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**THE PROFITABILITY OF MOMENTUM INVESTMENT STRATEGY IN AN
INTERNATIONAL STOCK MARKET SETTING**

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ABSTRACT

This Master's thesis examines the profitability of four different momentum investment strategies with formation periods of 3–12 months and each predicting the returns 2 months ahead during the years from 2006 to 2015 in an international stock market setting. Stocks of 11 different indices (CAC 40, DAX, FTSE 100 Index, MICEX, Nikkei 225, OMX Helsinki 25, OMX Stockholm 30, ASX 100, TSX 60, S&P 100 and EUROSTOXX 50) which represent four different continents are used in order to determine whether or not momentum gains exist. This thesis adopts the view of an American investor who is investing in a global pool of stocks. In total 705 stocks are used in the analysis and three different portfolios are formed from these stocks. Out of these portfolios the winner portfolio is bought and the loser portfolio is sold. This analysis is repeated four times for different datasets. Two datasets include stocks and two datasets include the used indices as a whole. The represented countries are also analyzed individually in order to point out the differences between countries.

The results of the analysis for the whole time period indicate that the momentum returns are still present and persistent even though the stock market anomaly i.e. the used investment strategy has been found decades earlier. The momentum returns are also statistically significant in many of the used strategies. The results for the crisis period suggest that the momentum strategy is either not profitable or not statistically significant during a time period with a financial crisis. The results for the time period after the crisis however suggest that the momentum has been again profitable but the magnitude of the returns is smaller than during the whole time period. The results for the countries alone, however, point out that many of the countries do not have statistically significant momentum returns when the country is analyzed alone. Only U.S. and Great Britain have significant returns for all of the strategies.

Even though these results are not statistically significant in all aspects, they still provide evidence for a well-researched finance topic and point out the importance of momentum in an academic and current setting.

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1. INTRODUCTION

How to beat the market? That has been the motivation for many researchers, stockbrokers, portfolio managers etc. and many different investment strategies have been developed and tested in order to gain larger profits than the market and a typical buy-and-hold - strategy normally has to offer. Efficient market hypothesis explains that stock prices include all information and therefore it is not possible to invent an investment strategy that is based on previous stock prices and that would generate abnormal positive returns (Fama 1970). Therefore, the best investment strategy would be the buy-and-hold the market portfolio which will generate returns that are obviously equal to the market return of the same time period (Shleifer 2000).

Some investors have reached returns that are greater than the market return using different investment strategies, and researchers have found evidence that using past information as an investment strategy can help to generate abnormal returns. Many investment strategies have been developed and Levy's research (1967) is considered to be the first one to examine something very similar to momentum investment strategy. His investment strategy uses stocks that are priced above their 27 week average price. (Levy 1967.) His results have been questioned and somewhat proven false by Jensen and Bennington (1970) but later researchers have been studying past prices and concluded that momentum investment strategy i.e. buying past winners and selling past losers, is profitable.

Momentum investment strategy is only one among many investment strategies and later on even an opposite strategy – contrarian i.e. buying past losers and selling past winners – has been developed or rather discovered. Not only has new investment strategies been discovered but also stock market anomalies have been discovered. These anomalies show that it is possible to gain abnormal returns on stock markets simply investing on certain time periods of the year or on certain kind of stocks. Momentum is also considered as a stock market anomaly. Momentum has been widely acknowledged and studied but recent literature still emerges and different viewpoints have been developed.

1.1. The purpose or the thesis

The purpose of this thesis is to expand the international view to this well researched investment strategy while also using the viewpoint of an American investor which is managed by confirming all the prices to USD. This thesis will aim to figure out whether

or not the momentum investment strategy is usable for a regular investor by testing a set of momentum strategies in a diverse stock environment. In addition to the viewpoint of an American investor the global data will also be examined individually i.e. all countries will be examined individually in order to find out if momentum profits differ between countries. While the main analysis of this thesis concentrates on the momentum profits of the stock portfolios, this thesis also uses a new viewpoint in which indices are used instead of stocks as an investment subject. The earliest studies on momentum concentrate on using only the U.S. data and most of them use also nearly or exactly the same time period. This results in similar research conclusions and accusations of data mining. More recent studies have concentrated on using either global data outside of the U.S. or global data including also the U.S. data. Motivated by the earlier research but inspired by the recent research this thesis will aim to contribute to all the studies made in this field by expanding the international evidence as well as making comparisons between countries and different indices.

1.2. Limitations and assumptions

The main limitation for the master's thesis is the small size of the data compared with other similar studies. The maximum amount of firms in a sample with multiple European indices (with EUROSTOXX 50) is 760 (585) out of which 655 (506) stocks qualify to be used in the thesis. Compared to other studies in this field, this sample is small. The data is, however, still comprehensive because it includes stocks from four different continents and 10 different countries and also the additional European countries that are present in the second sample which includes the EUROSTOXX 50. Many of the main western or westernized countries are included which also means that many of the indices that are considered to be the most important ones in the global stock markets are included in the data set. However, including only western or westernized countries means obviously that the next limitation of the thesis stems from the fact that some important stock markets, indices and stocks might be left out because they belong to the countries that are outside the so called westernized world. The data is limited to the westernized countries because of the easier availability of data in these countries' stock markets and also because of the fact that westernized countries' indices possibly have more stocks in them that have observations for the whole time period. The length of the time period is also rather short compared to many of the previous momentum studies. The time period is limited to ten years in order to collect as many observations as possible because only stocks that have observations for the whole time period are included in the study.

Previous studies have proven that there are abnormal returns that could be gained if momentum is used as an investment strategy. Because of the academic nature of the previous studies, it is difficult to say if this investment strategy would actually work in a practical, real-life situation. Additional factors (which control for e.g. the risk factor or data mining) should be included in order to clarify the practical point-of-view. For example, degree of turnover and trading costs can have a significant impact on the gained returns in a practical market place investment situation. (Nørregård 2008: 5.) Additional factors have been used in many of the more recent studies to determine whether momentum gains are the result of some sort of other anomaly or if they are purely due to the momentum strategy's significance. This thesis will not use any of the additional factors. This thesis will concentrate on the pure momentum strategy which could be considered as a limitation when comparing this thesis with those studies that have used additional factors in their research.

The main assumption of the thesis is that momentum strategy does exist and that this research should provide more evidence for the strategy. This is based on the vast amount of previous studies that have proven the momentum strategy to be profitable. However, this thesis does accept the fact that opposing conclusions have also been made and some of the previous studies conclude that not all countries behave similarly in this respect. There has been evidence that momentum strategy is not profitable in some of the countries included in this thesis. This has to be taken into consideration. Therefore it is obvious that if this research does not support the momentum strategy or at least some of the countries results do not support the momentum strategy, it has to be acknowledged and for the sake of academic research it has to be made public in the thesis even though the main assumption of the thesis is that momentum strategy does exist and that it does generate abnormal returns.

1.3. Structure of the thesis

The rest of this thesis is organized in six parts that will give different views to understanding momentum strategy and the meaning of the thesis. The second part of the thesis concentrates on theoretical background, adding momentum to a pool of finance related theories. The third part includes a literature review with views to previous studies on momentum, contradicting results and criticism. Fourth part will define the research questions for the empirical study. Fifth part consists of data and methodology. This part introduces descriptive data and defines the formation and holding periods as well as

describes the data by means of describing the chosen indices and the characteristics of the chosen time period. The sixth part of the thesis introduces the empirical results from the analytical research of the momentum strategy and the indices. Finally, the last part consists of conclusions based on the entire thesis. It will also give answers to the posed research questions.

2. THEORETICAL BACKGROUND

2.1. Efficient Market Hypothesis

Fama (1970) introduces the Efficient Market Hypothesis (EMH) which basically states that it is impossible to gain excess returns because if the markets are efficient, no additional, public or private, information results to a profitable investment strategy because the market prices already contain all possible and relevant information. Only new information can cause the stock prices to react and the reaction will be immediate and correct. Therefore information asymmetry or delayed price reactions do not exist and cannot be utilized in seek for gaining abnormal returns. The losses and gains experienced in the stock markets are therefore due to luck and chance. The EMH suggests a division of the markets into three different categories each representing the level of efficiency i.e. the extents to which all possible information is reflected to the market. (Bodie, Kane & Marcus 2014; Fama 1970.)

The weak form of market efficiency means that the market prices contain all the available past information e.g. the past stock prices and trading volume. The market has been widely tested for the weak form of market efficiency and the evidence suggests that the stock market actually is in its weak form of market efficiency. (Fama 1970). The weak form makes the technical analysis, which uses the historical prices, useless. Therefore it is obvious that those in favor of technical analysis or momentum which also uses past price information do not concur with this conclusion. (Ruotsalainen 2016.)

The semi-strong efficient market includes all the historical information and also all the publicly available information about the firm and the stock. These include e.g. the financial statements and patents. (Fama 1970; Bodie et al. 2014.) All this publicly available information is reflected to the stock prices (Ruotsalainen 2016). The strong form of market efficiency includes all the private and insider information and all the publically available information (Fama 1970). Combined to the immediate and correct reaction to new information this means that the prices should be able to react to the new insider information immediately and with a correct magnitude in order for the markets to be in the strong form of market efficiency (Bodie et al. 2014). Even Fama (1970 & 1991) concludes that the strong form of market efficiency is most likely false and it rather should be used as a benchmark in later research. Due to linkages of EMH with transaction costs and positive information the strong form of market efficiency cannot hold true but can still be used as a benchmark (Fama 1991).

Fama (1991) states that one of the biggest problems for the EMH are the joint-hypotheses which stem from the fact that the EMH in itself cannot be tested alone. Therefore EMH is tested by using asset-pricing models. If the chosen asset-pricing model succeeds in explaining the prices then the markets are efficient. This is obviously problematic because it announces the importance of finding the perfect asset-pricing model that will explain the returns no matter where the returns originate from. For example momentum returns have not been successfully explained by any asset-pricing model. (Fama 1991; Ruotsalainen 2016.) Joint-hypotheses are not the only method that have been used in market efficiency studies. Event studies aim for recognizing the exact moment and the speed and the correctness of the price reaction to a certain new information. (Fama 1991.)

The existence of stock market anomalies i.e. returns that cannot be explained by any asset-pricing model (e.g. momentum returns), can either be taken as evidence for inaccurate asset-pricing models or inefficient stock markets which again highlights the problem of joint-hypotheses (Schwert 2002; Ruotsalainen 2016). Schwert (2002) points out that the stock market anomalies have a tendency to disappear or weaken gradually over time after they have been discovered. This might suggest that the anomalies are only historically profitable or that the anomalies are taken advantage of so that they are eventually arbitraged away. This tendency to disappear or weaken questions the usage of anomalies as an evidence against market efficiency. However, it seems that the momentum returns have persisted over time, decades after they have been discovered. A very popular notion is that the momentum returns are due to a yet unidentified risk factor. (Schwert 2002.)

2.2. Asset-pricing models

All of the six asset-pricing models presented in this chapter offer different viewpoints to the theory of how stock prices are in theory formed. The momentum investment strategy bases its sell/buy decisions on historical prices and therefore, in order to understand the prices and momentum, the theoretical asset-pricing models are an important addition to the theoretical background. Stock prices are affected by a vast amount of factors which most likely have not all to this date been identified. These asset-pricing models all try to explain the asset prices by using different factors in their models. (Ruotsalainen 2016.)

2.2.1. Dividend Discount Model (DDM)

The dividend discount model (DDM) – as its name suggests – considers the stock's price as a result of the future dividends from current time to perpetuity. Dividends are discounted to represent the current value of the stock. Its reasoning stems from the viewpoint that the capital gains are already included in the dividends already when the stock is sold i.e. the price of the stock is purely based on the future cash flow incoming for the investor. (Bodie et al. 2014).

(1.) $$V_0 = \frac{D_1}{1+k} + \frac{D_2}{(1+k)^2} + ... + \frac{D_t}{(1+k)^t}$$

Where, V_0 is the current value of the stock, D is the dividend at time t, and k is the return on equity (Bodie et al. 2014).

The DDM suggests that the returns of momentum strategy or any other anomaly could be traced back to the firm's past dividends. Because these announcements are public information, momentum would be arbitraged away. Momentum returns are not, however, tied to firms with high dividend yields and therefore the DDM simply cannot explain the momentum returns. (Ruotsalainen 2016.)

2.2.2. Free Cash Flow Model (FCF)

The free cash flow model (FCF) uses a similar viewpoint with the previous DDM. Whereas DDM only considers the future dividends as a source of cash flow, the FCF considers the cash flow as everything that is available to stock holders on top of the capital they have invested (Bodie et al. 2014). This is obviously a usable model while analyzing firms that do not issue dividends. The original model can be further improved by replacing the return on equity with the weighted average cost of capital (WACC), out of which the firm's debt can be reduced so that the value of equity can be found. The formula leads to the current value of the firm and needs to be divided by the amount of outstanding shares. (Puttonen & Knüpfer 2009; Bodie et al. 2014.)

(2.) $$P_0 = \sum_{t=1}^{\infty} \frac{FCF_t}{(1+WACC)^t}$$

Where P_0 is the current value of the firm, t is the time period, FCF is the free cash flow, and WACC is the weighted average cost of capital (Puttonen & Knüpfer 2009).

2.2.3. Capital Asset Pricing Model (CAPM)

CAPM has been developed by Sharpe (1964) and Lintner (1965) at approximately the same time although they worked individually. They aimed at finding a way to predict the future behavior of capital markets and creating a theory that would explain how conditions of risk affect the outcome in markets. CAPM describes the relationship between the asset's price and its risk. The model simplifies the markets and states that the expected returns of an asset increase linearly with its beta. The result is a security market line on which the assets are on average assumed to be located. (Sharpe 1964; Lintner 1965; Brealey et al. 2011: 220–224.) The theory developed by Lintner and Sharpe has ever since been considered as one of the most important theories in the field of finance and it has been used continuously on a large scale even though it has been widely proven that the CAPM is not the ultimate truth. It is one of the most used models in the field of financial research. CAPM is calculated by finding out the risk premium of a certain stock which is then added with the risk free interest rate. The risk premium is calculated by multiplying the stock's beta with the risk premium of the market. (Puttonen & Knüpfer 2009.)

(3.) $\qquad E(r_i) = r_f + \beta_i[E(r_m) - r_f]$

Where E(r_i) is the expected return for stock i, r_f is the riske free interest rate, B_i is the beta of stock i, and E(r_m) is the expected return of the market (Puttonen & Knüpfer 2009).

2.2.4. Arbitrage Pricing Theory (APT)

Arbitrage pricing theory (APT), developed by Ross (1976), has a somewhat similar but still completely different viewpoint to the problem of how to predict the future returns of an asset if compared to its "kindered spirit" CAPM. While CAPM uses beta as a tool to predict future returns, the APT uses the asset's sensitivity to a small set of pervasive factors that might be different for different firms. Sensitivity to the microeconomic factors is the main attribute in terms of asset's price but its price is also affected by unique set of firm-specific factors. (Ross 1976; Brealey et al. 2011: 228–229.)

(4.) $$E(r_j) = r_f + b_{j1}RP_1 + b_{j2}RP_2 + \cdots + b_{jn}RP_n$$

Where $E(r_j)$ is the expected return of an asset, r_f is the risk free rate, b_j is the sensitivity of the asset to the factor and RP is the risk premium of the factor (Ross 1976).

2.2.5. Three-factor model

Three-factor model, developed by Fama and French (1993), is one form of the APT. Fama and French (1993) have found factors that may help to predict the future expected returns. (Fama & French 1993.) Small firms and high book-to-market firms have shown that they can provide above average returns which cannot be explained with the CAPM (Bodie et al. 2014). Three-factor model states that all returns on top of the risk free return are explained by the sensitivity to the three factors used in the formula. These factors are market (i.e. the excess returns which are calculated by subtracting the risk free interest rate from the market returns), size (i.e. the returns of small stocks minus the returns of large stocks; SmallMinusBig) and book-to-market (i.e. the returns of high book-to-market firms minus the returns of low book-to-market firms; HighMinusLow). (Fama & French 1995; Brealey et al. 2011: 229–230.)

(5.) $$R_i - R_f = \alpha_i + b_i(r_m - r_f) + s_i SMB + h_i HML + \varepsilon_i$$

Where R_i is the return of the stock/portfolio i, R_f is the risk free rate, a_i is the intercept, $b_i(r_m-r_f)$ is the factor beta for market returns multiplied by market index returns, $s_i SMB$ is the factor beta for small minus big multiplied by the returns of the small minus big, $h_i HML$ is the factor beta for high minus low multiplied by the returns of high minus low, e_i is the influence of other factors affecting the stock's/portfolio's price (Fama & French 1996).

The model performs better than the CAPM in predicting the returns of small stocks and other anomalous returns but not those of the momentum strategy (Fama & French 1993; 1996). To be perfect i.e. if the factors in the model were the only risk factors affecting the price of an asset, the intercept of the model should always be zero (Bodie et al. 2014). For momentum strategy the intercepts have been positive and to a greater extent than the intercepts from the CAPM. This is somewhat confusing because the three-factor model

is considered to be more robust than the CAPM. (Ruotsalainen 2016.) Later the model has been criticized as being incomplete and not being able to depict much of the variation that actually occurs due to profitability and investments (Titman, Wei & Xie 2004; Novy-Marx 2013). This is why Fama and French's five-factor model was introduced (Fama & French 2015: 5).

2.2.6. Five-factor model

The five-factor model expands the previous three-factor model by adding two more variables: profitability (i.e. the returns of portfolios with robust profitability minus the returns of portfolios with weak profitability; RobustMinusWeak – which was suggested by Novy-Marx (2013)) and investment patterns (i.e. the returns of conservatively invested portfolios minus the returns of aggressively invested portfolios; ConservativeMinusAggressive). Five-factor model has also been used to explain the anomalous returns and the results have been compared with the three-factor model in order to find out whether or not it was able to do that. The five-factor model produces intercepts that are closer to zero than the intercepts of the three-factor model which suggests that the five-factor model performs better in explaining the returns of the stocks. It is estimated to explain 71–94 % of the cross-variance in expected returns. However, Fama and French concluded that a four-factor model (i.e. the five-factor model without HML) performs nearly as well as the five-factor model which would suggest that the HML factor is not that important in explaining asset prices. Again, this model is not able to explain the returns of momentum strategy. (Fama & French 2015.)

(6.) $$R_i - R_f = \alpha_i + b_i(r_m - r_f) + s_i SMB + h_i HML + r_i RMW + c_i CMA + \varepsilon_i$$

Where R_i is the return of the stock/portfolio i, R_f is the risk free rate, a_i is the intercept, $b_i(r_m-r_f)$ is the factor beta for market returns multiplied by market index returns, $s_i SMB$ is the factor beta for small minus big multiplied by the returns of the small minus big, $h_i HML$ is the factor beta for high minus low multiplied by the returns of high minus low, $r_i RMW$ is the factor beta for robust minus weak multiplied by returns of robust minus weak, $c_i CMA$ is the factor beta for conservative minus aggressive multiplied by the returns of conservative minus aggressive, e_i is the influence of other factors affecting the stock's/portfolio's price (Fama & French 2015).

2.3. Stock market anomalies

As stated earlier in this thesis: it has been documented that the EMH does not hold and that excess returns do occur. Researchers have proven, that excess returns occur especially in certain ways that can be implemented as an investment strategy. Stock market anomalies have been identified in huge numbers and their amount only keeps getting bigger. In this context only few of the vast amount of stock market anomalies are explained briefly. Needless to say, that momentum is an anomaly as well and will be explained in length later. In this chapter some seasonal anomalies will be considered. It is important to notice that these anomalies have been studied quite heavily but in this context only one (or possibly few) of all the studies are mentioned. Needless to say secondly, is that the field of anomalies includes much more anomalies in all possible shapes, colors and forms (so to say).

2.3.1. January effect

January effect is probably one of the best known seasonal stock market anomalies. Researchers have shown that returns tend to be higher during January but also that this anomaly is closely related to firm size and book-to-market (e.g. Banz 1981; Houge & Loughran 2005). Since gaining all of its interest the debate of January effect's existence or disappearance has been on-going. The debate has concentrated on either still existing or not existing or existing in some parts of the world (mainly in less developed countries). Patel (2016) concludes that January effect has lost its persistence and does not exist anymore. Signs of January effect are not found neither from high nor low volatility periods and neither bearish nor bullish markets. The main conclusion is that January effect does not exist. (Patel 2016.) Simbolon (2015) and Georgiou (2015) study Indonesian and European stock markets. Both of them come to the same conclusion as Patel, and conclude that the January effect does not exist in these markets. (Simbolon 2015 & Georgiou 2015.) This is evidence of an anomaly that has slowly disappeared after its discovery.

2.3.2. Halloween effect

Jacobsen, Mamun and Visaltanachoti (2005) report that unlike the January effect, the Halloween effect – which means that returns tend to be higher right after Halloween i.e. in November – is unrelated to the size and book-to-market factors (Jacobsen et al. 2005). Carrazedo, Curto and Oliveira (2016) report significant Halloween effect returns on

European markets. They state that a Halloween effect based trading strategy would outperform the buy and hold strategy 8 times out of 10 and that it would generate approximately 2.4 % of excess returns. (Carrazedo et al. 2016.) Loon, Mei, San, Yong & Min (2015) study the existence of Halloween effect in Malaysia, Taiwan, Singapore, China and Indonesia in order to find out if this effect is present in Asian markets as it is normally considered a European effect. During their time period from 2000 to 2014 they find persistent evidence that the Halloween effect is also part of the Asian stock markets. (Loon et al. 2015.)

2.3.3. Other seasonal anomalies

Bouman and Jacobsen (2002) report significantly lower returns during summer months than what can be expected during winter months. Their study of 37 countries shows that returns are below or close to zero for many of the countries from May to October and significantly higher from November to April. This leads to a "Sell in May" anomaly or investment strategy. (Bouman & Jacobsen 2002.) Rossi, Della Peruta and Mihai Yiannaki (2016) study four European countries in order to find out whether or not some of the newer seasonal anomalies exists in European markets. Day of the week and day of the month effects provide abnormal returns in European markets as well as in previously well studied U.S. markets. The results are not that convincing though and they conclude that strong across-the-board evidence is not found and that the strongest and the most favorable results are only country-specific. This could lead to a conclusion that the seasonal anomalies are at best country-specific and therefore different countries might have different anomalies present in their markets. (Rossi et al. 2016.)

3. LITERATURE REVIEW

3.1. Previous studies on momentum

As stated in the introduction, Levy (1967) is one of the first researchers to examine, what he calls relative strength trading rule. His intention is to prove, that the dominant idea of stock prices being independent and not related to any statistically observable pattern, does not hold. He wants to prove that there are patterns which can predict the future returns of stocks. His approach to the matter is to study the co-movement of stock prices with the different methods of technical analysis. This method filters out the co-movement of stocks by using ranking of the stocks which measures the relative strength of the stocks. His study concludes that buying stocks, that are priced significantly higher than what their average prices have been over the past 27 weeks, generates significant abnormal returns. Basically this method is the same as in the strategy that is nowadays called the momentum strategy. Levy also states that the results of his study do not totally reject the random walk hypothesis (even though the results obviously point that way). (Levy 1967: 595–596, 609.) Levy's study has later been criticized and the critique is covered later in this thesis (Chapter 3.3.).

Later, Jegadeesh and Titman (1993) state that some evidence for the momentum strategy can actually be found from the success of mutual funds, out of which many still use the momentum strategy. They examine momentum and come to the conclusion that the momentum portfolios performance persists over medium-term horizon. A portfolio that is based on buying past winners and selling past losers generates statistically significant positive returns over the following three to twelve months holding period. However it seems that after twelve months the positive returns vanish and the strategy is not profitable during the two years following the holding period. They report momentum returns that are statistically significant in all of their portfolios which use formation and holding periods of 3–12 months. The returns in their study vary from 0.0149 % (12-3 lagged strategy) to 0.0058 % (3-6 strategy) suggesting that during the years of 1965–1989 the average momentum portfolio returns are quite small but still statistically significant. (Jegadeesh & Titman 1993.)

Jegadeesh and Titman's (1993) study also proves that the success of momentum strategies is not due to the systematic risk or lead-lag effects that are due to delayed reactions of the stock prices to the common factors. However their results do indicate that delayed price reactions to the firm-specific information have something to do with the abnormal returns

that momentum strategy generates. Jegadeesh and Titman (1993) state that in their opinion overreaction (return reversals) and under reaction (return persistence) are most likely too simplistic reasons for momentum gains. They call for a more sophisticated model to explain the pattern of returns. One explanation given in their research is that the act of buying past winners and selling past losers is what makes the prices shift from their long-term average and therefore it causes the prices to overreact. Another possible explanation for over- and under reaction is that the markets overreact to the long-term prospects of firms and on the other hand markets underreact to the short-term prospects of firms. (Jegadeesh and Titman 1993: 66–69, 89–90.)

Again Jegadeesh and Titman (2001) examine momentum and demonstrate that the momentum profits still exist nearly a decade later. They document that the momentum returns are of the same magnitude during the 8 years following their first study. Their previous results have been widely accepted but on the other hand some have said that the momentum profits are either compensation for risk or product of data mining. Because of these allegations, they examine momentum profits for the second time. Jegadeesh and Titman discover that the previous results are still reality and the magnitude has stayed on the same level, thus supporting the fact that the earlier results are not due to data mining. Therefore, momentum strategy still generates about one percent per month for the following year after the formation period. Their second motivation for this second study was to find possible reasons why the momentum strategies are profitable and also to evaluate these reasons. Their research supports the behavioral explanation of delayed overreactions that are finally reversed but the research also states that this supportive evidence should be dealt with caution and is at best only a partial explanation for the momentum strategy. (Jegadeesh and Titman 2001: 699–701, 718–719.)

Novy-Marx (2012) concludes that past performance information which is collected using intermediate time horizon generates better returns than when using recent time horizon. He reports returns of 1.21 % to the 12-7 strategy and 0.77 % to the 6-2 strategy. Similar results can also be found for other asset classes besides stocks. He also concludes that momentum is not really driven by the trend of falling stock prices to keep falling or rising prices to keep rising, but it is the result of the firms' performance seven to twelve months before the formation of the portfolio. The information which is used when forming the portfolios should be gathered several months before the actual formation period. Therefore, in his opinion the term momentum does not accurately describe what the strategy is really about. This is due to the theoretical definition of the term momentum which states that momentum is "the tendency of an object in motion to stay in motion"

(Novy-Marx 2012). His result that the intermediate time horizon is better than the recent time horizon does not support the traditional view of momentum – that is the short run autocorrelation of the stock prices. Novy-Marx states that his results cannot be explained by any known results – the behavioral and the rational explanations do not explain the results. Finally, he also states that the large cap firms have not been given enough attention and that the momentum is stronger in the large cap firms that has previously been acknowledged. (Novy-Marx 2012.)

Rouwenhorst (1998: 283) examines 12 European countries during 1980–1995. His motivation for the research and for the European data stems from the previous criticism that the conclusions and evidence for momentum phenomenon are the result of data snooping. Previous studies use mainly, basically the same U.S. data. Rouwenhorst examines firms from Austria, Belgium, Denmark, France, Germany, Italy, the Netherlands, Norway, Spain, Sweden, Switzerland and the United Kingdom. Rouwenhorst constructs his portfolios using the same method with Jegadeesh and Titman's study in 1993. He documents returns that vary from 0.0077 % (3-3 strategy) to 0.0135 % (12-3 strategy) per month for a data with all the countries in his data. The results state that the medium-term winner-portfolio outperforms the medium-term loser-portfolio by about one percent per month. These results prove that momentum strategy generates abnormal returns in Europe whereas earlier studies prove this phenomenon in the U.S. The results also prove that the data snooping claim is not valid. (Rouwenhorst 1998: 267–269, 283.)

Nørregård (2008) continues with a European data and studies momentum in the Danish stock market and finds evidence that the momentum is also apparent in the Danish stock market environment. The returns of momentum strategies in Danish stock markets vary from 0.014 % (3-3 strategy without lag) to 0.192 % (12-3 strategy with and without a lag). He also concludes that the price momentum should not anymore be called a market anomaly but it should be called a dominating market factor because of the extensive research results that have shown its existence. Nørregård does stress that the results are academic in nature and therefore there is no proof that the strategy will actually work in a real-life investing scene. He compares his results with one of the most popular studies in this field. He concludes that his results are similar to the ones which are discovered by Jegadeesh and Titman in 1993. (Nørregård 2008: 1–2, 4–5, 57.)

MSCI BARRA –research center (2010) has published a study of the momentum strategy in the Asian stock markets. The overall view of the Asian stock markets and the

momentum strategy during the years of 1995–2009 is similar to the other studies in this field. The momentum strategy is profitable in Asia but there are huge local differences among the different regions. Some of the countries, for example Australia (together with New Zealand 3.3 %) and India (together with Pakistan 4.2 %) have larger momentum gains than the data set as a whole. On the other hand, for example the Philippines and Thailand (with Indonesia and Malaysia) have negative momentum gains of -2.7 % during the time period. This is due to the market crash of Asia which hit these countries the worst. The research of the MSCI BARRA has interesting results concerning the Japanese stock market. The results show that the momentum strategy is profitable only during the years of 1996–1999 due to the rise technology industry. After this time period the momentum strategy has not beaten the market in Japan. For the whole time period the average momentum gains in the Japanese stock markets are -2.2 % per year. The following figure presents the level of returns in MSCI BARRA's research. (MSCI BARRA 2010.)

For this thesis the interesting results of the MSCI BARRA (2010) concern Australia and Japan. These two countries and their indices are included in this research and because the time period of the thesis and the MSCI BARRA study are partly overlapping, similar results might be expected. This means that the Australian stocks should generate positive returns and possibly even larger momentum gains than some of the other countries. On the other hand the results concerning the Japanese index can be expected to be worse than the other countries' returns. It might even mean that the Japanese stocks have not outperformed the market during the time period used in this thesis.

Hancock (2010) uses a data spanning from 1927 to 2009. He concludes that the strategy generates returns approximately 3 % per year more than the stock market. But he also concludes that the beginning of the 21st century has been the weakest for the momentum strategy and during the first years of the century it has only barely beaten the market. Hancock names two explaining reasons for the weak performance of the strategy. First, he concluded that the momentum strategy is not at its best if used when the stock market is either at the bottom or at the top. Six months after hitting the bottom/top the strategy does not anymore beat the market. Second, the volatility of the stock market does not favor the momentum strategy because it is not related to the "trendiness" of the market or the stocks which is something that the momentum strategy is closely related to. Volatility on the other hand is related to the mean revision – in other words, volatility is related to how the prices return to their mean values. Obviously volatility is not good for momentum because the users of momentum strategy do not want the prices to return to their mean

values but they want them to keep rising. As a conclusion, Hancock's research states that the momentum strategy generates abnormal positive returns – i.e. it works – when the stock market is in its so called normal state but it does not work when the stock market is volatile or when it is at its bottom or at its top position. (Hancock 2010.)

Daniel and Moskowitz (2014) study the recent recessions and conclude that using the momentum strategy comes with a risk of statistically high negative returns after major market crashes. Daniel and Moskowitz (2014) report that the worst returns of the momentum portfolio in 21st century have occurred in 01/2001, 10–11/2001, 11/2002, 03–04/2009 and 08/2009. These worst momentum returns range from -24.98 % (in 10/2001) to -49.19 % (in 01/2001). They call this phenomenon a momentum crash and state that these crashes are driven by the loser portfolios because of the bear markets and the up- and down-beta differentials. In other words, this phenomenon is mainly due to the fact that when the conditions of the stock markets start to improve, the past losers begin to generate large positive returns. In the end this results in the so called momentum crash because the past losers are sold and not bought which would be the best thing to do in that situation. (Daniel & Moskowitz 2014.)

Grobys' (2014) study is one of the most recent ones and it is done using a global data which is partly the same as the one used in this thesis. He examines momentum during the recent economic downturns and concludes that this strategy generates significant negative returns during those specific times. His study also concludes that the momentum strategy was profitable during the years of 1993–2013 but as stated earlier it generates statistically significant negative returns during the recent recessions. Besides his study, there has been surprisingly few studies (apart from Daniel & Moskowitz 2014) about how momentum strategy would perform during economic downturns even though there has been many studies about momentum in the so called normal economic setting. His study includes indices from almost every continent, excluding Africa. Some of the indices are also included in this thesis (CAC 40, DAX, FTSE100, S&P/TSX Canada and Nikkei 225). This thesis and Grobys' study do differ in the used time period as well as in the used indices because both use many other indices as well. (Grobys 2014: 100–103.)

Jannen and Pham (2009) compare three different momentum strategies in order to find out which one of them generates the largest returns when using the same data set. First of the strategies is the one that is used by Jegadeesh and Titman (1993). Second strategy has previously been used by Moskowitz and Grinblatt (1999). Their strategy uses an industry factor and is therefore called the industry momentum. The last strategy is a strategy that

has been used by George and Hwang (2004) which is based on using the highest price of the preceding 52 weeks as a comparison. The stocks are chosen to the portfolio if their current price is near the 52 week high. Jannen and Pham's study concludes that during the years of 1999–2007 the most profitable of the three strategies is the industry momentum which generates returns of 1.357 % per month during the six month holding period. Jegadeesh and Titman's (1993) strategy generates the second best returns of 0.888 % per month and the 52 week high price comparison is the least profitable of the three strategies and generates returns of 0.174 % per month. (Jannen & Pham 2009.)

The stock markets are not the only ones to show persistent momentum returns. Other asset classes also provide abnormal returns that occur when using a momentum strategy. Asness, Moskowitz and Pedersen (2013) find in their wide study from 1972 to 2011 that momentum return premia occurs across eight different markets (the U.S., the U.K., continental Europe and Japan) but also across different asset classes – such as currencies, commodities and government bonds. Asness et al. (2013) document momentum gains from currencies are 3.0 % on average and momentum gains from commodities are on average 12.4 % while globally all asset classes generate on average 5.0 %. (Asness et al. 2013.)

Not only is momentum profitable when it is used alone but its profitability increases when it is used alongside with other investment strategies. Using momentum as a part of a larger investment strategy has inspired researchers. Asness, Ilmanen, Israel and Moskowitz (2015) conclude that combining different investment strategies that have low correlations with each other most likely leads to a successful investment portfolio. They combine momentum strategy with value, carry and defensive. Their study shows that momentum strategy along with the other three strategies on average "work everywhere", i.e. the strategies work across different asset classes and different markets. Combining these four strategies proves to be more beneficial than only using one of the strategies or alternating between these strategies (but only using one at a time). Asset classes that are included in their research consist of for example currencies and commodity futures. (Asness et al. 2015: 34–35, 56.)

Another example of a combined strategy is in Fuertes, Miffre and Fernandez-Perez' (2014) research. They introduce a – what they call – triple-screen strategy which combines momentum with term structure and idiosyncratic volatility. They analyze the excess returns that are generated in the commodity futures markets. They report that during the period of 1979–2011 triple-screen strategy generates annualized total returns

of 11.46 %. However, momentum alone during that same time period generates 11.42 % of annualized total returns whereas term structure and idiosyncratic volatility could only generate returns of 7.02 % and 3.76 % when they are used alone. The triple-screen strategy also has an average Sharpe ratio of 0.69 whereas the average Sharpe ratio of individual strategies is 0.37. (Fuertes et al. 2014: 1–2, 16, 22.)

3.2. Explaining the momentum returns

Even though the momentum investment strategy has been widely studied and accepted – at least in some of the finance research circles – the reasons behind the anomaly are not mutually accepted. The reasons behind momentum gains have been studied and some conclusions have been made but the conclusions and results have been contradicting and no consensus has been found on the true reason behind momentum gains. Some of the reasons in previous studies are for example stock-specific factors, industry related factors and broader macroeconomic factors. Also so called temporarily explanatory factors – factors that explain the existence of momentum gains on a temporary basis – have been found in previous studies. These factors include for example the risk factor which strongly supports the traditional finance literature. Traditional finance literature is based on the theories such as the Efficient Market Hypothesis and the Capital Asset Pricing Model (introduced in Chapter 2.). It is suggested that an existence of an anomaly such as the momentum means that those traditional theories are not be valid anymore mainly because they do not manage to explain the existence of these anomalies. The classical theorists have argued that the momentum is only a temporary illusion that will not exist for long. On the other hand the supporters of the momentum strategy – and other stock market anomalies – insist that the traditional views should be all in all dismissed because of the fact that they do not provide an explanation for the question why these anomalies keep existing. (Nørregård 2008: 1–2.)

As stated earlier, various factors have been examined in order to determine the true reason behind the momentum strategy's success and why the stock markets seem to be acting irrationally. These factors and the reasons that have been found in previous studies to explain the momentum gains at least to some extent are now briefly examined. Explanation for momentum gains has been searched from the size of the company. Many studies have shown that the momentum gains are larger for smaller firms while larger firms generate lower momentum gains. (Fama & French 1993 & 2010; Kothari, Shanken & Sloan 1995.) Jegadeesh and Titman's (1993) study indicates that the firm-specific

information might explain the momentum strategy's success at least to some extent. Their other explanation for momentum is that the momentum itself causes the prices to move from their long-term average and therefore causes also the overreaction of the prices. The third explanation in their study is that the momentum gains are due to the markets overreacting/underreacting to long-term/short-term prospects of the firms. They also supported the behavioral explanation. (Jegadeesh & Titman 1993; 2001.)

Ruotsalainen (2016) has summarized some of the possible explanations behind momentum strategy's success. These are shown in his table below (Table 1.).

Table 1. Reasons behind momentum (Ruotsalainen 2016.)

Researchers	Explanations
Jegadeesh & Titman (1993)	Overreaction and return persistance.
Chan, Jegadeesh & Lakonishok (1996)	Underreaction to past earnings-announcements.
Rouwenhorst (1998)	Risk-premium, underreaction, or both.
Grundy & Martin (2001)	Unaccounted transaction costs.
Jegadeesh & Titman (2001)	Possible overreactions, but more likely something that accounts for both behavioral and EMH.
Antoniou, Lam & Paudyal (2006)	Mispricing linked to global business cycles.
Chui, Titman & Wei (2010)	Cultural differences explain differences between countries.
Novy-Marx (2011)	Refutes underreactions, but doesn't offer up new explanations.
Bandarchuk & Hilscher (2012)	Volatility and extreme past returns.
Asness, Frazzini, Israel & Moskowitz (2014)	Underreactions and Overreactions as behavioral explanations. Investment risks and cash-flow risks as risk based explanations.

3.3. Contradicting results and criticism

As mentioned, Levy is one of the first researchers to study the momentum strategy. However, his study does not satisfy all other researchers and because of that, it has been criticized. For example, Jensen and Benington (1970) study Levy's rules and they come to the opposite conclusion. They state that Levy's relative strength rules do not hold and that random walks or efficient market hypothesis cannot be abandoned. Jensen and Benington also stated that Levy studied nearly 70 different trading rules before he came up with the relative strength trading rule and they state that this is obviously problematic. They test Levy's rule with a data that was for the most parts different to the data which Levy has used. Their result is that this relative strength trading strategy does not outperform a simple buy and hold strategy. Because they cannot certify Levy's results, they conclude that Levy's results must have been due to data mining. They state that Levy's rule is useless with any other dataset than the one that is used by Levy himself and this means that the rule does not exist as a trading rule. (Jensen and Benington 1970.)

Momentum, has been well examined and evidence has been found that it is able to generate abnormal results. The opposite strategy – contrarian strategy – has also been proven to generate abnormal returns. Whereas momentum is based on buying past winners and selling past losers, contrarian strategy is based on selling past winners and buying past losers. (Jegadeesh & Titman 1993: 65-66.) How can two opposite strategies, momentum and contrarian, both generate abnormal returns? Two possible reasons can be found. First, previous results might be unrelated to buying past winners or they might have been misleading. Second, the inconsistency might be because there is a difference between the time periods that are used in research and those that are used in practice. Momentum strategies are most frequently analyzed using a 3 to 12 month period. However, there is evidence that the price changes that are realized during the holding period may not be permanent. Momentum portfolios generate negative abnormal returns right around 12 months after the portfolio is formed. The negative abnormal returns then continue up to the 31st month. (Jegadeesh & Titman 1993: 66-67.) Jegadeesh (1990) studies a U.S. data from the years 1963–1990. He studies stocks that have either increased or decreased during the last month or the last week. He concludes that the loser portfolio generates approximately 2 % better returns than the winner portfolio. (Jegadeesh 1990.)

De Bondt and Thaler are among the first researchers who study the contrarian strategy and they can be thought to be the ones who have created the basis for the contrarian strategy theory. De Bondt and Thaler (1985 & 1987) suggest that stock prices have the

tendency to overreact to market information which suggests that the contrarian strategies will generate abnormal returns. They also show that contrarian strategy is profitable in a longer time period than momentum strategy. They prove that stocks that perform poorly during a three to five year formation period will generate positive returns during the following three to five year holding period compared to the stocks that perform well during the formation period. The main difference between the contrarian strategy and the momentum strategy is the holding period. De Bondt and Thaler form two different portfolios out of which first consists of recent stock market losers and the other consists of recent stock market winners using a data from 1926–1982. They compare the two portfolios and their returns on a long time period and come to the conclusion that the portfolio that includes the recent losers outperforms the portfolio with the recent winners. The so called loser portfolio generates approximately 25 % larger gains on a three year time period than the so called winner portfolio. The loser portfolio outperforms the winner portfolio also on a five year time period but the gains are not as much significantly higher than on the three year time period.

The studies on contrarian strategy – much like the studies on momentum – have been mainly done with an U.S. data. But evidence about the functionality of the contrarian strategy has been found also using data sets from other parts of the world. Doeswijk (1997) uses a Dutch data set and has similar results with other studies on this field. Contrarian strategy generates about 8–9 % better results on the Dutch stock market than those stocks that are popular among investors. (Doeswijk 1997.) Bildik and Gülay (2002) study the contrarian strategy with a Turkish data. Their data shows that abnormal returns can be generated with stocks from the Istanbul stock market. During the years of 1991–2000 the loser portfolio outperforms the winner portfolio with about 15 % per year and when comparing the returns of the two portfolios with the ISE-100 index, the winner portfolio beats the index by 0.65 % per month while the loser portfolio beats the index by 1.79 % per month. (Bildik & Gülay 2002.) Similar results have also been found from other stock markets, for example the Indian market (Pathak 2011) and the Hong Kong market (Ramiah, Cheng, Orriols, Naughton & Hallahan 2011).

It has been widely accepted that the contrarian strategy generates abnormal positive returns when a longer time period is used compared to the momentum strategy which uses a shorter time period. However, this is not completely true. Also a shorter time period while using the contrarian strategy can prove profitable. During the years of 1999–2010 in the Hong Kong stock market this has been proven to be true. The research is done using different holding periods – two, four, six and eight weeks (in this case weeks while

normally months). Out of these the best strategies turn out to be the so called 6-2 and 8-2 strategies (the first number indicates the length of the formation period and the second number indicates the length of the holding period). In other words, the stocks that have performed poorly (well) during the last six or eight weeks are bought (sold) and then hold for two weeks. The shorter time period proves to be more profitable with smaller stocks than with larger stocks – which is contradicting with the momentum strategy because it is also thought to be more profitable in a shorter time period and with smaller firms. (Haomin 2011.) Note, that the time period is significantly shorter than the so called normal time period that is used in momentum strategies.

Lakonishok, Shleifer and Vishny (1994) have a relatively rational view to the profitability of the contrarian strategy. They state that a value investor should buy stocks that are not popular among other investors. This is based on the fact that when the market encounters positive news, these unpopular stocks will react with higher increase in stock prices than the stocks that are already popular. They also state that these unpopular stocks can stay as unpopular stocks if they cannot change their market situation. To avoid this from turning into a trap, they combine the earlier described method with momentum – this had never been done before in the value investment scene. During the years of 1973–1993 this strategy generates positive return of about 23 % per year which again proves that the contrarian strategy is a functional investment strategy. (Lakonishok, Shleifer & Vishny 1994.)

Contrarian strategy – because it is opposite to the momentum strategy – can be considered to be the strongest contradiction even though it has been proven that these two normally have differences for example in the time frame in which the strategies generate positive returns. Different explanations for the returns either the momentum strategy or the contrarian strategy generate, have been formed during the years of research. The reasons behind the success of these strategies have emerged for example from behavioral views, imperfection of the stock market or stroke of luck. Both of the first two reasons can be divided into two groups – the investor-oriented and the market-oriented reasons. These try to explain the abnormal positive gains from the traditional finance point of view using different theories that explain the anomalies either from the perspective of the investor or from the stock market. The reasons include such traditional theories as the Rational Choice Theory, the Efficient Market Hypothesis, Prospect Theory, and Overreaction and Underreaction of the Market. (Nørregård 2008: 8–24.)

Finally, data snooping is one of the main sources of critique towards momentum. It is mainly due to the fact that most of the early studies in this field use an U.S. data. The U.S. data of the previous studies is collected from mainly the same time period and most of the stocks included in the studies are the same stocks that previous studies have used. This obviously means that it could be concluded that the results are similar if the data is similar. This critique has been dismissed and proven to be a false source of critique in the more recent studies. The more recent studies have also used data sets that are both global and the time period of the studies is more recent than earlier. The more recent studies have used data sets for example from Asia and South America.

The previous studies and results are summarized in chronological order in Table 16 which can be found in the end of this thesis from Appendix 1. The first part of the table represents the literature on momentum and the later part represents the literature on contrarian strategy and other critique. Note, that this table represents the main findings of the main research papers mentioned in this thesis. The literature about momentum is vast and due to that many papers are left unmentioned.

4. RESEARCH QUESTIONS AND HYPOTHESES

The research questions of the thesis follow closely the results of the previous studies on momentum. As stated earlier, there have been many studies that have proven the existence of abnormal positive returns in portfolios that buy the past winners and sell the past losers. The results have been similar across the field and in studies that have used basically the same data sets as well as in studies that have used totally different data sets. Similar results have therefore been found in the U.S. and in the Europe as well as in other countries around the world. Because of the vast amount of evidence for momentum, the main assumption of the thesis is that similar results should be found in the used data. However, the academic nature of the research does not allow the opposing view to be dismissed. An important fact to remember is also the study done by Grobys (2014) which concludes that the momentum strategy generates significant negative returns during the recent recession periods. Because the time period in this thesis does include a recession period, the mentioned conclusion has to be considered a possibility. Another important fact to remember is the study done by MSCI BARRA (2010). This study concludes that the Australian stock markets are able to generate larger positive momentum gains than other Asian countries. On the other hand, the study concludes that the Japanese stock markets do not support the momentum strategy theory. Because these countries are included in the research, similar results can be expected.

The research questions for the thesis are as follows:

1. Based on historical prices, would the momentum strategy have been profitable during 2006–2015?
2. How did the momentum strategy perform during the recent economic downturns?
3. How does the momentum strategy perform in different countries?
4. How does the momentum strategy perform when it consists of different indices?

5. DATA AND METHODOLOGY

5.1. Data: indices and stocks

The data includes the stocks from 11 indices from different parts of the world. Monthly stock and index prices are used. Almost all of the indices can be considered to be from a western or at least westernized countries. This makes the indices more comparable with each other. The seven European indices included in the thesis are EUROSTOXX 50, CAC 40 (France), DAX (Germany), FTSE 100 Index (Great-Britain), OMX Helsinki 25 (Finland) and OMX Stockholm 30 (Sweden). Out of these seven indices EUROSTOXX 50 is the only one that is not based on a certain country's stock market – rather it includes stocks from various European countries. These countries are Austria, Belgium, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, the Netherlands, Portugal and Spain. It is described as the leading blue-chip index in the Eurozone. All the other European indices are concentrated in a certain country's stocks indicated in the Chapter 5.3. When EUROSTOXX 50 is used in the analysis, all other European indices will be excluded from the data and vice versa. This is due to their overlapping stock content.

The North-American indices are S&P 100 (USA) and S&P/TSX 60 (Canada). These indices include many of the most influential stocks in North-American stock market domain. The five Asian indices are MICEX (Russia), Nikkei 225 (Japan) and RTS Index (Russia). The Asian indices are the ones that do not represent the western world in the most obvious ways but all of the countries are westernized to some extent and have western qualities in them. Finally, one Australian index is included, the S&P/ASX 100. The Australian index includes the stocks that could be considered to be the most important ones in Australia.

The data includes stocks from the above mentioned indices i.e. the stocks that were listed on a certain index in the beginning of the year 2016. All the stocks will be estimated as individuals. They will be compared with all other stocks in the data set and their results. This approach will give an international view to the momentum strategy and it also makes it possible to compare stocks from different parts of the world. The second approach uses the indices as a whole i.e. the price of the index and studies if there are momentum returns. If the first approach proves the existence of momentum gains in the used dataset, the second approach can be expected to give similar results as the first approach. All of the results will be compared with the risk free rate to see if the portfolios would have generated abnormal returns during the time period.

Not all of the stocks listed in the above mentioned indices will be included in the thesis research. Stocks need to fulfill certain criteria to be included in the thesis. First, stocks will be expected to have observations throughout the time period. If a stock has 119 or less observations, it will not be included in the research because the time period is 120 months. Stocks that do not have 120 price observations will be excluded. Second, some stocks might be included in two or more indices. Stocks that are listed in several indices will be excluded from other indices and only included in the index that is closest to that company's home market/country. However, as the EUROSTOXX 50 includes several stocks that overlap with the other European indices, these will be used separately in the analysis. This means that, when EUROSTOXX 50 is used (the second part of the analysis), the other European indices will not be included and when the other European indices are used (the first part of the analysis), EUROSTOXX 50 will not be included in that particular analysis. The EUROSTOXX 50 is an important part of the dataset because it includes stocks from other European countries that are not included in the study in any of the other indices. Third, if an index has two or more stocks that represent the same company e.g. A and B stocks, these have been reduced so that only one stock per firm is included in the dataset.

5.2. Characteristics of the time period

The time period chosen for the thesis spans from January 2006 to December 2015. The time period is limited to ten years in order to gain more observations. This is critical because only stocks with observations for the entire time period will be included in the data. Therefore, the data set includes ten years i.e. 120 monthly observations for each stock and index. The time period could be divided roughly into three different subsets that have their own time specific characteristics. First subset spans from January 2006 to December 2006. This time period precedes the recent financial crisis that has impacted the whole world. During this time period the markets were mainly stable and therefore momentum gains should have been present. This time period will be called the stable market period. This time period is quite short and most of the observations (11 out of 12) are lost in the momentum strategy analysis. Therefore, this time period will not be analyzed individually.

Second subset spans from 2007 to roughly 2010. This time period includes the recent financial crisis period which began in 2007 and ended few years later. There are different views of the year the crisis truly ended due to different impacts in different parts of the

world. For example, Europe had countries that had to be bailed out of their debts still in the year 2012 while Northern America was already doing a lot better but because the view of an American investor is adopted the time period of the financial crisis is restricted to end at the end of 2010. This time period will be called the financial crisis period. The last subset of the time period spans from 2010 to December 2015. This period followed the global financial crisis and is characterized by the slow up-turning markets. Some countries have recovered better from the crisis than other countries which are still suffering from the impacts of the financial crisis. This time period will be called the aftermath period.

The time period includes three totally different kinds of subsets and therefore the empirical findings can be different among these three subsets. The stable market period (even though not empirically examined in this thesis) could be supposed to show that the momentum strategy generates abnormal returns. The possible differences of the indices and different countries during this time period would indicate that momentum strategy would work differently in different settings. The financial crisis period is similar and also the same as one of the crisis periods studied by Grobys (2014). Therefore, similar results should be found in this empirical research for this particular time period. The aftermath period should show that the countries and indices have differences in the possibly generated momentum gains and the way the momentum strategy would have worked during this time period. This is mainly because the time period holds different characteristics for different countries and that is due to the fact that some countries have recovered better and faster from the financial crisis than others.

The data will be analyzed in terms of momentum strategy's performance in three different time periods: the whole time period (from December 2006 to December 2015), the financial crisis period (from December 2006 to December 2010), and the aftermath period (from January 2011 to December 2015). Note that the first 11 observations are lost in the analysis and therefore the months from January 2006 to November 2006 will not be included in the final results but the information from those months will of course be part of the rolling time window and therefore also part of the momentum strategy.

5.3. Summary statistics of the data

The following table points out the characteristics of the used dataset. It provides various descriptive statistics. As stated in previous chapters, indices originate from different parts

of the world including 10 different countries and four different continents. The indices represent the most important financial markets and the most important indices of the western stock market. Africa, South America, Middle East and the South Eastern Asia are not included among the countries and indices from these parts of the world will not be researched. Some important stock markets are obviously left out of this thesis, for example China and India. Leaving out some of the important stock markets and their indices does not mean that there are not momentum gains in those countries.

Most of the previous studies have concentrated on the North American stock markets and recently also to the European stock markets but for example the Asian stock markets have been left out of many of the previous research. In the case of India – for example – it has been shown that momentum investment strategy does exist and it does generate positive abnormal returns (Sehgal & Balakrishnan 2008). Also the study done by MSCI BARRA (2010) shows evidence for the momentum gains in the Asian stock markets. In this study only few of the so called westernized countries of Asia have been included to the research. However, this can still give an important and mostly not recognized perspective to the momentum investment strategy.

Table 2. points out that the indices included in the thesis differ also in size and in the ratio of stocks included in the thesis compared to the number of listed stocks. There are huge differences between the indices. While majority of the indices reach 80 % or more in the ratio of accepted stocks, the Russian index has a much smaller percentage (28 %) of accepted stocks. Table 2. further describes the indices by presenting additional information from foundation year to the stock exchange. The information has been collected either from the home page of the index or from the home page of the stock exchange. The indices are mostly large cap indices and therefore include the biggest stocks of each stock market that they represent. Most of the indices are fairly new in terms of the foundation year – they have been founded in the late 20th century. The youngest index for example is the S&P/ASX 100 index which has been calculated since 2001.

Table 2. Indices.

Number of included stocks points out the number of stocks that qualify for the analysis from that particular index and the ratio points out the percentage of stocks that are represented from that index.

Indices	Country	Founded	Weighting Method	Exchange	Type	Number of Listed Stocks	Number of Included Stocks	Ratio of Accepted Stocks
CAC 40	France	1987	Capitalization-weighted	Euronext Paris	Large Cap	40	38	95.0 %
DAX	Germany	1988	Capitalization-weighted	Frankfurt Stock Exchange	Large Cap	30	29	96.7 %
EUROSTOXX 50	Europe	1998	Free float market capitalization	Eurex	Mega Cap	50	50	100.0 %
FTSE 100 Index	Great Britain	1984	Capitalization-weighted	London Stock Exchange	Large Cap	100	84	84.0 %
MICEX	Russia	1997	Capitalization-weighted	Moscow Exchange	Large Cap	50	14	28.0 %
Nikkei 225	Japan	1950	Price-weighted	Tokyo Stock Exchange	-	225	213	94.7 %
OMX Helsinki 25	Finland	1988	Market value weighted	Helsinki Stock Exchange	Most Traded	25	21	84.0 %
OMX Stockholm 30	Sweden	1986	Capitalization-weighted	Stockholm Stock Exchange	Most Traded	30	27	90.0 %
ASX 100	Australia	2001	Float-adjusted market capitalization	Australian Securities Exchange	Large & Mid Cap	100	82	82.0 %
TSX 60	Canada	-	Float-adjusted market capitalization	Toronto Stock Exchange	Large Cap	60	55	91.7 %
S&P 100	USA	1976	Float-adjusted market capitalization	New York Stock Exchange	Large Cap	100	92	92.0 %
Total						810	705	

5.4. Methodology

The main data (index and stock prices) is collected from university's databases, the data for the risk free interest rate is collected from Kenneth French's website, the used exchange rates for the currency exchange is collected from the database of European Central Bank. Each of the index and stock price observations has to be first transferred to USD and then modified into monthly returns which are then modified into monthly excess returns by subtracting the risk free return rate from the indices' and stocks' monthly returns.

Momentum strategies are divided into two periods: the formation period and the holding period. During the formation period, the observed stocks are ranked from high to low based on their past returns. Those stocks that performed well are expected to perform well in the near future and those are the stocks that should be invested in. On the other hand, those stocks that performed poorly are expected to perform poorly in the near future. These stocks should be either not invested in, sold or taken a short position in order to gain from their decreasing price. The holding period is the time period for which the momentum portfolio is held. Both of these periods vary in length but the most extensive results have been found in the intermediate time period e.g. 3–12 months i.e. the length of formation periods and holding periods is usually within that 3–12 months.

This thesis uses four different momentum strategies consisting of 3, 6, 9 and 12 month holding periods and each predicting the 2 month ahead returns (3-1-1, 6-1-1, 9-1-1 and 12-1-1). After calculating the excess returns for each index and stock, (depending on the used strategy) a 3/6/9/12 month rolling formation period is used to form the momentum portfolios. The data is divided in three different portfolios. The top 30 % of the data will be the winner portfolio or the bought portfolio while the low 30 % of the data will be the loser portfolio or the sold portfolio. The mid 40 % of the data will be the middle portfolio which' results will not be reported. The portfolios are then used to predict the 2 month ahead returns and these portfolio returns are reported in the tables of chapter 6. The portfolios are first formed from the stock datasets (first the dataset without EUROSTOXX 50 and then the dataset with EUROSTOXX 50) and then the portfolios are formed from the index datasets (again first without the EUROSTOXX 50 and then with EUROSTOXX 50).

All of the four strategies are used to analyze the stock datasets and only the 3-1-1 strategy is used to analyze the index datasets. This is due to the results not being that significant

and the datasets being small samples, therefore the results lack in significance and in reliability. The stock datasets are analyzed by using all of the four strategies and also using three different time periods. The analysis is done for the whole time period and repeated for the crisis and aftermath time periods alone. The results for the buy and sell portfolios as well as for the buy-sell portfolio are reported. Then the data is divided into groups by index i.e. by country and then again all four strategies are analyzed for each of the countries for the whole time period alone because of the significant results for this time period in the previous analysis. The results for the buy-sell portfolio are reported.

6. EMPIRICAL RESULTS

The empirical results of this thesis, in short, further prove the existence of momentum returns during the years of 2006–2015. Winner (buy) and loser (sell) portfolios are presented alone in the tables and then as a momentum portfolio (buy-sell). First analysis does not include market factor and the second analysis does include the market factor. The market factor is important because it shows whether or not the market returns impact the momentum portfolios' returns. If this factor is not statistically significant, it means that the momentum portfolio's returns have been determined by momentum and not at all by the market returns which obviously is the aim in order to have a successful momentum strategy. For this thesis the most important result is the last row of each analysis i.e. the result of the buy-sell portfolio with the market factor.

For the stock samples the results suggest that for the whole time period, presented in Table 3., the 3-1-1 momentum strategy generated 5.231 % monthly returns which also are statistically significant and 6.298 % for the crisis period (Table 4.) and 3.576 % for the aftermath period (Table 5.) when using the 3-1-1 strategy. The returns for the crisis period are not statistically significant (but they do come close) while for the aftermath period the returns are significant. A thing to notice is also the fact that for the whole time period the market factor is not significant which means that the momentum strategy is very influential. For the sub time periods the market factors are statistically significant. For the other stock dataset (with EUROSTOXX 50) the results are mostly not statistically significant and for the first strategy 3-1-1 only one of the time periods (full time period) provides a significant result of 0.321 % but at the same time also the market factor is statistically significant.

Table 3. 3-1-1 strategy full time period.

Full 3-1-1		Constant	t-statistics	MSCI-RF	t-statistics
Panel A.					
	Sell	-1.054	-0.504	-	-
	Buy	4.141	1.961	-	-
	Buy-Sell	5.195	2.275	-	-
	Sell	-1.563	-1.163	0.276	12.457
	Buy	3.668	2.452	0.257	10.418
	Buy-Sell	5.231	2.281	-0.019	-0.507
Panel B.					
	Sell	-0.008	-0.036	-	-
	Buy	0.319	1.262	-	-
	Buy-Sell	0.327	1.497	-	-
	Sell	-0.068	-0.579	0.033	16.789
	Buy	0.253	1.772	0.036	15.232
	Buy-Sell	0.321	1.467	0.003	0.918
Panel C.					
	Sell	-3.036	-0.101	-	-
	Buy	2.674	0.098	-	-
	Buy-Sell	5.710	0.151	-	-
	Sell	-10.254	-0.527	3.919	12.208
	Buy	-2.622	-0.121	2.875	8.043
	Buy-Sell	7.632	0.203	-1.043	-1.684
Panel D.					
	Sell	-3.385	-0.182	-	-
	Buy	-3.575	-0.262	-	-
	Buy-Sell	-0.190	-0.009	-	-
	Sell	-7.588	-0.582	2.283	10.615
	Buy	-6.060	-0.541	1.349	7.297
	Buy-Sell	1.529	0.072	-0.933	-2.662

Table 4. 3-1-1 strategy crisis time period.

Crisis 3-1-1		Constant	t-statistics	MSCI-RF	t-statistics
Panel A.					
	Sell	-4.475	-1.080	-	-
	Buy	2.307	0.732	-	-
	Buy-Sell	6.782	1.576	-	-
	Sell	-3.209	-1.356	0.341	10.025
	Buy	3.090	1.307	0.211	6.200
	Buy-Sell	6.298	1.518	-0.130	-2.184
Panel B.					
	Sell	-0.344	-0.805	-	-
	Buy	0.077	0.218	-	-
	Buy-Sell	0.421	1.222	-	-
	Sell	-0.203	-1.033	0.038	13.430
	Buy	0.184	0.914	0.029	9.986
	Buy-Sell	0.039	1.152	-0.009	-1.854
Panel C.					
	Sell	-13.260	-0.229	-	-
	Buy	-3.030	-0.069	-	-
	Buy-Sell	10.229	0.148	-	-
	Sell	3.907	0.111	4.626	9.120
	Buy	6.594	0.184	2.593	5.021
	Buy-Sell	2.687	0.040	-2.033	-2.114
Panel D.					
	Sell	-6.500	-0.185	-	-
	Buy	1.455	0.058	-	-
	Buy-Sell	7.955	0.190	-	-
	Sell	3.512	0.154	2.698	8.222
	Buy	6.813	0.325	1.444	4.794
	Buy-Sell	3.301	0.082	-1.254	-2.159

Table 5. 3-1-1 strategy aftermath time period.

Aftermath 3-1-1	Constant	t-statistics	MSCI-RF	t-statistics
Panel A.				
Sell	1.739	1.025	-	-
Buy	5.639	1.975	-	-
Buy-Sell	3.900	1.748	-	-
Sell	0.622	0.503	0.175	7.404
Buy	3.576	1.912	0.323	9.031
Buy-Sell	2.954	1.458	0.148	3.819
Panel B.				
Sell	0.266	1.313	-	-
Buy	0.517	1.442	-	-
Buy-Sell	0.250	0.888	-	-
Sell	0.112	0.915	0.024	10.262
Buy	0.225	1.219	0.046	12.971
Buy-Sell	0.112	0.458	0.022	4.610
Panel C.				
Sell	5.313	0.195	-	-
Buy	7.333	0.212	-	-
Buy-Sell	2.020	0.051	-	-
Sell	-13.292	-0.692	2.918	7.936
Buy	-13.838	-0.518	3.320	6.485
Buy-Sell	-0.546	-0.014	0.402	0.520
Panel D.				
Sell	-0.840	-0.047	-	-
Buy	-7.683	-0.551	-	-
Buy-Sell	-6.842	-0.334	-	-
Sell	-11.693	-0.830	1.702	6.309
Buy	-15.641	-1.383	1.248	5.765
Buy-Sell	-3.948	-0.192	-0.454	-1.151

For the 6-1-1 strategy the results are somewhat similar (Tables 6.–8.). The momentum strategy generates 5.519 % for the whole time period (Table 6.), 7.504 % for the crisis time period (Table 7.) and 2.701 % for the aftermath time period (Table 8.). The first two out of these are statistically significant and the returns for the aftermath period are not significant. Again for the whole time period regression the market factor is not significant which highlights the importance of the momentum strategy. In Panel B. no significant buy-sell portfolio returns are reported.

Table 6. 6-1-1 strategy full time period.

Full 6-1-1		Constant	t-statistics	MSCI-RF	t-statistics
Panel A.					
	Sell	-1.202	-0.571	-	-
	Buy	4.234	2.086	-	-
	Buy-Sell	5.436	2.539	-	-
	Sell	-1.735	-1.377	0.290	13.936
	Buy	3.784	2.605	0.245	10.204
	Buy-Sell	5.519	2.584	-0.045	-1.283
Panel B.					
	Sell	0.121	0.539	-	-
	Buy	0.173	0.704	-	-
	Buy-Sell	0.052	0.255	-	-
	Sell	0.060	0.519	0.033	17.248
	Buy	0.108	0.801	0.035	15.904
	Buy-Sell	0.048	0.233	0.002	0.697

Table 7. 6-1-1 strategy crisis time period.

Crisis 6-1-1	Constant	t-statistics	MSCI-RF	t-statistics
Panel A.				
Sell	-5.121	-1.247	-	-
Buy	2.896	0.956	-	-
Buy-Sell	8.017	1.986	-	-
Sell	-3.838	-1.721	0.346	10.788
Buy	3.667	1.645	0.208	6.475
Buy-Sell	7.504	1.956	-0.138	-2.506
Panel B.				
Sell	-0.283	-0.674	-	-
Buy	-0.032	-0.089	-	-
Buy-Sell	0.252	0.779	-	-
Sell	-0.145	-0.739	0.037	13.141
Buy	0.080	0.417	0.030	10.896
Buy-Sell	0.226	0.707	-0.007	-1.540

Table 8. 6-1-1 strategy aftermath time period.

Aftermath 6-1-1	Constant	t-statistics	MSCI-RF	t-statistics
Panel A.				
Sell	1.999	1.132	-	-
Buy	5.327	1.938	-	-
Buy-Sell	3.328	1.614	-	-
Sell	0.722	0.625	0.200	9.048
Buy	3.423	1.801	0.299	8.209
Buy-Sell	2.701	1.362	0.098	2.590
Panel B.				
Sell	0.452	2.087	-	-
Buy	0.341	0.998	-	-
Buy-Sell	-0.111	-0.424	-	-
Sell	0.283	2.272	0.026	11.067
Buy	0.065	0.361	0.043	12.529
Buy-Sell	-0.218	-0.912	0.017	3.670

The 9-1-1 strategy generates significant returns of 4.535 % for the whole time period with a market factor not being significant (Table 9.), 4.697 % statistically not significant

returns for the crisis period (Table 10.) and 4.074 % statistically significant returns for the aftermath period with a market factor not being significant (Table 11.). The returns in Panel B. are not statistically significant.

Table 9. 9-1-1 strategy full time period.

Full 9-1-1		Constant	t-statistics	MSCI-RF	t-statistics
Panel A.					
	Sell	-0.727	-0.380	-	-
	Buy	3.829	1.866	-	-
	Buy-Sell	4.556	2.535	-	-
	Sell	-1.208	-1.042	0.261	13.655
	Buy	3.327	2.547	0.272	12.647
	Buy-Sell	4.535	2.512	0.011	0.376
Panel B.					
	Sell	0.047	0.206	-	-
	Buy	0.256	1.067	-	-
	Buy-Sell	0.209	1.049	-	-
	Sell	-0.014	-0.114	0.033	16.358
	Buy	0.191	1.537	0.035	17.189
	Buy-Sell	0.206	1.028	0.002	0.588

Table 10. 9-1-1 strategy crisis time period.

Crisis 9-1-1		Constant	t-statistics	MSCI-RF	t-statistics
Panel A.					
	Sell	-3.456	-0.983	-	-
	Buy	1.297	0.386	-	-
	Buy-Sell	4.753	1.407	-	-
	Sell	-2.401	-1.153	0.284	9.496
	Buy	2.296	1.136	0.269	9.260
	Buy-Sell	4.697	1.375	-0.015	-0.306
Panel B.					
	Sell	-0.256	-0.629	-	-
	Buy	-0.040	-0.106	-	-
	Buy-Sell	0.216	0.659	-	-
	Sell	-0.126	-0.603	0.035	11.658
	Buy	0.082	0.433	0.033	12.060
	Buy-Sell	0.208	0.628	-0.002	-0.465

Table 11. 9-1-1 strategy aftermath time period.

Aftermath 9-1-1	Constant	t-statistics	MSCI-RF	t-statistics
Panel A.				
Sell	1.502	0.775	-	-
Buy	5.897	2.339	-	-
Buy-Sell	4.395	2.472	-	-
Sell	0.075	0.006	0.224	9.458
Buy	4.149	2.383	0.274	8.220
Buy-Sell	4.074	2.297	0.050	1.148
Panel B.				
Sell	0.294	1.164	-	-
Buy	0.499	1.616	-	-
Buy-Sell	0.204	0.825	-	-
Sell	0.099	0.668	0.031	10.806
Buy	0.251	1.513	0.039	12.195
Buy-Sell	0.152	0.622	0.008	1.724

The last strategy 12-1-1 generates returns for the whole time period of 5.131 % which are significant while the market factor is not significant (Table 12.), statistically not significant returns for the crisis period 5.004 % (Table 13.) and for the aftermath period 3.832 % which are statistically significant but also the market factor is statistically significant. (Table 14.). Panel B. again does not have statistically significant buy-sell portfolios.

Table 12. 12-1-1 strategy full time period.

Full 12-1-1		Constant	t-statistics	MSCI-RF	t-statistics
Panel A.					
	Sell	-1.009	-0.501	-	-
	Buy	4.124	1.861	-	-
	Buy-Sell	5.133	2.202	-	-
	Sell	-1.500	-1.165	0.267	12.550
	Buy	3.631	2.299	0.268	10.282
	Buy-Sell	5.131	2.190	0.001	0.034
Panel B.					
	Sell	-0.030	-0.134	-	-
	Buy	0.355	1.354	-	-
	Buy-Sell	0.384	1.621	-	-
	Sell	-0.087	-0.685	0.031	14.854
	Buy	0.286	1.925	0.037	15.091
	Buy-Sell	0.373	1.583	0.006	1.524

Table 13. 12-1-1 strategy crisis time period.

Crisis 12-1-1		Constant	t-statistics	MSCI-RF	t-statistics
Panel A.					
	Sell	-3.808	-0.937	-	-
	Buy	1.609	0.489	-	-
	Buy-Sell	5.418	1.252	-	-
	Sell	-2.572	-1.095	0.333	9.858
	Buy	2.432	0.989	0.222	6.267
	Buy-Sell	5.004	1.182	-0.112	-1.832
Panel B.					
	Sell	-0.340	-0.775	-	-
	Buy	0.087	0.245	-	-
	Buy-Sell	0.457	1.133	-	-
	Sell	-0.197	-0.937	0.039	12.746
	Buy	0.192	0.898	0.028	9.216
	Buy-Sell	0.389	1.060	-0.010	-1.936

Table 14. 12-1-1 strategy aftermath time period.

Aftermath 12-1-1	Constant	t-statistics	MSCI-RF	t-statistics
Panel A.				
Sell	1.278	0.840	-	-
Buy	6.178	2.063	-	-
Buy-Sell	4.901	2.068	-	-
Sell	0.225	0.213	0.165	8.200
Buy	4.057	2.013	0.333	8.625
Buy-Sell	3.832	1.811	0.168	4.135
Panel B.				
Sell	0.224	1.242	-	-
Buy	0.573	1.515	-	-
Buy-Sell	0.350	1.149	-	-
Sell	0.097	0.793	0.020	8.466
Buy	0.257	1.438	0.050	14.530
Buy-Sell	0.160	0.687	0.030	6.708

As shown in Tables 5., 8., 11. and 14. the crisis period mainly has no significant momentum returns. The only exception is for the 6-1-1 strategy which has a statistically significant and positive coefficient for momentum returns. All other coefficients, even though not significant, are also positive. For the indices only one strategy is employed, the 3-1-1 strategy (Tables 3.–5. Panels C and D). The results show no significance which may be due to the small sample size. Therefore the other strategies are not used to analyze indices and it may be concluded that investing in indices is – at least according to this study – not profitable in terms of momentum strategy.

Interestingly the market factor (MSCI-RF) does not seem to have statistical significance in many of the strategies and time periods. Basically these results indicate that if the momentum strategy has significant returns the market factor has no significance and if the momentum strategy does not have significant returns the market factor has a significant influence on the returns. Also interestingly the returns in Panel B. are for the momentum portfolios not significant. Some of the winner portfolio returns are significant alone but when combined with the loser portfolio the returns are not significant.

The analysis for different countries (Table 15.) shows the results of all the four momentum strategies for the whole time period of 2006–2015. It suggests that only Great-Britain and the U.S. have statistically significant momentum returns for all of the

strategies and besides these only few other statistically significant returns are reported. Almost all of the market factors for these two countries are not significant which further improves the meaning of the strategy itself. Out of the other countries in this study only Australia and Sweden have one statistically significant momentum strategy. For Japan (which has earlier been reported not to have any momentum returns) the results are for all strategies statistically not significant and apart from 12-1-1 also negative.

Table 15. Momentum strategies for countries.

	3-1-1	MSCI-RF	6-1-1	MSCI-RF	9-1-1	MSCI-RF	12-1-1	MSCI-RF
France	-0.192	0.004	-0.369	-0.006	0.018	-0.006	-0.112	0.003
	(-0.622)	(0.817)	(-1.189)	(-1.102)	(0.064)	(-1.183)	(-0.317)	(0.497)
Germany	0.32	-0.009	0.256	-0.009	0.017	-0.003	0.472	-0.006
	(0.666)	(-1.192)	(0.534)	(-1.138)	(0.040)	(-0.459)	(0.934)	(-0.696)
Great Britain	22.417	-0.031	25.430	-0.223	18.917	0.052	21.613	0.187
	(2.270)	(-0.189)	(2.683)	(-1.428)	(2.141)	(0.353)	(2.175)	(1.141)
Russia	2.386	-0.062	-5.298	-0.016	-0.471	-0.019	2.897	-0.058
	(0.609)	(-0.962)	(-1.307)	(-0.242)	(-0.113)	(-0.272)	(0.743)	(-0.894)
Japan	-0.149	0.001	-0.156	0.001	-0.097	0.000	0.010	0.001
	(-0.145)	(0.350)	(-1.588)	(0.501)	(-1.056)	(0.018)	(0.091)	(0.322)
Finland	-0.117	0.000	0.024	-0.001	0.064	-0.001	-0.123	0.003
	(-0.676)	(0.064)	(0.152)	(-0.274)	(0.417)	(-2.358)	(-0.727)	(1.095)
Sweden	0.085	0.001	0.053	0.000	0.167	-0.003	0.120	0.001
	(1.155)	(0.834)	(0.788)	(-0.296)	(2.227)	(-2.567)	(1.601)	(0.586)
Australia	0.080	0.000	0.151	-0.001	0.110	-0.002	0.018	0.001
	(0.834)	(-0.082)	(1.635)	(-0.488)	(1.311)	(-1.368)	(0.172)	(0.417)
Canada	-0.056	0.007	-0.122	0.000	-0.019	-0.004	0.037	0.008
	(-0.275)	(1.966)	(-0.655)	(-0.160)	(-0.118)	(-1.719)	(0.177)	(2.420)
U.S.	0.836	0.010	0.857	0.005	1.024	0.005	0.933	0.016
	(1.934)	(1.404)	(2.110)	(0.772)	(2.982)	(0.956)	(2.140)	(2.255)

7. CONCLUSIONS

This thesis examined the possible profitability of momentum investment strategies during the years 2006–2015 in an international stock index setting. Even though momentum has gained attention and the amount of previous literature is vast, new evidence of its persistent existence is still sought from many different perspectives. As beating the market returns is and will be the main goal of the investors worldwide, finding not only new ways to do that, but also to prove that the so called old ways still work and offer abnormal returns, is important.

This paper concentrated on several indices internationally, collecting data from several westernized countries worldwide. Four momentum strategies were applied on same datasets: 3-1-1, 6-1-1, 9-1-1 and 12-1-1. Each of them using a formation period of a certain length (either 3, 6, 9 or 12 months) and each of them predicting the returns of the strategy two months ahead i.e. two months after the end of the certain formation period. The time period is used as a whole and it is also divided into two smaller sub periods: the crisis period (12/2006–12/2010) and the aftermath period (01/2011–12/2015). In light of previous studies which have stated that momentum strategy leads to great losses during economic downturns, it is important to have a crisis period included in the time period. However, the division used in this thesis is not perfect because this thesis' crisis period may be defined somewhat longer than the actual real-life financial crisis.

Based on the historical prices used in this thesis from 2006 to 2015 the momentum strategy seems to still be able to generate abnormal returns even when using the entire time period to analyze the data even though it includes the financial crisis. The returns for the whole time period range from 4.535 % monthly to 5.519 % monthly. These returns are somewhat larger than some of the returns in previous studies but on the other hand some of the previous studies have reported returns of the same magnitude as those found in this study. The crisis period alone generates only one significant result (6-1-1: 7.504 %) while all other strategies did not generate significant returns for the crisis period which is somewhat in line with the conclusion in previous studies that the momentum strategy can even generate highly negative returns during economic downturns. However, even though the returns of this thesis for the crisis period are not statistically significant, they are also not negative which they should be in order to fully support the previous conclusion of momentum crashes during financial crises. Also the fact that the only significant return of that time period is positive is totally opposite with the previous conclusion. This may be due to the fact that the crisis period was actually shorter than the

one used in this thesis. A pure analysis of only the crisis period, i.e. the actual length of the crisis in real-life, could provide more similar returns with the previous studies. As a conclusion this study does provide evidence that suggests that the momentum strategy is still profitable on a longer time period even if a crisis is included in the period. The results of this thesis suggest that the momentum strategy when constantly used and updated can be profitable in a longer investment horizon i.e. when there are resources to keep the portfolios up to date and to keep on investing according to the plan. However, the previously reported momentum crashes cannot be dismissed and they are so notable that their existence is rather the truth than the results of this thesis.

The so called aftermath period shows positive and for two strategies statistically significant returns of 3.832 % (9-1-1) and 4.074 % (12-1-1). These are somewhat lower than for the whole time period. The lower significance and the lower level of returns may be due to the fact that even though momentum returns are persistent and they still exist decades after this anomaly has been discovered, the momentum returns have not been as large as they used to be. As stated in the literature review (Chapter 3.), momentum strategy has lately been more or less in trouble and only barely beaten the market. (Hancock 2010.) A significant result of this thesis is also the fact that the market factor does not play a significant role in the returns when the portfolio's momentum returns are significant.

This thesis also used a momentum investment strategy that bought the winner portfolio consisting of indices and shorted the loser portfolio consisting of other indices. These datasets were quite small and did not provide at all statistically significant results. Therefore, only 3-1-1 strategy was applied. The results of the 3-1-1 strategy when formed from indices indicates that returns could be positive during the whole time period and during the crisis period but they could be negative during the aftermath period. This is the case for both of the index settings. However, as stated these results are not statistically significant while the market factor is significant in both the whole time period and the crisis period. This indicates that the returns of these index momentum portfolios are more impacted by the market factor i.e. the excess return on top of the MSCI World index than momentum itself. It is also worth mentioning that a momentum strategy when it comprises of indices might be difficult to keep up to date and to manage mainly due to possibly limited resources.

The countries alone seemed not, in general, have significant momentum returns. Only Great Britain and the U.S. have statistically significant returns for the whole time period

and for all strategies. These returns ranged from 18.917 % (9-1-1) to 25.430 % (6-1-1) for Great Britain and from 0.836 % (3-1-1) to 1.024 % (9-1-1) for the U.S. Also the market factor is not significant in many of the strategies for these two countries which again improves the significance of the momentum returns. Especially the returns for the U.S. are of the same magnitude than the returns found in many of the previous studies which, as stated earlier, have for a long time mainly used only U.S. data. The returns of larger magnitude have often been found from other markets. The reason behind the insignificance of the other countries remains a mystery.

However, the returns of the Japanese stocks lacking in significant momentum returns is in line with previous literature These Japanese returns range from -0.156 % (6-1-1) to 0.010 % (12-1-1). Only the 12-1-1 strategy has a positive return (although close to zero) and all the other returns for Japanese stocks are negative. This combined with the fact that the returns are not statistically significant suggests that the previous studies' conclusion of Japanese stock markets not having momentum is true. On the other hand the Australian stocks have earlier provided much larger momentum returns than other countries. In this thesis the Australian stocks did not manage to generate abnormal and significant returns in other strategies besides the 6-1-1 strategy which generates 0.151 % monthly returns (while the market factor was insignificant) and all in all Australian stocks provided momentum returns that vary from 0.018 % (12-1-1) to 0.151 % (6-1-1). This does not support the previous conclusion of Australian stock markets. According to this study it is the Great Britain which generates above average momentum returns and not Australia which generates returns that are of the same magnitude with the U.S. and mainly not even significant. Besides U.S., Great Britain and Australia, only Swedish stocks provided statistically significant returns but only in one of the strategies. The 9-1-1 strategy provided 0.167 % monthly but the market factor was also significant.

The momentum strategy is able to produce statistically significant returns when it is used for the whole dataset i.e. for all stocks, but when it is used to analyze the countries individually, it does not provide that many statistically significant returns. Also the fact that if the portfolios are formed from the indices (which include the same stocks with the same prices), the momentum strategies' returns do not exist, is somewhat interesting. Similar interesting fact in this thesis is that the dataset with EUROSTOXX 50 is not able to produce statistically significant momentum portfolios i.e. buy-sell portfolios. Even though some of the individual portfolios are significant the most important combination portfolio is not. The EUROSTOXX 50 also includes many of the same stocks than what are included in the other indices (e.g. CAC 40) in the first dataset and the second dataset

is still not able to generate even close to similar returns than the first dataset. This is somewhat puzzling but a possible reason can be found. The returns for the FTSE 100 index (Great Britain) are much larger than for the other indices. The returns of the first dataset (without EUROSTOXX 50) may be driven by the FTSE 100 index' returns and while it is dismissed from the second dataset (with EUROSTOXX 50) and only few of its stocks are included i.e. the stocks from FTSE 100 that are also listed to EUROSTOXX 50, this might cause the low and insignificant momentum returns of the second dataset – the same way it could be causing the larger returns of the momentum portfolio in the first dataset.

The field of momentum study has been well-researched and the main focus of most recent studies in this field has been aiming towards either combining momentum with other investment strategies (such as triple-screen strategy (Fuertes et al. 2014.)), or combining momentum with totally new aspects (such as managing the risks of momentum strategies (Barroso & Santa Clara 2015; Ruotsalainen 2016.)), or studying the effect of deviant market circumstances (such as financial crises (Daniel & Moskowitz 2014; Grobys 2014.)). This thesis represents more classical trend of momentum study, providing views to the ultimate question whether or not the momentum strategies are still able to provide abnormal returns.

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APPENDIX 1.

Table 16. Summary of previous literature on momentum and critique.

Writer	Year	Time period	Data	Conclusions
Levy	1967	10/1960 - 10/1965	200 stocks listed on NYSE; weekly data.	Buying stocks that are priced higher than the average price of past 27 weeks generates abnormal returns; the relative strength trading rule; solely based on previous stock prices; considered as the first momentum researcher.
Jegadeesh & Titman	1993	01/1965 - 12/1989	NYSE & AMEX; stocks from the Center for Research in Securities Prices (CRSP).	3 - 12 month holding period generates positive returns but a longer holding period causes the returns to vanish; the act itself (buying past winners and selling past losers) is what makes the prices shift from their long-term average and causes the prices to overreact.
Fama & French	2011	11/1989 - 03/2011	23 countries from North America, Europe, Asia Pacific and also Japan; monthly data.	Strong momentum returns in all markets but Japan; value premiums are found in every market (larger for small stocks); absolutely no hint of momentum in Japan; winner-loser spread in momentum decreases from small to large.
Rouwenhorst	1998	1980 - 1995	12 European countries; 2,190 stocks; monthly data.	Motivation for the study arise from the claims of data snooping (U.S. data was the main source of data); followed the method of Jegadeesh and Titman's 1993 study; winner portfolio outperformed the loser portfolio by about 1 % per month; momentum is a profitable strategy as well in Europe.

Moskowitz & Grinblatt	1999	07/1963 - 07/1995	20 value-weighted industry portfolios for every month; CRSP and Compustat; on average 230 stocks per industry.	Industry momentum is strong and persistent; industry momentum cannot be explained by microstructure effects, individual stock momentum or the cross-sectional dispersion in mean returns; industry momentum contributes to the profitability of individual momentum strategy; captures these individual profits almost entirely (except for the 12 month individual stock momentum).
Jegadeesh & Titman	2001	1965 - 1998	All NYSE stocks (some are excluded on certain criteria).	Momentum profits still existed and were approximately on the same 1 % per month one year after the formation period; their previous results were not due to data mining.
George & Hwang	2004	1963 - 2001	All stocks from CRSP; collected and constructed as Moskowitz & Grinblatt (1999).	How close is the current stock price to the 52-week high; returns are twice as large as for the other two strategies (individual momentum and industry momentum); the difference is even larger outside January; easiest information for the investors to collect.
Nørregård	2008	05/1988 - 03/2008	Danish stock market; 79 stocks.	Momentum strategy would generate returns in the Danish stock markets that are similar with the results of Jegadeesh and Titman's 1993 study; momentum should not be called a market anomaly but a dominating market factor because of the extensive research even thouhg the researches have been academic in nature.
Jannen & Pham	2009	01/1998 - 05/2007	Large cap U.S. stocks; 1,500 stocks per year.	Compared three different momentum strategies; 1) Jegadeesh & Titman's, 2) Moskowitz & Grinblatt's industry momentum, 3) George & Hwang's highest pric momentum; industry momentum was the most profitable, Jegadeesh and Titman's strategy came second and the least profitable was the highest price of the 52 week.

Hancock	2010	1927 - 2009	U.S	Approximately 3 % larger abnormal returns per year than the stock market; 21st century has been the weakest for momentum strategy; momentum strategy generates abnormal returns when the stock market is at a so called normal state but not when it is at its bottom or top.
MSCI BARRA	2010	1995 - 2009	Asian stock markets	The strategy is profitable but huge local differences were present; e.g. Australia and India had larger momentum returns than the whole data but Filippines and Thailand had negative momentum returns (due to Asian market crash); Japanese stock market showed signs of momentum only during years of 1996 - 1999 whereas the average momentum gains were approximately -2.2 % per year;
Novy-Marx	2012	01/1926 - 12/2008	All stocks from CRSP.	Intermediate (7 - 12 months) time horizon generates better returns than short (less than 7 months) time horizon; similar momentum returns can be found from other asset classes beside stocks; the momentum does not accurately describe the phenomenon; momentum is stronger in large-cap firms than previously has been acknowledged.
Asness, Moskowitz & Pedersen	2013	U.S. & U.K. 01/1972 - 01/2011; Europe & Japan 01/1974 - 01/2011	U.S., U.K., continental Europe and Japan; average number of stocks per area 724, 147, 290 and 471.	Momentum return premia occurs in the eight different markets but also in different asset classes such as currencies, commodities and governement bonds.

Daniel & Moskowitz	2013	07/1927 - 03/2013; divided in three samples 07/1927 - 12/1939, 01/1940 - 12/1999 and 01/2000 - 03/2013	NYSE, AMEX & NASDAQ; monthly and daily data; all firms listed on the formation date.	The momentum strategy comes with a risk of high negative returns after major market crashes; momentum crashes are driven by the loser portfolios because they start to generate high positive returns when the market starts to improve after a crash.
Fuertes, Miffre & Fernandez-Perez	2014	01/1979 - 08/2011	Commodities (such as agriculture, energy, live stock, metals); daily data.	Triple-screen strategy combines momentum with term structure and idiosyncratic volatility; this combined strategy provided 11.46 % annualized returns; momentum provided 11.42 % returns while term structure provided 7.02 % and idiosyncratic volatility provided 3.76 %.
Grobys	2014	07/1998 - 07/2013	Worldwide data (such as India, Brazil, U.S. and Germany); monthly data.	Momentum strategy generates significant negative returns during the years of economic downturn; the strategy has been profitable but during the recent recessions it has generated negative returns
Asness, Ilmanen, Israel & Moskowitz	2015	All samples end 06/2013; samples start as follows: stocks, industries, developed market currencies and indices 01/1990, commodities 02/1990, government bonds 01/1991, interest rates 04/1990, emerging market indices 01/1996 and emerging market currencies 04/1997	7 asset classes: stocks, industries, indices, government bond indices, interest rate futures, currencies, commodities; global data.	Combining momentum strategy with other investment strategies that have a low correlation with each other leads most likely to succesfull investment portfolio; momentum, value, carry and defensive are combined; using all four seems more profitable than using only one or alternating between strategies; works for other asset classes as well.

Critique				
Jensen & Benington	1970	01/1926 - 03/1966	NYSE; 1,952 securities; monthly data.	Critiqued Levy's study; relative strength trading rule did not outperform a simple buy and hold strategy when they used a different data set than Levy had used; according to them Levy had studied almost 70 different trading rules before he came up with the relative strength trading rule which is obvioulsy problematic.
De Bondt & Thaler	1985 & 1987	1926 - 1982	All NYSE stocks; monthly data.	Contrarian strategy; argued that the stock prices have a tendency to overreact to market information which suggests that contrarian strategy will generate abnormal returns; longer time period is more profitable for contrarian strategy than for momentum strategy; 3 - 5 year formation period and 3 - 5 year holding periods are used; loser portfolio generated approximately 25 % larger gains on a three year holding period compared to the winner portfolio.
Jegadeesh	1990	1963 -1990	U.S. data	Studied stocks that had either increase or decreased during the last month or the last week; the loser portfolio generated approximately 2 % better returns than the winner portfolio.
Lakonishok, Shleifer & Vishny	1994	04/1963 - 04/1990	AMEX & NYSE	A value investor should buy unpopular stocks which will react to positive market news with a higher increase in stock prices; contrarian strategy and momentum strategy are combined; this combination provides 23 % positive return per year.
Doeswijk	1997	06/1973 - 06/1995	Dutch data; all listed domestic stocks.	Contrarian strategy generated about 8 - 9 % better returns than popular stocks

Bildik & Gulay	2002	1991 - 2000	Turkish data	The loser portfolio outperformed the winner portfolio with about 15 % per year; the winner portofolio beat the ISE-100 index by 0.65 % while the loser portfolio beat it by 1.79 %.
Haomin	2011	1999 - 2010	Hong Kong stock market	Also a shorter time period can be profitable for the contrarian strategy; the most profitable strategies consisted of 6 week formation period and 2 week holding period or 8 week formation period and 2 week holding period; smaller stocks seem to be more profitable than large stocks.
Pathak	2011	03/1993 - 03/2007	Indian data; all BSE listed stocks.	Buying unpopular stocks is profitable; value strategy earns good returns and outperforms the glamour stocks.
Ramiah, Cheng, Orriols, Naughton & Hallahan	2011	03/2001 - 03/2006	Hong Kong stock market; 1,399 stocks (761 stocks listed only on Hong Kong stock exchange + 638 dually-listed stocks; monthly data.	Substantial conrarian profits; on average contrarian strategy earns up to 6.08% per month; returns for dually-listed stocks were systematically higher than for those listed only on Hong Kong stock exchange.