Momentum strategy during a financial crisis
Analyses of the Dutch stock market

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Abstract

This paper investigates the momentum strategy during the financial crisis for the Dutch stock market. There has been a lot of research concerning the momentum strategy. Most of this research was done during good market states. But I found in this paper that a bad market state leads to a negative momentum return. During the period where the uptick rule was active, it was better to keep your cash in your pocket and not invest it in a momentum strategy. I have proved that the momentum strategy can be a very volatile strategy. The volatility of the momentum strategy depends on the rebalancing period: a more frequent rebalancing period leads to a higher volatility.
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1. Introduction

It is proved that the momentum strategy generates a return around the one percent per month. This high return rate for a no cost strategy makes the momentum strategy an interesting topic. Almost everyone can use the momentum strategy, it is a very easy strategy to apply: ranking the past stock returns and holding a winner minus loser portfolio is all you have to do.

There has been a lot of research about the momentum strategy. One part of this research is about the question: “Why does the momentum strategy earn a profit around the one percent per month?” Some researchers have argued that the momentum returns provide a strong evidence of market inefficiency, other have argued that the returns from the momentum strategies are a compensation for the risk. In this paper I will not search for a possible explanation for the momentum strategy, but I will investigate the momentum strategy during the financial crisis.

Cooper, Gutierrez JR. and Hameed (2004) investigated the returns of the momentum strategy per market state. They found a monthly return of 0.93% for the up-state, while the down-state reports a loss of 0.37% per month. During my research there was a down-state, this means that a loss can be expected. The uptick rule is a crucial rule in my research, this uptick rule exists because short selling contributes to undesirable market volatility. There cannot form a momentum portfolio during the uptick rule period, because the uptick rule prohibits holding short positions. The Dutch government implemented a special form of the uptick rule, this allows a momentum investor to apply the momentum strategy in the Netherlands during the uptick rule period.

My research question: Is it wise to invest in the momentum strategy during the uptick rule period? In other words, what for return will the momentum strategy generate during the uptick rule period?
I am going to test this question in the Netherlands, because the Netherlands is the only country where an investor can form a momentum strategy during the uptick rule period. The hypothesis which is tested according the research question is: The strategy which keeps all the cash in the pocket during the uptick rule period and does not form a momentum strategy is significantly better than the strategy which forms a momentum strategy during the uptick rule period. The other hypothesis which is tested is formulated as follows: The standard deviation of the monthly rebalancing strategy is significantly larger than the standard deviation of the half-yearly rebalancing strategy.

I find in agreement with previous literature that the momentum strategy is an unprofitable strategy during the crisis. The loss is smaller if the cash stays in the pocket during the uptick rule period, in other words, the strategy which does not invest is significantly better than the strategy which invests during the uptick rule period.

The strategy tested in hypothesis one is a strategy that rebalanced its portfolio every month. It is a very volatile strategy. This strategy is compared with a strategy that rebalanced its portfolio every half-year. Evidence is found that the strategy which rebalanced their portfolio every half-year has a significantly smaller volatility than the strategy which rebalanced their portfolio every month.

This thesis is organised as follows: section 2 provides a review of relevant literature about the momentum strategy. Section 3 describes the dataset and the methodology which are used for the research. The theory and the hypotheses are discussed in section 4. In section 5 the empirical results of this paper are presented and discussed. Section 6 concludes the thesis.
2. Literature review

2.1 Momentum strategy

There has been a lot of research about the predictability of stocks. A part of this stock predictability is based on past returns. The research based on past returns can be divided into three time-parts. The first part is about the very short run, such as a week or a month. This was researched by Jegadeesh (1990) and Lehmann (1990) and showed a reversal return. This reversal return means that “the losers” of yesterday outperform “the winners” of yesterday. The time-horizon from three to twelve months (momentum) is the second time-part. Jegadeesh and Titman (1993) report that “the winners” outperform “the losers” in the period up to one year. The momentum strategy generates high profits, with an average annual return of 9.5%. On the long horizon (2 to 5 years), the third time-part, De Bondt and Thaler (1985) report a reversal stock return. My research is focused on the second part, the momentum-part.

Momentum is tested for stocks, currencies and commodities. There are only used stocks in this research to test the momentum strategy. The momentum strategy for stocks uses long positions and short positions in stocks. A long position earns money if the stock price rises. By contrast, a short position earns money if the stock price falls. The momentum strategy is a no cost strategy if the transaction costs are neglected. The transactions cost will be neglected in my research. There is an uptick rule, this rule prohibits investors to go short in the falling stocks. There cannot be construct a momentum portfolio in this period where the uptick rule is active. The uptick rule exists because short selling contributes to undesirable market volatility. The period in which the uptick rule is active is a crucial period for my research.

The momentum strategy can be divided into three periods. A visual overview of these periods is given in figure 1. Period J is the period where the past returns are ranked on past performance, the ranking period. Period K is the period where the portfolio of long stocks and short stocks are held, the holding period. The long positions in stocks are “the winners” of period J and the short positions in stocks are “the losers” of period J. Between period J and period K is period S, this is the “skip-period”. Period S is an optional period. If there is a
“skip-period”, this period often consist of one month. Chan, Jegadeesh and Lakonishok (1996) skip the first five days after the portfolio formation to mitigate the performance of the price momentum strategy. This is done because return measures over contiguous intervals may be spuriously related due to bid-ask bounce.

| J = Period where the stocks are ranked |
| S = Skipping period between the ranking period and the holding period |
| K = Period where the portfolio is held |

Figure 1 A visual overview of the three parts of the momentum strategy

Strategies with different durations for the ranking period and different durations for the holding period are tested in the literature. Period J and period K are tested with durations of three, six, nine and twelve months. A large body of research, including Jegadeesh and Titman (1993) and Rouwenhorst (1998), reports positive returns for all of the zero-cost momentum portfolios. By constructing a portfolio, it is usual that the investor buys the stocks of the top 10% of the ranking (long position) and sells the stocks of the bottom 10% of the ranking (short position). I will use nearly the same percentage in my research. The momentum strategy is a strategy for active investors, because the investors must monitor their portfolio regularly.

2.2 Explanations for the momentum strategy

The momentum strategy cannot be explained by the three-factor model of Fama and French (1993). This three factor model can predict the average return of stocks with a SMB-factor and a HML-factor. SMB means small minus big, a size factor. Big firms tend to have a larger return on assets than small firms. HML means high minus low, a book-to-market-equity factor. Firms that have a high book-to-market ratio tend to have a low return on assets. This Fama and French model only explains expected returns for the long run and does not explain future return in the short run (momentum). Chordia and Shivakumar (2002) suggest that they are able to explain the momentum strategy by common macroeconomic variables. They use
the dividend yield, the default spread, the yield on three month T-bills and the term structure spread to explain the profits of a momentum strategy. I will not build a model to explain the profitability of the momentum strategy. I will test the return reaction of the momentum strategy in a crisis.

“Why does the momentum strategy earn a profit around the one percent per month?” is an interesting question. More and more researchers try to answer this question. Some researchers have argued that the momentum results provide a strong evidence of market inefficiency, other have argued that the return from the momentum strategies is a compensation for the risk. Daniel, Hirshleifer and Subrahmanyam (1998) found that the momentum could be explained partially due to overconfidence of the investor (market inefficiency). They say that investors attribute successes to their own skills more than they should and attributes failures to external noise (bad luck), more than they should. The increase in overconfidence stimulates the overreaction and pushes up the stock price of the winners above their fundamental values, a positive momentum return. In the long-run, as an investor observes future news and realizes his errors, the overreaction will be corrected and the stock price reverts to their fundamentals, a long run reversal.

Grinblatt and Han (2005) will explain the momentum effect with an equilibrium model. They say that the prospect theory (PT, a theory that tries to model the real life choices and not the optimal decisions) together with mental accounting (MA, it tries to described the reaction process of people on economic outcomes) explains the disposition effect (sell winners too soon and hold losers too long). They see momentum in stocks because high stock returns in the past tend to have positive unrealized capital gains for most PT/MA investors and stocks with low return in the past are more likely to have unrealized capital losses.

Hong and Stein (1999) designed a unified behaviour model with two groups of (boundedly rational) agents: “newswatchers” and “momentum traders”. A “newswatcher” receives only private information, but he does not use stock price information. The “momentum trader” uses only the past stock prices as information source. If only “newswatchers” are active in the market, Hong and Stein show that the stock price has an underreaction (prices adjust slowly
to new information). They disappear the underreaction of the “newsworthers”, if they add the “momentum traders” to their model. Hong and Stein believe in inefficient markets and they show an overreaction by the momentum strategy.

Conrad and Kaul (1998) have argued that the returns from the momentum strategy are a compensation for the risk of the investor. They suggest that a higher return of a winner in the holding period represents his unconditional expected rate. In other words, Conrad and Kaul predict that the returns of the momentum portfolio will be positive even after the 12 months holding period. But this is inconsistent with all the momentum data research.

Chui, Titman and Wei (2010) suggest that the risk-based theory must explain why momentum returns are risky in Europe and in the US, but not in Japan and in most East-Asian countries. Their evidence indicates that the culture of a country can have an important effect on the stock return pattern. Less individualistic cultures put less weight to their own skills and more weight on the consensus of their peers. This event results in less overconfidently acting as described by Daniel, Hirshleifer and Subrahmanyam (1998). This paper shows that the momentum strategy is a good strategy for individualistic countries like the Netherlands.

Voyanos and Woolley (2008) have another explanation for the momentum and the reversal. They seek an explanation by the fund performance. A mutual fund cannot immediately buy or sell stocks because they have institutional constraints. If there is a negative shock, private investors will sell the stocks immediately, but the mutual funds cannot do this, they will have to sell the stock in the next period. These delayed actions of the mutual funds push the price of the stock below its fundamental value, leading to momentum. After the momentum, the stock price will rise to its fundamental value, leading to reversal. The fund performance will not be involved in my research.

In this paper, the following question will not answer: “Why does the momentum strategy earn a profit around the one percent per month?”. This is a question that has to deal with behavior, my paper is a finance research.
2.3 Momentum in combination with other features

Cooper, Gutierrez JR. and Hameed (2004) have researched the momentum strategy and the state of the market. They define two states: the up-state, when the lagged three-year market return is positive and the down-state, when the lagged three year market return is negative. The monthly momentum profit in this research was 0.93% for the up-state, while the down-state reports a loss of 0.37% per month. This means that the momentum strategy is not a good strategy in a decreasing market. Chordia and Shivakumar (2002) agree with Cooper, Guiterrez and Hameed that momentum returns are positive only during expansionary periods. They find negative returns during a recession.

Griffin, Ji and Martin (2003) find opposite results with respect to the momentum strategy in bad market states. They find that the momentum strategy generates a positive return in both good and bad business cycle states. This result is also inconsistent with their theory that momentum is a reward for the priced business cycle risk. There has not been much research about the momentum strategy in different economical states. It is not clear if the momentum strategy is always a good strategy. In my research is used data from a decreasing market. My research can provide more evidence about the momentum strategy in the bad market state.

Most of the momentum investors invest in small and in mid-cap firms. The momentum investors focus on small companies because the market is more inefficient for smaller firms than for larger firms. Jegadeesh and Titman (2001) test of the momentum effect also works for large firms. They excluded small firms because it is proportional more expensive to trade smaller capitalization stocks. They assume that it is not possible to execute active trading strategies with stocks of small firms. The results of Jegadeesh and Titman show that the momentum effect is valid for large stocks as well as for small stocks. In my research, I will use the largest stocks of the Dutch market. But this Dutch market does not have very large companies in comparison with the US companies.

A disadvantage of the momentum strategy in relation to the finance theory is the fact that momentum strategy results in poorly diversified portfolios. Rouwenhorst (1998) examines
the international diversification of the momentum strategy. A large country specific positive shock can create many stocks of one country in the top decile of the ranking, and on the contrary, a country specific negative shock can result in many stocks of one country in the bottom decile of the ranking. These shocks cause a poor international diversified momentum portfolio. Rouwenhorst creates an international portfolio where every country contributes the same share of stocks. The average monthly excess return (of winners over losers) reduces from 1.16% to 0.93%. The standard deviation reduces as well from 3.97% to 2.39% per month. This suggests a relatively unimportant country momentum. Rouwenhorst pays attention to the returns and the risks, in most of the momentum literature there has only been paid attention to the return part. I will look to the return part as well as to the risk part.

Moskowitz and Grinblatt (1999) examined industries in relation to momentum. They test the industry diversification. Moskowitz and Grinblatt construct a portfolio with a long position in the best industries and with a short position in the worst industries. This is a poorly diversified strategy. They find that industry momentum earns more profit than individual stock momentum. Moskowitz and Grinblatt findings are against the finance theory of diversification. No attention will be given to any form of diversification in my research.

Jegadeesh and Titman (1993) do research to the existence of the January effect into the momentum strategy. The January Effect is an increase in the stock prices in the month of January. Keim (1983) documents abnormal high returns for small firms in the first week of January. Jegadeesh and Titman report a momentum loss of 7% on average in January, but achieved positive abnormal returns in each of the other months with a zero cost momentum strategy. One logical explanation for this January effect in the momentum strategy is the fact that “Losers” are on average smaller firms than “Winners”. This corresponds to the findings of Keim. In my research the January effect will not be discussed, because the momentum strategy is still a profitable strategy if the January effect is neglected. Adding this effect into the strategy goes beyond the purpose of this research. Moreover, the uptick rule is not active in the month January and this makes the January effect less important for my research.
Asness, Moskowitz and Pedersen (2009) studied the momentum effect in conjunction with the value effect. These two effects are “two of the most studied capital market phenomena” according to them. The value effect is the relation between the asset return and its long-run value relative to its current market value. They studied the link between value and momentum strategies and found that those two effects result in positive expected abnormal returns in a variety of markets and assets classes. The value/momentum combination performs better than the features separately. The value effect will be neglected in this research and the focus will be mainly on the momentum effect.
3. Data and methodology

3.1 Data
Data from the beginning of 2004 until April 2010 have been studied for this research. There was a worldwide economic crisis during this period. This economic crisis found its origin at the end of 2006.¹ This is when many American house-owners could not pay the repayments on their mortgages. The financial crisis starts in Europe in the middle of 2007. The first small growth of the financial market, after the starts of the crisis, was in the second quarter of 2009. This research is about the return of a momentum strategy during this crisis.

The market close stock prices of the Dutch Amsterdam Exchange Index (AEX-Index) are used for this research. I get the data from Datastream, which supplies the stock prices of the 25ste largest Dutch companies which are listed on March 2009 on the AEX. One stock (TomTom) does not have stock price data for the whole data period and was therefore removed from the data. The AEX listed companies give a good representation of the state the European economy, because the Dutch economy has a lot of interaction with the rest of Europe. Europe is a well developed continent and the economic crisis has a major impact on this well developed continent.

3.2 Methodology
In my research are formed portfolios based on a ranking period of 6 months. The holding period also consists of 6 months. There is no skipping period. I used monthly stock prices. Every month the stocks are ranked again and every month there is formed a new portfolio. I have taken long positions in three stocks with the best performance in the ranking period and I have taken short positions in three stocks with the worst performance in the ranking period. This corresponds to the top 12.5% and the bottom 12.5% of the ranking.

¹ http://www.nrc.nl/nieuwsthema/kredietcrisis/article1987320.ece - NRC Handelsblad, 17 September 2008
I use two fundamentals (dividends and earnings) to calculate the stock return. The stock return is the dividend yield plus the capital gain:

\[ R_{stock} = \frac{D_t}{P_{t-1}} + \frac{(P_t - P_{t-1})}{P_{t-1}} \]

Were \( D_t \) is the dividend in month \( t \); \( P_{t-1} \) is the market close stock price at time \( t-1 \) (the beginning of a month); and \( P_t \) is the market close stock price at the end of the month. The capital gain is the arithmetic return of the monthly stock prices. I use the geometric average returns (a multi-period return) to calculate the average monthly return per share for the ranking period and for the holding period. I have chosen these geometric average returns, because these are often used in the research and they give the best picture of an average of a period.

3.3 Winner – losers

There is formed a portfolio with long positions in “the winners” and short positions in “the losers”. The return of the no cost momentum portfolio is equal to: “the winners” minus “the losers”. This is the regular form of calculating the return for a momentum strategy. If the economy is in a growing state, “the winners” have a higher return than “the losers”. In other words, the portfolio is profitable. I do not know exactly what I must expect of the momentum strategy in a recession.

3.4 Uptick rule

The uptick rule is an important rule for my research. The uptick rule prohibits investors to go short in decreasing stocks. The uptick rule is only valid if the government has implemented this rule for a temporary period. The government implements this rule only in a decreasing market. In a decreasing market, the market is very volatile and the short positions increase the volatility. By prohibiting short position in decreasing stocks, the government will decrease the volatility.
The momentum strategy is a strategy that goes short in the losers of yesterday. During the crisis, the losers of yesterday are decreasing stocks. Short positions cannot be taken in decreasing stocks during the period where the uptick rule is active (Hereafter named “the uptick rule period”). This means that a momentum portfolio cannot be made during the uptick rule period.

In the Netherlands the uptick rule was active in the period from 22 September 2008 to 22 December 2008\(^2\). The Dutch Government did not implement the regular uptick rule, but they implemented a different one, only naked short selling is not allowed in this period. The normal form of short selling was allowed in the Netherlands during the uptick rule period: borrowing stocks and sell them with the intention to repurchase the stock for a lower price. Naked short selling is an unsecured form where no stocks are borrowed. Other governments, like the governments of the US, Great-Britain, Germany, Belgium and France, prohibits investors all forms of short selling. A regular momentum portfolio can be constructed during the uptick rule period in the Netherlands, because the Dutch government implements a different uptick rule. Constructing a regular momentum portfolio during the uptick rule period is not possible for the other countries which are mentioned above.

In a falling market you earn money by holding the short position. In countries like the US, Great-Britain, Germany, Belgium and France, is forbidden this way to make money. Germany and France want to introduce in June 2010 a European prohibition at the naked short selling form.\(^3\) An action like the Dutch government anno 22 September 2008 is not possible (and not necessary) if this European prohibition is implemented.

\(^2\) [http://www.nrc.nl/economie/article1992251.ece/Nederland_legt_omstreden_speculatie_aan_banden](http://www.nrc.nl/economie/article1992251.ece/Nederland_legt_omstreden_speculatie_aan_banden)  
NRC Handelsblad, 22 September 2008

\(^3\) [http://www.nrc.nl/economie/article2561450.ece/Voorlopig_geen_EU-verbod_op_short_gaan](http://www.nrc.nl/economie/article2561450.ece/Voorlopig_geen_EU-verbod_op_short_gaan)  
NRC Handelsblad, 10 June 2010
4. Theory and hypotheses

4.1 Theory

Momentum strategy during the uptick rule period
First I am going to test if the momentum strategy is profitable during the uptick rule period. The Dutch government implemented a strange form of the uptick rule (only naked short sales are not allowed), this implies that I can form a momentum strategy during the uptick rule period. But is it wise to form a momentum portfolio during the uptick rule period?

During the uptick rule period, the market is decreasing. Cooper, Gutierrez JR. and Hameed (2004) and other researchers have proven that a momentum strategy during a falling market gives a negative return. But there are also researchers who find positive momentum returns during the bad market state. In this paper I am going to test if the strategy in which cash stays in the pocket during the uptick rule period (not investing if the uptick rule is active), is a significantly better strategy than the strategy which forms a momentum strategy during the uptick rule period.

I expect that the momentum strategy during the uptick rule period has a negative return, as shown in most of the previous research. This means that investing during the uptick rule period would not be smart. The only way to make money in a decreasing market is holding short positions. If I book the same results as previous research, the loss of holding a long position is larger than the benefit of holding a short position during the uptick rule period. This results in an overall loss.

The two strategies above are both no cost strategies (if the trading costs are neglected). There are also two other strategies possible if the ranking data of the momentum strategy is used. These strategies are: the strategy which holds only long positions in the winners of the ranking period and the strategy which holds only short positions in the losers of the ranking period. These are both, in opposite to the momentum strategies, costly strategies. Holding a
long position during a crisis is not popular under the investors. I shall not pay a lot of attention to the strategy that holds only long positions.

It seems that the strategy which holds only short positions during the uptick rule period is a good strategy. This strategy is not possible in the countries where the uptick rule prohibits all the short selling. The Netherlands is the only country where investors can apply this strategy. I will take a look at the results of this strategy, because it is an interesting strategy. There is a great chance that this strategy is no longer possible in the future, because the interference of the Dutch government is a strange one and is not going to happen again soon. It is possible that naked short selling will be prohibited forever in Europe, in this case the Dutch government cannot use this form of the uptick rule again.

Volatility for different rebalancing periods

The volatility plays a big role in the crisis period. The government introduced the uptick rule to decrease this volatility. The momentum strategy has some different features which influence the volatility: The durations of the ranking period; the durations of the holding period; and the frequency of rebalancing. In this paper the last volatility-feature will be tested: different rebalancing periods.

The strategy of above, where the momentum strategy is tested during the uptick rule period, tests the momentum strategy with a rebalancing period of one month. Every month a new ranking period based on the last six months was made and I selected a portfolio which was held for the next six months. At an arbitrary point of time, six portfolios with each three long positions and three short positions are held. In other words, there are held 18 long positions and 18 short positions. This strategy is a strategy which often rebalanced its portfolio.

I will compare this strategy with a strategy which rebalanced its portfolio less often. I am going to compare it with a strategy that rebalanced its portfolio each six months (every half year). With this strategy, exactly one portfolio of three long positions and three short
positions is hold at any point of time. A new portfolio is formed if the holding period of the previous portfolio is over.

I am going to test if the strategy of rebalancing every half year has a significantly smaller volatility than the strategy that rebalances every month. You hold less long positions and less short positions if you rebalanced your portfolio every six month, I expect that this strategy results in a less risky portfolio.

4.2 Hypothesis
In this paragraph the hypotheses of the theories mentioned above are given. In the next section, I am going to test the below presented hypothesis with a significance level of 99% (\(\alpha = 0.01\)). I take a small alpha (\(\alpha\)), because I want to test it with a high certainty.

**Momentum strategy during the uptick rule period**
I am going to test the difference between expectations of two populations. These expectations of the two populations are formulated with \(\mu_F\) and \(\mu_{NF}\):

\[
\mu_F = \text{Expected mean of the strategy which forms a momentum strategy during uptick rule period.}
\]

\[
\mu_{NF} = \text{Expected mean of the strategy in which all the cash is kept in the pocket during the uptick rule and does not form a momentum strategy during this period.}
\]

The following hypotheses are formed:

\(H_0: \mu_F - \mu_{NF} \geq 0\)

\(H_1: \mu_F - \mu_{NF} < 0\)

The alternative hypothesis is smaller than zero, because I expect that the strategy which keeps all the money in the pocket is significantly better than the strategy which forms a momentum strategy during the uptick rule period.
Volatility for different rebalancing periods

I am going to test the hypothesis, that the standard deviation of the half-yearly momentum strategy is significantly smaller than the standard deviation of the monthly momentum strategy. I use the following symbols:

\[ \sigma_{HY} = \text{The standard deviation of the half-yearly momentum strategy} \]

\[ \sigma_{M} = \text{The standard deviation of the monthly momentum strategy} \]

The following hypotheses are formed:

\[ H_0: \frac{\sigma_{HY}^2}{\sigma_{M}^2} \geq 1 \]

\[ H_1: \frac{\sigma_{HY}^2}{\sigma_{M}^2} < 1 \]

If both variances are exactly the same, the solution of this formula is exactly 1. I will test if the standard deviation of the monthly rebalancing strategy is significantly larger, this means that I expect that the solution of the formula is smaller than one (alternative hypothesis).
5  Empirical Results

5.1 Development of the Dutch stock market (AEX-Index)

In this paragraph is the development of the Dutch stock market shown. The AEX-Index represents the average development of the 25 largest Dutch stocks. In figure 2 can be seen when the crisis had his impact on the Dutch stock market and at which point of the crisis the government intervened with the uptick rule.

![AEX-Index from January 2004 to April 2010](image)

Figure 2  AEX-Index from January 2004 to April 2010

In figure 2 can be seen an increase of the AEX-index from January 2004 to October 2007. From October 2007 to November 2008 the financial crisis causes a hard decrease of the AEX-Index. After November 2008, the AEX-Index has again an upward trend. This figure gives a global picture of the effects of the financial crisis on the Dutch stock market. It's possible that some industries were affected by the financial crisis before October 2007, but that these negative results were compensated by positive returns from other industries.
The uptick rule was introduced on 22 September 2008. At that point, the Dutch stock market was a falling market. In that three month’s period where the uptick rule was active, the market made its turnaround from a decreasing market to an increasing market. It can be coincidence that the turnaround found place during the uptick rule, but it can also be the case that the government’s intervention has led to a positive reaction on the Dutch stock market. In this research I am not going to trace why the Dutch stock market makes its turnaround.

5.2 Momentum strategy during the financial crisis

Figure 3 is an overview of a winner minus loser momentum portfolio based on 24 stocks of the AEX market. In July 2004 the first “winner” minus “loser” portfolio is formed. This portfolio is based on the ranking period from January 2004 to June 2004. In this figure was formed every month a new portfolio and all the portfolios were held for six months. The last portfolio was formed in October 2009 and was held from October 2009 to April 2010.
Figure 3 starts with an index of 100 basic points and there can be seen a profitable momentum strategy in the first part of the time horizon. At the end of 2005, the line of the index changes from an increasing line to a decreasing line. Comparing the momentum return of figure 3 with the AEX-Index of figure 2, in figure 2 there is an increase of the AEX-index from January 2004 to October 2007. The momentum return had a negative slope in the period from January 2006 to July 2007. I had expected a positive slope for the momentum strategy in this period, because the literature proofs that the momentum strategy is profitable in an increasing market. This is inconsistent with the previous literature.

The fact that the momentum strategy shows a high positive return in the period that the financial crisis starts to affect the AEX-index (October 2007 –March 2008) is remarkable. In this period, the ranking period is based on an increasing market and the holding period is a decreasing market. From this event I can conclude that winners of the ranking period were affected later by the financial crisis. Figure 3 shows a negative slope from March 2008. This event agrees with the position of Cooper, Gutierrez JR. and Hameed (2004) and Chordia and Shivakumar (2002). They document a negative return if the market is in a bad state. A same kind of remarkable thing is shown at the end of the financial crisis: The AEX-Index makes its turnaround from a decreasing market to an increasing market earlier in time than the momentum strategy.

The two lines of the different strategies go away from each others at the moment that the Dutch government implemented the uptick rule. The uptick rule was active in the Netherlands from 22 September 2008 to 22 December 2008. One strategy, the blue-checkered line, forms a momentum portfolio in the uptick rule period. The other strategy, the pink-triangular line, keeps all the cash in the pocket during the uptick rule period and does not forms new portfolios during this period. This last strategy results in a horizontal line of the index during the uptick rule period. As can be observe in figure 3, the best strategy for my data was to mind the uptick rule and do not form a portfolio during the uptick rule. The difference between those two strategies is further specified in the next paragraph.
In this paper an index-value is being used. But what is the economic impact on this strategy? Assuming that the investor holds an amount of 100,000 euro in long positions and holds an amount of 100,000 euro in short positions at the start of every holding period. After one year of investment (June 2005), the investor had almost a value of 130,000 euro. In the period of June 2005 to June 2008, first the value shrinks and later, the value creeps up. In June 2008 the investor had a value around the 125,000 euro. After June 2008, the investor loses money almost all the time. At the end of the investment period, the value is around the 55,000 euro for the investor which also invests during the uptick rule period and the value is around the 70,000 euro for the investor which keeps all cash in the pocket during the uptick rule period. The economic value fluctuates a lot, the strategies of figure 3 are very volatile strategies.

5.3 Momentum strategy during the uptick rule period

Figure 4 is a graph with data from September 2008 to December 2008, the period where the uptick rule was active in the Netherlands. The index starts at 100 basic points at September 2008. In figure 4 is clearly visible that the strategy which keeps the cash in the pocket during the uptick rule, the pink-triangular line, is a horizontal line with the value 100. The strategy that forms a momentum portfolio during the uptick rule, the dark blue-checkered line, decreases during the whole uptick rule period. The conclusion is the same from figure 4 as from figure 3, it is better not to invest in the momentum strategy during the uptick rule period.

Figure 4 has two strategies more than figure 3. These are the strategy which hold only short positions in the worst three stocks of the ranking period (the green-diamond line) and the strategy which holds only long positions in the best three stocks of the ranking period (the light blue-bullet line). I expected a decreasing slope for the strategy which holds only long positions, because the data comes from a decreasing market. On the opposite, I expected a positive slope for the strategy which holds only short positions. Holding the strategy which holds only short positions together with the strategy which holds only long positions makes the strategy that forms a momentum strategy during the uptick rule period.
The strategy which holds only short positions has the first two months a positive return. But in the third month, the line falls down to the line of the strategy which keeps all the cash in the pocket during the uptick rule period. In other words, based on the collected data, there is no value creation by holding only short positions during the uptick rule period. The turnaround of the strategy that holds only short positions (in November 2008) is at the same moment in time as the turnaround of the AEX-Index of figure 2. There is probably a negative correlation between those two features.

Now I will test if it is wise to invest in the Dutch stock market in the period where the uptick rule holds. The hypothesis is tested with an independent samples T-test. Two groups are formed for this test. Group F is the index of the strategy which forms a momentum strategy during the uptick rule period. Group NF is the index of the strategy which keeps all the cash in the pocket and does not form a momentum strategy during the uptick rule period. It is a one-tailed T-test, because the test consists of the question of the strategy of group NF it is better that the strategy of group F. The output of the independent samples T-test is found in Appendix A.
The independent samples T-test tests the difference between expectations of two populations ($\mu_F$ and $\mu_{NF}$). I assume that my separate samples come from two normally distributed populations. The independent samples T-test can be exercised for equal variances and for different variances. I tested the variances and conclude that the variances are different (the methodology of this F-test is clearly explained in the next section):

The rejection border: $F^{-1}(0.99;3,3) = 0.0339$

The F-value

$$\frac{\sigma_{NF}^2}{\sigma_F^2} = \frac{0^2}{5.3^2} = 0$$

The rejection border for a left-sided T-test can be determined with the following Excel-formula: $T^{-1}(2\alpha; df)$. The abbreviation “df” stands for the degrees of freedom. This value can be found in appendix A. The rejection border for alpha ($\alpha$) 0.01 is $T^{-1}(0.02;3) = -4.5407$. An overview of the one-tailed T-test is given in figure 5.

Interpreting the output of the independent samples T-test of appendix A, group NF has a higher mean than group F. The T-test gives a T-value of –2.027 and it gives a two-tailed P-value of 0.136. This is the same as a one-tailed P-value of 0.068.
Comparing the T-value of the SPSS-output with the rejection region, there can be conclude that the null-hypothesis cannot rejected at a signification level of 99% (and also not at a signification level of 95%). \( \mu_{NF} \) is not significantly better than \( \mu_F \). If I test it on a 90% signification level, the T-value must compare with the SPSS-output with the T-value of -1.6377 (T.inv(0.20;3)). In this case, the null-hypothesis can reject and the alternative hypothesis holds true. In other words, my data proofs that a strategy which does not form momentum strategy during the uptick rule period is a significantly (90%) better strategy than the strategy which forms a momentum strategy during the uptick rule period.

In appendix A is also shown an 80% confidence interval of the difference. This is a two-tailed confidence interval and this gives the same solution as a one-tailed 90% confidence interval. I can conclude the same as above, that \( \mu_{NF} \) is significantly (90%) better than \( \mu_F \), because the whole interval lies entirely left from the zero.

A Dutch bank fell during the financial crisis. This has its impact on the whole banking sector. But it did not have a major impact on my momentum strategy, because there is use a ranking period of six months. If there was used a ranking period of one month, the large decrease of the banking sector would have a much larger impact at the ranking period. This can result in more benefits from the short positions of the momentum strategy. This topic is an interesting topic for further research.

In a crisis there is mainly made money by the short positions. But if a company has a falling stock, the company does everything to reverse this decreasing stock to an increasing stock as soon as possible. They will revert to an increasing stock faster than six months (the time of my holding period). Maybe there is made more money from the short positions if there was a shorter holding period, like one month or three months. This is also an interesting topic for further research.
5.4 Interpreting all the groups

In the previous literature of Rouwenhorst (1998), Jegadeesh and Titman (2001) and many others is often proven that the winners of yesterday outperform the losers of yesterday in the near future. In this previous literature, it is usual to see a negative trend between the returns of the different groups, starting with the highest returns for the first group (the winners) and ending with the lowest return for the last group (the losers). For example, the number 12 of the ranking will outperform the number 15 of the ranking in the near future. In this paragraph I am going to look if this is also the case with my data.

<table>
<thead>
<tr>
<th>Group 1 Average return:</th>
<th>Group2</th>
<th>Group3</th>
<th>Group4</th>
<th>Group5</th>
<th>Group6</th>
<th>Group7</th>
<th>Group8</th>
<th>Winner - Loser</th>
</tr>
</thead>
<tbody>
<tr>
<td>22/07/2004 - 22/3/2007</td>
<td>3.10%</td>
<td>2.08%</td>
<td>2.02%</td>
<td>2.01%</td>
<td>2.16%</td>
<td>2.16%</td>
<td>2.35%</td>
<td>2.91%</td>
</tr>
<tr>
<td>23/3/2007 - 22/10/2009</td>
<td>-1.90%</td>
<td>-1.68%</td>
<td>-0.62%</td>
<td>-0.85%</td>
<td>-0.03%</td>
<td>-1.23%</td>
<td>-0.08%</td>
<td>-0.19%</td>
</tr>
<tr>
<td>Total average</td>
<td>0.68%</td>
<td>0.26%</td>
<td>0.74%</td>
<td>0.63%</td>
<td>1.10%</td>
<td>0.52%</td>
<td>1.17%</td>
<td>1.40%</td>
</tr>
</tbody>
</table>

Table 1 The momentum returns per group

Table 1 represents the momentum returns per group in the period from July 2004 to October 2008. Group 1 includes the best three stocks (12.5% of the data collection) of the ranking period, group 2 includes the fourth, fifth and sixth stock of the ranking period, etcetera. Table 1 splits the data in two parts, the first part is until March 2007 (6 months before the start of the financial crisis, the last holding portfolio is held before the financial crisis). The second part is after March 2007 (the first holding period starts around the start of the financial crisis).

Until March 2007, Group 1 and group 8 were the best performing groups. The performance of group 1 is in agreement with the results of previous literature. The performance of group 8 is in contradiction with the findings of previous literature. Furthermore, group 2 to group 7 performs almost equally, in other words, there is not to see a negative trend. A few possible
explanations for these opposite results in relation to the previous literature is the volatile period of research, the short time span of the research and the small data collection.

After March 2007, there cannot be any linear trend detected. A remarkable fact is that group 1 and group 2 perform much worse than the other groups. Nothing important can be concluded from table 1.

5.5 Volatility for different rebalancing periods

Figure 6 shows the returns of two momentum strategies for different rebalancing periods. The blue-checkered line is a momentum strategy that rebalanced their portfolio every six months. The investor of this strategy ranked the stocks at time t for the period from t \(-6\) till t and he holds the portfolio from t till t\(+6\). The next balancing period is at time t\(+6\). The investor of this strategy holds a maximum of one momentum portfolio every month. The red-triangular line is a momentum strategy that rebalanced their portfolio every month. The first time to rank the stocks and to construct a portfolio is time t, the second point of time to rebalance is time t\(+1\). Almost the whole investing period, the investor of the monthly rebalancing strategy holds six different momentum portfolios.

![Figure 6: Returns of two momentum strategies for different rebalancing periods](image-url)
Interpreting figure 6, the blue line is a much more constant line than the red line. After five years investing, both strategies have a loss, but the blue line has a smaller loss than the red line. A logic explanation for the difference between the two lines is the number of stocks which are held. If you hold more stocks (monthly rebalancing), you bear more risk. This extra risk results in a higher standard deviation and in a more fluctuating line.

Appendix B gives an overview of the data which were used for figure 6. In the second and the fourth column of the appendix, the half-yearly winner minus loser return are given for respectively the momentum strategy that rebalanced every half year and the momentum strategy that rebalanced every month. In the second column the winner minus loser return is based on one portfolio and in the fourth column the winner minus loser return is based on the sum of all the six portfolios which are held during this period. Column three and column five represent the indexes. The values of column three and column five are used for figure 5.

Needed is a left-sided F-test to test the hypothesis that the standard deviation of the half-yearly momentum strategy is significantly smaller than the standard deviation of the monthly momentum strategy. I assume that my separate samples come from two normally distributed populations. The rejection border for a left-sided F-test can be determined using the following Excel-formula: $F_{\text{inverse}}(1-\alpha; N_1-1; N_2-1)$. The rejection border for my test is: $F_{\text{inverse}}(0.99;10;10) = 0.2062$. Figure 7 gives an overview of this F-test.

![Figure 7](image-url)  
Figure 7: An overview of the acceptance region and the rejection region of the F-test
The half-yearly variances of the winner minus loser return, from appendix B, are inserted in the formula. This results to the following solution:

\[
F\text{-value: } \frac{\sigma_{\text{half-yearly}}^2}{\sigma_{\text{monthly}}^2} = \frac{0.0017}{0.0192} = 0.0889
\]

The F-value 0.0889 is located in the rejection region, this means that the null-hypothesis is rejected and that the alternative hypothesis stands. In other words, this data confirms that the standard deviation of the monthly rebalancing strategy is significantly larger than the standard deviation of the half-yearly rebalancing strategy.

It has been shown that the standard deviation of the monthly rebalancing strategy is significantly larger than the standard deviation of the half-yearly rebalancing strategy. This result is found in a period where the market fluctuates a lot. An interesting topic for further research is the question if the standard deviation of a monthly rebalancing momentum strategy in relation to the half-yearly rebalancing strategy is larger in every market state.
6. Conclusion

This study explores the development of the momentum return during a financial crisis. In this paper I looked at the impact of the uptick rule to the momentum return. There has never been research about the momentum strategy in combination with the uptick rule before.

My research question is: Is it wise to invest in the momentum strategy during the uptick rule period? In other words, what for return will the momentum strategy generate during the uptick rule period?

I tested two hypotheses in this paper. In the first hypothesis is tested the research question: if the strategy which keeps all the cash in the pocket and does not form a momentum strategy during the uptick rule period is significantly better than the strategy which forms a momentum strategy during the uptick rule period. In the second hypothesis is tested if the standard deviation of the monthly rebalancing strategy is significantly larger than the standard deviation of the half-yearly rebalancing strategy.

The strategy which does not form a momentum portfolio during the uptick rule period is significantly (90%) better than the strategy which forms a momentum portfolio during the uptick rule period. A negative return was obtained for the momentum strategy during the uptick rule period. Both strategies are not profitable. This is in line with the expectations based on most of the previous literature. The economic values of these strategies fluctuate a lot, these strategies are very volatile strategies.

Rebalancing every month looks like a very volatile strategy. In comparison to the half-yearly rebalancing strategy, the monthly rebalancing strategy has a significantly (99%) larger standard deviation than the standard deviation of the half-yearly rebalancing strategy. The amount of stocks which were held is a logic explanation for this result. The monthly rebalancing strategy holds six times as many stocks as the half-yearly rebalancing strategy and bears therefore more risks.
The fact that the momentum strategy shows a high positive return in the period that the financial crisis starts to affect the AEX-index (October 2007 –March 2008) is remarkable. In this period, the ranking period is based on an increasing market and the holding period is during a decreasing market. From this event is conclude that the winners of the ranking period were affected later by the financial crisis than the losers.

In this paper is used a ranking period of six months. If there was used a ranking period of one month, the large decrease of the banking sector, which took place in the Netherlands during the financial crisis, would have a much larger impact at the ranking period. This could result in more benefits from the short positions of the momentum strategy. This topic is an interesting topic for further research. Another interesting topic regarding the momentum strategy is the fact that maybe more money can be earned from the short positions if there is a shorter holding period. This because a company will reverse it decreasing stock price to an increasing stock as soon as possible.

Another interesting topic for further research with regard to the volatility in the momentum strategy is the question if the standard deviation of a monthly rebalancing momentum strategy in relation to the standard deviation of the half-yearly rebalancing strategy is larger in every market state. In an up-state, the momentum strategy is less volatile, the significant difference between the strategies disappear.
Appendix A  SPSS data of an independent samples T-test

### Group Statistics

<table>
<thead>
<tr>
<th>GROUP</th>
<th>N</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>Std. Error Mean</th>
</tr>
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<tbody>
<tr>
<td>INDEX</td>
<td>4</td>
<td>94.6250</td>
<td>5.30252</td>
<td>2.65126</td>
</tr>
<tr>
<td>NF</td>
<td>4</td>
<td>100.0000</td>
<td>0.0000</td>
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### Independent Samples Test

<table>
<thead>
<tr>
<th></th>
<th>Levene's Test for Equality of Variances</th>
<th>t-Test for Equality of Means</th>
<th>80% Confidence Interval of the Difference</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>F</td>
<td>Sig.</td>
<td>t</td>
</tr>
<tr>
<td>INDEX</td>
<td>Equal variances assumed</td>
<td>5.305</td>
<td>.063</td>
</tr>
<tr>
<td></td>
<td>Equal variances not assumed</td>
<td>-2.027</td>
<td>3.000</td>
</tr>
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</table>
## Appendix B  Momentum strategy for different rebalancing periods

<table>
<thead>
<tr>
<th>Time</th>
<th>winner - loser</th>
<th>Index (rebalancing every half year)</th>
<th>winner - loser</th>
<th>Index (rebalancing every month)</th>
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</thead>
<tbody>
<tr>
<td>22-01-2004</td>
<td></td>
<td>100,0</td>
<td></td>
<td>100,0</td>
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<tr>
<td>22-07-2004</td>
<td>7,2%</td>
<td>107,2</td>
<td>7,2%</td>
<td>107,2</td>
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<tr>
<td>22-01-2005</td>
<td>1,7%</td>
<td>109,0</td>
<td>2,9%</td>
<td>110,3</td>
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<tr>
<td>22-07-2005</td>
<td>2,0%</td>
<td>111,2</td>
<td>19,2%</td>
<td>131,4</td>
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<tr>
<td>22-01-2006</td>
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<td>110,1</td>
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<td>127,9</td>
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<tr>
<td>22-07-2006</td>
<td>-0,2%</td>
<td>109,9</td>
<td>-6,9%</td>
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<tr>
<td>22-01-2007</td>
<td>-3,0%</td>
<td>106,7</td>
<td>-8,7%</td>
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<table>
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<th>6-yearly return</th>
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<tr>
<td></td>
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<td>-5,40%</td>
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<table>
<thead>
<tr>
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<th>Annualized return</th>
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<td></td>
<td></td>
<td>-0,92%</td>
<td>-7,24%</td>
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<table>
<thead>
<tr>
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<th>Half yearly variance (index)</th>
<th>Half yearly variance (index)</th>
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<td>402,38</td>
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<td>28,37</td>
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<th>Half yearly variance (winner - loser)</th>
<th>Half yearly variance (winner - loser)</th>
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<tr>
<td></td>
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<td>0,0192</td>
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<thead>
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<th>Annualized Volatility (winner - loser)</th>
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<tr>
<td></td>
<td></td>
<td>0,06</td>
<td>0,20</td>
</tr>
</tbody>
</table>
References

C. Asness, T. Moskowitz, and L. Pedersen, Value and Momentum Everywhere, AFA 2010 Atlanta Meeting Paper, February 2009


