STOCKHOLM SCHOOL OF ECONOMICS

BACHELOR THESIS IN FINANCE

Can the Momentum Strategy be Improved by Adding a Risk Measure?

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Abstract

In this thesis it is tested if it is possible to gain momentum effects on a different type of evaluation and how momentum is affected when historical risk patterns are taken into account on Swedish data. The purpose of the thesis is to investigate whether an investor can generate higher momentum profits with lower risk if risk is included in the evaluation process. The risk in this study is represented by the value at risk. To test the hypothesis it first has to be confirmed that it is possible to gain momentum profits in Sweden during the time period chosen, which it is. Thereafter Fama-MacBeth regressions are done to evaluate the explanatory power of momentum and value at risk on the returns in the holding period. In these tests momentum turns out to be the only significant factor. Thereafter, the basic properties of momentum and value at risk are tested and finally a test for spreads between momentum and value at risk in the independent sort is done by creating matrices consisting of returns from the double sorted portfolios. The spreads are a comparison between the winner and loser portfolios. The spreads together with the rest of our results indicates that it is possible for an investor to create a portfolio with higher returns and lower risk relative to the original momentum strategy.

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1. Introduction

In this thesis we will test the following hypothesis: Is it possible to gain momentum effects on a different type of evaluation and how is momentum affected when historical risk patterns are taken into account on Swedish data?

The basic idea behind the momentum strategy is that historical patterns of security prices are expected to continue in the near future, that is winner will continue to increase in value and losers will continue to decrease. Therefore this zero-investment strategy is to buy past winners and to short sell past loser, based on the returns in the evaluation period, and make a profit on the difference in returns between the two during the holding period. The strategy, first discovered by Jegadeesh and Titman in 1993, has proven to generate significant returns in many countries over the past decades.

Momentum is considered to be a simple trading strategy and has grown to the extent that momentum investing is a well-recognized investment strategy in many equity markets, among them the U.S. (Chan, Jegadeesh and Lakonishok, 1996). Profitable trading strategies based on past returns will exist if stock prices either underreact or overreact to new information.

We have extended the momentum strategy by adding a risk measure to see how it relates to the momentum returns. The additional evaluation aspect is based on past risk, measured by value at risk, instead of past returns which is used in the original momentum strategy. The overall aim is to study the returns in the holding period and if they are better if sorted by momentum or by value at risk and how they are affected when both strategies are taken into consideration. This is done to be able to see if an investor can earn momentum profits based on a new type of evaluation and to see if it is possible to lower the risk and still gain the same amount of or higher momentum returns.

This subject is interesting because value at risk is a relatively new measure of risk and we have not found any studies on Swedish data that investigates if an investor can gain profit from evaluating past performance on value at risk. We have neither found any studies about momentum and value at risk and if they in combination can generate higher returns with lower risk. This is also interesting because in the original momentum strategy the risk of the investment is not taken into account.

In this thesis we will test for momentum profits in Sweden from 1997 through 2010. The different evaluation periods used are nine and twelve months and the holding periods are one and three months. We will also test if the evaluation period of momentum and value at risk has an explanatory power for the following holding period. We will perform an independent double sort based on the quintiles of both value at risk and momentum, creating 25 portfolios. This is done to see if there is a significant spread between these measures, hence if value at risk is priced in a momentum portfolio with for example only "winners" and vice versa. The sorting will be done on the raw returns and then we will adjust the returns to the market by using the CAPM-formula to get each portfolio's alpha and then again see if there are significant differences among the portfolios.

We will test if the net return between the winning and losing portfolios in both the momentum sorting and the value at risk sorting can be explained by macroeconomic factors. The dataset and time period are in line with previous studies to be able to compare the results, except that we have a more recent time period than earlier studies and are using Swedish data only.

To generate our final results we will run a series of tests. To begin with, we test whether we can generate significant momentum profits both with an evaluation period based on past returns and on past risk, which we can in both cases for almost all combinations of evaluation and holding periods. Thereafter, we test for the explanatory power of VaR and momentum on the holding period and controlling for some macroeconomic factors. As a result we get that momentum has a higher explanatory power on the returns in the holding period than VaR. A less significant result is that higher VaR, i.e. lower risk, generates higher returns. Thirdly, we test to see what basic properties momentum and value at risk have and conclude that the losing portfolio is the portfolio that contributes most to the profits made because of the negative loading on the market for both momentum and VaR. At last, we test for spreads between momentum and value at risk in the independent sort by creating matrices consisting of returns from the double sorted portfolios. The spreads are a comparison between the winner and loser portfolios. The spreads indicate that it is possible for an investor to create a portfolio with higher returns and lower risk relative to the original momentum strategy. However, this result should be tempered with caution, because the majority of the spreads are insignificant. The evaluation period of twelve months is always better and more significant than the nine months evaluation period

Section two begins this thesis with a short review of previous literature including studies about the efficient market hypothesis and momentum. EMH is interesting to us because if we are able to find momentum in our dataset we contradict the EMH. In section three we will describe our dataset, in section four we will explain our methodology, our results will be in section five and we will conclude in section six.

2. Previous Literature

The efficient market hypothesis

The efficient market hypothesis (EMH) proposed by Eugene Fama (1970) suggests that all security prices fully reflect all currently available information. If the EMH holds then it would be impossible to have a trading strategy that constantly outperforms the market portfolio, such as a market index. Hence, superior risk-adjusted returns will not be possible to receive. The EMH is interesting in this thesis since we are trying to generate returns based on evaluation of past performances, and this is supposed to contradict the efficient market hypothesis and not be possible.

There are three forms of market efficiency. The difference between them is how "all available information" is defined. The three different forms are: weak, semi-strong and strong form (Fama, 1970).

Market anomalies

Du Bondt and Thaler (1985) published one of the first papers proving long-term anomalies. The result from their study was that the past winners, ranked by returns over the last three- to five years, tend to be future losers. The reason behind this anomaly is behavioral finance due to overreaction. That is, most people tend to overreact to dramatic and unexpected news events. Portfolios of prior losers are outperforming prior winners, which is consistent with the predictions of the overreaction hypothesis. The opposite of overreaction is underreaction, which is the momentum effect.

The overall conclusion in Fama's paper (1970) on EMH, was that there is extensive evidence supporting the efficient market model and the evidence not supporting it is sparse. Fama (1998) confirmed that the efficient market exists through two arguments; first, in an efficient market overreaction is as common as underreaction. Second, most long-term market anomalies are sensitive to methodology and disappear when exposed to different statistical models and different models for expected returns. This was the argument that Fama (1998) considered the most important for the efficient market hypothesis. Therefore most market anomalies can only be explained by chance. Another conclusion in Fama's paper (1998) was that when value-weighted returns are used, anomalies shrink and typically becomes insignificant. This suggests that the anomalies mainly exist among small stocks.

Even though some form of market efficiency is generally accepted today there are many findings contradicting the EMH in different ways, for example the small-firm-in-January effect (Keim, 1983). Some of the market anomalies that have been found by researchers have after a short while disappeared because when they are known to the investors in the market they all try to take advantage of the arbitrage opportunity, which causes the price to adjust accordingly, and the anomaly disappear (Black, 1993).

Momentum - International studies

Testing for momentum effects

There are several previous reports that have confirmed that the momentum effect exists, hence if you buy winners and sell losers based on previous returns you will gain momentum and generate profits. Jegadeesh and Titman (1993) tested if it was possible to earn excess returns with a zero-investment strategy in the U.S, which means that they were testing to buy winners and sell losers through creating winner and loser portfolios. The total return from a zero-investment strategy comes from the net returns of the winner and loser portfolio. Jegadeesh and Titman used data on the returns for the stocks listed on the New York Stock Exchange (NYSE) and American Stock Exchange (AMEX) and created 16 portfolios with evaluation periods of three, six, nine and twelve months respectively and holding periods that were equally long. The time period was 1965 to 1989. The returns were positive and statistically significant for all portfolios except one, the one with both an evaluation period and holding period of three months. They claimed that neither lead-lag effects from delayed stock price reaction to general information nor increased risk could explain these excess profits. Moreover, they also found that in the following 24 months after the initial twelve months the strategies generate negative abnormal returns, hence a reversal effect in line with Du Bondt and Thaler (1985).

Jegadeesh and Titman followed up their first study in 1993 with another one in 2001 where they evaluated various explanations for the profitability of the momentum strategy they detected in their 1993-study. Firstly, they concluded that momentum profits have continued in the 1990s indicating that their original results were not a product of a data snooping bias or data mining[1]. They examined the returns of the portfolios in the post-holding period to learn more about the source of momentum profits. Secondly, they concluded that the results of the momentum portfolio in the 13 to 60 months following the portfolio formation month were negative. This evidence is consistent with the behavioral models but should, due to a number of reasons, be tempered with caution. Among other reasons, because evidence of negative post-holding period returns tend to depend on the composition of the sample, Jegadeesh and Titman (2001).

There is a similar paper by Rouwenhorst (1998) that used the same methodology as the Jegadeesh and Titman study from 1993, but Rouwenhorst (1998) used European data instead of American data. He studied twelve European countries from 1980 to 1995 and he found that, on average, the difference between winner and loser portfolios was one percent per month. The zero-investment portfolio with the best performance was the one with an evaluation period of twelve months and a holding period of three months. He also noticed that the companies in the winner and loser portfolio on average were smaller than the rest of the sample but further tests could conclude that there was a momentum effect in all size groups, but the effect was greater for smaller companies. Rouwenhorst also detected a reversal effect if a

[1] Snooping bias or data mining means that a form of statistical bias arises from a misuse of statistics. If a relationship is found it might be valid within the dataset used but does not have any statistical significance in a wider population.

holding period longer than eleven months was used, exactly like Jegadeesh and Titman (1993). Since Rouwenhorst's results have many similarities with Jegadeesh and Titman's results he claimed that it is unlikely that the results on the U.S. data was simply due to chance.

MACROECONOMIC FACTORS AND BUSINESS CYCLES

Another study on international data is the one performed by Griffin, Ji and Martin (2003). Their results in short are that momentum portfolio profits were large and positive abroad and only weakly co-move among the 40 countries, whether within regions or across continents, on which they did their study. The notion that if macroeconomic risk is driving momentum it must be largely country specific is supported by their results, which means that momentum profits cannot be explained by a global risk factor. Their data consisted of 40 countries that had at least 50 listed companies. They used equally weighted portfolios with a six months evaluation period and equally long holding period. They used the top and bottom 20 percent of the shares after the evaluation period to construct the portfolios. The total sample's momentum return was 0.49 percent. The momentum returns in Asia and for the emerging markets were on average lower than in other parts of the world. They also tested if momentum returns differed between bull and bear markets and they found that they did not, except for in emerging markets, hence momentum profits were not dependent on a certain state of the market in the developed countries in the sample. In short, neither an unconditional model nor a conditional forecasting model based on lagged instruments provided any evidence that macroeconomic risk variables could explain momentum. In addition, momentum profits around the world were economically large and statistically reliable in both good and bad economic states. Under both models they found that international momentum profits were generally positive in all macroeconomic states. Momentum could simply not be explained by their set of standard macroeconomic state variables. In contrast, Söderström (2000) reached the conclusion that when he excluded the devaluation of the Swedish krona 1992 the momentum returns increased, which could indicate dependence on different states of the market in extreme cases.

Chordia and Shivakumar (2002) found that momentum profits both for companies and industries as a whole can be explained by different macroeconomic variables that are related to the business cycle like dividend yield, default spread, term structure spread and the yield on three months treasury bills (T-bills). They also investigated if momentum returns changed during different economic states and the result showed that the returns were large during expansion and non-existent or negative during recessions. Their dataset consisted of securities from the NYSE and AMEX.

In the study made by Söderström (2008), he used the same methodology as Jegadeesh and Titman (1993) and the countries he chose was the same as Griffin, Ji and Martin (2003). His overall result was very similar to the previous studies, but he did not have the same focus as these previous articles. Instead, he focused on the return distribution of momentum returns and he found that the returns are far from normal. There was a leptokurtic distribution because the distribution had a negative skew and a high kurtosis. This means that the distribution had fat tails and he found that the probability of getting extreme negative values were significantly higher than getting extreme positive values. This was due to an increase in loser stock returns, which was not matched by previous winner stocks. Söderström also detected that when he excluded the least liquid stocks from the sample, which were the stocks with extremely negative returns the average momentum profits increased. Söderström (2008) believed that this was due to a linkage with macroeconomic shocks such as the currency flotation by Sweden in 1992 and East Asian crisis in 1997.

MOMENTUM AND TRANSACTION COSTS

When using an investment strategy with the purpose of making money one important aspect to take into account is the transaction costs. Transaction costs may have a significant effect on the returns and limit the potential upside of a momentum strategy. Jegadeesh and Titman (1993) investigated the effect of transaction costs and concluded that returns after transaction costs also are significant and positive. Cleary and Inglis (1998) came to the conclusion that the momentum strategy might not be exploitable for average retail investors, who are facing higher transaction costs. On the other hand, the momentum effect might be exploitable for more nimble traders facing lower transaction costs.

Carhart (1997) concluded that the transaction costs consume all the gains from following a momentum strategy in stocks in mutual funds. Carhart (1997) also came with three important rules-of-thumb for wealth maximizing mutual fund investors: avoid funds with persistently poor performance; funds with high returns last year have higher than average expected returns next year but not in the years thereafter; and the investment costs of expense ratios, transaction costs and load fees all have a negative and direct impact on performance. Carhart used data from January 1962 to December 1993, which was free from survivorship bias.

CHOOSING EVALUATION PERIOD

There is a study by Novy-Marx (2009) where he concluded that strategies based on recent past performance, six to one months before portfolio formation, generated positive returns but are less profitable than strategies based on intermediate horizon past performance, twelve to seven months before portfolio formation, especially among the largest and most liquid stocks. This means that he believed that intermediate horizon past performance and not recent past performance primarily drives momentum, both in the cross-section of US equities and in industries, investment styles, international equity indices, commodities and currencies. Novy-Marx (2009) did not find any way to explain this result in older studies; no one had previously described it. His data was from January 1926 through December 2008 and included all stocks in the CRSP universe. Novy-Marx also detected that the predictive power of recent returns seemed to have decreased in recent decades while the predictive power of intermediate horizon past returns had not, hence strategies based on intermediate horizon past performance have performed consistently over time and have even been more profitable over the last decades.

MOMENTUM - SWEDISH STUDIES

There have also been studies on momentum made on Swedish data, which are of importance in this thesis since only Swedish data is used. In the study made by Rouwenhorst (1998), mentioned above, all countries had significant results with the momentum strategy except for Sweden. The sample only contained 134 Swedish companies which might have had an effect on the outcome. The study made by Griffin, Ji and Martin (2003) also has a part that focuses on Sweden. Their results showed that there was no evidence of significant momentum profits in Sweden, again the Swedish sample is small.

Söderström (2000) replicated Rouwenhorst's study but on Swedish data in the period 1980-1999. Söderström (2000) also investigated the effect of the devaluation of the krona in 1992. His overall result was that momentum strategies performed well in economically stable periods. Sudden shocks may lead to extremely negative returns, because of the leptokurtic distribution described above, and the found momentum premium could be a compensation for bearing this kind of risk. In the study only two out of his 16 portfolios generated significant and positive returns before excluding the devaluation of the Swedish krona in 1992. When the devaluation was excluded the results changed and almost all the portfolios generated significant returns. The 16 portfolios had evaluation and holding periods ranging from three to twelve months.

There is a previous study from Stockholm School of Economics made by Hagwall and Lundén (2008) that also used Swedish data in the time period January 1987 to March 2008. Consistent with the study performed by Söderström (2000) they found significant momentum profits in Sweden.

VALUE AT RISK

Value at risk (VaR) is a statistical measure of possible portfolio losses due to market movements, however it does not take into account extremely rare events and the potential losses from this is disregarded (Bodie; Kane; Marcus, 2005).

Value at risk is a well known and one of the most common risk measures today. It is widely used by many financial institutions and plays an important part in the area of risk management.

According to Basel Committee on Banking Supervision the value at risk determines the capital requirement for banks. The Basel committee's recommendations have been implemented by many national regulatory agencies, among them Sweden. The Swedish Financial Supervisory Authority (Finansinspektionen, 2004) suggests a one percent significance level when calculating the value at risk.

All the major banks in Sweden have implemented the recommendation made by the Swedish Financial Supervisory Authority. According to their annual reports from 2010 Swedbank, Nordea, Handelsbanken and SEB all use a 99-percent probability to calculate their VaR. International investment banks like Goldman Sachs and Morgan Stanley also use the value at risk to measure market risk, but not all of them uses the 99-percent probability level. For example, Goldman Sachs uses a 95-percent probability level.

3. DATA

The dataset used is the returns on the stocks of all companies on the small, mid and large cap on the Stockholm Stock Exchange (SSE) from 1st of January 1997 to 31st of December 2010. The data represents the daily level of closing prices for each stock and have been recalculated into returns in STATA 11. The share prices take dividends, stock splits and stock repurchases into consideration. To find the dataset *Thomson Datastream* was used. The data also includes all the companies that now are delisted but once were listed for more than a year during the given time period, in line with what Rouwenhorst (1998) did. The reason why the unlisted companies were included was to avoid a bias that might appear if we leave out delisted companies. This bias is called the survivorship bias and means that if the data only includes companies that have "survived" during the whole time period the results might be overly positive or lead to other false conclusions, this bias is also called the delisting bias and is taken into consideration by Griffin, Ji and Martin (2003). A few of the delisted companies are not presented in the data because neither *Datastream* nor any place else had their price series stored.

We have chosen a relatively modern time period because there are already studies on older Swedish data made by Söderström (2000), Rouwenhorst (1998) and Griffin, Ji and Martin (2003). Söderström's time period was 1980 through 1999. The length of our time period is almost the same as Söderström's and we believe that it is a good length since Söderström was able to bring forth reliable results from his tests. When choosing the time period for the study Söderström's (2000) results have been taken into account and the period of the crisis and the devaluation of the krona in Sweden during the nineties have been left out to avoid the problems that made the momentum returns insignificant.

To avoid problems of illiquid stocks only the stocks listed on the three largest stock lists in Sweden have been selected. The lists are the large, mid and small cap and are generally thought of as the most liquid markets in Sweden. The reason why we have chosen the most liquid Swedish stocks is because Söderström (2008) came to the conclusion that if he excluded the least liquid stocks from the dataset, the stocks with extremely negative returns are excluded and the average momentum profits increases.

All shares were equally weighted because that is how Jegadeesh and Titman (1993), Griffin, Ji and Martin (2003) and Rouwenhorst (1998) have done in their studies, and to be able to compare our results we have constructed our portfolios in the same way. When choosing between value- and equally-weighted returns, Jegadeesh and Titman (1993) came to the conclusion in their paper that the difference between the two choices was very small, that is, it does not really matter which one you choose.

To calculate the excess returns the annual return on a daily basis of the 30 days Swedish Treasury bill was used as the risk-free rate. This Treasury bill was used because it is a common proxy for the risk-free rate in the financial industry.

In our regressions we use the inflation rate and the level of savings on an annual basis. Inflation and savings are important macroeconomic factors, and will therefore be taken into consideration. Since it is a Swedish dataset the Fama French factors are not available. The macroeconomic factors are taken from the Swedish Statistiska Centralbyrån (SCB). As the market factor in both our CAPM models and multifactor models we have used OMXS, which is an index containing all the stocks on the Stockholm Stock Exchange.

In line with most of the older studies we are not taking the transaction costs into consideration throughout this thesis.

HOW TO CALCULATE VALUE AT RISK

There are several different ways of calculating value at risk, but the following three are the most common ones.

DELTA-NORMAL APPROACH

This parametric approach requires the assumption that all the returns from all assets are normally distributed. The value at risk for a portfolio (stock) is calculated from the historical mean, variance and covariance (mean and variance). The exact calculation for portfolio value at risk according to this approach is the following:

$$Value\ at\ risk_{\alpha} = \mu - z_{\alpha}\sqrt{\sum_{i=1}^{n}\sum_{j=1}^{n}\omega_i\omega_j\sigma_{ij}} = \mu - z_{\alpha}\sigma_p$$

where z_α is the critical value of to the cumulative normal distribution that correspond to the chosen significance level. ω_i and ω_j denotes the weights of the assets *i* and *j* in the portfolio with *n* assets of each *i* and *j*. σ_{ij} denotes the covariance between the returns of assets *i* and *j*. μ denotes the mean of returns for the entire portfolio and σ_p is the standard deviation of the portfolio returns. For portfolios with a short holding period, approximately a few days, the mean is most often assumed to be zero (Letmark and Ringström, 2006).

The problem with the delta-normal approach when calculating value at risk is the model risk. Assumption of normally distributed returns often holds true for the centre of the distribution but when it comes to the tails empirical studies has shown that the assumption underestimates value at risk. This means that if the distribution has fatter tails there are more losses. Generally the 99-percent probability is used but it only covers 98,2-98,5 percent (Hendricks, 1996).

HISTORICAL SIMULATION

Historical simulation is a nonparametric method of calculating value at risk. This way of calculating the value at risk does not require any assumptions about the returns being normally distributed; hence the main assumption is that the past trends in the returns will continue in the future. To calculate value at risk using this method one is first required to choose a window of observations, normally six months to two years, and then rank the returns in ascending order in the chosen window, which thereafter are used to construct the probability distribution. From this distribution the potential losses are calculated depending on the percentage level one chooses.

The time frame used is called window size and the choice of window size has a large effect on the value at risk. If a large window is chosen then past performances that are not relevant today might be included and if the window is too small then recent and large abnormalities can have a large impact on the value at risk, hence giving it the "wrong" value (Manganelli and Engle, 2001).

MONTE CARLO SIMULATION

The Monte Carlo simulation and the historical simulation resemble each other, the main difference is that in the Monte Carlo simulation a statistical distribution is chosen, which is believed to approximately capture the possible changes in the market factor in a good way. There is no historical data used in this simulation, instead random numbers are used to simulate the future movements of the assets. This simulated distribution is then used to determine the value at risk, which is done in the same way as in the historical simulation.

OUR CHOICE

We have used the delta-normal approach because it is easy to implement and calculate as well as fairly accurate. It is suitable because stocks' distributions are often considered to be close to the normal probability density function. There is a problem and that is the fact that stock return distributions often have fatter tails than the normal probability density function, and a model based on the normal distribution would underestimate the proportion of outliers and therefore also the true value at risk. We still use this measure because we believe that the pros outweigh the cons, especially compared to the other methods previously mentioned.

CALCULATIONS

Firstly, the excess returns and the value at risk for the stocks were calculated and they have been used in the rest of the thesis. These figures are in decimal form throughout the thesis. Secondly, the mean and standard deviation of each stock's daily excess returns were calculated. These numbers were then used to calculate the value at risk. The significance level used is the one recommended by the Swedish Financial Supervisory Authority, one percent. The VaR is computed using the delta-normal approach with the following formula:

$$Value\ at\ risk_{\alpha} = \mu - z_{\alpha}\sigma$$

4. METHODOLOGY

EVALUATION AND HOLDING PERIODS

Throughout this thesis we have used something called evaluation period and holding period. The evaluation period is either nine or twelve months and is the period when the returns or the risk of a stock are evaluated to be able to divide the shares into quintiles in ascending order based on their past performance. Winners are the shares with the highest returns and losers are the shares with lowest returns in the momentum. In value at risk winners are the shares with high value at risk and losers have low value at risk. The evaluation periods chosen are the ones that have generated the best momentum returns in previous studies.

The holding period is either one or three months and is the period when the investor holds the portfolios that has been constructed based on the historical patterns from the evaluation period. The holding periods have been chosen mainly because they are the ones that have generated the highest profits in older studies. When choosing holding period the argument that Novy-Marx (2009) stated is also taken into consideration, it is simply to keep the number of strategies manageable. It has been proven by for example Jegadeesh and Titman (1993) that too long holding periods may have a reversal effect on the profits, and the momentum effect disappears. In this thesis we will not use overlapping periods. The reason for not having overlapping periods is due to problems with serial correlation in the holding periods and is also in line with the study on Swedish data performed by Hagwall and Lundén (2008).

The first holding period starts one month after the first evaluation period is completed, which means that we will use a gap month before the formation of the portfolios. This is in line with previous studies that also have a gap period before the holding period starts, for example Jegadeesh and Titman (1993) use one week and Novy-Marx (2008) uses months. One of the reasons for using a gap period is the bid-ask-bounce. The bid-ask-bounce is most common among illiquid stocks, but may affect more liquid stocks as well. The bid-ask-bounce can create the illusion of a price change when there in fact was not a real change.[2]

In the rest of the thesis we sometimes refer to the twelve months evaluation period and one month holding period as 12x1 and so on.

TESTING FOR MOMENTUM EFFECTS

The first test performed is to see if it is possible to find significant momentum returns during our time period in Sweden. This is done by taking the mean of the returns from the highest and lowest quintiles, winners and losers, and then perform a t-test to see if the means are significantly different from each

[2] For example, if the bid price is 15 SEK and the ask price is 16 SEK then the bid-ask spread is 1 SEK. Bid-ask bounce is when the ”true” price is different from the bid price, which in turn is different from the ask price. Both the bid and ask price are determined by the market. The true price is the price the investor end up paying.

other. If the difference between the winning and losing portfolio (W-L) is positive and significant then there is a momentum effect. The return displayed in the winning and losing cells in *Table 1* are the mean of the returns for the winners and losers in the holding periods during the whole time period. The result will be presented in the same way as the following table:

Table 1. Example of the winner-loser table

Holding Period		Evaluation Period 12	9
1	Winner	$return_{winner}$	$return_{winner}$
	Loser	$return_{loser}$	$return_{loser}$
	W-L	R_w-R_l	R_w-R_l
	t-stat	(t-stat)	(t-stat)
3	Winner	$return_{winner}$	$return_{winner}$
	Loser	$return_{loser}$	$return_{loser}$
	W-L	R_w-R_l	R_w-R_l
	t-stat	(t-stat)	(t-stat)

Afterwards, we will construct a similar table but instead we will rank the winners and losers based on their historical value at risk.

TESTING FOR EXPLANATORY POWER

Once the test for the momentum effects is done we will do a Fama-MacBeth regression to see how high the explanatory power of value at risk and momentum is on the returns in the holding period controlling for the market, inflation and savings. As mentioned above, we believe that inflation and savings are interesting macroeconomic variables and we are controlling for these factors instead of controlling for the Fama French factors.

TESTING THE BASIC PROPERTIES OF MOMENTUM AND VALUE AT RISK

Thereafter, a time series regression is used to see which basic properties momentum and value at risk have. To do this we will run multi-factor regressions including the market, inflation and savings in turns and at last all together in a three-factor model. The dependent variable is the winner minus loser return, i.e. the net return from the strategy. This regression is done for all the combinations of evaluation and holding period.

$$\hat{R}_{w-l_i} = \alpha_i + \hat{\beta}_1 * MktRf_i + \hat{\beta}_2 * Inflation_i + \hat{\beta}_3 * Savings_i$$

CREATING THE MATRICES

Hereafter, we will construct the matrices to be able to test for the spread between sorting according to momentum and sorting according to value at risk. The momentum sorting is based on the excess returns from every time period and the value at risk sorting is based on the value at risk for the same time period. The sorting of the momentum and the value at risk will be done independently.

THE SORTING

All the stocks will be sorted according to their past returns and value at risk respectively. Thereafter, the double sort according to both momentum and value at risk will be constructed. The data will first be sorted independently, i.e. the quintiles in both momentum and value at risk are calculated separately. Then the quintiles will be combined to create 25 portfolios based on past return and value at risk, i.e. a portfolio in the lowest quintile according to momentum will be placed into portfolio 21, 16, 11, 6 or 1, exactly where is decided by its value at risk. This means that the column "Winner" consists of all winner shares according to value at risk, only separated by their past returns.

Table 2. Double sorting

		Value-at-Risk				
		Winner	2	3	4	Loser
Momentum	Winner	25	20	15	10	5
	2	24	19	14	9	4
	3	23	18	13	8	3
	4	22	17	12	7	2
	Loser	21	16	11	6	1

What the double sorting looks like is illustrated in *Table 2*, where each number represents a portfolio. Winner in momentum means that the securities in question have the highest historical returns during the evaluation period in the sample and winner in value at risk has the highest value. To test if there is a significant spread between the momentum- and VaR-sorting every winner in the horizontal level will be subtracted by the value of the loser in the same horizontal level and every winner in the vertical level will be subtracted by the loser in the same vertical level, see *Table 3*.

Table 3. Example of subtractions in the horizontal and vertical level

		Value-at-Risk					
		Winner	2	3	4	Loser	Horizontal Subtraction
Momentum	Winner	25	20	15	10	5	25-5
	2	24	19	14	9	4	24-4
	3	23	18	13	8	3	23-3
	4	22	17	12	7	2	22-2
	Loser	21	16	11	6	1	21-1
	Vertical Subtraction	25-21	20-16	14-11	10-6	5-1	

Hereafter, we will construct the same matrices but this time they will be based on the alphas from the CAPM, in other words, the returns will be market adjusted according to the following formula:

$$E(r_i) = r_f + \beta_i(r_m - r_f)$$

Once again the spread between winners and losers will be calculated in the same way as described above, and tested with a t-test to see if there are any significant spreads. The result in the alpha matrices will then be compared with the results from the matrices with raw returns above. The t-statistic will be calculated according to the following formula:

$$T - statistics = \frac{\hat{\alpha}_i - \hat{\alpha}_j}{\sqrt{(se_i)^2 + (se_j)^2}}$$

5. RESULTS

In this section we will present our results. To make it easy to follow, we will present them in the same order as in the methodology.

MOMENTUM AND VALUE AT RISK RETURNS

The first test performed is to see if we can detect any momentum returns with our choice of evaluation and holding periods during the time period. *Table 4* illustrates the mean returns during the different holding periods based on the evaluation period. We see that an investor gain positive significant momentum returns, on a one percent level, with three of the combinations of evaluation periods and holding periods. The one that is insignificant has nine months evaluation period and three months holding period but it is also positive.

Table 4. Momentum Returns

Holding Period		Evaluation Period 12	9
1	Winner	0.001673	0.000258
	Loser	-0.00058	-0.00114
	W-L	0.002255***	0.001395***
	t-stat	(5.33)	(4.01)
3	Winner	0.000916	0.000556
	Loser	0.000294	0.000258
	W-L	0.000622***	0.000298
	t-stat	(2,74)	(1,19)

The table reports the average excess return for all the assets in the winner and the loser portfolio during the holding period. The W-L is the net return for the momentum portfolio.

t statistics in parentheses
*significant at 10% level, **significant at 5% level, ***significant at 1% level

It is no surprise that the portfolio with the longest evaluation period and the shortest holding period is the one that generates the best momentum returns of 0.23%, because almost all of the previous studies have reached the same conclusion, among them Jegadeesh and Titman (1993).

Since we are comparing the returns from the value at risk evaluation with the momentum evaluation a similar table based on evaluation of value at risk instead of past returns was created. Here we try to see historical patterns in the value at risk, instead of historical patterns in the returns that will possibly continue in the future.

Table 5. Value at Risk Returns

Holding Period		Evaluation Period 12	9
1	Winner	0.001573	0.000177
	Loser	0.000287	-0.00028
	W-L	0.001286***	0.000453*
	t-stat	(3.21)	(1.93)
3	Winner	0.001014	0.000347
	Loser	0.000334	0.000594
	W-L	0.00068***	-0.00025
	t-stat	(2.86)	(-1.04)

The table reports the average excess return for all the assets in the winner and the loser portfolio during the holding period. The W-L is the net return for the value at risk portfolio.

t statistics in parentheses
*significant at 10% level, **significant at 5% level, ***significant at 1% level

In *Table 5* we also reach the conclusion that twelve months evaluation period and one month holding period generates the best return and that it is possible to earn profits by evaluation value at risk. The return for the nine months evaluation period and three months holding period is insignificant and negative. The reason why the portfolio with the longest evaluation period and shortest holding period has the best return is probably because the twelve months evaluation period captures the value at risk that best predicts what will happen in the near future and therefore generates the best returns. If the chosen window size (evaluation period) is too small it might not reflect the fluctuations of a share's price relevant to the holding period accurately.

To test our results for robustness we did the same tables from 1990, see appendix *Table A1 - Table A2*. In these tables the "winner-loser" is significant for the momentum portfolio with twelve months evaluation period and one month holding period. For the value at risk the most significant is also the portfolio with twelve months evaluation period and one month holding period. The portfolio with twelve months evaluation period and three months holding period is also significant for the VaR. In both momentum and value at risk most of the insignificant returns are negative. This means that the losers have outperformed the winners and might indicate that when we get positive returns in our sample from 1997 to 2010 with nine months evaluation period they might not be as robust as the ones with a twelve months evaluation period. Through the whole thesis the portfolios with twelve months evaluation period are more significant so we will focus on them.

TESTING EXPLANATORY POWER

To test the explanatory power of the momentum and value at risk we run a Fama-MacBeth regression and control for the market. We also did the regressions controlling for savings and inflation, however they did not affect the holding period or the other coefficients and they were insignificant so we have excluded them from our result tables. Below are the tables for 12x1 and 9x1.

Table 6. Results from the Fama-Macbeth regression for 12x1

Fama-MacBeth for twelve months evaluation and one month holding

	(1)	(2)	(3)	(4)
Intercept	0.000759	0.00189***	0.00173***	0.00173***
	(1.26)	(4.28)	(4.06)	(4.06)
Momentum	0.00130***		0.00133***	0.00133***
	(2.78)		(3.29)	(3.29)
Value at risk		0.00981	0.0125	0.0125
		(1.12)	(1.51)	(1.51)
R^2	0.021	0.0341	0.0521	0.0521

The table reports the return from Fama-MacBeth regressions of firms' returns on past performance measured both as past returns and past value at risk. Specification (4) includes control for market returns.
t statistics in parentheses
*significant at 10% level, **significant at 5% level, ***significant at 1% level

Table 7. Results from the Fama-Macbeth regression for 9x1

Fama-MacBeth for nine months evaluation and one month holding

	(1)	(2)	(3)	(4)
Intercept	-0.00026	0.000043	-0.000021	0.000232
	(-0.41)	(0.08)	(-0.04)	(0.32)
Momentum	0.00112***		0.00140***	0.00137***
	(3.64)		(4.74)	(4.32)
Value at risk		0.00254	0.0042	0.0081
		(0.36)	(0.56)	(1.37)
R^2	0.0118	0.0177	0.0295	0.0251

The table reports the return from Fama-MacBeth regressions of firms' returns on past performance measured both as past returns and past value at risk. Specification (4) includes control for market returns.
t statistics in parentheses
*significant at 10% level, **significant at 5% level, ***significant at 1% level

In the 12x1 and 9x1 tables the momentum factor is positive and significant. For all tables see appendix *Table A3 – Table A4*. In both the 12x1 and 12x3 tables the intercepts are positive. In specification (4) the market factor is added in all the tables and it does not have an effect on the betas in the tables with twelve months evaluation period. In contrast, the market factor does affect the betas in the tables with nine months evaluation period, but the changes are marginal and the R^2 is slightly reduced.

In all tables except 9x3 both momentum and VaR have a positive relationship to the returns in the holding period. The impact and significance of both VaR and momentum increases when controlling for both of these factors. Since the value at risk is positive in nine out of twelve regressions it indicates that increased value at risk, i.e. a lower risk level, generates higher returns. This fact must be handled with caution since the beta values on value at risk are insignificant.

Overall, momentum has a higher effect on the returns than VaR. That is, generally momentum better explains the returns in the holding period.

There probably is an endogenous problem in our regressions, which leads to biased estimates. Some potential omitted variables can be the Fama and French factors since they are not available in Sweden. The bias appears because if we have left out an important casual factor the model might compensate for the missing factor by underestimate or overestimate one of the other factors.

TESTING FOR BASIC PROPERTIES ON MOMENTUM AND VALUE AT RISK

In the following tables the basic properties of the two test strategies, that is momentum and value at risk, are displayed through presenting results of time-series regressions on the two strategies' returns on the market, the inflation and the savings rate. In the tables below we only show the results for the 12x1 and 12x3, for the other tables see appendix *Table A5 – Table A6*.

Table 8. Time series regression employing the returns to the momentum and VaR strategies for 12x1

	y= winner-loser Mom(12x1)				y= winner-loser VaR(12x1)			
Independent Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Intercept	0.0022445***	0.00202***	0.000677	0.00091	0.0013249***	0.00265***	0.00276***	0.00287***
	(5.3)	(2.61)	(0.47)	(0.59)	(3.31)	(3.66)	(4.28)	(4.97)
Mktrf		0.00155	0.163	0.0557		-1.444***	-1.457***	-1.506***
		0	(0.36)	(0.13)		(-7.72)	(-7.88)	(-7.65)
Inflation			0.000929	0.0011			-0.000077	-1.83E-06
			(0.87)	(1.26)			(-0.17)	(-0.00)
Savings				-0.000289				-0.000131
				(-1.15)				(-1.54)
R^2		0.00000314	0.126	0.233		0.807	0.807	0.813

The table reports the results from the time-series regressions employing the returns to momentum and VaR strategies. The dependent variable is the net return from the winner-minus-loser portfolio.
t statistics in parentheses
*significant at 10% level, **significant at 5% level, ***significant at 1% level

Both strategies generate significant average returns in specifications (1) and (5). Mom(12x1) generates a return of 0.22% and VaR(12x1) generates a return of 0.13%, hence the Mom generates greater returns. Momentum has positive loadings on the market factor as well as inflation, but it has a negative loading on savings. None of these figures are significant so we cannot draw any conclusions from this. There are more significant findings for the value at risk. It has a negative and significant loading on the market but positive on inflation and savings but they are not significant. The VaR(12x1) generates significant abnormal returns of 0.29% relative to the three-factor model, see specification (8), while Mom(12x1) also has a positive intercept but it is insignificant. The intercept for Mom(12x1) is lower than for VaR(12x1).

In the table 12x3, both Mom and VaR have a negative loading on the market, which means that if the market goes down the profits from both of the strategies will increase. This is explained by the fact that the losing portfolio decreases more than the winning portfolio increases so the positive returns mainly come from the losing portfolio. However, this is not the case in all of our tables, especially not 9x1 and 9x3 probably due to the fact that those tables are not as robust as the tables with a twelve months evaluation period. The result from the 12x3 table is still reliable because it has more significant results and is in line with previous studies, Söderström (2008).

Table 9. Time series regression employing the returns to the momentum and VaR strategies (12x3)

	y= winner-loser Mom(12x3)				y= winner-loser VaR(12x3)			
Independent Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Intercept	0.000622*** (2.74)	0.00166*** (2.97)	0.00127 (1.03)	0.00102 (0.83)	0.00068*** (2.86)	0.00197*** (4.55)	0.00194* (1.89)	0.00191* (1.76)
Mktrf		-1.244*** (-3.15)	-1.139*** (-2.60)	-1.018** (-2.51)		-1.492*** (-8.82)	-1.483*** (-4.67)	-1.468*** (-4.26)
Inflation			0.000228 (0.32)	0.0005 (0.75)			0.0000194 (0.04)	0.0000533 (0.1)
Savings				-0.0001700 (-0.96)				-0.0000211 (-0.44)
R^2		0.517	0.523	0.562		0.797	0.797	0.797

The table reports the results from the time-series regressions employing the returns to momentum and VaR strategies. The dependent variable is the net return from the winner-minus-loser portfolio.
t statistics in parentheses
*significant at 10% level, **significant at 5% level, ***significant at 1% level

When comparing with VaR(12x3) the results are very similar to the 12x1 table. The intercept and beta value for the market are highly significant at a one percent level. The rest of the factors in the specifications are insignificant. The 9x1 and 9x3 VaR tables consist of more insignificant values. For 9x1 the intercept by itself is significant, but in the following specifications when controlling for other factors, the market is the only significant factor. In 9x3 there are only insignificant values.

Comparing the other momentum tables, see appendix *Table A5 – Table A6*, with 12x1, the intercept in the two first specifications is significant in both 12x3 and 9x1. However, in 12x3 the market factor is significant in all specifications unlike the other tables.

In line with previous results from *Table 5*, the returns for VaR are generally more significant with a twelve months evaluation period than a nine months evaluation period. The results are in line with the results earlier shown in *Table 4* and *Table 5* until we add the inflation and savings as control variables. When we add inflation and savings to the Mom(12x1) the intercept decreases and becomes insignificant. When the control factors are added to VaR(12x1) both the intercept and market factor stay significant.

The R^2 is generally higher for the regressions on VaR than momentum. For momentum the R^2 increases when the holding period is three months. Overall, the R^2 is higher for twelve months evaluation period. To conclude, regressions with VaR and 12 months evaluation period have better R^2 values, which means that they have a better measure of fit when it comes to predicting winner minus loser returns, i.e. momentum returns.

In these regressions we probably also have an endogenous problem like the Fama-MacBeth regressions above. There are probably more important factors when it comes to determine the returns from the "winner-minus-loser" portfolio that we have omitted.

TESTING THE SPREAD

After creating the double sorted matrices we test for a spread between momentum and VaR to see if it is significant or not. In most of the cases the spread is insignificant, in the best case four out of ten spreads in a matrix are significant. When the spreads are insignificant it means that the value at risk or momentum is not priced. For example, if we look at the matrix for twelve months evaluation period and one month evaluation period (12x1) we see that the spread between the value at risk in momentum portfolio one (the horizontal level) is insignificant, which means that the value at risk is not priced. That is, if you take on more risk in that portfolio, the winner momentum portfolio, you will not get a risk premium because the returns in the holding period are not significantly different for the different VaR-classes.

Table 10. Matrix over the spreads for 12 months evaluation period and 1 month holding period

		Value at Risk					
		Winner	2	3	4	Loser	Spread
Momentum	Winner	0.0008691	0.001506	0.001445	0.0012131	0.0023466	-0.0014775 (-1.18)
	2	0.0017425	0.0019803	0.0013555	0.0022194	0.000303	0.0014395* (1.92)
	3	0.0016034	0.0011466	0.0012809	0.0008489	0.001682	-7.86E-05 (-0.12)
	4	0.0017147	0.0013181	0.0009645	-0.0000169	0.0007903	0.0009244 (1.22)
	Losers	0.0011757	0.0005185	0.001503	-0.0010372	-0.002409	0.0035847*** (2.94)
	Spread	-0.0003066 (-0.41)	0.0009875 (1.48)	-5.8E-05 (-0.07)	0.0022503*** (2.85)	0.0047556*** (4.88)	

The table displays the mean of the excess returns from the assets in each portfolio sorted in quintiles according to momentum and value at risk.

t statistics in parentheses

*significant at 10% level, **significant at 5% level, ***significant at 1% level

Table 11. Matrix over the spreads for 9 months evaluation period and 1 month holding period

Momentum \ Value at Risk	Winner	2	3	4	Loser	Spread
Winner	-0.0002464	-0.0001994	-0.0002996	0.0003461	0.0007217	-0.0009681 (-1.17)
2	-0.0001023	0.0003397	0.0004294	0.0003427	-0.0005382	0.0004359 (0.69)
3	0.000478	-0.0000235	-0.0001546	0.000887	0.000256	0.000222 (0.36)
4	0.0002849	0.0000776	-0.0006703	-0.0012143	-0.0013406	0.0016255** (2.27)
Loser	-0.0001295	0.0001304	-0.0006698	-0.0021121	-0.0013422	0.0012127 (1.26)
Spread	-0.0001169 (-0.16)	-0.0003298 (-0.60)	0.0003702 (0.54)	0.0024582*** (3.47)	0.0020639*** (2.68)	

The table displays the mean of the excess returns from the assets in each portfolio sorted in quintiles according to momentum and value at risk.

t statistics in parentheses

*significant at 10% level, **significant at 5% level, ***significant at 1% level

In the 9x1 matrix above less spreads than in 12x1 are significant. In the 12x3 matrix even more spreads are insignificant and in the 9x3 matrix none of the spreads are significant, see appendix *Table A7 – Table A8*. Because there are so few significant results we cannot draw a general conclusion that momentum is always priced in a value at risk setting or the other way around. In many of the spreads the "raw" returns fail to price both the momentum and the value at risk.

In the cases when the spreads are significant, the difference between the winner and the loser is always positive. Most of the significant returns are in the lower right corner of the matrix, among the loser portfolios, hence the spreads in volatile (vertical level) and bad performing (horizontal level) shares have more significant values.

In general, there are more significant spreads for the returns with a one month holding period, and the evaluation period with the most significant spreads is twelve months, which is consistent with our previous tests. This might be because the twelve months evaluation period better captures reliable historical patterns both for the returns and for the value at risk. As mentioned earlier, the window size is of great importance when calculating VaR and has to be taken into consideration when trying to estimate the future risk patterns.

To test for robustness we did the same matrices from 1990, see appendix *Table A9 – Table A12*. From this we can conclude that the 12x1 is the most robust matrix.

CAPM-ADJUSTED MATRICES

When transforming the "raw" returns to alphas through the CAPM model we get the following results.

Table 12. Matrix over the alphas with 12 months evaluation period and 3 months holding period

		Value at Risk					
		Winner	2	3	4	Loser	Spread
Momentum	Winner	0.00467	0.00149	0.000489	0.000142	0.0000303	0.004640 (1.40)
	2	0.000808	0.000969	0.000762	-0.000128	-0.00128	0.002088*** (2.67)
	3	0.000976	0.000646	0.000254	0.000124	0.0000376	0.000938 (1.49)
	4	0.000481	0.000496	0.0000789	-0.000825	-0.00111	0.001591** (2.03)
	Loser	0.000511	0.00104	0.000143	-0.00106	-0.00193	0.002441*** (3.74)
	Spread	0.004159 (1.26)	0.000450 (0.87)	0.000346 (0.74)	0.001202** (2.39)	0.001960*** (2.91)	

The table displays the mean of the market adjusted excess returns from the assets in each portfolio sorted in quintiles according to momentum and value at risk.

t statistics in parentheses

*significant at 10% level, **significant at 5% level, ***significant at 1% level

When we sort the returns based on their alphas, the 12x3 matrix is the one with most significant returns. The rest of the alpha matrices are in the appendix *Table A13 – Table A15*. It is hard to draw a general conclusion from these tables, mainly because it is difficult to see a pattern in the significant spreads. Hence, we cannot make a general conclusion if momentum always is priced in a value at risk setting or the other way around. However, the patterns in 12x1 and 12x3 are similar to the one mentioned above. As in the matrices with raw returns, in many of the spreads the alphas fail to price both the momentum the value at risk.

The 12x1 matrix is very similar to the 12x3 matrix when it comes to significant values, however in the 9x1 and 9x3 matrices almost all spreads are close to zero and insignificant. Overall, in the alpha matrices the majority of the spreads are positive, except for in the 9x3 matrix where the majority of the spreads are negative. Within the winning momentum group the spread between winner and loser in VaR is 0.46% (horizontal level). The tests we have done are pretty easy to do for an investor and are smart to take into consideration if the investor wants to get higher returns with less risk.

In general, the matrices with twelve months evaluation period are much more significant than the matrices with nine months evaluation period. The biggest difference between the "raw" returns matrices and the alphas is that the 12x3 matrix has most significant values with the alphas, while in the "raw" returns it is the 12x1 which has most significant spreads.

6. CONCLUSIONS

In this thesis we have found evidence supporting that there is a momentum effect in Sweden between 1997 and 2010. In general, the twelve months evaluation period generates the largest returns. The momentum strategy generates larger returns with one month holding period compared to three months holding period. When sorting on value at risk instead of past returns the results are similar.

The value at risk estimated after a twelve months evaluation period has proven to have an explanatory power on the returns in "winner-minus-loser" portfolios, it does not have a significant explanatory power on the returns in the holding period when all the shares are taken into account but it still indicates that lowering the risk can increase the returns. In most of our tests the momentum and VaR have a negative loading on the market, it means that if the market goes down the profits from both of the strategies will increase. This is explained by the fact that the losing portfolio decreases more than the winning portfolio increases so the losing portfolio generates the major part of the positive returns, which supports the results from previous studies.

When we create the market adjusted matrices there are more positive spreads than in the raw return matrices. This means that in the market adjusted returns the winners always outperforms the losers and a positive spread is generated, although not always significant. To get the highest returns through the momentum strategy it is, according to all the tests in our study, best to consider both the past return patterns and past risk patterns. This would generate higher returns and lower the risk in the holding period.

Not all of the test results are significant; this does not mean that nothing is robust. The reason why they are insignificant might be due to the fact that our dataset is small because we have excluded some smaller stock lists and because of our restricted time period.

Our main conclusion is that there are positive significant returns to be made in Sweden using the momentum strategy. However, our study suggests that it would be possible to earn higher profits and lower the estimated risk if a risk measure like value at risk is considered when evaluating which stocks that belong to the winner and the loser portfolio.

For future studies it would be interesting to do a more extensive study on how VaR affects the future share price and hence the returns. It would also be interesting to study how much the transaction costs really affects the profits made through the momentum strategy.

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8. APPENDIX

Table A1. Momentum Profits from 1990 to 2010

Momentum 1990-2010

Holding Period		Evaluation Period 12	9
1	Winner	0.0014067	0.0014203
	Loser	0.0000099	0.0029923
	W-L	0.0013968***	-0.001572
	t-stat	(3.34)	(-0.97)
3	Winner	0.000956	0.0006966
	Loser	0.0007226	0.0013034
	W-L	0.0002334	-0.0006068
	t-stat	(1.07)	(-1.08)

The table reports the average excess return for all the assets in the winner and the loser portfolio during the holding period. The W-L is the net return for the value at risk portfolio.

t statistics in parentheses
*significant at 10% level, **significant at 5% level, ***significant at 1% level

Table A2. Value at Risk Profits from 1990 to 2010

Value at risk 1990-2010

Holding Period		Evaluation Period 12	9
1	Winner	0.0015711	0.0009391
	Loser	0.0005197	0.0034351
	W-L	0.0010514**	-0.002496
	t-stat	(2.54)	(-1.54)
3	Winner	0.0010681	0.0006985
	Loser	0.0006501	0.0015164
	W-L	0.000418**	-0.0008179
	t-stat	(1.96)	(-1.46)

The table reports the average excess return for all the assets in the winner and the loser portfolio during the holding period. The W-L is the net return for the value at risk portfolio.

t statistics in parentheses
*significant at 10% level, **significant at 5% level, ***significant at 1% level

Table A3. Results from the Fama-Macbeth regression for 9x3

Fama-MacBeth for nine months evaluation and three months holding

	(1)	(2)	(3)	(4)
Intercept	0.000285	0.00018	-0.000043	0.000286
	(0.69)	(0.29)	(-0.07)	(0.44)
Momentum	0.00023		0.000417	0.000488
	(0.72)		(1.1)	(1.34)
Value at risk		-0.00262	-0.00385	0.0015
		(-0.46)	(-0.60)	(0.33)
R^2	0.0207	0.0228	0.0481	0.0318

The table reports the return from Fama-MacBeth regressions of firms' returns on past performance measured both as past returns and past value at risk. Specification (4) includes control for market returns.
t statistics in parentheses
*significant at 10% level, **significant at 5% level, ***significant at 1% level

Table A4. Results from the Fama-Macbeth regression for 9x3

Fama-MacBeth for twelve months evaluation and three months holding

	(1)	(2)	(3)	(4)
Intercept	0.000707**	0.00130***	0.00109***	0.00109***
	(2.42)	(5.84)	(5.76)	(5.76)
Momentum	0.000275		0.000349	0.000349
	(0.57)		(0.74)	(0.74)
Value at risk		0.00407	0.00524	0.00524
		(0.88)	(1.14)	(1.14)
R^2	0.0451	0.0357	0.077	0.077

The table reports the return from Fama-MacBeth regressions of firms' returns on past performance measured both as past returns and past value at risk. Specification (4) includes control for market returns.
t statistics in parentheses
*significant at 10% level, **significant at 5% level, ***significant at 1% level

Table A5. Time series regression employing the returns to the momentum and VaR strategies (9x1)

Independent Variables	y= winner-loser Mom(9x1)				y= winner-loser VaR(9x1)			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Intercept	0.001395*** (4.01)	0.00135*** (3.84)	0.000516 (1)	0.00052 (0.92)	0.000453* (1.93)	0.000666 (0.99)	0.00023 (0.28)	0.00018 (0.18)
Mktrf		-0.143 (-0.85)	-0.0664 (-0.42)	-0.0666 (-0.40)		0.46** (2.28)	0.501*** (2.71)	0.504** (2.48)
Inflation			0.000712** (2.24)	0.000714** (2.17)			0.000373 (0.54)	0.000335 (0.46)
Savings				-0.0000057 (-0.05)				0.0000858 (0.33)
R^2		0.0828	0.290	0.290		0.204	0.218	0.226

The table reports the results from the time-series regressions employing the returns to momentum and VaR strategies. The dependent variable is the net return from the winner-minus-loser portfolio.

t statistics in parentheses

*significant at 10% level, **significant at 5% level, ***significant at 1% level

Table A6. Time series regression employing the returns to the momentum and VaR strategies (9x3)

Independent Variables	y= winner-loser Mom(9x3)				y= winner-loser VaR(9x3)			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Intercept	0.000298 (1.1883)	0.000253 (0.56)	-0.000847 (-1.07)	-0.000843 (-1.20)	-0.00025 (-1.04)	-0.0003 (-0.82)	-0.000117 (-0.19)	-0.00011 (-0.24)
Mktrf		0.181 (0.76)	0.241 (1.2)	0.241 (1.29)		0.128 (0.8)	0.118 (0.65)	0.118 (0.78)
Inflation			0.000905** (2.06)	0.000982** (1.98)			-0.000148 (-0.39)	-0.0000185 (-0.06)
Savings				-0.0000866 (-0.47)				-0.0001100 (-0.24)
R^2		0.0400	0.306	0.327		0.0281	0.0382	0.122

The table reports the results from the time-series regressions employing the returns to momentum and VaR strategies. The dependent variable is the net return from the winner-minus-loser portfolio.

t statistics in parentheses

*significant at 10% level, **significant at 5% level, ***significant at 1% level

Table A7. Double sorted raw returns 9x3

Momentum	Value at Risk: Winner	2	3	4	Loser	Spread
Winner	0.000409	0.000193	0.000448	0.000505	0.000997	-0.0005885 (-1.07)
2	0.000002	0.000164	0.000871	0.001010	0.000370	-0.00036805 (-1.00)
3	0.000545	0.000340	0.000713	0.000609	0.000084	0.0004611 (1.35)
4	0.000618	0.000449	-0.000561	0.000069	0.000266	0.0003528 (0.96)
Loser	0.000327	0.000474	-0.000103	0.000005	0.000539	-0.0002119 (-0.24)
Spread	0.000082 (0.13)	-0.000282 (-0.84)	0.000552 (1.45)	0.000500 (1.10)	0.000458 (0.74)	

The table displays the mean of the excess returns from the assets in each portfolio sorted in quintiles according to momentum and value at risk.

t statistics in parentheses
*significant at 10% level, **significant at 5% level, ***significant at 1% level

Table A8. Double sorted raw returns 12x3

Momentum	Value at Risk: Winner	2	3	4	Loser	Spread
Winner	0.0015651	0.0015254	0.0009532	0.0008706	0.0006306	0.0009345 (1.24)
2	0.0007994	0.0011305	0.0017662	0.0009276	0.0011684	-0.000369 (-0.56)
3	0.0011686	0.0011606	0.0011991	0.0008382	0.0008772	0.0002914 (0.83)
4	0.0011923	0.0009289	0.0006358	0.0006863	0.0008236	0.0003687 (0.83)
Loser	0.0007549	0.0011144	0.0011487	0.0002869	-0.0006535	0.0014084** (1.97)
Spread	0.0008102 (0.82)	0.000411 (1.24)	-0.0001955 (-0.44)	0.0005837 (1.35)	0.0012841** (2.42)	

The table displays the mean of the excess returns from the assets in each portfolio sorted in quintiles according to momentum and value at risk.

t statistics in parentheses
*significant at 10% level, **significant at 5% level, ***significant at 1% level

Table A9. Double sorted raw returns 9x1 from 1990

		Value at Risk					
		Winner	2	3	4	Loser	Spread
Momentum	Winner	0.0022827	0.0022479	0.001212	0.001084	0.00148	0.0008024 (1.04)
	2	0.0013252	0.0014489	0.001025	0.001425	0.001956	-0.000631 (-0.76)
	3	0.0011686	0.0011606	0.001199	0.000838	0.000877	-0.001538** (-1.87)
	4	0.0011923	0.0009289	0.000636	0.000686	0.000824	-0.000465 (-0.76)
	Loser	0.0007549	0.0011144	0.001149	0.000287	-0.000654	-0.007089 (-0.93)
	Spread	0.0022519** (2.38)	0.0017413*** (3.14)	0.000339 (0.49)	-0.000993 (-1.37)	-0.00564 (-1.16)	

The table displays the mean of the excess returns from the assets in each portfolio sorted in quintiles according to momentum and value at risk.

t statistics in parentheses
*significant at 10% level, **significant at 5% level, ***significant at 1% level

Table A10. Double sorted raw returns 9x3 from 1990

		Value at Risk					
		Winner	2	3	4	Loser	Spread
Momentum	Winner	0.001228	0.0013223	0.000221	0.000681	0.000581	0.0006469 (1.40)
	2	0.0008812	0.000847	0.000833	0.000676	0.001274	-0.000393 (-1.01)
	3	0.0011686	0.0011606	0.001199	0.000838	0.000877	-0.000532 (-1.39)
	4	0.0011923	0.0009289	0.000636	0.000686	0.000824	0.0000534 (0.15)
	Loser	0.0007549	0.0011144	0.001149	0.000287	-0.000654	-0.002854 (-1.10)
	Spread	0.0010814* (1.80)	0.0008675*** (2.79)	-0.00032 (-0.85)	-1.72E-05 (-0.04)	-0.002419 (-1.46)	

The table displays the mean of the excess returns from the assets in each portfolio sorted in quintiles according to momentum and value at risk.

t statistics in parentheses
*significant at 10% level, **significant at 5% level, ***significant at 1% level

Table A11. Double sorted raw returns 12x1 from 1990

		Value at Risk				
Momentum	Winner	2	3	4	Loser	Spread
Winner	0.001069	0.0020455	0.001804	0.000965	0.001172	-0.000103 (-0.09)
2	0.001907	0.0022285	0.001658	0.001303	0.001424	0.0004835 (0.65)
3	0.0011686	0.0011606	0.001199	0.000838	0.000877	0.000054 (0.08)
4	0.0011923	0.0009289	0.000636	0.000686	0.000824	-0.000713 (-0.68)
Loser	0.0007549	0.0011144	0.001149	0.000287	-0.000654	0.0030932*** (2.89)
Spread	-0.0003524 (0.48)	0.0013906** (1.96)	0.000249 (0.29)	0.001211 (1.50)	0.002844*** (2.91)	

The table displays the mean of the excess returns from the assets in each portfolio sorted in quintiles according to momentum and value at risk.

t statistics in parentheses

*significant at 10% level, **significant at 5% level, ***significant at 1% level

Table A12. Double sorted raw returns 12x3 from 1990

		Value at Risk				
Momentum	Winner	2	3	4	Loser	Spread
Winner	0.0018198	0.0016524	0.001005	0.001016	0.000453	0.0013672* (1.67)
2	0.0009206	0.0013357	0.00115	0.000877	0.000542	0.0003783 (0.96)
3	0.0011686	0.0011606	0.001199	0.000838	0.000877	-1.48E-05 (-0.04)
4	0.0011923	0.0009289	0.000636	0.000686	0.000824	-0.000411 (-0.83)
Loser	0.0007549	0.0011144	0.001149	0.000287	-0.000654	0.0004399 (0.72)
Spread	0.001066 (1.02)	0.0006034* (1.84)	-0.00014 (-0.33)	0.000289 (0.65)	0.000139 (0.27)	

The table displays the mean of the excess returns from the assets in each portfolio sorted in quintiles according to momentum and value at risk.

t statistics in parentheses

*significant at 10% level, **significant at 5% level, ***significant at 1% level

Table A13. Double sorted alphas 9x1

		Value at Risk					
		Winner	2	3	4	Loser	Spread
Momentum	Winner	0.000035	0.000055	-0.000179	0.000384	0.000234	-0.000200 (-0.16)
	2	0.000159	0.000340	0.000391	0.000300	-0.000623	0.000782 (0.78)
	3	0.000504	-0.000003	-0.000251	0.000446	-0.000021	0.000525 (0.46)
	4	-0.000402	0.000041	-0.000588	-0.000747	-0.000504	0.000102 (0.07)
	Loser	-0.000767	-0.000255	-0.001150	-0.002050	-0.001050	0.000283 (0.22)
	Spread	0.000802 (0.95)	0.000310 (0.31)	0.000971 (1.01)	0.002434* (1.84)	0.001284 (0.80)	

The table displays the mean of the market adjusted excess returns from the assets in each portfolio sorted in quintiles according to momentum and value at risk.

t statistics in parentheses
*significant at 10% level, **significant at 5% level, ***significant at 1% level

Table A14. Double sorted alphas 9x3

		Value at Risk					
		Winner	2	3	4	Loser	Spread
Momentum	Winner	0.000980	0.000178	0.000518	0.000401	0.001040	-0.000060 (-0.06)
	2	0.000269	0.000230	0.000484	0.000391	0.000632	-0.000363 (-0.50)
	3	0.000426	0.000329	0.000625	0.000589	0.000207	0.000219 (0.36)
	4	0.000030	0.000369	-0.000690	0.000220	0.000648	-0.000618 (-0.60)
	Loser	0.000007	0.000251	-0.000247	-0.000058	0.000589	-0.000582 (-0.62)
	Spread	0.000973 (1.22)	-0.000073 (-0.10)	0.000765 (1.12)	0.000459 (0.54)	0.000451 (0.40)	

The table displays the mean of the market adjusted excess returns from the assets in each portfolio sorted in quintiles according to momentum and value at risk.

t statistics in parentheses
*significant at 10% level, **significant at 5% level, ***significant at 1% level

Table A15. Double sorted alphas 12x1

		Value at Risk					
		Winner	2	3	4	Loser	Spread
Momentum	Winner	0.00117	0.0012	0.000892	-0.000359	-0.0000812	0.001251 (0.83)
	2	0.0016	0.00153	0.000518	0.000525	-0.00151	0.003110*** (2.61)
	3	0.00161	0.00102	0.000875	-0.00000898	0.000849	0.000761 (0.83)
	4	0.000898	0.000842	0.000363	-0.000848	-0.000865	0.001763 (1.41)
	Loser	0.00130	0.000955	0.000546	-0.00177	-0.00261	0.003910*** (2.87)
	Spread	-0.000130 (-0.07)	0.000245 (0.24)	0.000346 (0.47)	0.001411* (1.71)	0.002529*** (3.02)	

The table displays the mean of the market adjusted excess returns from the assets in each portfolio sorted in quintiles according to momentum and value at risk.

t statistics in parentheses
*significant at 10% level, **significant at 5% level, ***significant at 1% level