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# Momentum and reversal patterns in Europe

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## Abstract

Overall, momentum does not seem to be very strong in the sample studied. The strategy only seems to be significant when buying as well as shorting, and only for a holding period of 6 months. Adjusting for risk, these results are still robust. There does not seem to be a significant difference in whether the reversal comes from stocks that realize their momentum and stocks that do not realize their momentum in the 6 month holding period. Creating portfolios at the intersection of size and book-to-market, and momentum, seems to be a profitable strategy.

Keywords: Momentum, Reversal, Anomaly, Portfolios, Past Returns

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## Introduction

Factor investing is becoming increasingly popular among investors. As more research into factors is done, more factors seem to emerge, creating a real factor ‘zoo’. Attempts to boil these down to persisting and well-rewarding factors have been made by Harvey, Liu and Zhu (2016) amongst others, and momentum is one of the factors that seems to be robust to time, different markets and different asset classes. This paper therefore focuses on momentum.

The momentum anomaly is one of the most studied anomalies in finance. A momentum portfolio which buys past winners and sells past losers generates excess returns in the following 6-12 months (Jegadeesh and Titman, 1993). The momentum anomaly is present in international markets (Rouwenhorst, 1998), in other asset classes (Asness, Moskowitz and Pedersen, 2013) and even in industries (Moskowitz and Grinblatt, 1999). Next to the profits found in the first 6-12 months, researchers find a reversal or negative returns after the first year (Jegadeesh and Titman, 1993; Chan, Jegadeesh and Lakonishok, 1996). There is still a lot of debate about the origins of momentum, whether it is a proxy for risk or whether it exploits irrational behaviour of other investors. It is important to get a better understanding of what the momentum factor exactly is to better implement it in a diversified portfolio. On the one hand, the fact that the momentum factor is still present after all these years and has not yet been diversified away can not rule out an explanation based on risk, and if it is related to risk, it could persist forever. But in the view of many, momentum can be explained by biases in the behaviour of investors. A behavioural explanation of momentum can also be an explanation as to why the anomaly is still present in asset classes. Thorsten Hens calls momentum an ‘explosive’ strategy, which means that ‘the more people who jump on board, the higher the return’ (Robeco, March 2018). This would be an explanation for the persistence of the anomaly.

When further exploring the characteristics of the momentum anomaly, research often finds reversal after 1-3 years as mentioned before. However, evidence shows that stocks that actually exhibit momentum in the momentum portfolio show no significant reversal, while the stocks that do not contribute to the momentum profits do show reversal (Conrad and Yavuz, 2017). They argue that stocks with momentum can be separated from stocks that show reversal by sorting on size and book-to-market equity ratio. While this is shown for US stocks, research on this matter for European stocks is still missing. Their research is important because it dissects one of the characteristics of momentum, the reversal, and in this way helps us understand momentum even further. To test their theory and examine if this finding holds out-of-sample, this paper will examine where the reversal comes from in momentum in Europe.

This paper will shed light on the momentum and reversal patterns for stocks in The Netherlands, Germany, France, Italy, Spain and Portugal. It will answer the research question; Are reversal and momentum patterns linked?

The paper will be structured as follows: Section I will elaborate on the previous literature. Section II will contain the data and methodology. Section III will report the standard momentum portfolios. Section IV will examine portfolios that realize their momentum and portfolios that do not. Section V will further characterize returns on size and book-to-market to try and separate stocks from those that exhibit reversal. Section VI will conclude and interpret.

## Section I.

### Literature

Patterns in stock returns that are not explained by the CAPM by Sharpe (1964) and Lintner (1965) are referred to as anomalies. One of these anomalies is the momentum anomaly. The literature on momentum is significant. Jegadeesh and Titman (1993) find that buying winners and selling losers based on past performance generate significant positive returns, and they report that these are not due to their exposure to systematic risk. Furthermore, they also find a reversal in the following two years. Rouwenhorst (1998) examined momentum on an international scale and finds outperformance of the winner portfolio compared to the loser portfolio after adjusting for risk. Moskowitz and Grinblatt (1999) find that the momentum effect is even present in industries, also after controlling for size and book-to-market. Griffin, Ji and Martin (2003) report that macroeconomic risk factors based on Chen, Roll and Ross (1986) can not explain momentum. They also report that momentum profits exist globally and that they experience reversal over 1 to 5 year horizons.

When it comes to trading costs, Korajczyk and Sadka (2004) find that value-weighted strategies are robust to trading costs. Equal-weighted strategies however perform best before trading costs, and worse after trading costs. On the other hand, Lesmond, Schill and Zhou (2004) argue that standard momentum strategies require frequent trading, and that the stocks that contribute most to momentum returns are those with high trading costs, and therefore the momentum profits disappear after trading costs.

Fama and French (2008) find the abnormal returns associated with momentum to be pervasive, and that they appear in all size groups. Moskowitz, Ooi and Pedersen (2012) find momentum in indices, currencies, commodities and bond futures. Consistent with previous literature, they also find partial reversal over longer horizons. They attribute this to an initial under-reaction and a delayed over-reaction.

To continue with the behavioural theories underlying momentum, Chui Titman and Wei (2010) find that individualism, which is related to overconfidence and self-attribution bias, is positively associated with the magnitude of momentum profits. Daniel, Hirshleifer and Subrahmanyam (1998) argue that overconfidence can push prices further up or down and cause price momentum. Barberis, Shleifer and Vishny (1998) model investor sentiment with overreaction and underreaction. DeBondt and Thaler (1985) report on the overreaction theory and a reversal in long-term returns; low long-term past returns tend to have higher future returns.

The three-factor model as developed in Fama and French (1993) says that the sensitivity of a portfolio to the market portfolio, a size factor and a book-to-market equity factor, explains the portfolios return

in excess of the risk-free rate. Fama and French (1996) show that the three factor model can capture the long term reversal that DeBondt and Thaler (1985) find. However, they admit that their model can not explain the short term momentum that Jegadeesh and Titman (1993) find. Hong and Stein (1999) model a market to try to explain momentum as under- and overreaction, of which the latter will happen inevitably at long horizons. However, Conrad and Yavuz (2017) find that the stocks that actually go on to exhibit momentum are not the ones to experience reversals. They find that a separation can be made by stocks that will reverse and stocks that exhibit momentum by further sorting on size and book-to-market. They do this to examine the way the value and size anomaly relate to the momentum factor. Controlling for these risk factors can help rule out certain explanations for the momentum premium. Examining the factor in this way is fundamental to a better understanding of the factor and how it moves in relation to other factors like value and size. Fama and French already acknowledged that their three-factor model (1993) does not capture momentum. The Carhart four factor model (1997) expands the three factor model with a WML factor, which is the difference between the returns of winners and losers over the past year. However, Avramov and Chordia (2006) find in their paper that the model Carhart proposed does not actually capture all momentum in the US stock market. It is therefore still important to further examine momentum returns. By taking a closer look at the reversal characteristic of momentum, we can gain a better understanding of the factor. Daniel and Moskowitz (2016) already examined the crashes of momentum. They find that the momentum premium is low when market volatility is high and when the market has fallen. Their explanation is that when the market falls, the stocks that are hurt the most are high (market)beta stocks, and stocks that crash less are low beta stocks. And therefore, the momentum portfolio will have a long position in low beta stocks and a short position in high beta stocks. They design a strategy that predicts momentum volatility, creating dynamic weights and therefore improving the standard momentum portfolio. Such a finding dramatically improves the momentum strategy. Next to crashes, examining reversals found after 2-3 years is also a way to improve the standard momentum portfolio. Therefore this paper extends the research of Conrad and Yavuz (2017) to try and find more insights into momentum and reversals. The reason Conrad and Yavuz (2017) double sort on size and book-to-market is to see if these risk factors explain the momentum factor. Their main finding is that momentum stocks can be separated from those that experience reversal by sorting on size and book-to-market. If the reversal can be avoided in a momentum portfolio, portfolio management will be much easier. Their findings are therefore of importance and by testing whether their results are also present in Europe will be a significant contribution to the understanding of momentum.

## Section II.

### Data

Data is used from December 31<sup>st</sup> 1985 to December 31<sup>st</sup> 2017 for The Netherlands, Germany, France, Italy, Spain and Portugal. In total, 5191 companies are analyzed. Data is derived from Compustat. Excluded from the sample are stocks with a price below 5 euros to follow the example of Conrad and Yavuz (2017) and stocks without any shares outstanding, as these can not be traded. Log returns are calculated by using the daily closing price(PRCCD), the daily adjustment factor(AJEXDI), and the daily total return factor(TRFD) with the formula;

$$\log \frac{\left( \frac{PRCCD}{AJEXDI} \right) * TRFD [current]}{\left( \frac{PRCCD}{AJEXDI} \right) * TRFD [prior]}$$

The reason log returns are chosen is because upon examining the data, there were a lot of outliers. Calculating average returns resulted in unrealistic numbers, so log returns are used to reduce the impact of outliers on the results. The daily returns are transformed into monthly returns by compounding them. Next to the returns, size and book-to-market are also used. The definitions of size and book-to-market are taken from Ken French's Data Library and are as follows;

#### *Size*

Market Equity (ME). It is the price times shares outstanding. Price and shares outstanding are from Compustat.

#### *Book-to-Market*

Book equity(BE) divided by ME. Book Equity is constructed from Compustat data. BE is the book value of stockholder's equity, plus balance sheet deferred taxes and investment tax credit (if available), minus the book value of preferred stock.

#### *Three Factor Model*

The returns to the momentum portfolios are also adjusted for risk. They are regressed on size and book-to-market, more specifically the High Minus Low factor (HML) based on book-to-market, and Small Minus Big (SMB) based on size, and on the market factor. In a formula form, the model looks like this:

$$R_i - R_f = a_i + b_i(R_M - R_f) + s_iSMB + h_iHML + \varepsilon_i$$

## **Methodology**

A normal momentum portfolio shows significant momentum in the 0-6 months after portfolio formation and significant reversal in the 12-24 month period.

The first step is to form momentum portfolios. This is done by sorting stocks on their past 6 month return. Portfolios are made where the formation period(J) is 6 months. The stocks are then held for holding periods(K) 6, 12, 24, 36, 48 and 60 months. Then the winner-loser return can be calculated, a portfolio which simulates a zero investment portfolio by buying the winners, and shorting the losers. To follow the methodology of the previous literature, 1 month is skipped between the formation period and holding period to avoid market microstructures.

After these results, the stocks are further separated to examine whether momentum and reversal are generated by the same securities. A realized momentum portfolio is formed by taking past winners that are winners in the next 0-6 months, and past losers that are losers in the next 0-6 months. The contrarian portfolio includes past winners that become losers in the next 0-6 months, and past losers that become winners.

To further examine the returns, the stocks are sorted into terciles based on size and book-to-market. This is done to try and separate stocks that realize their momentum and stocks that exhibit reversal. A stock is classified as high risk (small size and high B/M) if one of the characteristics is in the highest tercile, and the other characteristic in at least the middle tercile. A stock is classified as low risk if at least one of the characteristic is in the lowest tercile, and the other in the middle tercile. All other stocks are placed in the medium risk group. After this, portfolios are created at the intersection of momentum and risk group. The MAX portfolio will invest in the highest risk winners and the lowest risk losers. So it will buy high B/M winners and small winners, and sell low B/M losers and large losers. The MIN portfolio will then buy low risk winners and sell high risk losers. And the NEUTRAL portfolio will then include stocks that are not included in the MAX or MIN portfolios.

By examining raw monthly returns, it can then be seen whether or not these portfolios show momentum in the 0-6 month interval and reversal in the 12-24 month period. To control for risk, the returns are adjusted for the Fama and French Three Factor Model.



### Section III.

#### Momentum portfolios

To begin with, the stocks in the sample are ranked based on their past 6 month return for each month, and held for 6 to 60 months. For the different holding periods, monthly returns are calculated. Forming standard momentum portfolios is the first step necessary to explore the reversal characteristic of the momentum anomaly. The next sections will build on this data. Below are presented the returns to the standard momentum portfolios for the sample.

Table 1. Standard Momentum Portfolio Returns

The table shows the raw returns. Stocks are sorted into deciles based on their past 6 month return. A stock is categorized as winner if its past 6 month return is in the top decile of all stocks, and as a loser if its past 6 month return is in the bottom decile. The t-statistics are reported in the second row and calculated with Newey-West standard errors using a 12 month lag. The portfolios are formed with 1 month lag between formation and holding period to avoid market microstructures. A simple t-test is performed and the t-statistics reported in the second row. The data consists of stocks from The Netherlands, France, Germany, Belgium, Spain, Portugal and Italy from January 1985 to December 2017. Stocks under the price of 5 euros are dropped. Also stocks with zero shares outstanding are excluded.

	0-6 months	0-12 months	12-24 months
Winner	0.0041	0.0013	0.0007
t-stat	(1.31)	(0.37)	(0.24)
Loser	-0.0062	-0.0041	0.0016
t-stat	(-1.46)	(-1.09)	(0.59)
Winner-Loser	0.0103	0.0054	-0.0009
t-stat	(4.36)	(2.19)	(-0.70)
Table 1 continued.			
	24-36 months	36-48 months	48-60 months
Winner	-0.0003	-0.0016	0.0015
t-stat	(-0.08)	(-0.38)	(0.46)
Loser	-0.0027	-0.0009	0.0039
t-stat	(-0.72)	(-0.21)	(1.45)
Winner-Loser	0.0024	-0.0007	-0.0025
t-stat	(1.82)	(-0.69)	(-2.23)

As can be seen in Table 1, buying winners and selling losers in itself do not produce significant results for any of the holding periods studied (up to 5 years). However, when taking a long position in the winning stocks and a short position in the losing stocks a significant result shows up. In the 0-6 month holding period, we can see a positive monthly return of 1.03% with a t-stat of 4.36. This is where the result is statistically the best. In the 0-12 month period the return is 0.54% per month with a t-stat of 2.19, meaning the first 6 months produce better returns than the 6-12 month period. There seems to be a reversal in the 12-24 month period where we can see a very slight negative return, although it is insignificant at a t-stat of -0.70. Although the results are not significantly negative, they are not significantly positive either so we can conclude that the momentum disappears in the 12-24 month period. In the 24-36 month period it turns positive again with a return of 0.24% per month and a t-statistic of 1.82. These turn negative in the 36-48 month period, although insignificantly (t-stat -0.69) and they are significantly negative in the 48-60 month period, where we can see a monthly return of -0.25% with a t-stat of -2.23. This negative result seems to be consistent with the reversal found in DeBondt and Thaler (1985) who find a reversal after 3-5 years.

#### Section IV.

### **Do Stocks Exhibit Reversal After Exhibiting Momentum?**

The following section tries to explore what the connection is between momentum and reversal. The literature suggests that momentum patterns show up in the following 6 to 12 months, and are then followed by a reversal after a year. To examine this phenomenon, stocks are categorized based on their 0-6 month holding return. If a stock is marked as a winner(loser) based on its past 6 month return, and it belongs to the top (bottom) 40% of all stock's returns in the next 6 months, it is a realized winner(loser), and thus placed in the Realized Momentum portfolio. If a stock is marked as a winner(loser) based on its past 6 month return, and it belongs to the bottom(top) 40% of all stock's returns in the next 6 months, it is a contrarian winner(loser), and placed in the Contrarian Portfolio. If momentum and reversal are linked like the literature suggests, it is expected that stocks in the Realized Momentum portfolio are more likely to experience reversal than stocks in the Contrarian portfolio.

Table 2. Fraction of stocks that follow momentum and reversal patterns

The table shows the probability of being sorted into the high or low return portfolios.

A stock's return is marked as high (low) if its past 6 month return belonged to the top (bottom) decile of all stocks past 6 month return. If that stock's return then belongs to the top (bottom) 40% of all

stocks next 6 month returns, it is again marked as high (low). This step is taken once more for the 12-24 month period after formation. The portfolios are formed with 1 month lag between formation and holding period to avoid market microstructures. The data consists of stocks from The Netherlands, France, Germany, Belgium, Spain, Portugal and Italy from January 1985 to December 2017. Stocks under the price of 5 euros are dropped. Also stocks with zero shares outstanding are excluded.

-6 to 0 months	0 to 6 months	12 to 24 months	-6 to 0 months	0 to 6 months	12 to 24 months
High (49743)	High 42.56% (21169)	High 34.83% (7374)	Low (50078)	High 33.51% (16780)	High 32.12% (5389)
		Low 35.85% (7590)			Low 33.86% (5681)
	Low 37.85% (18827)	High 30.19% (5684)		Low 43.58% (21822)	High 28.86% (6297)
		Low 36.67% (6904)			Low 31.72% (6921)

Of the 50078 losers, 21822 (43.58%) continue to be losers. 16780(33.51%) show reversal and become winners. Of the 49743 winners, 21169 (42.56%) continue to be winners, in the subsequent 6 month period. 18827(37.85%) show reversal and become losers.

Of the 21169 realized winners, 7374 (34.83%) continue to be winners, and 7590(35.85 %) reverse to be losers. The remainder end up in the middle deciles of the sample; they belong to the 5<sup>th</sup> and 6<sup>th</sup> decile and are considered neither winners nor losers. Of the 21822 realized losers, 6921 (31.72%) continue to be losers in the following period, while 6297(28.86%) reverse to become winners. Again, the remainder here becomes neither winners nor losers, they end up in the 40-60% range of the return ranking. Thus the bottom 40% performing stocks are considered losers, the top 40% is considered winning.

What these results mean is that of the realized winners, 7590 of the 49743 (15,26%) are the ones that show reversal. Of the realized losers, 6297 of the 50078(12,57%) show reversal. On average, about 14% of realized momentum stocks therefore reverse. When looking at the winner stocks that do not show immediate momentum, 6904 of the 49743(13,88%) contribute to the reversal in the 12 to 24 month period. Of the loser stocks that do not show momentum, 5389 of the 50078(10,78%) contribute to the reversal. So on average, 12,3% of the contrarian stocks exhibit reversal. Although this is slightly

lower than what we can see with the realized momentum stocks, it is not very different. We can therefore say that there does not seem to be a difference in where the reversal comes from. It does however seem as if losing stocks are less likely to reverse in the 12 to 24 month period than winning stocks. Comparing the two, we can see that on average 14,6% of original winners and 11,67% of original losers show reversal in the 12 to 24 month period. This shows that losing stocks are less likely to become winning stocks than winner stocks becoming loser stocks.

Overall, we can conclude that the results are contrary to the results of Conrad and Yavuz (2017) who examined this for NYSE, Amex and Nasdaq stocks from 1965 to 2010. They find that ‘stocks that do not contribute to momentum are more likely to experience reversal’. However for this sample, a different result is found. The table suggests that there does not seem to be a difference in where the reversal comes from. The stocks that realize their momentum do not seem more or less likely to exhibit reversal than the stocks that do not realize their momentum. However, losing stocks are less likely to reverse than winning stocks. This result is as expected when we keep in mind the prospect theory proposed by Kahneman and Tversky (1979), which says that losses are more painful than gains from equal size. What this means is that investors might not want to buy losing stocks and that they therefore do not turn to winners in the 12-24 month period. For the winner stocks, it might mean that investors are more likely to sell their winning stocks and thus create a downward pressure on the price, causing the winning stocks to be more likely to reverse in the 12 to 24 month period.

The next step is to compute the monthly returns of the portfolio of stocks that actually show momentum in the next 6 months compared to the portfolio of stocks that fail to realize their momentum. Table 3 will present those returns.

Table 3. Do stocks that exhibit momentum reverse?

The table presents monthly holding returns for the Realized Momentum and Contrarian portfolios. Realized Momentum portfolios are formed from winner and loser stocks that show momentum in the following 6 months after portfolio formation. Contrarian portfolios are formed from stocks that do not show momentum in the following 6 months and therefore do not realize their momentum. The stocks are ranked based on their past 6 month return (Jegadeesh & Titman, 1993). A stock is categorized as winner if its past 6 month return is in the highest decile of all stocks returns, and as a loser if its past 6 month return is in the lowest decile. If a stock performs in the top 40% of all stocks according to its return in the following 6 months, it is again a winner, and thus realized its momentum. Losers that belong to the worst 40% stocks in the next period also realize their momentum. The portfolios are formed with 1 month lag between formation and holding period to avoid market microstructures. T-

statistics are calculated using Newey-West standard errors with a lag of 12 months and are reported in the second column. The data consists of stocks from The Netherlands, France, Germany, Belgium, Spain, Portugal and Italy from January 1985 to December 2017. Stocks under the price of 5 euros are dropped. Also stocks with zero shares outstanding are excluded.

	Realized Momentum Winner-Loser		Contrarian Winner-Loser		Realized minus Contrarian Returns	
0-6 months	0.011	(4.16)	-0.011	(-4.16)	0.021	(4.16)
0-12 months	0.002	(1.82)	-0.002	(-1.82)	0.004	(1.82)
12-24 months	-0.001	(-0.42)	0.001	(0.42)	-0.001	(-0.42)
24-36 months	-0.002	(-1.48)	0.002	(1.48)	-0.004	(-1.48)
36-48 months	0.001	(0.79)	-0.001	(-0.79)	0.001	(0.79)
48-60 months	-0.002	(-1.98)	0.002	(1.98)	-0.004	(-1.98)

Table 3 reports monthly raw returns and table 4 presents the alphas to the Fama and French three factor model. As can be seen, the realized momentum portfolio shows significant positive monthly returns (1.1% with a  $t$ -statistic of 4.16) for the first 6 months followed by a reversal starting in the 12 to 24 month period, which is only significant in the 48-60 month period ( $t$ -statistic of -1.98). Analysing the Contrarian portfolio, we can see that it shows significant negative returns (-1.1% with a  $t$ -statistic of -4.16) in the first 6 months followed by reversal. It shows significant reversal in the 48 to 60 month period, where the returns turn positive (0.2% with a  $t$ -statistic of 1.98).

As mentioned above, table 4 will present the alphas adjusted for risk by regressing the returns of the Realized Momentum portfolio and the Contrarian portfolio on the Three Factor Model.

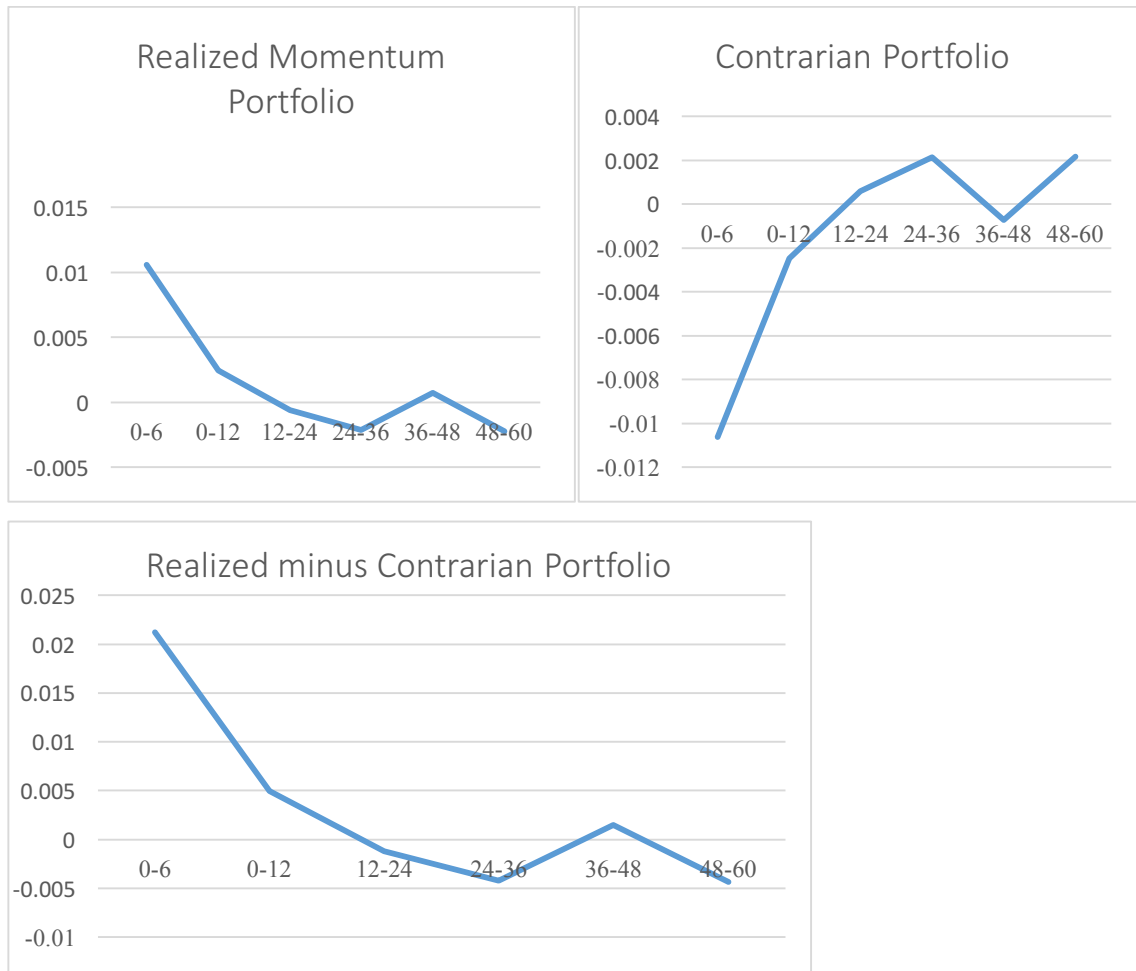
Table 4. Monthly risk adjusted alphas for Realized and Contrarian Portfolios

The table presents monthly alphas adjusted for the Fama and French three factor model. See table 4 for a discussion about how the portfolios are formed.

	Realized Momentum Winner-Loser		Contrarian Winner-Loser		Realized minus Contrarian Returns	
0-6 months	0.010	(5.12)	-0.010	(-5.12)	0.021	(5.12)
0-12 months	0.002	(1.79)	-0.002	(-1.79)	0.005	(1.79)
12-24 months	-0.001	(-0.43)	0.001	(0.43)	-0.001	(-0.43)
24-36 months	-0.002	(-1.43)	0.002	(1.43)	-0.004	(-1.43)
36-48 months	0.001	(0.82)	-0.001	(-0.82)	0.002	(0.82)
48-60 months	-0.002	(-1.98)	0.002	(1.98)	-0.004	(-1.98)

When we interpret these two tables we can see that the t-statistics increase after adjusting for risk, meaning the results are not explained by these known risk factors, size and book-to-market. We can see that the realized momentum portfolio shows an insignificant reversal after about 1-2 years. This result is in line with previous literature, but because the reversal is not very strong while the momentum in the first 6 months is, we can conclude that for this sample, momentum seems to be present in the first 6 months, and diminishes thereafter until a slight but insignificant reversal shows up. The momentum anomaly seems to be very different in Europe than in the US and other parts of the world. Comparing it to the results of Conrad and Yavuz (2017) for example, momentum in Europe seems to have a lot of different characteristics than in the US. The fact that there is a difference however is in line with the results of Chui, Titman and Wei (2010) who argue that momentum differs around the globe depending on individualism in a country. They argue that cultural differences play a role in the magnitude of momentum returns. They relate their findings to overconfidence and self-attribution bias.

It is also interesting to visualize the return patterns of the realized momentum and contrarian portfolio. Graph 1 shows these patterns to try and get a better understanding of the returns. As can be seen in the previous tables, the momentum returns disappear after 1 year and show a slightly negative return. This is in line with the previous literature which says that momentum strategies show reversal after 12-24 months.



Graph 1. A graphic visualization of the return patterns of realized momentum and contrarian stocks, and the realized minus contrarian portfolio. It presents monthly returns. In the realized winners category are stocks that belong to the top decile of past 6 month return, and the top 40% in the next 6 month period. In the realized losers category are stocks that belong to the bottom decile of the past 6 month returns, and the bottom 40% in the next 6 month period. The contrarian winners are stocks that are losers in the past 6 month period but reverse to end up in the top 40% performing stocks. Contrarian losers are stocks that are winners in the past 6 month period but reverse to end up in the bottom 40% performing stocks.

### **Identifying Stocks with Momentum versus Reversals**

To further explore the sources of momentum, we sort stocks based on their size and book-to-market and then on past returns. This is done because size and book-to-market are, according to the Fama French three factor model, proxies for risk. And according to theory and the CAPM, a higher risk implies higher rewards. Stocks are first sorted on size and book-to-market into terciles. A stock is sorted into the high risk group if it is included in the lowest tercile for size, and medium or highest tercile for book-to-market, or, if it is in the highest tercile for book-to-market and the medium or lowest tercile for size. Stocks are sorted into the low risk group if they are included in the highest tercile for size, and medium or lowest tercile for book-to-market, or, if they are in the lowest tercile for book-to-market and the medium or highest tercile for size. All other stocks are sorted into the medium risk group. Book-to-market is calculated as in Fama & French (1992). Size is the market capitalization: price times shares outstanding. A stock is categorized as winner if its past 6 month return belongs to the top decile of all stocks past 6 month return and as loser if its past 6 month return belongs to the bottom decile of all stocks past 6 month return. MAX winners are past 6 month winners in the high risk group and MAX losers are past 6 month losers in the high risk group. MIN winners are past 6 month winners in the low risk group, and MIN losers are past 6 month losers in the low risk group. MAX and MIN buy winners and sell losers in their own group. Table 5 shows the raw return patterns and table 6 shows these adjusted for size and book-to-market.

Table 5. MAX and MIN monthly raw returns.

The table reports the monthly raw returns for the MAX, MIN and NEUTRAL portfolios for the 0-6, 0-12, 12-24, 24-36 and 36-48 month holding periods. Stocks are first sorted on size and book-to-market into terciles. A stock is sorted into the high risk group if it is included in the lowest tercile for size, and medium or highest tercile for book-to-market, or, if it is in the highest tercile for book-to-market and the medium or lowest tercile for size. Stocks are sorted into the low risk group if they are included in the highest tercile for size, and medium or lowest tercile for book-to-market, or, if they are in the lowest tercile for book-to-market and the medium or highest tercile for size. All other stocks are sorted into the medium risk group. Book-to-market is calculated as in Fama & French (1992). Size is the market capitalization: price times shares outstanding. A stock is categorized as winner if its past 6 month return belongs to the top decile of all stocks past 6 month return and as loser if its past 6 month return belongs to the bottom decile of all stocks past 6 month return. MAX winners are past 6 month winners in the high risk group and MAX losers are past 6 month losers in the high risk group. MIN winners are past 6 month winners in the low risk group, and MIN losers are past 6 month losers in the low risk group. MAX



and MIN buy winners and sell losers in their own group. The portfolios are formed with 1 month lag between formation and holding period to avoid market microstructures. The t-statistics are reported in parentheses below the returns. The data consists of stocks from The Netherlands, France, Germany, Belgium, Spain, Portugal and Italy from January 1985 to December 2017. Stocks under the price of 5 euros are dropped. Also stocks with zero shares outstanding are excluded.

Portfolio	0-6 months	0-12 months	12-24 months	24-36 months	36-48 months
MAX Winners	0.005	-0.001	0.001	-0.001	-0.004
<i>t</i> -stat	(1.54)	(0.45)	(0.25)	(-0.20)	(-0.81)
MAX Losers	-0.005	-0.002	0.002	-0.004	-0.003
<i>t</i> -stat	(-1.15)	(-0.98)	(0.63)	(-1.05)	(-0.74)
MAX	0.011	0.003	-0.001	0.003	-0.000
<i>t</i> -stat	(3.97)	(2.10)	(-0.67)	(2.66)	(-0.25)
MIN Winners	0.005	0.001	-0.001	-0.004	-0.004
<i>t</i> -stat	(1.54)	(0.45)	(0.25)	(-1.05)	(-0.81)
MIN Losers	-0.005	-0.002	0.002	-0.000	-0.003
<i>t</i> -stat	(-1.15)	(-0.98)	(0.63)	(-0.20)	(-0.74)
MIN	0.011	0.003	-0.001	0.003	-0.000
<i>t</i> -stat	(3.97)	(2.10)	(0.67)	(2.66)	(-0.24)

As can be seen in table 5, the MAX portfolio shows significant positive results for the 0-6 and 0-12 month period, and the 24-36 month period. In the 12-24 month period there is a reversal, although this is insignificant. The same holds for the 36-48 months period. Looking at the MIN portfolio, we can see a positive return of 1.1% per month in the 0-6 month period (*t*-stat 3.97). There is an insignificant (*t*-stat 0.67) reversal in the 12-24 month period with a return of -0.1%.

As mentioned before, table 6 will present the alphas of the MAX and MIN portfolio adjusted for risk by regressing the returns on the Three Factor Model.

Table 6. Risk adjusted returns

The table presents monthly alphas to the Fama and French Three Factor Model for the MAX and MIN portfolios. See table 5 for a further description of how the portfolios were formed.

Portfolio	0-6 months	0-12 months	12-24 months	24-36 months	36-48 months
MAX	0.011	0.003	-0.002	0.004	-0.002
t-stat	(4.06)	(1.44)	(-1.23)	(2.18)	(-2.28)
MIN	0.009	0.003	-0.002	0.003	-0.002
t-stat	(3.76)	(1.62)	(-1.00)	(2.11)	(-1.98)

Looking at the risk adjusted returns in table 6, we can see that the MAX portfolio shows significant positive returns in the first 6 months of 1.1% per month (t-stat 4.06). There is an insignificant reversal in the 12 to 24 month period (-0.2% with a t-stat of -1.23) while there are positive returns in the 24-36 month period, 0.4% per month (t-stat 2.18). After this there is a significant reversal in the 36 to 48 month period of -0.2% per month (t-stat -2.28).

The MIN portfolio shows significant positive returns in the first 6 months of 0.9% per month (t-stat 3.76). Furthermore, we can see a similar pattern as with the MAX portfolio. After turning negative in the 12 to 24 month period (insignificant), there is a significant monthly return of 0.3% per month (t-stat 2.11) which reverses in the next period, -0.2% with a t-stat of -1.98).

Because size and book-to-market are proxies for risk, and thus expected returns, doing a double sort can tell us whether the momentum returns we observe are a result of loading on size and book-to-market, and thus are the result of higher expected returns, or whether they are not explained by risk. So when forming portfolios based on size and book-to-market, like the MAX and MIN portfolio, that differ in expected returns, we can learn more about the observed returns. However the MAX and MIN portfolio do not seem to produce that different results. This could be due to the fact that the momentum anomaly is not that strong in the sample studied, as mentioned in the previous sections. The result is again contrary to the results of Conrad and Yavuz (2017), who find the MAX portfolio returns to show significant momentum patterns without any reversal. The MIN portfolio that they construct does not seem to show any momentum, but does show reversal. This result then indicates that for the sample that they studied, the US stock market, momentum and reversal do not seem to be linked. In this sample however, Europe, this is not the case.

### **Conclusion and Interpretation**

To conclude, buying winners or selling losers by itself does not seem to generate significantly positive (or negative) monthly returns. The momentum strategy which buys winners and sells losers does however generate significant positive returns. Consistent with previous literature, these returns are positive in the first 12 months and then reverse (although insignificant in this sample). When further categorizing stocks based on their next 6 month returns we can see which stocks realize their momentum and which do not. When looking at which percentage of stocks reverse and which realize their momentum, there does not seem to be a significant difference in whether the reversal comes from realized or contrarian stocks. This result is contrary to other literature, who find that contrarian stocks contribute more to the reversal than realized momentum stocks. There does however seem to be a difference in which stocks reverse; losing stocks are less likely to reverse than winning stocks. Furthermore, the returns of the realized momentum and contrarian portfolio follow a similar pattern in their returns and subsequent reversal. When adjusting for the Fama-French three factors, these returns become stronger.

When creating intersecting portfolios sorted on size and book-to-market, and past 6 month returns, we can see that investing in low risk tercile winners and high risk tercile losers seems to be a profitable strategy. Adjusting for risk, the MAX portfolio realizes higher alphas than the MIN portfolio in the first 6 months. However, the return patterns of the MAX and MIN portfolio do not seem to indicate that momentum and reversal are not linked, contrary to the results of Conrad and Yavuz (2017).

Overall, momentum does not seem to be very strong in the sample studied. The strategy only seems to be significant when buying as well as shorting, and only for a holding period of 6 months. Adjusting for risk, these results are still robust. Regressing the results on size and book-to-market does not seem to decrease the alphas, meaning the results are not entirely driven by known risk factors. This paper seems to show that there are differences in the momentum anomaly in Europe and in the US. This could be due to different behaviour by investors as explained in other papers.

One of the shortcomings of this paper is that it examines equal-weighted portfolios. Examining value-weighted returns is something that further research can do. Also, with the recent development in momentum strategies, like the dynamic weighted portfolios as in Daniel & Moskowitz (2016), different types of momentum strategies should be tested across time periods and across markets and asset classes to gain a full understanding of the anomaly. Another shortcoming of this paper is that it examines momentum in Western-Europe instead of in each country individually. It therefore can not say anything about the momentum anomaly in each specific country. Next to that, this paper uses the Jegadeesh and

Titman (1993) methodology to sort stocks into winners and losers. It might be useful to use another method as well to make the results more robust. An example is the Lo and MacKinlay(1990) method, which takes the average stock return each month, and categorizes stocks as winners or losers depending on their return relative to the average.

Other research needs to further explore the difference in momentum between countries and the interaction of momentum and other anomalies. In this way we can gain a better understanding of each anomaly and one day come to a conclusion on whether these anomalies are risk driven or due to irrational investor behaviour, and we can make predictions on how long they will still be around. Anomalies and factor investing is already becoming increasingly popular and getting a place in diversified portfolios, but more research is necessary to get a better understanding of what kind of risks such factors expose a portfolio to.

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