The Momentum Effect: Evidence from the Swedish stock market
Abstract

This thesis investigates the profitability of the momentum strategy in the Swedish stock market. The momentum strategy is an investment strategy where past winners are bought and past losers are sold short. In this paper Swedish stocks are analyzed during the period 1999 – 2007 with the approach first used by Jegadeesh and Titman (1993). The results indicate that momentum investing is profitable on the Swedish market. The main contribution to the profits is derived from investing in winners while the losers in most cases do not contribute at all to total profits. The profits remain after correcting for transaction costs for longer termed strategies while they diminish for the shorter termed ones. Compared to the market index, buying past winners yield an excess return while short selling of losers tend to make index investing more profitable. The analysis also shows that momentum can not be explained by the systematic risk of the individual stocks. The evidence in support of a momentum effect presented in this thesis also implies that predictable price patterns can be used to make excess returns; this contradicts the efficient market hypothesis.

Keywords: momentum effect, efficient market hypothesis, Jegadeesh and Titman
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1 Introduction

1.1 Background

Momentum is a simple trading strategy where past winners are bought and past losers sold short in the stock markets. The basic idea of the strategy is that winners and losers maintain their historical pattern of return in future periods and buying the winners and short selling the losers should generate above average returns. If the markets were efficient as the efficient market hypothesis asserts then it should not be possible to profit from historical trends using a simple, costless strategy such as momentum trading. However, previous studies have shown that momentum strategies have indeed been highly profitable. The phenomenon was first studied by Jegadeesh and Titman (1993) who studied US stocks during the period 1965 – 1989 and found that the strategy of selecting stocks based on their past six months returns and holding them for six months generated an excess return on 12.01% per year on average. Their results also indicated that the profitability of the strategy was not due to the systematic risk.

Chan, Jegadeesh and Lakonishok (1996) also studied a ranking period of six months for all stocks listed on NYSE, AMEX and NASDAQ over the period 1977 – 1993. They document a spread in return between a portfolio of past winners and a portfolio of past losers of 8% for the consecutive six months. Grundy and Martin (2001) study of NYSE and AMEX listed stocks for the full period 1926 – 1995 using a six months ranking period and a one month holding period show that momentum profits are stable even after adjusting for dynamic risk exposure. They also show that the strategy yields negative returns in January with a mean of -5.85%.

The momentum strategy has been thoroughly studied on the US equity markets. However in recent years the phenomena has been documented on other equity
markets as well. Muga and Santamaría (2007) find that momentum strategies yields excess returns in the emerging markets of Latin America. Their results also indicate that the momentum effect appears to be stronger in Latin America than in developed markets. Other non-US studies include Hameed and Kusnadi (2002) who can not find evidence for momentum profits in six Asian stock markets and Ray and Schmid (2007) who find momentum profits in Swiss markets to be in line with the US markets.

Griffin, Ji and Martin (2003) study momentum globally covering 40 markets and find evidence that the strategy is profitable in a variety of different markets although smaller in emerging markets. They do not find evidence of price momentum in the Swedish equity markets which is the focus of this paper. Other results from the Swedish markets come from Parmler and González (2007) using data over the period 1979 – 2003 they conclude that momentum yields significant profits for Swedish equities.

Several attempts have been made to explain the underlying mechanism that causes the momentum effect. Chan, Jegadeesh and Lakonishok (1996) argue that the markets underreaction to information regarding earnings results in price momentum and suggests that the markets respond only gradually to new information. Hong and Stein (1999) presents a behavioral framework that models momentum as the result of the interplay between momentum traders who only condition their trades on past price changes and arbitrage traders who try to exploit underreactions to new information. While the arbitrage traders eliminate the underreaction and thus make prices more efficient, momentum traders push prices beyond the equilibrium value and the result is instead an overreaction in the long run. This also implicates that momentum trading is only profitable when the price change is due to a correction of an underreaction and not due to previous momentum. Conrad and Kaul (1998) suggest that the returns momentum strategies yield is due to cross sectional variation in the mean returns of individual stocks rather than to a predictable pattern. The momentum strategy is simply buying stocks with high mean returns and short selling stocks with low mean returns. If the variation in mean returns is due to the variations in expected returns of
the individual stocks then the profits from a momentum strategy can be explained with the differences in risk. Riskier stocks are expected to yield higher returns so buying high risk stocks and shorting the low risk stocks may be an explanation.

The strategy is trading intensive and the frequent portfolio changes induce transaction costs which limits the profitability. Jegadeesh and Titman (1993) find that the profits from momentum are large enough to cover transaction costs that were estimated to one percent for a round-trip trade. However recent evidence show that the profitability can be wiped out from the transaction costs. Grundy and Martin (2001) show that round-trip cost above 1.5 percent is enough to make the strategy unprofitable. Li, Brooks and Miffre (2007) show that a large part of the profits are due to the short selling of losers and the higher transaction costs associated with short selling greatly limits the profits. Agyei-Ampomah (2007) conclude that for the UK markets, momentum profits disappear for shorter time horizons due to the impact of trading costs and frequent portfolio turnover.

This phenomenon has been scarcely studied on the Swedish market so it will contribute to existing research by testing the strategy for a sample of liquid stocks, different time periods, shorter holding periods and statistically test the profitability of the strategy compared to a benchmark which has not previously been done on Swedish data. It will also contribute by determining the profitability after correcting for transaction costs and the maximal transaction cost for the strategy to remain profitable. This has not either been assessed on Swedish data in the literature previously.

1.2 Purpose

The aim of this paper is to study the momentum effect on the Swedish equity market and its profitability compared to a passive index tracking strategy. The impact of transaction costs will also be addressed and the possible explanation of variation in systematic risk is to be tested.
2 Theory

2.1 The Efficient Market Hypothesis

In financial economics, the efficient market hypothesis (EMH) is a fundamental theory but also the subject of intense debate among academics and professional investors because of its profound implications. EMH asserts that markets are efficient in the sense that the prices fully reflect all relevant information (Copeland, Weston, and Sastri 2005). Fama (1970) defines three types of market efficiency, weak-form efficiency, semi-strong efficiency and strong efficiency, each of which will be discussed briefly:

- **Weak-form efficiency.** In the weak form it is not possible for investors to make excess returns by using trading strategies based on historical price information. This implies that the momentum strategy which is entirely based on historical returns should not generate excess returns.

- **Semi-strong efficiency.** The semi-strong efficiency states that it is not possible to use any publicly available information to earn excess returns. Publicly available information includes financial statements and annual reports of companies. This also implies that fundamental analysis and equity research is useless in terms of creating excess returns.

- **Strong-form efficiency.** The strong-form of market efficiency asserts that prices reflect all information including information that is not publicly available. In the strong-form no investor, not even insiders, can earn excess returns using any kind of information.
The efficient market hypothesis has been thoroughly studied in numerous empirical studies and most evidence supports it (Copeland, Weston, and Sastri 2005). However as the introduction of this paper shows, empirical evidence of the momentum effect refutes efficient markets in the weak-form. De Bondt and Thaler (1985) report that overreaction to new information causes stock prices to deviate from intrinsic values. Using this overreaction they found that portfolios of prior losers outperformed prior winners by 25 percent. This strategy is known as contrarian and is the opposite of the momentum strategy but with a shorter time perspective. The evidence in support of the contrarian strategy also indicates weak-form inefficiency.

There are also a few well known anomalies in equity markets that are not consistent with weak-form efficiency. One of these anomalies is an interesting seasonal pattern in stock prices known as the January effect. The average return in January is greater than other months of the year and the effect is particularly strong for small cap firms. The January effect has been documented in the US and in other stock markets globally in several empirical studies. The explanation for the effect is year-end tax-loss selling that causes prices to fall in December for certain stocks and repurchases after the New Year that causes the same stocks to rally (Haugen, 2001).

A strong evidence of semi-strong efficiency is the underperformance of actively managed mutual funds. Jensen (1968) looked at the performance of 115 mutual funds in the period 1945 through 1964 and concluded that on average they were not able to outperform a buy-the-market-and-hold strategy. However, more recent studies of mutual funds performance show that they can indeed persistently outperform the market (Haugen 2001). EMH in its strong form implies that not even insiders can benefit from their information. However empirical evidence suggests that insiders do earn abnormal returns and insider trading is strictly regulated (Holmén 2007).
2.2 Capital asset pricing model

The capital asset pricing model (CAPM) is a market equilibrium model used to determine the price of risky assets. This model will be used as a market model in the analysis that follows. The model is derived with the following assumptions:

- Investors are risk-averse individuals who maximize the expected utility of their wealth.
- Investors have homogeneous expectations about future returns and the returns have a normal distribution.
- Investors may borrow or lend unlimited amounts at a risk free interest rate using a risk free asset.
- There are no frictions in the capital markets. This means that there are no transaction costs, taxes on capital gains or dividends. It also assumes that there are no restrictions on short selling.
- Information is costless and flows freely between all investors.
- All assets are marketable and divisible.

These assumptions are to some degree reasonable and the simplifications are necessary to derive the model. The assumption that investors have homogeneous expectations means that they all perceive the same investment opportunity set. If they are rational and maximize expected utility then their choice of portfolios will be efficient which simply means that the portfolio risk is minimized given the expected return. The market portfolio, M, is the combination of all investors portfolios and since they chose efficient portfolios then the market portfolio is also efficient. This is a necessary condition in the derivation of CAPM (Haugen 2001). In figure 2.1 the opportunity set is combinations of risky assets plotted with respect to the expected return, E(R), and risk measured as the standard deviation σ(R). M denotes the market portfolio and R_f is the risk free asset. The capital market line is a linear combination of the market portfolio and the risk free asset.
Given homogenous expectations investors will chose portfolios on the capital market line since it gives the optimal trade off between risk and return.

Figure 2.1 The capital market line and the market portfolio in risk-return space.

In market equilibrium the excess supply or demand for a risky asset must be zero. Under this condition it is possible to derive the CAPM equation which relates the expected return to systematic risk for an individual asset. The equation is given by:

$$E(R_i) = R_f + \left[ E(R_m) - R_f \right] \beta_i$$  \hspace{1cm} (2.1)

In equation 2.1 the expected return of security $i$, $E(R_i)$, is equal to the risk free rate, $R_f$, plus a risk premium which consists of the expected return of the market, $E(R_m)$, minus the risk free rate multiplied by beta.
The systematic risk is captured by beta which has the following definition:

$$\beta = \frac{\text{COV}(R_i, R_m)}{\text{VAR}(R_m)}$$  \hspace{1cm} (2.2)

Beta is defined as the covariance between the return of the risky asset and the return of the market portfolio divided by the variance of the market portfolio. According to this definition the beta value of the market portfolio is one and the risk free asset has beta value zero. It can be shown that the beta value of a portfolio of risky assets is the weighted combination of the individual assets beta values. Beta can easily be estimated empirically from historical return on the security and market. The following regression can be used:

$$R_i = c + \beta_i R_m$$  \hspace{1cm} (2.3)

The return on security \(i\) is regressed against the market return and the slope is thus the beta value. The regression used in equation 2.3 is ordinary least squares (OLS). Equation 2.2 can also be used to estimate the beta value.
The CAPM equation can be illustrated in a figure:

*Figure 2.2 The security market line and market portfolio.*

The security market line describes the relation between expected return and risk measured with beta for an individual security (Copeland, Weston, and Sastri 2005).
3 Methodology and data

3.1 Methodology

The methodology in this paper is in line with Jegadeesh and Titman (1993) original approach to study the momentum effect. The momentum portfolios consist of long positions on previous winners and short positions on previous losers and its return is recorded on a monthly basis. A short position is the selling of a borrowed security. If an investor borrows a stock for example and sells it on the market then he must eventually buy it back and return it to the lender. If the price of the stock has fallen then the investor can buy it back at a lower price and thus make a profit.

The portfolios are constructed as follows: at the end of each period the individual securities are ranked based on the return it generated during the ranking period. The top 10 percent are defined as the winners and the bottom 10 percent are thus the losers. The return of two equally weighted portfolios of the winners and the losers is then recorded during the holding period. At the end of the holding period the two portfolios are liquidated and replaced by the winners and losers from the next ranking period. To get comparable results with previous studies different combinations of ranking periods and holding periods is used. The strategy is thus defined by the lengths of the ranking and holding periods which can be written as $R/H$ where $R$ is the length of the ranking period and $H$ the length of the holding period. The following combinations are tested in this paper:

<table>
<thead>
<tr>
<th>R/H</th>
<th>12/12</th>
<th>12/6</th>
<th>6/6</th>
<th>6/3</th>
<th>3/3</th>
<th>3/1</th>
<th>1/1</th>
</tr>
</thead>
</table>

Earlier evidence by Jegadeesh (1990) shows that for periods shorter than one month there is a return reversal or contrarian effect which is the opposite of the momentum effect. In order to avoid this effect a one month lag is introduced between the ranking
period and holding period. In other words the holding period begins one month after the end of the ranking period. This technique was also used in the Jegadeesh and Titman (1993) study and has since then been more or less the standard approach in the literature.

To assess the systematic risk the beta value is estimated for each individual stock. The beta values are estimated by regressing the monthly return on the stock against the market return using equation 2.3. The slope of the regression is determined in Excel with the built in Slope() formula. The regression is based on the past 24 months. The beta value is then calculated for the two portfolios which is just the weighted average of the individual stocks beta values. The estimation period consumes 24 months from the total data period so the momentum analysis is based on the remaining period 1999 – 2007. The beta values are assumed to vary with time and are thus estimated on a rolling basis from the last 24 months.

The calculations have been made in Excel and will now be shortly described. For each strategy the individual stocks return is first calculated for the given ranking and holding periods, then all stocks are ranked with the Excel formula Rank(). Each stock is given a rank number based on its return during the ranking period from the formula. This is repeated for all ranking periods. A VBA program then selects the top 10% and bottom 10% for a ranking period and their return in the holding period is found with the Excel worksheet formula HLookup. Using the same formula the beta values are found and these values are copied to a result sheet in Excel. The VBA program then loops over all the ranking periods for a given strategy and records the result to the result sheet. In the next loop the new winners and losers are compared with the previous ones so the portfolio turnover can be calculated, this is later used to analyze transaction costs. The complete VBA code is shown in appendix A.
3.2 Data

The analysis is based on all the stocks listed on the Stockholm stock exchange during the period 1997-2007. The data is obtained from Reuters Ecowin database. Other financial instruments such as warrants and other derivatives are not included in the sample. The chosen time period is limited by the data set which gives a sample which is too small for the years before 1997. Still, the period covers full stock market cycles and should not limit or bias the analysis. The sample includes a large proportion of small cap stocks with limited liquidity. Since these stocks are also quite volatile they would be greatly overrepresented in the top and bottom portfolios so to get a more fair representation only stocks listed on the main lists; Large, Mid and Small will be included in the analysis while stocks listed on the smaller lists will be excluded. When a company has listed both common and preferred stocks, for example Ericsson is listed as Ericsson A and Ericsson B where the A stocks have a higher voting value, then only the preferred stock is included because of its higher liquidity.

These restrictions give a total sample of 248 stocks which is included in the analysis. For each stock the closing price is given which has been used to calculate the return, $R$, for a given period using the formula:

$$ R = \left( \frac{P_t}{P_{t-1}} \right) - 1 $$ (3.1)

In formula 3.1 $P_t$ denotes the closing price at time $t$ and $P_{t-1}$ is the closing price at time $t-1$ which is of course the previous period. This calculation assumes that it is possible to buy and sell the stocks at the closing price which is a reasonable assumption. Table 3.1 summarizes descriptive statistics for the sample. It can be noted in table 3.1 how the number of stocks in the sample almost doubles during the time period and how the mean returns varies over time, this ensures that the sample covers periods of different market trends.
### Table 3.1 Descriptive statistics for the sample

<table>
<thead>
<tr>
<th>Year</th>
<th>No. Of Stocks</th>
<th>Mean</th>
<th>Std. Dev</th>
</tr>
</thead>
<tbody>
<tr>
<td>1997</td>
<td>127</td>
<td>0.014479</td>
<td>0.098946</td>
</tr>
<tr>
<td>1998</td>
<td>144</td>
<td>-0.00016</td>
<td>0.144065</td>
</tr>
<tr>
<td>1999</td>
<td>172</td>
<td>0.038092</td>
<td>0.184703</td>
</tr>
<tr>
<td>2000</td>
<td>198</td>
<td>0.008465</td>
<td>0.229715</td>
</tr>
<tr>
<td>2001</td>
<td>215</td>
<td>-0.00755</td>
<td>0.206165</td>
</tr>
<tr>
<td>2002</td>
<td>221</td>
<td>-0.02919</td>
<td>0.159716</td>
</tr>
<tr>
<td>2003</td>
<td>225</td>
<td>0.032425</td>
<td>0.186091</td>
</tr>
<tr>
<td>2004</td>
<td>236</td>
<td>0.024012</td>
<td>0.207636</td>
</tr>
<tr>
<td>2005</td>
<td>243</td>
<td>0.033989</td>
<td>0.133695</td>
</tr>
<tr>
<td>2006</td>
<td>248</td>
<td>0.022189</td>
<td>0.113013</td>
</tr>
<tr>
<td>2007</td>
<td>248</td>
<td>-0.00343</td>
<td>0.108963</td>
</tr>
</tbody>
</table>

3.2.1 Index

The stock market Index represents a benchmark to the momentum strategy since it gives the possible return from a passive strategy of buying an index tracking fund. Index tracking funds for the Swedish stock market are available today with almost no management fee and this investment is thus viewed as the comparable alternative to the momentum strategy. The index used in this paper is Affärsvarldens generalindex (AFGX) which is a value weighted index for the Stockholm stock exchange. This data is also retrieved from the Ecowin database. The index is quoted on a daily basis and the returns have been calculated in the same manner as the stocks using formula 3.1. Figure 3.2 illustrates how AFGX has developed during the period 1997-2007.
Figure 3.1 The AFGX index development during the sample period
4 Results

In this chapter the empirical results will be presented and analyzed. To test for the momentum effect, different combinations of ranking and holding period length are used. This will make the results robust and comparable with existing literature.

The empirical test consists of three parts. First of all the raw return generated from the momentum strategies are statistically tested. Second, the return is compared to the AFGX index. This will show whether or not the strategies can yield a return that is in excess of the index and beat the passive strategy of buying an index fund. Finally, market frictions are introduced in terms of transaction costs which consist of bid ask spreads and commission. The raw return from the strategies will be corrected for these frictions and we shall see how it affects the total return in the end. The beta values of the portfolios are also calculated and the hypothesis that the returns can be explained with the systematic risk is tested.
4.1 Raw returns

<table>
<thead>
<tr>
<th>R/H</th>
<th>12/12</th>
<th>12/6</th>
<th>6/6</th>
<th>6/3</th>
<th>3/3</th>
<th>3/1</th>
<th>1/1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Winners</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>2.03</td>
<td>1.18</td>
<td>1.24</td>
<td>3.00</td>
<td>1.63</td>
<td>1.49</td>
<td>2.02</td>
</tr>
<tr>
<td>t-stat</td>
<td>3.05</td>
<td>2.43</td>
<td>1.80</td>
<td>2.33</td>
<td>1.78</td>
<td>1.91</td>
<td>2.57</td>
</tr>
<tr>
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<td><strong>0.00</strong></td>
<td><strong>0.01</strong></td>
<td><strong>0.04</strong></td>
<td><strong>0.01</strong></td>
<td><strong>0.04</strong></td>
<td><strong>0.03</strong></td>
<td><strong>0.01</strong></td>
</tr>
<tr>
<td>Losers</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>0.58</td>
<td>0.00</td>
<td>-0.53</td>
<td>0.72</td>
<td>0.34</td>
<td>1.31</td>
<td>0.34</td>
</tr>
<tr>
<td>t-stat</td>
<td>0.49</td>
<td>-0.06</td>
<td>-0.47</td>
<td>-0.38</td>
<td>-0.35</td>
<td>1.10</td>
<td>0.33</td>
</tr>
<tr>
<td>P-value</td>
<td>0.32</td>
<td>0.48</td>
<td>0.32</td>
<td>0.35</td>
<td>0.36</td>
<td>0.86</td>
<td>0.63</td>
</tr>
<tr>
<td>Momentum</td>
<td></td>
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<tr>
<td></td>
<td>1.45</td>
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<td>2.28</td>
<td>1.30</td>
<td>0.18</td>
<td>1.68</td>
</tr>
<tr>
<td>t-stat</td>
<td>2.24</td>
<td>2.31</td>
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<td>2.99</td>
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<td>2.42</td>
</tr>
<tr>
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<td><strong>0.02</strong></td>
<td><strong>0.00</strong></td>
<td><strong>0.00</strong></td>
<td><strong>0.05</strong></td>
<td><strong>0.42</strong></td>
<td><strong>0.01</strong></td>
</tr>
</tbody>
</table>

Table 4.1 Monthly raw returns from the winners, losers and momentum portfolio.
The t-statistics is calculated as the mean return divided by its standard error and tests the hypothesis of positive returns. Significant P-values on the 5% level is indicated in bold face.

The raw returns for the different strategies are given in table 4.1. The momentum strategy yields a return in the range of 0.18 – 2.28 % per month. This return is significant for all strategies except 3/1. Another interesting note is that the winner’s portfolio gives significant returns for all the tested strategies while a short position in the loser’s portfolio never yields significant results. The return from momentum investing is almost entirely derived from the long position in this sample.

4.2 Excess returns

<table>
<thead>
<tr>
<th>R/H</th>
<th>12/12</th>
<th>12/6</th>
<th>6/6</th>
<th>6/3</th>
<th>3/3</th>
<th>3/1</th>
<th>1/1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Winners</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1.345</td>
<td>0.495</td>
<td>0.555</td>
<td>2.315</td>
<td>0.945</td>
<td>0.805</td>
<td>1.335</td>
</tr>
<tr>
<td>t-stat</td>
<td>2.08</td>
<td>1.92</td>
<td>0.64</td>
<td>2.33</td>
<td>1.32</td>
<td>1.38</td>
<td>1.51</td>
</tr>
<tr>
<td>P-value</td>
<td><strong>0.035</strong></td>
<td><strong>0.036</strong></td>
<td><strong>0.266</strong></td>
<td><strong>0.013</strong></td>
<td><strong>0.097</strong></td>
<td><strong>0.085</strong></td>
<td><strong>0.067</strong></td>
</tr>
<tr>
<td>Losers</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>-1.265</td>
<td>-0.685</td>
<td>-0.155</td>
<td>-1.405</td>
<td>-1.025</td>
<td>-1.995</td>
<td>-1.025</td>
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<tr>
<td>t-stat</td>
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<td>-0.45</td>
<td>-1.06</td>
<td>-0.38</td>
<td>-0.15</td>
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<tr>
<td>P-value</td>
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<td>0.847</td>
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<td>0.440</td>
<td>0.251</td>
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<tr>
<td>Momentum</td>
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<td></td>
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</tr>
<tr>
<td></td>
<td>0.76</td>
<td>0.48</td>
<td>1.08</td>
<td>1.59</td>
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<td>1.99</td>
<td>1.10</td>
<td>0.34</td>
<td>1.07</td>
</tr>
<tr>
<td>P-value</td>
<td>0.202</td>
<td>0.115</td>
<td>0.140</td>
<td><strong>0.027</strong></td>
<td>0.138</td>
<td>0.174</td>
<td>0.144</td>
</tr>
</tbody>
</table>

Table 4.2 Monthly excess returns from the winners, losers and momentum portfolio. The excess return is calculated as the return in excess of the index return which is 0.68% per month on average during the period. The t-statistics is calculated as a paired t-test for the returns of the portfolios and the index. The tested null hypothesis is a one tailed test of positive excess returns. Significant P-values on the 5% level is indicated in bold face.

The returns compared to the index return, which was 0.68% per month on average, is shown in table 4.2. Only one strategy can give significant excess returns and that is
the 6/3 strategy. However if we only look at the winner portfolio we can see that 12/12, 12/6 and 6/3 all yield significant excess returns. The strategy of going long in the winners from a ranking period of six months and holding them for three months yields 2.315% per month in excess of the index. On a yearly basis this amounts to 31.62%.

4.3 Market frictions

In some cases the momentum strategy seems to give a return that is significantly profitable and in one case a return which is significantly greater than the market index. However, if an investor seeks to take advantage of the momentum effect then the impact of transaction costs must also be assessed. Transaction costs include trading commission, short sale borrowing cost and bid-ask spreads. These costs can be difficult to determine to an exact degree and they may differ depending on whether the investor is a financial institution or a private investor. Commission costs for private investors has decreased a lot during the sample period and today online brokerages offers trading for as little as 0,15% per trade (Aktiedirekt). Bid-ask spread is the difference or spread between the price an investor paid for a stock and the price at which it can be sold. This spread is usually larger for small cap stocks with limited trading volume. The Swedish stock exchange also limits the minimum spread by the tick size which determines the smallest price increment on the exchange. The tick size for the Swedish exchange is shown in table 4.3

<table>
<thead>
<tr>
<th>All other stocks</th>
<th>Interval (SEK)</th>
<th>Tick size</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.00 - 4.99</td>
<td>0.01</td>
<td></td>
</tr>
<tr>
<td>5.00 - 14.95</td>
<td>0.05</td>
<td></td>
</tr>
<tr>
<td>15.00 - 49.90</td>
<td>0.10</td>
<td></td>
</tr>
<tr>
<td>50.00 - 149.75</td>
<td>0.25</td>
<td></td>
</tr>
<tr>
<td>150.00 - 499.50</td>
<td>0.50</td>
<td></td>
</tr>
<tr>
<td>500.00 - 4999.00</td>
<td>1.00</td>
<td></td>
</tr>
<tr>
<td>5000.00 -</td>
<td>5.00</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Most liquid stocks</th>
<th>Interval (SEK)</th>
<th>Tick size</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.00 - 4.99</td>
<td>0.01</td>
<td></td>
</tr>
<tr>
<td>5.00 - 14.95</td>
<td>0.01</td>
<td></td>
</tr>
<tr>
<td>15.00 - 39.38</td>
<td>0.02</td>
<td></td>
</tr>
<tr>
<td>40.00 - 149.90</td>
<td>0.10</td>
<td></td>
</tr>
<tr>
<td>150.00 - 499.50</td>
<td>0.25</td>
<td></td>
</tr>
<tr>
<td>500.00 - 4999.00</td>
<td>0.50</td>
<td></td>
</tr>
<tr>
<td>5000.00 -</td>
<td>1.00</td>
<td></td>
</tr>
</tbody>
</table>

*Table 4.3 The tick size on the Swedish stock exchange. (Source: Nordnet)*
For stocks with a low price the tick size can have a large effect on the total spread. For example, consider a stock trading at SEK 0.5. The minimum spread determined by the tick size will then be \(0.01 / 0.5 = 2\%\) while the actual spread can be much larger.

Jegadeesh and Titman (1993) assume that total transaction cost for a round-trip trade is one percent. However more recent studies show that this may underestimate the true transaction costs. For example, Li, Brooks and Miffre (2007) show that the total transaction cost can be as high as 6.71\% for losers and 3.77\% for winners and Lesmond, Ogden and Trzcinka (1999) estimate round-trip costs to 1.2\% and 10.3\% for large and small cap stock respectively. Their study is based on the UK and US markets and thus includes stamp duties and higher commission fees and may not be directly applicable to the Swedish markets.

This paper will try two approaches to assess the profitability of momentum strategies on the Swedish markets after correcting for transaction costs. In order to get comparable results with Jegadeesh and Titman (1993) the one percent round-trip cost will be used. The second approach is in line with Grundy and Martin (2001) who calculated the maximum possible round-trip cost for the strategy to remain profitable.

<table>
<thead>
<tr>
<th>R/H</th>
<th>12/12</th>
<th>12/6</th>
<th>6/6</th>
<th>6/3</th>
<th>3/3</th>
<th>3/1</th>
<th>1/1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Winners</td>
<td>1.98</td>
<td>1.09</td>
<td>1.11</td>
<td>2.82</td>
<td>1.36</td>
<td>0.96</td>
<td>1.19</td>
</tr>
<tr>
<td>t-stat</td>
<td>2.84</td>
<td>2.22</td>
<td>1.61</td>
<td>2.64</td>
<td>1.48</td>
<td>1.23</td>
<td>1.52</td>
</tr>
<tr>
<td>P-value</td>
<td>0.01</td>
<td>0.015</td>
<td>0.06</td>
<td>0.00</td>
<td>0.07</td>
<td>0.11</td>
<td>0.06</td>
</tr>
<tr>
<td>Momentum</td>
<td>1.42</td>
<td>1.04</td>
<td>1.29</td>
<td>1.95</td>
<td>0.75</td>
<td>-0.89</td>
<td>0.03</td>
</tr>
<tr>
<td>t-stat</td>
<td>2.18</td>
<td>1.97</td>
<td>2.21</td>
<td>2.10</td>
<td>0.93</td>
<td>-</td>
<td>0.04</td>
</tr>
<tr>
<td>P-value</td>
<td>0.03</td>
<td>0.03</td>
<td>0.02</td>
<td>0.02</td>
<td>0.17</td>
<td>-</td>
<td>0.48</td>
</tr>
</tbody>
</table>

**Excess Return**

<table>
<thead>
<tr>
<th>R/H</th>
<th>12/12</th>
<th>12/6</th>
<th>6/6</th>
<th>6/3</th>
<th>3/3</th>
<th>3/1</th>
<th>1/1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Winners</td>
<td>1.29</td>
<td>0.40</td>
<td>0.42</td>
<td>2.14</td>
<td>0.67</td>
<td>0.27</td>
<td>0.51</td>
</tr>
<tr>
<td>t-stat</td>
<td>1.73</td>
<td>0.85</td>
<td>-</td>
<td>2.03</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>P-value</td>
<td>0.05</td>
<td>0.20</td>
<td>-</td>
<td>0.02</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Momentum</td>
<td>0.74</td>
<td>0.36</td>
<td>0.60</td>
<td>1.26</td>
<td>0.07</td>
<td>-1.58</td>
<td>-0.65</td>
</tr>
<tr>
<td>t-stat</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>1.40</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>P-value</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>0.08</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

Table 4.3 Total return and excess return after correcting for round-trip transaction costs of 1 percent. Statistical significance is indicated with bold face.

After correcting for round-trip costs of one percent the strategy remains profitable for the longer ranking and holding periods but quickly becomes less profitable for shorter
periods. This is due to the fact that the strategy becomes more trading intensive when the holding period gets shorter and shorter. However it should be noted that the portfolio turnover is far from 100% for the shorter holding periods. This is due to the fact that two consecutive ranking periods overlap and share many of the winners and losers. This has been taken into account and if a winner or loser stays in the portfolio for the next holding period only a one-way transaction cost of 0.5% has been used. Still, the effect causes the 3/3 and 1/1 to lose their statistically significant profits compared to the raw returns in table 4.1.

The return in excess of the market is positive for the winners but yields negative returns for the momentum portfolio for the two short term strategies 3/1 and 1/1. However statistically only two strategies yields excess return with significance and that is the winner portfolio for 12/12 and 6/3. The momentum portfolio never manages to yield statistically significant excess returns for any of the tested periods. When calculating the excess return the AFGX index return has been used. This will not give an entirely accurate comparison since from an investor’s point of view the correct alternative would be to buy an index fund which has a management fee. However this fee is only charged annually and is usually around 0.1-0.3%, hence the effect it would have on the comparison is negligible especially for holding periods shorter than 12 months.

Finally let’s have a look at what maximum level of transaction cost is possible for the strategy to remain profitable.

<table>
<thead>
<tr>
<th>R/H</th>
<th>12/12</th>
<th>12/6</th>
<th>6/6</th>
<th>6/3</th>
<th>3/3</th>
<th>3/1</th>
<th>1/1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Winners</td>
<td>33.30</td>
<td>11.60</td>
<td>9.40</td>
<td>17.10</td>
<td>5.90</td>
<td>0.20</td>
<td>2.50</td>
</tr>
<tr>
<td>Momentum</td>
<td>12.50</td>
<td>6.30</td>
<td>5.50</td>
<td>6.20</td>
<td>3.60</td>
<td>-</td>
<td>1.10</td>
</tr>
</tbody>
</table>

*Table 4.4 Break even transaction costs in percent for the different strategies.*

The dependence on portfolio turnover and trading intensity becomes apparent from the results in table 4.4. While it’s possible to have transaction costs as high as 33% for a 12/12 winners portfolio the profits are eliminated for a 1/1 momentum portfolio at costs of 1.1%. The figures in table 4.4 are quite high for the longer termed
strategies and it’s reasonable to assume that the true transaction costs are significantly lower.

4.4 Systematic risk

<table>
<thead>
<tr>
<th>R/H</th>
<th>12/12</th>
<th>12/6</th>
<th>6/6</th>
<th>6/3</th>
<th>3/3</th>
<th>3/1</th>
<th>1/1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Winners beta</td>
<td>0.96</td>
<td>0.96</td>
<td>0.86</td>
<td>1.10</td>
<td>1.10</td>
<td>1.02</td>
<td>1.04</td>
</tr>
<tr>
<td>Losers beta</td>
<td>1.45</td>
<td>1.44</td>
<td>1.34</td>
<td>1.21</td>
<td>1.23</td>
<td>1.28</td>
<td>1.23</td>
</tr>
</tbody>
</table>

*Table 4.5 Average beta values for the winners and losers portfolios.*

According to CAPM, a security’s expected return is a function of its beta value which is the covariance with the market. Securities with high beta value are thus expected to yield a higher return and vice versa. Table 4.5 show that the average beta values for the winners portfolios are in fact lower than the losers portfolios for all the different time periods. Assuming that the CAPM theory is valid and that systematic risk is the explanation of the momentum effect then the results would have been completely opposite. Hence, it is not possible to explain the momentum effect with differences in systematic risk based on these measures. The beta values in table 4.5 have been estimated using the regression given in equation 2.3.

4.5 Conclusions

The results from the empirical study of the momentum effect on the Swedish stock market can be summed up in a few important findings.

First of all, the strategy of buying winners and short selling losers is indeed profitable on the Swedish markets. Ignoring transaction costs, the average monthly return for a momentum portfolio varies between 0.18 – 2.28% and only one strategy, 3/1, does not manage to yield significant profits. However the profitability of the strategy is almost entirely explained by the long position in the winners while the contribution from the short position in the losers is only positive for the 6/6 strategy. This result is in line with Jegadeesh and Titman (1993) and Griffin, Ji and Martin (2003) who also show that the long position yields higher return than the short one. Griffin, Ji and Martin (2003) also show that in the Americas and Asia, losers actually outperform the market while in the US and Europe they underperform. The result
contradicts Li, Brooks and Miffre (2007) who found that in the UK the short position explained most of the momentum profits. Parmler and González (2007) study of the Swedish market indicates that the contributions from the long and short positions are of equal size. However, they include all listed stocks on the Swedish market while this paper has excluded small, illiquid stocks and Li, Brooks and Miffre (2007) show that the high profits of the loser portfolio in the UK is explained by its large exposure to small cap firms which may indeed also be the case for Swedish stocks. Evidently it is not possible to draw any general conclusion regarding the profits from the short position but the long position seems to be profitable regardless of market or region. The fact that investing long in the winners yields higher returns also makes the strategy available to mutual funds who have restrictions on short selling.

From an investor’s point of view, it’s only interesting to follow a momentum strategy if it can yield higher returns than a passive buy-the-index strategy which can be implemented much more easily by buying an index fund. Therefore it is of interest to compare the momentum returns with the market returns, and see if it can yield an excess return. All strategies except the short termed ones give a return which is higher than the market index, however only one momentum strategy can show statistical significance. When ignoring the short position and only focus on the long position then three strategies produce statistically significant excess returns. This can be compared with Griffin, Ji and Martin (2003) who show that $1 invested in global winners during the period 1975-2000 would have given $413 while the market would only have given $59 during the same period.

Since momentum strategies involve frequent trading and result in a high portfolio turnover the transaction costs will severely limit its profitability for shorter horizons. Assuming the same round-trip costs as Jegadeesh and Titman (1993) of 1 percent, it is still a profitable strategy for the longer time horizons. When we look at the excess return after correcting for transaction costs it still yields excess returns for the longer periods in the range of 0.07 – 1.26 % per months. Statistically, the long positions give significant excess returns for two strategies 12/12 and 6/3. Since it is hard to assess
the true transaction costs the break even costs have been estimated to give a better picture of the influence of transaction costs on profitability. For longer holding periods this break even cost is quite high and certainly higher than the plausible true costs. For shorter periods the break even cost quickly decreases and is as low as 1.1% for the 1/1 strategy. These results indicate that the momentum strategy do give profits that are high enough to cover the transaction costs for longer holding periods. This result is in line with Jegadeesh and Titman (1993), Parmler and González (2007) and Griffin, Ji and Martin (2003).

A final test was to see whether the abnormal profits generated from momentum trading can be explained by differences in systematic risk, measured as beta. Perhaps surprisingly, the winner portfolios have a lower beta value than the loser portfolios for all combinations of ranking and holding periods. For the winner portfolio the beta value is also in many cases smaller than one which is the market beta and hence it implies that investing in winners is less risky than buying the index. To conclude, it is not possible to explain the profits with beta values. Similar results was also found in Jegadeesh and Titman (1993) and Ray and Schmid (2007).

The results presented here show that momentum in general and winners in particular have given impressive returns during the sample period for the Swedish equity market. When considering the efficient market hypothesis in its weak form who asserts that it is not possible to profit from historical prices, the results presented here refute week efficiency. The momentum effect remains to be one of the few anomalies that can not be fully explained and continues to question the validity of efficient markets. This phenomenon has been given increased attention recently and last year a Swedish asset management firm introduced a mutual fund who uses a 1/1 momentum strategy. It’s the first of its kind in Sweden but globally hedge funds and other investors have and certainly will try to exploit the effect on a greater scale in the future. It remains to be seen how increasing amount of capital seeking to profit from momentum will affect its profitability in the longer run.
5 References


Haugen, Robert A ”Modern Investment Theory”, 2001, Prentice Hall

Holmén, Martin; “Financial Theory”, Lecture Notes, Uppsala University 2007


Lesmond, David A; Ogden, Joseph P; Trzcinka; “A New Estimate of Transaction Costs” The Review of Financial Studies, Vol.12, pp 1113-1141

Li, Xiafei; Brooks, Chris; Miffre, Joëlle; “Low Cost Momentum Strategies” EDHEC Risk and Asset Management Research Centre, EDHEC Working Paper, August 2007

Parmler, Johan; Gonzalez, Andres; “Is Momentum Due to Data-Snooping?” European Journal of Finance, April-June 2007, v. 13, iss. 3-4, pp. 301-18

Appendix A - VBA Code

This code was used for the 6/3 strategy. A few hard coded values are tweaked for each individual strategy.

Sub momentum()

Cour = 0.01 'Transaction costs

While Sheets("Resultat").Cells(118, 2).Value > 0 'Possibility to estimate break even costs
Cour = Cour + 0.01

For m = 119 To 160 'First loop which finds the winners and losers
  t = 258
  g = 258
  For n = 6 To 253 'Loop through all stock’s rank values
    If IsNumeric(Cells(m, n).Value) Then 'Winners from the ranking are copied to a list
      If Cells(m, n).Value <= Cells(m, 2).Value Then
        Cells(3, n).Copy
        Cells(t, 5).Activate
        ActiveSheet.Paste
        t = t + 1
      End If
      If Cells(m, n).Value >= Cells(m, 3).Value Then 'Losers from the ranking are copied to a list
        Cells(3, n).Copy
        Cells(g, 6).Activate
        ActiveSheet.Paste
        g = g + 1
      End If
    End If
  Next n

r = 0 'r calculates the number of overlapping winner's in two subsequent portfolios
r1 = 0 'r1 calculates the number of overlapping losers
l = 0
a = 0
For y = 258 To g - 1  
a = a + 1  
For h = 258 To g - 1  
   If Cells(y, 5).Value = Cells(h, 1).Value Then  
      r = r + 1  
   End If  
   If Cells(y, 6).Value = Cells(h, 2).Value Then  
      r1 = r1 + 1  
   End If  
   Next h  
Next y  

l = (r1 + r) / (2 * a) 'total portfolio turnover  
l = 1 - l  
w1 = r / a 'portfolio turnover for winner's  
w1 = 1 - w1  

Range(Cells(258, 5), Cells(g - 1, 6)).Copy 'The old portfolios are stored before the  
new ones are created  
Range(Cells(258, 1), Cells(g - 1, 2)).Activate  
ActiveSheet.Paste  

k = 258  
For o = 1 To Cells(m, 2).Value 'Winners, losers and beta values are copied from  
the holding period  
   Cells(k, 7).Value = Application.WorksheetFunction.HLookup(Cells(k, 5),  
   Range("E46:IS87"), m - 117)  
   Cells(k, 8).Value = Application.WorksheetFunction.HLookup(Cells(k, 6),  
   Range("E46:IS87"), m - 117)  
   Cells(k, 9).Value = Application.WorksheetFunction.HLookup(Cells(k, 5),  
   Range("E384:IS424"), m - 117)  
   Cells(k, 10).Value = Application.WorksheetFunction.HLookup(Cells(k, 6),  
   Range("E384:IS424"), m - 117)  
   k = k + 1  
Next o  

' Winners are equally weighted for the holding period and copied to the result sheet in Excel  
Cells(k, 7).Value = (((Application.WorksheetFunction.Sum(Range(Cells(258, 7),  
   Cells(k - 1, 7)))) / Cells(m, 2).Value)) - w1 * Cour  
Cells(k, 7).Copy  
Sheets("Resultat").Activate
Cells(m - 115, 2).Activate
ActiveSheet.Paste

' Losers are equally weighted for the holding period and copied to the result sheet in Excel
Sheets("Returns12").Activate
Cells(k, 8).Value = (Application.WorksheetFunction.Sum(Range(Cells(258, 8),
Cells(k - 1, 8)))) / Cells(m, 2).Value
Cells(k, 8).Copy
Sheets("Resultat").Activate
Cells(m - 115, 3).Activate
ActiveSheet.Paste

'Winner's beta values
Sheets("Returns12").Activate
Cells(k, 9).Value = (Application.WorksheetFunction.Sum(Range(Cells(258, 9),
Cells(k - 1, 9)))) / Cells(m, 2).Value
Cells(k, 9).Copy
Sheets("Resultat").Activate
Cells(m - 115, 5).Activate
ActiveSheet.Paste

'Loser's beta values
Sheets("Returns12").Activate
Cells(k, 10).Value = ((Application.WorksheetFunction.Sum(Range(Cells(258, 10),
Cells(k - 1, 10)))) / Cells(m, 2).Value)
Cells(k, 10).Copy
Sheets("Resultat").Activate
Cells(m - 115, 6).Activate
ActiveSheet.Paste

'Equally weighted momentum portfolio
Sheets("Returns12").Activate
Cells(k, 6).Value = (Cells(k, 7) - Cells(k, 8)) - Cour * 1 'Adjustment for transaction costs
Cells(k, 6).Copy
Sheets("Resultat").Activate
Cells(m - 115, 4).Activate
ActiveSheet.Paste
Sheets("Returns12").Activate

Next m
Wend
MsgBox Cour 'Gives the break even transaction cost if used

End Sub