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Profitability of Momentum Strategies Around the World

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Abstract

In this paper we investigate the international profitability of momentum strategies for a number of countries during the time period between 1995 and 2010. Positive abnormal returns were generated over 3 to 12 months by strategies buying the best past performance stocks and selling the worst past performance stocks. Although adjustments for risk-, size- and value factors didn't result in any significant changes in the monthly excess returns, CAPM and Fama-French three factor model still couldn't explain the source of these anomalies. Therefore, behavioral theories seem to be a possible explanation for the existence of these anomalies.

Keywords: Momentum, zero-cost strategy, international, anomalies, efficient market hypothesis

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Table of Contests

1. Introduction

In the introductory chapter the reader is provided with the background of the topic, problem discussion and problem formulation. In addition we present the purpose and limitations as well as a comprehensive outline of the study.

Not long ago, the Efficient Market Hypothesis (EMH) was generally accepted by academics. Assuming investor's rationality, security markets were believed to be efficient in fully reflecting all publicly available information, without any delay. (Malkiel, 2003). Hand in hand with the Brownian motion, security prices were said to be unpredictable implying a stochastic process following a so called Random Walk (Lo & Mackinlay, 1990). The idea behind the random walk hypothesis (RWH) is that the price changes should be independent over time, meaning that today's information is worthless in forecasting future prices (Sullivan & Weithers, 1991). In general, no strategy applied by the investor should enable abnormal returns greater than could be achieved holding any unsystematically chosen portfolio of stocks. Later on the validity of the EMH and RW hypothesis has been questioned by many critics since some studies in the finance area showed tendencies of market inefficiencies, with appearance of both abnormal returns and irrationality in investor's behavior. Many economists have claimed that changes in security prices don't follow a RW and security prices are at least partially predictable. (Malkiel, 2003). Besides, it would enable the investor to make economic profits on the basis of forecasts made on available information by applying zero-cost strategies (Debondt & Thaler, 1985, Chan, Jegadeesh & Lakonishok, 1996).

Since 1980s, as the predictability of security prices lead to the violation of EMH and RW hypothesis, market efficiencies as well as the rationality of the investor have been disputed by many researchers (Shiller, 2003). There've been numerous studies done with the intention of explaining the existence of zero-cost strategies which results in abnormal profits. The contrarian strategy has been discussed by Debondt and Thaler (1985) as a way of earning profits in the long run (3-5 years), by purchasing previous loser stocks and selling previous winner stocks. By contrast, Jegadeesh and Titman (1993) have demonstrated the momentum strategy which results in gaining excess returns during the medium term (3-12 months),

through buying securities that have been previously performed well and selling those who have previously performed badly.

As CAPM and Fama-French three factor model fail to give an acceptable explanation for the sources of anomalies, many studies turn to behavioral finance theories as a matter of interest since they relax the assumption of rational investors. According to behavioral theories investors would underreact to new publicly available information which leads to momentum profits and overreact to new private information released which results in contrarian profits in the long run.

According to our knowledge no other similar study has been found verifying the international success of momentum strategies during 1995-2010 using the same data sample. Therefore, we found it both interesting and relevant to fill the gap of knowledge and investigate whether the momentum strategy is profitable internationally. We also intend to investigate possible sources of these abnormal returns by testing the effect of market risk, size and value.

As both time and resources are limited, we found it necessary to make certain limitations referring to the research implemented. We therefore use monthly MSCI data for 45 countries during the time period of 1995-2010 including both distress periods (IT-bubble and financial crisis).

This research is structured as follows: Chapter two contains a presentation of relevant theoretical issues and researches. Data selection as well as work procedure will be covered in chapter three. In the fourth chapter empirical findings and analysis of the results will be explained. The final chapter will contain the conclusion.

2. Theoretical Framework

The chapter begins with an explanation of central issues and relevant researches done in the area. The theoretical framework will represent a good basis for further analysis of the empirical findings.

2.1 Efficient Market Hypothesis

The efficient market hypothesis is a simple statement of prices fully incorporating all available value added information (Ogden, Jen and O'Connor, 2002). Returns are unpredictable since price fluctuations depend on existing information. Malkiel (2003) argues that achieving excess returns without increasing the risk would be considered impossible as price rapidly adjusts to new information. According to Fama (1970) and Campbell, Lo and Mackinlay (1997) three main forms of EMH have been distinguished, regarding adjustments of security prices to relevant information subsets:

Weak form efficiency: Claims that the security price only reflects past publicly available information, meaning that the information set only represents the history of prices and returns.

Semi-strong form efficiency: Asserts that all publicly available information is widely known to the market participants, past as well as new information is incorporated in the security price.

Strong form efficiency: In addition to what's stated in previous forms of efficiencies, the strong form efficiency includes all value added information known to any market participant. Including both public- and private information held in the information set reflecting the security prices.

Although the definition of the efficient market might be different according to many studies, they all agree on the fact that stock prices should include all the available information at the time (Brenner, 1979).

2.2 Random Walk Hypothesis

There have been many prominent scientists trying to "beat the market" by the usage of past security price changes as the base of future forecasts in order to create abnormal profits (Sullivan & Weithers, 1991). According to Sullivan and Weithers (1991) conforming to RW hypothesis, patterns or trends in security prices cannot be exploited throughout time periods, since movements do not show evidence of any systematic tendencies. In the view of most empirical studies it has been shown evidence of security returns not following the process of random walk (Copeland, Weston & Shastri, 2005). Hence, deviations from RW hypothesis implicate predictable security price changes (Lo & Mackinlay, 1990). Three forms of random walks have been distinguished (Campbell, Lo & Mackinlay, 1997):

Random Walk 1: Assuming independently and identically distributed (IID) price changes we get the strongest version of RWH (Campbell, Lo, & Mackinlay, 1997). This is discussed by Sullivan and Weithers (1991) as a crucial assumption for EMH and the basis of the modern financial theory.

Random Walk 2: In the long run identically distributed increments are not likely for security prices, consequently RW 2 relaxes the second assumption of RW 1. Instead, stating that price changes are independent but not identically distributed (INID). (Campbell, Lo, & Mackinlay, 1997).

Random Walk 3: This form is considered as being the more general version of RWH as well as the weakest version of the hypothesis. RW 3 relaxes the assumption of independence found in RW 2, meaning that the property of security returns can be dependent but have to be uncorrelated. (Campbell, Lo, & Mackinlay, 1997).

2.3 Trading Strategies Based on Past Returns

The profitability of short, medium and long term trading strategies have been considered since long time ago. In contrast with the efficient market hypothesis, stock returns are believed to be predictable due to the abnormal returns yielded by momentum and contrarian investment

strategies. Momentum strategy purchases the best past performance stock and sells the worst past performance stock while the contrarian indicates the exact opposite.

2.3.1 Momentum

Jegadeesh and Titman (1993) found out that the momentum strategies provide positive abnormal returns (average return of 1% per month) over holding period of three to twelve months in sample period of 1965 to 1989 in the US market. They constructed winner and loser portfolios for different formation and holding periods (1, 2, 3 and 4 quarters). According to their findings the strategy which formed based on the past 12 month's performance and held for 3 more months was the most profitable momentum strategy. They also reached to the conclusion that this anomaly wouldn't last forever and part of it would fade away gradually as the time goes by. As stated by their findings and in contrast with Lo and Mackinlay (1988), these abnormal returns neither could be explained by lead lag effects nor by systematic risk but attributed by delayed price reactions to firm-specific information.

The markets' underreaction to the information as a source of abnormal profits was questioned by Chan, Jegadeesh and Lakonishok (1996) over the sample period 1977-1993 in US market. They came to the conclusion that the effect of market risk, size and book to market couldn't explain the profitability and the reaction of the market to new information is little by little.

Rouwenhorst (1998) analyzed the medium-term momentum strategies in 12 European countries. Using the same technique as Jegadeesh and Titman (1993), he formed loser and winner portfolios based on the monthly returns from 1980 to 1995 and analyzed the zero investment portfolio in 16 different strategies. The same results obtained for these 12 European countries.

In another study Moskowitz and Grinblatt (1999) documented the profitability of momentum strategies in medium-term prospect using the monthly data from July 1963 until July 1995 for 20 industries and investigated a range of reasons for its existence. They focused their analyze on industry momentum which they found more beneficial compared to individual stock momentum strategies even after controlling for several factors like size, market to book equity, individual stock momentum etc. Industry momentum strategies are highly profitable in

short term and intermediate horizons but similar to individual stock momentum strategies have a tendency to dissipate after one year.

Nijman, Swinkels and Verbeek (2002) examined the presence of medium term return continuation using portfolio-based regression approach over the period 1990-2000 in 15 countries in Europe. They categorized country, industry and individual momentum effects. In contrast with the results gained by Moskowitz and Grinblatt (1999), the individual stock effects consequent the momentum effect, while industry and country played less significant roles.

Cooper, Gutierrez and Hameed (2004) stated that the profitability of buying winner and selling loser stocks strategy is highly related to the state of the market. As they defined in their paper "up" state is when lagged three-year market return is not negative and "down" state is when it's negative. Cooper, Gutierrez and Hameed (2004) used the monthly data from CRSP (The Center for Research in Security Prices) over the sample period from January 1926 to December 1995. They documented that the short-run momentum portfolio provides excess return following "up" market states which also boosts up as the lagged market return enhances. Moreover, their findings signified a considerable long-run reversal in "down" state.

2.3.2 Contrarian

DeBondt and Thaler (1985) did a research about the overreaction of the market to unpredicted events which seemed to be one of the first studies in the area. In order to form the loser and winner portfolio they used the CRSP monthly returns data. They found contradictions with Bayes' rule which imposes the precise response of the individuals to the new events and information. According to their consequences which were coherent with the overreaction hypothesis, prior "loser" portfolios do better than prior "winners". Their results also showed that the contrarian strategy is effective in long term outlook since the effects were observed between three to five years after the construction of the loser and winner portfolios. The two authors latter did another investigation in 1987 which was also consistent with the behavioral hypothesis that individuals have tendency to overweight the recent information and therefore they overreact. The data they used was over the period of 1926-1981. They examined the effect of size and risk characteristic as well. The results indicated that the winner-loser effect

is not attributed neither to changes in risk nor the size of the firm. Fama and French (1988) also examined the expectedness of long term returns and got the same outcome as Debondt and Thaler (1987).

Lo and Mackinlay (1988) used the weekly returns in their analyses in order to find the answer to the question that if the effectiveness of buying loser and selling winner (contrarian) investment strategies necessarily implies stock market overreaction. They conclude that the cross effects between the securities had a more important effect in explaining the profitability of contrarian strategy than market overreaction. Since they used the weekly data their findings were based on short-horizon returns. In 1992 another research by Jegadeesh and Titman led to the reverse result. Their investigation demonstrated that the market overreaction was the main source of abnormal returns not the lead lag effect.

In line with previous studies, Conrad and Kaul (1998) examined the profitability of trading strategies over the sample period of 1926-1989. Consistent with DeBondt and Thaler (1985) and Jegadeesh and Titman (1993), based on their research contrarian strategy is profitable in short (weekly) and long term (3 to 5 years or even longer) horizons while momentum strategy yields significant abnormal returns in medium term horizon (3 to 12 months) except during 1936-1947. Conrad and Kaul (1998) documented that cross sectional differences in mean returns of individual stocks is the main determinant of profitability of trading strategies.

2.4 Behavioral Finance

Behavioral finance as a combination of classical finance with psychology and decision-making science has become a matter of interest recently. While some authors argue that part of anomalies gained through momentum and contrarian strategies may be explained within an efficient market framework i.e. CAPM and Fama-French models, number of studies try to explain return predictability due to the over- and underreaction context using behavioral models. (Shiller, 2003). Behavioral theories relax the assumption of rational investors either because of the preferences or flawed beliefs and consider that investors are emotionally influenced at the time of investing. Several irrationalities might results in making complicated decisions. (Hong & Stein, 1999). Behavioral finance predicts the over- and under reacting to information. It concerns how investors make expectations according to the future and how

these could be transformed into security prices. Overreaction of the stock prices to information in short and long term could lead to contrarian profits while underreaction in medium term could result in momentum profits. (Debondt & Thaler, 1985)

Barberis, Shleifer and Vishny (1998) present a model which is based on psychological evidence. It shows how investor's expectations and beliefs are being formed and how they affect the process of decision making, which could lead to both over- and underreaction. According to their point of view investors would be able to make greater returns without bearing additional risk, just by taking advantage of under and over reactions. As it stated by Barberis, Shleifer and Vishny (1998) the underreaction is defined as an increase in average returns due to the good news and a decrease caused by the bad news, this is also supported by Jegadeesh and Titman (1993). They observed that stock returns would underreact to earning announcement from 1 to 12 months and overreact to consistent pattern of good and bad news over longer period of time, 3 to 5 years. Barberis, Shleifer and Vishny (1998) also mention heuristic and conservatism (slow reaction while facing the new information) as the causes for over- and underreactions.

Daniel, Hirshleifer and Subrahmanyam's (1998) theory relies on investor's overconfidence and biased self-attribution which they used as an explanation for several patterns of stock returns. They documented that investors would over react to private information since they are overconfident and they overestimate their own capability to value securities while they would underreact to public news arrival. Self-attribution bias indicates that the overconfidence of the investors will increase if the new public information confirms what they believed in but it wouldn't decrease if it contradicts their private information. Underreaction to public signals as well as overreaction to private signals could explain the mid-term continuation and long-term reversals respectively.

Hong and Stein (1999) assumed that two different types of traders exist and their model is based on the interaction of these traders with each other. News watchers who rely on their own private information and rationally use fundamental news but ignore prices and momentum traders who in contrast trust in past price information and pay less attention to the basic news. They also assumed that private information spread slowly across the news watchers. According to their findings underreaction is present only when news watchers are

active and involvement of momentum traders doesn't lessen this underreaction and also doesn't lead to efficiency in the market. According to Hong and Stein (1999) underreaction in short- and medium term will result in overreaction in the long-term.

3. Methodology

In the following chapter we explain the data selection process. Later on we describe both methods of portfolio construction and portfolio evaluation as the work procedure.

3.1 Data

The theoretical population corresponds to all the countries worldwide but since the method of choice is the quantitative approach we believe that the investigation of 45 countries (Appendix A., table A.1) defined by MSCI (Morgan Stanley Capital International) would be sufficient to answer the problem. Our data sample consists of 45 countries chosen from 7 different continents. Almost 70 percent of the countries are selected from Europe and Asia, while the rest 30 percent are chosen from South America, North America, Africa, Oceania and Middle East respectively (Appendix A., table A.2). According to the level of development, 62 percent of these countries have been categorized as developed countries whereas the rest 38 percent are being considered as developing countries. Thus, we consider our data as a representative sample of the entire population. Our motivation of countries chosen lays in the fact of the availability of data throughout the time period from 1995 to 2010. This time duration would allow us to include both distress periods and investigate the effect of internet bubble and current financial crisis on momentum profits.

The main source of our data is secondary data selected from Thomson DataStream and the Kenneth R. French data library. The theoretical framework is based on relative scientific articles and journals which allow us to obtain reliable information. We have also used books on the topic related to the problem.

3.2 Portfolio Construction

In this subsection we describe the work procedure of testing the profitability of momentum strategy and its potential sources. We start the process by calculating the monthly returns, using MSCI price index for each country during the whole period.

To get the return we apply the following formula:

$$R_t = (P_t / P_{t-1}) - 1$$

Whereas R_t is the monthly return for time t, P_t and P_{t-1} are stock prices for month t and t-1 respectively. All figures are in US dollars, since according to Fama and French it's accepted as international currency.

We formed the winner and loser portfolios similar to the methods used by Jegadeesh and Titman (1993) since the most previous researches applied their method. We carry on the procedure by ranking the stock returns according to their pervious J-month's performance, where J is the formation period of 3, 6, 9 and 12 months. We divide all the countries into 3 groups. The winner group consists of 35% of the countries with higher returns while the loser group holds the 35% countries with lower return. So each winner and loser group consists of 16 countries. The resulting winner and loser portfolios are then held for K months, where K is the holding period of 3, 6, 9 and 12 months. The combination of different formation (J) and holding (K) periods will give us a total of 16 momentum strategies. For each month t, the momentum profit is obtained by the difference between winner and loser portfolio returns. We are latter able to establish the profit yielded from a certain strategy, whether the winner portfolio outperforms the loser portfolio or vice versa. Each profitable zero-cost strategy would be an indication of market inefficiency. We get portfolios with overlapping holding periods since each strategy holds a set of portfolios that are chosen in recent K month as well as the preceding K-1 months. The usage of overlapping holding periods would result in an increase in the strength of the tests. (Jegadeesh & Titman, 1993)

3.3 Portfolio Evaluation

Without testing for significance of the obtained results, we restrict the value of our investigation. Therefore, to guarantee the validity of the inferences made, we do statistical tests to ensure whether to reject or not reject the null hypothesis.

We test the following null and alternative hypotheses at the 5% significance level:

H_0: Momentum returns, $\mu = 0$

H_1: Momentum returns, $\mu \neq 0$

We significantly test our hypothesis with the intention of finding out if the zero-cost momentum strategies are profitable internationally. The t-test is performed using the following formula:

$$t = \frac{\overline{X} - \mu}{s/\sqrt{n}} \sim t - \text{distribution with } n - 1 \text{ degrees of freedom}$$

$\overline{X}$ stands for the mean return of the portfolio, μ is set to zero since it represents the expected value under the null hypothesis. s is the standard deviation of the sample which is estimated since the standard deviation of the population, σ, is unknown. N equals to the total number of observations made. High positive values of the test function that exceeds the critical value will lead to a rejection of the null hypothesis, at a 95% confidence interval (Körner & Wahlgren, 2000).

To analyze the consistency of the zero-cost strategies throughout different time horizons we will split our sample period of 1995-2010 in four sub-periods (1995-2000, 2000-2005, 2005-2010, 1995-2007). We include the fourth sub period as an attempt to analyze the profitability of the zero-cost strategies without the influence of the recent financial crisis which was started in 2007. The results would allow us to analyze the consistency of the strategies in the different sub-periods and identify the effect of financial crisis on the profitability of momentum strategies.

3.4 CAPM and Fama-French Three Factor Model

In order to analyze the market efficiency we consider the excess returns yielded by the zero-cost strategies as a compensation for holding risky assets in the winner and loser portfolios

(Campbell, Lo, Mackinlay, 1997). We apply the Sharpe (1964) and Lintner (1965) Capital Asset Pricing Model (CAPM) by running the OLS time series regression.

$$R_{jt} - R_{ft} = \alpha + \beta(R_{mt} - R_{ft}) + \varepsilon_t$$

Whereas R_{jt} is the expected monthly return of winner or loser portfolios at time t, R_{ft} is the risk free rate (one month Treasury bill rate), R_{mt} stands for the return on market portfolio, ε_t represents the error term. α and β are parameters that should be estimated.

We regress the monthly returns in excess of the risk free rate ($R_{jt} - R_{ft}$) on the market risk premium ($R_{mt} - R_{ft}$) and the beta coefficient is being used as a measure of risk. If the obtained beta for the zero-cost portfolio found to be greater than one ($\beta > 1$) then the momentum profits could be explained by the riskiness of the stocks holding in the portfolios if not we reach to the conclusion that the excess returns are not a compensation for bearing extra risk.

According to Fama and French (1996) different patterns in asset earnings have been identified, both showing long-term reversal (Debondt & Thaler, 1985) and continuation of short-term returns (Jegadeesh & Titman, 1993). Fama and French (1996) discuss the fact that average returns are also related to other factors such as size and book-to-market value since CAPM risk factor solely wouldn't be able to capture these average-return anomalies. Fama-French three factor model:

$$R_i - R_f = \alpha_i + \beta_i(R_m - R_f) + \gamma_i SMB + \delta_i HML + \varepsilon_i$$

Whereas β, $\boldsymbol{\gamma}$ and $\boldsymbol{\delta}$ are the factor sensitivities of returns (Ogden, Jen & O'Connor, 2002).
(1) ($R_M - R_f$) is the market risk premium. (2) Small minus big capitalization stocks, SMB, stands for the spread in the returns between small and big portfolio of stocks. (3) High minus low value stocks, HML, represents the spread in the returns between high book-to-market and low book-to-market stocks. (Fama & French, 1996).

Significant positive $\boldsymbol{\gamma}$ would imply that the size of the stock in the portfolio can explain the abnormal returns. Similarly, positive significant $\boldsymbol{\delta}$ also would be an indication of the influence of value factor on the momentum returns.

4. Empirical Results and Analysis

In this chapter we represent our empirical findings and further analyze the sources of the momentum strategy.

4.1 Profitability of Momentum Strategies

We used MSCI for 45 countries around the world to build the winner and loser portfolios on the monthly returns. The descriptive statistics of the data can be found in Appendix A., table A.3. The winner groups consist of 35% of the countries with higher returns while the loser groups hold the 35% countries with lower returns. The average monthly returns for all the strategies are summarized in table 4.1.

		Holding period(K)			
Formation period (J)		**3**	**6**	**9**	**12**
	Loser	-0,04%	-0,05%	-0,02%	0,00%
3	Winner	0,10%	0,17%	0,21%	0,26%
	Winner-Loser	**0,14%**	**0,22%**	**0,23%**	**0,26%**
		(3,04)	*(5,22)*	*(2,72)*	*(5,13)*
	Loser	-0,02%	-0,07%	-0,07%	-0,05%
6	Winner	0,08%	0,19%	0,26%	0,31%
	Winner-Loser	**0,10%**	**0,26%**	**0,33%**	**0,36%**
		(2,56)	*(4,09)*	*(5,08)*	*(2,97)*
	Loser	-0,01%	-0,04%	-0,08%	-0,08%
9	Winner	0,07%	0,17%	0,28%	0,35%
	Winner-Loser	**0,08%**	**0,21%**	**0,36%**	**0,43%**
		(3,39)	*(2,87)*	*(5,03)*	*(4,45)*
	Loser	-0,01%	-0,03%	-0,06%	-0,09%
12	Winner	0,07%	0,16%	0,26%	0,36%
	Winner-Loser	**0,08%**	**0,19%**	**0,32%**	**0,45%**
		(3,11)	*(2,97)*	*(3,41)*	*(2.84)*

Table 4.1 Average returns of momentum strategies, from 1995 to 2010. The stock returns are ranked according to their pervious J-months performance and are held for K-months. Note: (t –statistics).

As it shows in the table 4.1, for all the 16 strategies the winner group out-performs the loser group which result in momentum profitability. But since our data provides the average return of the zero-cost strategies 0.25 percent per month which is far from the result gained by Jegadeesh and Titman (1993) (average return of 1% per month), we can conclude that although the momentum profitability exists universally, it's not considerable. According to t-statistic, all the strategies yielded profit at a significance level of 5%. The highest abnormal return was created by J12K12 strategy (0.45%) while the lowest earned by J12K3 (0.08%). This is in the sharp contrast with what Jegadeesh and Titman (1993) documented since they found J12K3 as the most successful momentum strategy. Generally, the combination of longer J and K periods will result in higher average monthly return and an increase in its significance. As the formation and holding period reach to one year, the winner portfolio return increases while the loser portfolio return decreases.

For further detailed investigations from now on we choose J6K6 strategy as a represent of the whole momentum strategies. The motivation behind choosing J6K6 is due to following the paper written by Jegadeesh and Titman (1993) and the fact the average excess return of J6K6 strategy (0.26 percent) is almost the same as the average monthly return of all the strategies (0.25 percent).

4.2 Robustness Test and Consistency

We divided the whole period into 4 sub-periods with the purpose of investigating the consistency of the zero-cost momentum strategies. The results are shown in table 4.2.

	1995-2010	1995-2000	2000-2005	2005-2010	1995-2007
Winner	-0,07	0,24	0,16	0,19	0,20
Loser	0,19	-0,10	-0,09	-0,03	-0,06
Winner-Loser	**0,26**	**0,34**	**0,24**	**0,22**	**0,27**
	(4,09)	(4,60)	(5,84)	(4,46)	(6,39)

Table 4.2 Results of robustness test: Investigation for the consistency of momentum profitability during four different sub-periods (J6K6 strategy). Note: (t-statistics).

As we can see among these sub-periods the highest average monthly return is for 1995-2000. Although the average return per month at least in two of the sub-periods are above the average return of the momentum strategies during the whole period of 1995-2010 (0.26 percent per month) they're still low, yet the profits are significant at 5% confidence level. As the results show, excluding the financial crisis (sub-period 1995-2007) enhances the profitability of momentum strategies but only by 0.01 percent compared to the whole period. So the effect of the crisis on the excess returns wasn't substantial and we came to the conclusion that although based on our data the excess returns gained by momentum strategies are not high but they still exist and they are consistent throughout the entire period analyzed (1995-2010).

4.3 Sources of the Momentum Profits

In this part we are going to find out the main sources of the momentum profits. We will investigate whether some factors such as market risk, firm size and value would be able to explain the existence of these abnormal returns.

4.3.1 CAPM

To examine whether the abnormal returns gained from momentum strategies are due to the systematic risk or not, we regress the monthly excess returns of the winner and loser portfolios on the market risk premium.

$$R_{jt} - R_{ft} = \alpha + \beta(R_{mt} - R_{ft}) + \varepsilon_t$$

In order to check for the stationary of the data, we applied the Augmented Dickey-Fuller test. As the results of ADF test show (Appendix B.), all the data found to be stationary. Since we apply OLS regression to estimate the parameters of CAPM, five basic assumptions must be satisfied in order to obtain Best Linear Unbiased Estimators (BLUE). First assumption $E(u_t)=0$ wouldn't be violated since we have already included intercept in the regression equation. Second assumption requires the variance of the errors to be constant which is known as homoscedasticity. According to the results gained by the White test there is no evidence for

the presence of heteroscedasticity (Appendix C., table C.1). The error terms should be uncorrelated with one another due to the third assumption. One of the most popular ways to test for first order autocorrelation is Durbin-Watson test. The results of the DW test indicate a positive autocorrelation in the residuals (Appendix C., table C.2). Therefore, in order to deal with this problem and obtain BLUE estimators we apply the Cochrane-Orcutt procedure. The fourth assumption implies that the regressors should be non-stochastic. But even if this assumption is violated the OLS estimators would be unbiased and consistent. We apply Bera-Jarque test with the purpose of testing normality assumption. The results confirm that in four of the regressions we should reject the null hypothesis of normality in 5% confidence level (Appendix C., table C.3). But even with the presence of non-normality the estimators would still be unbiased with minimum variance and we can use the data in order to do the analysis. (Brooks, 2008)

The regressions results are presented in Table 4.3.1. As it can be seen the intercept for the winner portfolio is 0.19 percent and not significant, however it is significant for both loser and winner-loser portfolios. The significant alpha coefficient of the resulting zero-cost portfolio demonstrates the fact that adjustment for market risk doesn't change the average monthly excess returns (0.26 percent).

	α	t(α)	β	t(β)
Loser	-0,071	3,22	0,438	3,53
Winner	0,190	0,56	0,359	2,01
Winner-Loser	**0,261**	**2,85**	**-0,079**	**-3,15**

Table 4.3.1 The outcome of CAPM. The results show the risk adjusted excess returns.

The beta coefficients for winner, loser and the resulting winner-loser portfolios are significant. The higher loser's beta (0.438) compared to the winner's (0,359) point to the fact that the loser portfolio is riskier, which might be due to the fact that it contains countries consisting of smaller firms associated with higher risk. According to negative beta coefficient, the abnormal returns can't be considered as a compensation of bearing an extra risk. In other words, market risk factor can't explain these anomalies.

4.3.2 Fama-French Three Factor Model

In addition to the previous CAPM regression we have now added two other explanatory variables, SMB and HML into the regressions:

$$R_i - R_f = \alpha_i + \beta_i(R_m - R_f) + \gamma_i SMB + \delta_i HML + \varepsilon_i$$

	α	t(α)	β	t(β)	γ	t(γ)	δ	t(δ)
Loser	-0,075	-5,64	0,518	2,83	0,375	0,99	0,826	2,08
Winner	0,187	6,34	0,527	3,61	-0,187	-0,43	0,723	1,58
Winner-Loser	**0,262**	**5,14**	**0,009**	**2,02**	**-0,562**	**-1,32**	**-0,103**	**-0,41**

Table 4.3.2 The outcome of Fama-French three factor model. The results show risk-, size- and value-adjusted excess returns.

The results presented in table 4.3.2 indicate a significant alpha for all portfolios. The significance of the momentum portfolio's alpha implies that the adjustment for market risk, size and value doesn't change the average monthly return of the J6K6 strategy (0.26 percent). All beta coefficients found to be significant according to t-statistics. However, comparing this coefficient for winner and loser portfolios, winner portfolio appear to be riskier since it has higher beta (0,527 compared to 0,518). The momentum profits are not attributed by risk since the beta coefficient of the resulting zero-cost portfolio obtained very low. This also supports our previous CAPM results. The other coefficients point out that there is no specific relation between excess returns and size- (SMB) and value (HML) factors. In other words, Fama-French three factor model can't explain the profitability of zero-cost strategies.

4.3.3 Behavioral Finance

In line with our results neither CAPM nor Fama-French three factor model could demonstrate any significant sources explaining the momentum returns. In order to be able to clarify the sources of these anomalies, behavioral theories seem to be a considerable alternative (Shiller, 2003). The rejection of efficient market hypothesis would be a consequence of investor's irrationality. According to Barberis, Shleifer and Vishny (1998) these irrationalities can be defined as two different regularities (under- and overreaction) which can affect the stock prices. As stated by Jegadessh and Titman (1993) momentum profits can be obtained due to

the underreaction of the stock prices to new information released while overreaction will lead to long run reversals.

5. Conclusion

In this chapter we sum up our findings and bring a suggestion for further researches.

The purpose of this paper is to examine the profitability of momentum strategies around the world as well as identifying potential sources of the abnormal returns. Since our data for 45 countries can be considered as a representative sample of the whole world we will use the results in order to make inferences of the population. Sixteen different strategies were formed considering different formation and different holding periods (3, 6, 9 and 12 months). Positive abnormal returns were generated by strategies buying the best past performance stocks and selling the worst past performance stocks. According to our results, all the strategies gained positive and significant momentum returns. The average monthly excess return found to be 0.25 percent. The highest abnormal return created by 12 months formation period and 12 months holding period strategy and the lowest abnormal return provided by J12K3 strategy. The presence of momentum profits in our results will lead to the rejection of EMH and RWH. Our results showed consistency throughout all the sub-periods and even the financial crises didn't seriously affect the profitability of momentum strategies.

Since the results gained by applying CAPM and Fama-French three factor model couldn't help us explaining the source of these abnormal returns we turned to behavioral theories as a possible explanation for the existence of these anomalies. According to these theories there is a possibility for investors to benefit from under- and overreactions without taking further risk in order to make greater returns. Underreaction to public signals as well as overreaction to private signals could explain the mid-term continuation and long-term reversals respectively. Our findings of momentum profits are somehow consistent with the results documented by previous researchers (e.g. Jegadeesh & Titman, 1993 and Rouwenhorst, 1998). However, the distinctions lie in the fact that we used different sample data for different time horizon. The main difference is that average monthly return related to our data sample (0.25 percent) is much lower than the 1 percent average monthly return reported by Jegadeesh and Titman (1993). Besides, the momentum return gained by J12K3 strategy found to be the lowest which goes against the results of Jegadeesh and Titman (1993) stating it as the most profitable strategy. Unlike the above mentioned authors our findings indicate that as we reach towards one year in both formation and holding periods the profitability will tend to increase.

We believe that for further research behavioral models can be tested, with the intention of determining the sources of momentum profits.

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Appendix A. Countries representing the data sample

Country	
Argentina	Korea
Australia	Malaysia
Austria	Mexico
Belgium	Morocco
Brazil	Netherlands
Canada	New Zealand
Czech Republic	Norway
Chile	Peru
China	Philippines
Denmark	Poland
Egypt	Portugal
Finland	Russia
France	Singapore
Germany	South Africa
Greece	Spain
Hong Kong	Sweden
Hungary	Switzerland
India	Taiwan
Indonesia	Thailand
Ireland	Turkey
Israel	UK
Italy	USA
Japan	

Table A.1. Countries representing the data sample.

Continent	
Asia	27%
Africa	7%
Europe	44%
Middle East	2%
North America	7%
South America	9%
Oceania	4%

Table A.2. Number of countries as a percentage from each continent.

Descriptive statistics.	Mean	Std. Dev.	Skewness	Kurtosis	Minimum	Maximum
Argentina	0,0123	0,1139	-0,0991	1,7908	-0,3886	0,4583
Australia	0,0075	0,0631	-0,2962	1,4232	-0,2318	0,2190
Austria	0,0052	0,0795	-0,5831	4,1788	-0,3457	0,3205
Belgium	0,0042	0,0674	-1,2435	5,1889	-0,3555	0,1772
Brazil	0,0147	0,1121	-0,1186	0,8015	-0,3416	0,4058
Canada	0,0107	0,0652	-0,5162	2,2818	-0,2595	0,2303
Czech Republic	0,0122	0,0886	-0,2245	0,7997	-0,3030	0,2492
Chile	0,0081	0,0685	-0,2788	1,4301	-0,2613	0,2240
China	0,0049	0,1027	0,4474	1,6633	-0,2592	0,4159
Denmark	0,0106	0,0589	-0,8660	2,1485	-0,2416	0,1552
Egypt	0,0157	0,0993	0,5673	1,8780	-0,2665	0,4113
Finland	0,0123	0,1060	0,1605	1,1484	-0,2993	0,3866
France	0,0065	0,0638	-0,2579	0,9250	-0,2106	0,1838
Germany	0,0069	0,0697	-0,3672	1,2875	-0,2200	0,2247
Greece	0,0054	0,0987	0,1244	1,4486	-0,3442	0,3359
Hong Kong	0,0070	0,0768	0,2541	1,9624	-0,2509	0,3266
Hungary	0,0164	0,1151	0,1207	2,5742	-0,4256	0,4694
India	0,0115	0,0970	0,1773	0,5891	-0,2527	0,3966
Indonesia	0,0126	0,1393	0,4543	3,2590	-0,4228	0,5938
Ireland	-0,0008	0,0692	-1,0229	2,6210	-0,2667	0,2244
Israel	0,0098	0,0699	-0,3253	0,4098	-0,2007	0,1972
Italy	0,0044	0,0708	-0,0895	0,7293	-0,2260	0,2050
Japan	-0,0002	0,0588	0,4385	1,2094	-0,1694	0,2486
Korea	0,0107	0,1208	0,9217	4,0419	-0,3377	0,6117
Malaysia	0,0055	0,0909	0,3965	6,0717	-0,3315	0,4922
Mexico	0,0129	0,0888	-0,5749	1,4063	-0,3142	0,2519
Morocco	0,0093	0,0569	0,5135	2,6801	-0,1685	0,2772
Netherlands	0,0056	0,0641	-0,6955	1,8893	-0,2468	0,1676
New Zealand	0,0022	0,0687	-0,3207	1,2680	-0,2397	0,2191
Norway	0,0087	0,0835	-0,6268	2,3604	-0,3096	0,2667
Peru	0,0165	0,0950	0,1197	2,4871	-0,3341	0,3995
Philippines	0,0009	0,0918	0,6407	3,7712	-0,3119	0,4820
Poland	0,0112	0,1145	0,0311	1,2091	-0,3746	0,4220
Portugal	0,0052	0,0677	-0,0768	1,4314	-0,2260	0,2795
Russia	0,0261	0,1720	0,4940	3,7486	-0,5741	0,8453
Singapore	0,0054	0,0783	0,1760	2,2293	-0,2415	0,3190
South Africa	0,0084	0,0841	-0,1510	1,2982	-0,2817	0,2915
Spain	0,0097	0,0742	-0,0738	1,7857	-0,2550	0,2665
Sweden	0,0114	0,0803	-0,1975	0,7121	-0,2272	0,2167
Switzerland	0,0077	0,0539	-0,2875	1,5668	-0,1483	0,2031
Taiwan	0,0031	0,0882	0,2621	0,0513	-0,2070	0,2816
Thailand	0,0046	0,1228	0,8443	4,1903	-0,3392	0,6088
Turkey	0,0224	0,1613	0,4826	1,8660	-0,4246	0,6696
UK	0,0043	0,0507	-0,2367	2,3158	-0,1984	0,1811
USA	0,0064	0,0489	-0,5592	1,4733	-0,1705	0,1556

Table A.3. Descriptive statistics of data included in our study. The data consist of monthly returns for each country from February 1995 to December 2010.

Appendix B. Testing for non-stationarity

To test for non-stationarity we perform an augmented Dickey-Fuller test, whether to find out if we can reject the null hypothesis of data containing a unit root or not (Brooks, C., 2008). We find that for all regressions we reject the null hypothesis, since t-statistic shows more negative values than the critical value of 5% level. This leads to the conclusion that the data is stationary.

Dickey-Fuller test	t-statistic	critical value
Loser	-3,07	-2,87
Winner	-3,65	-2,87
Winner-Loser	-4,14	-2,87
Market risk premium (β)	-11,69	-2,87
SMB (γ)	-14,55	-2,87
HML (δ)	-12,02	-2,87

Table B.1 Results of Dickey-Fuller test.

Appendix C. Testing Ordinary Least Squares Assumptions

According to Brooks (2008) there are five assumptions which should be considered when applying the Ordinary Least Square:

$E(u_t) = 0$: Implying that the average value of the errors have zero mean. By including a constant term (α) in the regression we fulfill this assumption.

$Var(u_t) = \sigma^2 < \infty$: The second assumption implies that variance of the errors should be constant and finite, known as homoscedasticity. According to White's test results, the TR^2 values are considerably smaller than the critical values of χ^2 test statistics for 5% level and the p-values are in excess of the 0.05, hence there is no evidence for the presence of heteroscedasticity and the null hypothesis of homoscedastic errors cannot be rejected.

	CAPM			Fama-French		
	Obs*R-squared	Critical value	Prob.	Obs*R-squared	Critical value	Prob.
Loser	0,08	10,59	0,77	4,27	18,54	0,23
Winner	0,09	10,59	0,75	6,55	18,54	0,08
Winner-Loser	**0,68**	**10,59**	**0,4**	**5,81**	**18,54**	**0,12**

Table C.1. Results of the White's test.

$Cov(u_i , u_j) = 0$: The assumption of linearly independent errors requires errors to be uncorrelated over time periods. To test whether we have autocorrelation or not we do formal statistical tests. The test applied is the Durbin Watson, which tests for the first order autocorrelation.

	CAPM			Fama-French		
	d	dL	dU	d	dL	dU
Loser	0,17	1,74	1,8	0,2	1,74	1,8
Winner	0,25	1,74	1,8	0,26	1,74	1,8
Winner-Loser	**0,18**	**1,74**	**1,8**	**0,19**	**1,74**	**1,8**

Table C.2. Results of Durbin-Watson test.

According to the test results shown in the table C.2, since for all the regressions d is greater than zero and less than d_U , the presence of positive autocorrelation by rejecting the null hypothesis of no autocorrelation can be concluded. Brooks (2008) states that ignoring the presence of autocorrelation will lead to inefficient OLS estimators (estimators that are not BLUE). We therefore deal with the positive autocorrelation by applying the Cochrane-Orcutt procedure in order to obtain linearly independent residuals.

Cov(u_t , x_t) = 0: This assumption implies that the regressors should be non-stochastic, but even if this assumption is violated the OLS estimators would be unbiased and consistent.

$u_t \sim N(0, \sigma^2)$: The fifth assumption requires errors to be normally distributed. By applying the Bera-Jarque test we examine if the requirement for normality holds. According to the BJ-test results we can confirm that for 4 out of 6 regressions the null hypothesis of normality is rejected at the 5% confidence level. However, the estimators would still be consistent and we can therefore use the data in order to do further analysis.

	CAPM	Fama-French
	Prob.	Prob.
Loser	0,065	0,05
Winner	0	0
Winner-Loser	0,04	0,044

Table C.3 Results of Bera-Jarque test.