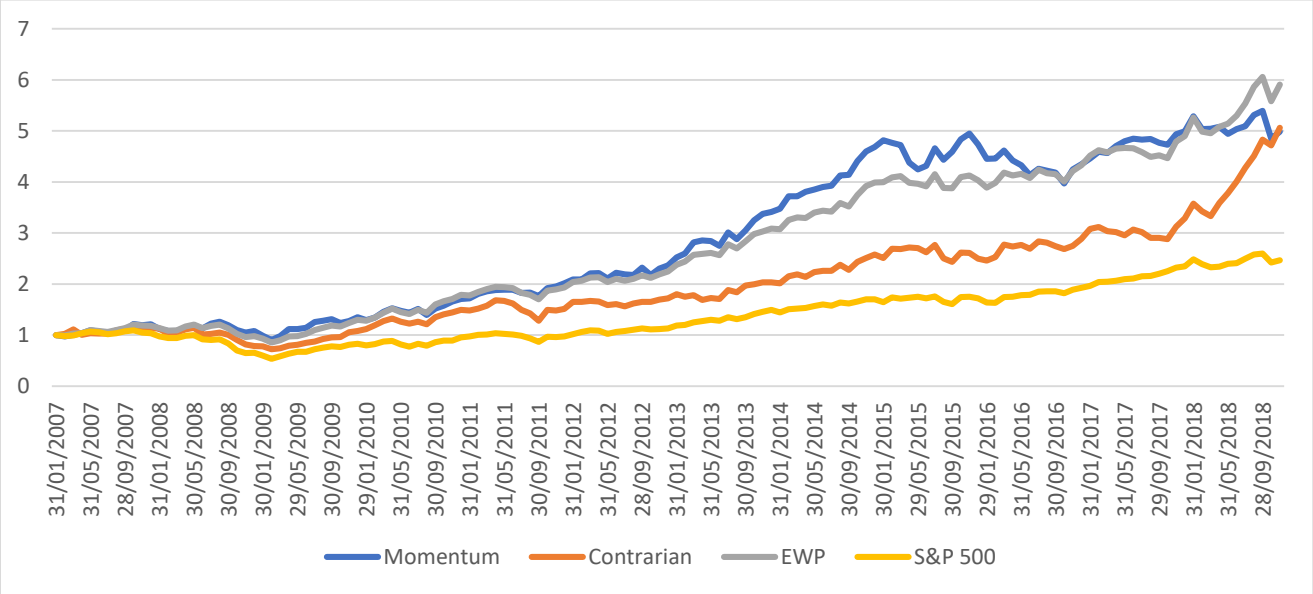
The returns of this strategy are the following:

Table 6: Monthly returns of the contrarian strategy

Date	Return	Date	Return	Date	Return	Date	Return	Date	Return	Date	Return
28/02/2007	0.0247	31/03/2009	0.0251	29/04/2011	0.0692	31/05/2013	0.0200	30/06/2015	-0.0297	31/07/2017	-0.0162
30/03/2007	0.0829	30/04/2009	0.0661	31/05/2011	-0.0066	28/06/2013	-0.0100	31/07/2015	0.0552	31/08/2017	-0.0376
30/04/2007	-0.0944	29/05/2009	0.0235	30/06/2011	-0.0300	31/07/2013	0.1034	31/08/2015	-0.0943	29/09/2017	-0.0018
31/05/2007	0.0310	30/06/2009	0.0500	29/07/2011	-0.0792	30/08/2013	-0.0214	30/09/2015	-0.0273	31/10/2017	-0.0086
29/06/2007	-0.0031	31/07/2009	0.0291	31/08/2011	-0.0444	30/09/2013	0.0686	30/10/2015	0.0743	30/11/2017	0.0861
31/07/2007	-0.0006	31/08/2009	0.0538	30/09/2011	-0.1003	31/10/2013	0.0131	30/11/2015	-0.0035	29/12/2017	0.0530
31/08/2007	0.0572	30/09/2009	0.0372	31/10/2011	0.1662	29/11/2013	0.0190	31/12/2015	-0.0433	31/01/2018	0.0871
28/09/2007	0.0304	30/10/2009	0.0031	30/11/2011	-0.0108	31/12/2013	0.0016	29/01/2016	-0.0141	28/02/2018	-0.0426
31/10/2007	0.0320	30/11/2009	0.0988	30/12/2011	0.0211	31/01/2014	-0.0109	29/02/2016	0.0281	30/03/2018	-0.0271
30/11/2007	-0.0138	31/12/2009	0.0237	31/01/2012	0.0933	28/02/2014	0.0707	31/03/2016	0.0970	30/04/2018	0.0770
31/12/2007	-0.0114	29/01/2010	0.0351	29/02/2012	0.0002	31/03/2014	0.0150	29/04/2016	-0.0146	31/05/2018	0.0533
31/01/2008	-0.0011	26/02/2010	0.0679	30/03/2012	0.0080	30/04/2014	-0.0228	31/05/2016	0.0122	29/06/2018	0.0613
29/02/2008	-0.0981	31/03/2010	0.0661	30/04/2012	-0.0061	30/05/2014	0.0446	30/06/2016	-0.0274	31/07/2018	0.0659
31/03/2008	0.0273	30/04/2010	0.0405	31/05/2012	-0.0403	30/06/2014	0.0127	29/07/2016	0.0531	31/08/2018	0.0548
30/04/2008	0.0639	31/05/2010	-0.0449	29/06/2012	0.0105	31/07/2014	0.0002	31/08/2016	-0.0086	28/09/2018	0.0708
30/05/2008	0.0247	30/06/2010	-0.0303	31/07/2012	-0.0271	29/08/2014	0.0518	30/09/2016	-0.0236	31/10/2018	-0.0239
30/06/2008	-0.1154	30/07/2010	0.0267	31/08/2012	0.0370	30/09/2014	-0.0414	31/10/2016	-0.0223	30/11/2018	0.0736
31/07/2008	0.0142	31/08/2010	-0.0353	28/09/2012	0.0168	31/10/2014	0.0677	30/11/2016	0.0232		
29/08/2008	0.0231	30/09/2010	0.1130	31/10/2012	0.0011	28/11/2014	0.0317	30/12/2016	0.0511		
30/09/2008	-0.0416	29/10/2010	0.0398	30/11/2012	0.0281	31/12/2014	0.0278	31/01/2017	0.0686		
31/10/2008	-0.0991	30/11/2010	0.0261	31/12/2012	0.0140	30/01/2015	-0.0290	28/02/2017	0.0109		
28/11/2008	-0.0934	31/12/2010	0.0367	31/01/2013	0.0483	27/02/2015	0.0739	31/03/2017	-0.0250		
31/12/2008	-0.0443	31/01/2011	-0.0108	28/02/2013	-0.0298	31/03/2015	-0.0023	28/04/2017	-0.0075		
30/01/2009	-0.0050	28/02/2011	0.0272	29/03/2013	0.0196	30/04/2015	0.0114	31/05/2017	-0.0194		
27/02/2009	-0.0701	31/03/2011	0.0354	30/04/2013	-0.0528	29/05/2015	-0.0056	30/06/2017	0.0381		

Then, we can use these returns in order to construct the performance of this strategy. At the performance chart, we also include the performance of the equally weighted portfolio and momentum strategy. Finally, this chart contains the performance of the S&P 500.

Graph 3: Performance of the contrarian, momentum and equally weighted portfolio strategy



5.5 Equity Market-Neutral Strategy

For the purposes of this strategy, we need a portfolio that consists of two stocks and an indicator which informs us when we should hold long or short position on these stocks.

In this dissertation, the investor's portfolio consists of the stocks of the ALASKA AIR GROUP and the SOUTHWEST AIRLINES. These companies fulfill the initial criteria and also, they both represent the industry of Airlines.

The indicator in this strategy is the P/E ratio which informs about the overvaluation or the undervaluation of a stock. In this study, P/E ratio will help us decide in which stock we will hold long position and in which who we will hold short position. At the end of every month, we compare the P/E ratios of those stocks. Finally, we decide to hold short position to the stocks of the company with the highest P/E ratio and to hold long position to the stocks of the company with the lower. This procedure will be repeated at the end of every month.

The weights of these assets will be equal as the methodology demands in a dollar-neutral strategy.

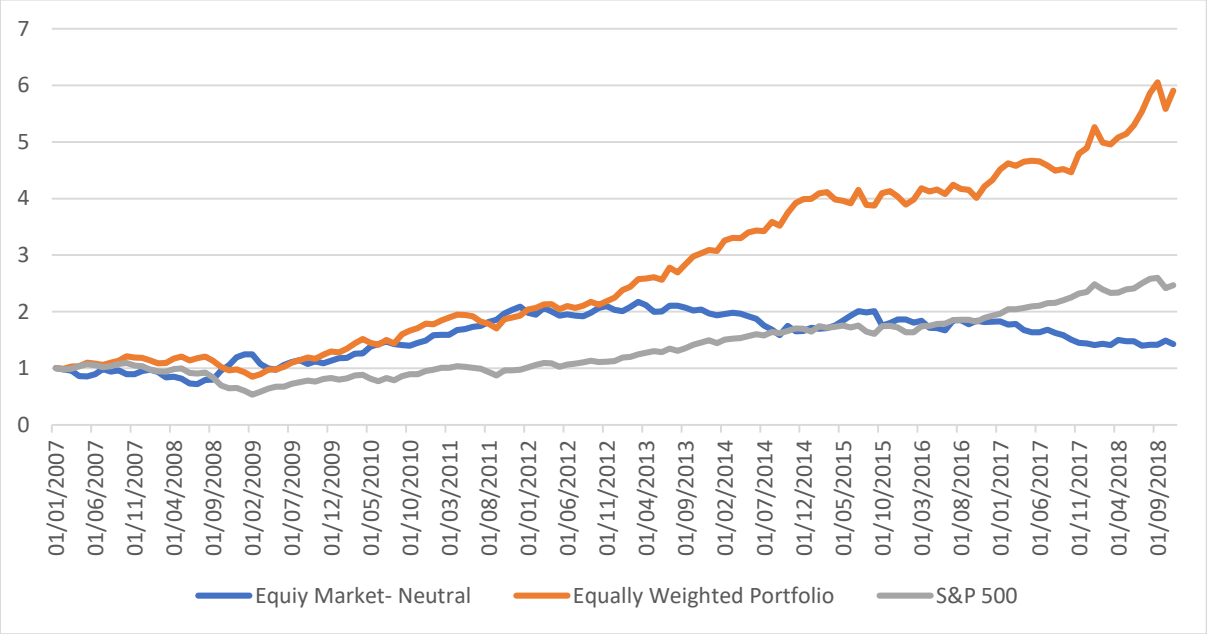
The returns of this strategy are the following:

Table 7: Monthly returns of the equity market-neutral strategy

Date	Return	Date	Return	Date	Return	Date	Return	Date	Return	Date	Return
28/02/2007	-0.0222	31/03/2009	-0.1364	29/04/2011	0.0542	31/05/2013	-0.0563	30/06/2015	0.0518	31/07/2017	0.0281
30/03/2007	-0.0215	30/04/2009	-0.0738	31/05/2011	0.0093	28/06/2013	0.0028	31/07/2015	0.0409	31/08/2017	-0.0317
30/04/2007	-0.0996	29/05/2009	-0.0189	30/06/2011	0.0241	31/07/2013	0.0517	31/08/2015	-0.0128	29/09/2017	-0.0260
31/05/2007	-0.0060	30/06/2009	0.0871	29/07/2011	0.0103	30/08/2013	-0.0003	30/09/2015	0.0124	31/10/2017	-0.0482
29/06/2007	0.0433	31/07/2009	0.0482	31/08/2011	0.0395	30/09/2013	-0.0153	30/10/2015	-0.1286	30/11/2017	-0.0394
31/07/2007	0.1065	31/08/2009	0.0260	30/09/2011	0.0212	31/10/2013	-0.0271	30/11/2015	0.0272	29/12/2017	-0.0080
31/08/2007	-0.0495	30/09/2009	-0.0559	31/10/2011	0.0592	29/11/2013	0.0103	31/12/2015	0.0356	31/01/2018	-0.0174
28/09/2007	0.0246	30/10/2009	0.0425	30/11/2011	0.0317	31/12/2013	-0.0348	29/01/2016	0.0004	28/02/2018	0.0150
31/10/2007	-0.0700	30/11/2009	-0.0336	30/12/2011	0.0301	31/01/2014	-0.0172	29/02/2016	-0.0327	30/03/2018	-0.0148
30/11/2007	0.0007	31/12/2009	0.0433	31/01/2012	-0.0527	28/02/2014	0.0123	31/03/2016	0.0210	30/04/2018	0.0628
31/12/2007	0.0626	29/01/2010	0.0422	29/02/2012	-0.0183	31/03/2014	0.0124	29/04/2016	-0.0685	31/05/2018	-0.0152
31/01/2008	0.0255	26/02/2010	0.0032	30/03/2012	0.0636	30/04/2014	-0.0077	31/05/2016	-0.0047	29/06/2018	-0.0015
29/02/2008	-0.0408	31/03/2010	0.0636	30/04/2012	-0.0306	30/05/2014	-0.0239	30/06/2016	-0.0226	31/07/2018	-0.0513
31/03/2008	-0.1037	30/04/2010	0.0037	31/05/2012	-0.0379	30/06/2014	-0.0251	29/07/2016	0.1047	31/08/2018	0.0101
30/04/2008	0.0135	31/05/2010	0.0919	29/06/2012	0.0128	31/07/2014	-0.0638	31/08/2016	0.0041	28/09/2018	0.0008
30/05/2008	-0.0386	30/06/2010	0.0347	31/07/2012	-0.0130	29/08/2014	-0.0390	30/09/2016	-0.0396	31/10/2018	0.0529
30/06/2008	-0.1065	30/07/2010	0.0316	31/08/2012	-0.0050	30/09/2014	-0.0577	31/10/2016	0.0334	30/11/2018	-0.0403
31/07/2008	-0.0150	31/08/2010	-0.0298	28/09/2012	0.0320	31/10/2014	0.1008	30/11/2016	-0.0123		
29/08/2008	0.0991	30/09/2010	-0.0145	31/10/2012	0.0425	28/11/2014	-0.0520	30/12/2016	0.0046		
30/09/2008	0.0089	29/10/2010	-0.0091	30/11/2012	0.0187	31/12/2014	0.0002	31/01/2017	0.0039		
31/10/2008	0.1998	30/11/2010	0.0368	31/12/2012	-0.0333	30/01/2015	0.0341	28/02/2017	-0.0312		
28/11/2008	0.0974	31/12/2010	0.0281	31/01/2013	-0.0121	27/02/2015	-0.0096	31/03/2017	0.0063		
31/12/2008	0.1390	31/01/2011	0.0660	28/02/2013	0.0369	31/03/2015	0.0076	28/04/2017	-0.0615		
30/01/2009	0.0428	28/02/2011	0.0026	29/03/2013	0.0443	30/04/2015	0.0262	31/05/2017	-0.0229		
27/02/2009	-0.0033	31/03/2011	-0.0004	30/04/2013	-0.0263	29/05/2015	0.0478	30/06/2017	-0.0015		

In the following chart, we will include the performance of this strategy, the performance of the S&P 500 and the performance of the equally weighted portfolio strategy.

Graph 4: Performance of the equity market-neutral and equally weighted portfolio strategies



5.6 Risk-on, Risk-off

This is the final strategy that it is examined in this study. The purpose of this strategy is to detect the confidence environment of the market. In other words, depending on the market's expectations about the volatility, we apply different strategies in risk-on and risk-off environment.

For this strategy, we need two different portfolio types. In a risk-on period, we use the equally weighted portfolio strategy, which was analyzed it above. In a risk-off period, the portfolio is compounded only by the United States Treasury Bill.

VIX is the indicator of this strategy. Looking at the historical data of this index (31/12/1999 to 31/12/2006) we conclude that the mean of the VIX was 5,5%. So, when the VIX expects that the next 30-day volatility of the market will be higher (or equal) of 5,5%, we choose the safer portfolio of the United States Treasury Bill. Otherwise, we use the equally weighted portfolio.

The returns of these strategy are:

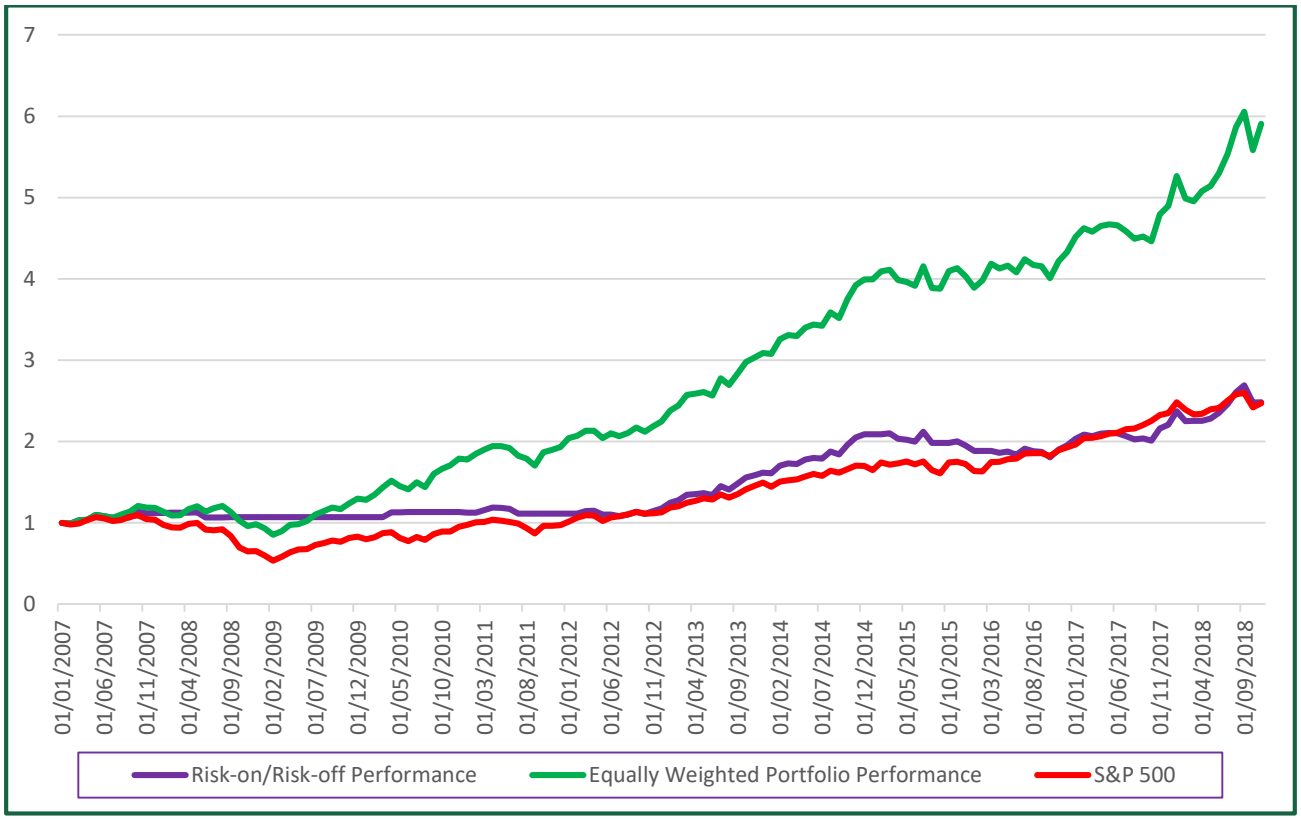
Table 8: Monthly returns of the risk-on, risk-off strategy

Date	Return	Date	Return	Date	Return	Date	Return	Date	Return	Date	Return
28/02/2007	-0.0092	31/03/2009	0.0002	29/04/2011	0.0239	31/05/2013	0.0080	30/06/2015	-0.0124	31/07/2017	-0.0161
30/03/2007	0.0416	30/04/2009	0.0001	31/05/2011	-0.0011	28/06/2013	-0.0168	31/07/2015	0.0618	31/08/2017	-0.0196
30/04/2007	0.0054	29/05/2009	0.0001	30/06/2011	-0.0111	31/07/2013	0.0827	31/08/2015	-0.0650	29/09/2017	0.0062
31/05/2007	0.0582	30/06/2009	0.0002	29/07/2011	-0.0502	30/08/2013	-0.0297	30/09/2015	0.0000	31/10/2017	-0.0129
29/06/2007	-0.0154	31/07/2009	0.0001	31/08/2011	0.0000	30/09/2013	0.0523	30/10/2015	0.0001	30/11/2017	0.0738
31/07/2007	-0.0195	31/08/2009	0.0001	30/09/2011	0.0000	31/10/2013	0.0499	30/11/2015	0.0084	29/12/2017	0.0217
31/08/2007	0.0032	30/09/2009	0.0001	31/10/2011	0.0000	29/11/2013	0.0185	31/12/2015	-0.0238	31/01/2018	0.0747
28/09/2007	0.0030	30/10/2009	0.0000	30/11/2011	0.0000	31/12/2013	0.0185	29/01/2016	-0.0346	28/02/2018	-0.0520
31/10/2007	0.0650	30/11/2009	0.0000	30/12/2011	0.0000	31/01/2014	-0.0047	29/02/2016	0.0003	30/03/2018	0.0014
30/11/2007	-0.0165	31/12/2009	0.0000	31/01/2012	0.0000	28/02/2014	0.0593	31/03/2016	0.0002	30/04/2018	0.0015
31/12/2007	0.0027	29/01/2010	0.0001	29/02/2012	0.0001	31/03/2014	0.0152	29/04/2016	-0.0138	31/05/2018	0.0121
31/01/2008	0.0016	26/02/2010	0.0001	30/03/2012	0.0300	30/04/2014	-0.0030	31/05/2016	0.0083	29/06/2018	0.0305
29/02/2008	0.0015	31/03/2010	0.0001	30/04/2012	0.0005	30/05/2014	0.0314	30/06/2016	-0.0197	31/07/2018	0.0451
31/03/2008	0.0011	30/04/2010	0.0557	31/05/2012	-0.0414	30/06/2014	0.0110	29/07/2016	0.0400	31/08/2018	0.0586
30/04/2008	0.0012	31/05/2010	0.0001	29/06/2012	0.0001	31/07/2014	-0.0046	31/08/2016	-0.0169	28/09/2018	0.0332
30/05/2008	0.0015	30/06/2010	0.0001	31/07/2012	-0.0175	29/08/2014	0.0480	30/09/2016	-0.0040	31/10/2018	-0.0782
30/06/2008	-0.0560	30/07/2010	0.0001	31/08/2012	0.0184	30/09/2014	-0.0190	31/10/2016	-0.0347	30/11/2018	0.0019
31/07/2008	0.0014	31/08/2010	0.0001	28/09/2012	0.0322	31/10/2014	0.0653	30/11/2016	0.0516		
29/08/2008	0.0014	30/09/2010	0.0001	31/10/2012	-0.0235	28/11/2014	0.0465	30/12/2016	0.0266		
30/09/2008	0.0007	29/10/2010	0.0001	30/11/2012	0.0319	31/12/2014	0.0178	31/01/2017	0.0431		
31/10/2008	0.0004	30/11/2010	0.0001	31/12/2012	0.0268	30/01/2015	0.0000	28/02/2017	0.0240		
28/11/2008	0.0000	31/12/2010	0.0001	31/01/2013	0.0602	27/02/2015	0.0000	31/03/2017	-0.0093		
31/12/2008	0.0001	31/01/2011	-0.0049	28/02/2013	0.0256	31/03/2015	0.0056	28/04/2017	0.0157		
30/01/2009	0.0002	28/02/2011	0.0001	29/03/2013	0.0542	30/04/2015	-0.0314	31/05/2017	0.0038		
27/02/2009	0.0002	31/03/2011	0.0283	30/04/2013	0.0056	29/05/2015	-0.0052	30/06/2017	-0.0023		

It is worth mentioning that over this period, we used 87 times the risk-on strategy and 55 times the risk-off strategy.

Finally, we present the performance chart of this strategy, in comparison with the equally weighted portfolio performance.

Graph 5: Performance of the risk-on, risk-off and equally weighted portfolio strategies



5.7 Performance Measures

The final part of this chapter presents a matrix of the performance measures of the above strategies. This matrix contains the average return, the standard deviation, the Sharpe Ratio, and the Upside Potential Ratio of the returns of these strategies (and the benchmark's performance measures).

Table 9: Performance Measures

	Equally Weighted Portfolio	Momentum	Contrarian	Equity Market-Neutral	Risk-on, Risk-off	S&P 500
Average Return	0.013346	0.01237623	0.012642	0.003709	0.006796	0.007271
Standard Deviation	0.039061	0.04478442	0.0482002	0.049009	0.027327	0.041728
Sharpe Ratio	0.326067	0.26274081	0.2496342	0.063239	0.226383	0.159638
Upside Potential Ratio	1.052211	0.9276032	0.8987972	0.62556	0.807662	0.668043

From the results of this matrix, we observe that all strategies perform better than the benchmark, except for the equity market-neutral strategy which is a total risk-averse strategy which aims to neutrality.

The equally weighted portfolio strategy would be the most profitable portfolio management method, in terms of this study.

Also, the risk-on, risk-off strategy has the lower standard deviation, fulfilling its purpose of avoiding the high volatility of the market. Finally, we have to mention that also equally weighted portfolio has a lower standard deviation than the S&P 500.

6 Conclusions and Recommendations

In this dissertation, we developed simulation approaches for managing portfolios of financial assets through extensive experiments using real data for stocks that are trading in the United States stock exchange markets. We used Microsoft Office Excel in order to construct the portfolio compounded by 20 stocks of the S&P 500. The portfolio management has been made according to the methodologies of the Equally Weighted Portfolio, Momentum, Contrarian, Equity Market-Neutral Strategy and Risk-on, Risk-off strategy. Moreover, through backtesting, we were able to construct portfolios for the periods 31/12/2006 through 30/11/2018 and present their performance charts.

From Graph 1, it is easy to see that the strategy of the equally weighted portfolio completely overperforms the S&P 500 index during all the period of this research. Even in the case with a 20-sock compounded portfolio, we can achieve very high returns.

Graph 3 shows the performance of the momentum and contrarian strategies. There, we can see that both these strategies had been performing better than the S&P 500. Even in the financial crises cases, both of these strategies did not suffer significant losses (less than the S&P 500), especially the portfolio which was constructed under the momentum methodology. Momentum was the most profitable strategy during almost all of the period of this study, except for the final year where equally weighted portfolio performed better.

The performance of the equity market-neutral strategy can be seen in Graph 4. As it is expected, this strategy is the least profitable for an investor. Until 2016, this strategy had been performing better than the S&P 500, but since then, things have been transposed. At this point, we have to underline the fact that the periods of recession seem to be profitable for this type of portfolio.

The final graph of this dissertation (Graph 5) shows the performance of the risk-on, risk-off strategy. There, we can find out the effectiveness of this strategy. During the recession periods, we can see that the performance of this strategy is almost stable, avoiding financial losses. Also, it is very effective when periods of economic growth appear.

In conclusion, this dissertation could be the basis for other studies, if applied some expansions. This study could be more precise if the assets of the portfolio were more than 20 (or the entire S&P 500 index) leading to results which are more accurate. Also, short positions could be included in the momentum and contrarian strategies. Finally, it would be interesting if, in the application of the equity market-neutral and risk-on, risk-off strategies were used other indicators than the P/E ratio and the VIX.

Acknowledgments

I would like to express my very great appreciation to the supervisor of this dissertation, Prof Nikolas Topaloglou for giving me the opportunity to search into the financial world, and for guiding me through the writing of this study.

Also, I would like to thank the people who are responsible for the lab of the Athens University of Economics and Business for their help to download the necessary data for this dissertation.

Finally, I would like to thank my entire family and my closest friends which they are always on my side and support me to achieve my goals.

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