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130/30 Investment Strategies – Is the Active Extension Value Adding?

Evidence from Momentum and Contrarian Based Approaches in the German Market Measured by the Omega Ratio

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ABSTRACT

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Objectives: In this thesis we studied the performance of active extension portfolios constructed by using momentum/contrarian strategies. Fundamentally, the difference between the 130/30 and the long-only asset classes is the relaxation from the long-only constraint. The main implication of this study is to find out whether the 130/30 strategy is value adding, in comparison to other actively managed asset classes. We examined the consequences of the fund managers stock selecting skills.

Theoretical Framework: The relaxation from the long-only constraint should in theory provide the portfolio manager with more possibilities to exploit the negative outlooks of stock performances. This should, according to the modern portfolio theory, lead to a more optimal portfolio composition.

Data and Methodology: The prudency of these strategies was measured using the "superior" performance measure, Omega ratio, as the main risk-adjusted performance measure. Furthermore, we measured the performance also using the Sharpe ratio and the reward-to-VaR. The empirical part applies data over the sample period of Jan 1991- Apr 2009, using the constituents of the German DAX index.

Results and Findings: The 130/30 portfolios underperformed in relation to the equivalent long-only portfolios but outperformed the benchmark index DAX. The outperformance over the DAX is through a size bias. The risk-return characteristics are comparable to the ones of a long-only. The Omega measure is more flexible than the conventional measures due to the possibility of adjusting the threshold return level to the market environment.

Keywords: 130/30, active extension, Omega ratio, long-only, DAX, short selling, momentum/contrarian, manager skill

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1. Introduction

1.1 Background

One of the fastest growing areas in the asset management industry is the so-called 130/30 class. The idea behind this investment strategy, also known as the "active-extension strategy", is to hold 130% of the invested capital in long positions and 30% in short positions. In this way the investment managers can utilize not only the positive outlooks for individual stocks by overweighting them in the portfolio, but also the negative outlooks via short sale positions.

The largest pension fund in the world, CalPERS, was among the early adopters of 130/30 investing. Several pension funds have followed their example since then. Tabb and Johnson (2007) state that 130/30 products have grown to over 75 billion USD in assets under management by 2007 and could reach two trillion by 2010. However recent surveys showed that the popularity of 130/30 products suffered during the recent financial crisis and skepticism towards the active extensions have risen. Scott Bondurant, global head of long/short investments for UBS Global Asset Management said, even though 130/30 strategies are clearly facing headwinds, that: "We think there is a lot of misperception about the strategy, some people don't realize or appreciate that the strategy is 100% net long in up markets and down markets so it's designed to outperform the benchmark but not provide protection in down markets." (Sarkar, 2009)

The approach of short selling unattractive stocks is not a new phenomenon. Hedge funds have been applying such techniques for quite some time. The main implementation of 130/30 strategies is that they are benchmark driven as are traditional mutual funds, whereas hedge funds tend to focus on absolute returns.

1.2 Problem discussion

From a theoretical point of view, the 130/30 strategy seems to be quite tempting. Short-selling the underperformer and investing the proceedings in the outperformer should intuitively lead to higher returns. Several studies have empirically demonstrated this phenomenon, for instance Agarwal et al. (2009), Jacobs and Levy, (2007), Martielli (2005) Clarke et al.(2004), Arnott and Leinweber (1994). Michaud (1993) argued that the costs related to short-selling can eliminate the benefits that are gained. On the other hand, Grinold and Khan (2000) and Jacobs and Levy (1995) suggested that these costs are not higher for long-only investing and further that the fees per active dollar managed may be higher in the long-only strategy.

A vast majority of the abovementioned previous papers have been discussing the topic of the 130/30 strategies by applying the information ratio (IR) and/or Jensen's Alpha as a measurement of portfolio performance. However the IR is a metric that assumes normal distribution which seems unrealistic in the cases of portfolio returns and only takes into consideration the two moments of the return distribution. Keating and Shadwick (2002a, 2002b) proposed a universal risk measuring tool, the Omega ratio, which takes all the moments (mean, standard deviation, skewness, and kurtosis) into consideration, and further on does not depend on a specific utility function.

Portfolio optimization and testing the prudency of 130/30 strategies have been discussed previously as being interrelated. For example the studies of Johnson et al. (2007) and Jacobs and Levy (2007) rely on the assumption that the managers' stock selecting skills are superior. In other words, the manager skills allow distinguishing between the future over- and underperformers.

Another issue occurs regarding the classification of the 130/30 products. On one side they provide the beta exposure of a traditional mutual fund, and on the other side they apply techniques to generate positive alpha values. Hence 130/30 products are sometimes also called "hedge fund light". Lo and Patel (2008) declare that there still exists confusion among managers and investors regarding the appropriate risk-return profiles of such

strategies, whether they should be considered as long-only or as long-short hedge fund – like instruments.

1.3 Purpose and Objectives

The purpose of this thesis is to explore whether the active-extension strategy delivers additional value vis-à-vis a long-only and a market neutral approach. We decided to choose a different approach to previous studies. As mentioned in chapter 1.2, these studies combine portfolio optimization with the 130/30 strategy. This has the consequence that the success of 130/30 strategies is only examined at the perspective of superior manager stock selection skills. However, in practice the portfolio manager is often not able to distinguish between the positive and the negative outlooks of stock performance. Not taking this factor into consideration could lead to a bias that favors the 130/30 strategies.

To avoid this bias, our objective is to test the consequences of implementing the 130/30 strategies for three different cases which we have named formally as green, yellow, and red. These different manager skills are:

- *Green* - Manager is in average able to pick the future over- and underperformers
- *Yellow* - Manager stock selecting skill does not provide any significant outcome
- *Red* - Manager continuously makes misforecasts while selecting stocks

As an example to clarify the bias that we seek to avoid, let's consider that the 130/30 portfolio provides better results to its long-only counterpart in "green" manager skill zone. This overperformance could be just a part of the truth. The other part of the story is if the long-only portfolio outperforms the 130/30 in the "red" manager skill zone. Hence we need to take all the possible manager skill outcomes into consideration, since it is difficult to choose the more skillful portfolio manager ex-ante.

The basis for the hypothetical managing skill categorization is created by applying different momentum/contrarian stock selection criteria. This stock selection method is applied for the reasons of simplicity and suitability, for example Cullen and Gasbarro (2009) empirically confirm that mutual fund managers use these strategies also in practice. Furthermore, the quantitative approaches seem to be dominating in the area of active-extension funds; with indications of 60%-80% of the 130/30 strategies in the marketplace being quantitatively run (Johnson et al. 2007).

A further contribution of this paper is the application of a more convenient measure to the conventional risk adjusted-performance measures, the Omega ratio which is used to compare the outcomes of the different portfolios (130/30, long-only, long-short market neutral).

For the empirical part, the focus will be on the German market, more specifically the DAX index. The characteristics of the DAX index, such as the broad sector diversification and the liquidity of the market makes it highly applicable for the purpose of this study.

Special interest is on finding out whether a 130/30 strategy can outperform its long-only equivalent strategy regarding the risk-adjusted return. In other words do the performances of the different portfolio types compensate for all different levels of incorporated risk, even if the manager skills are not within the "green" area?

1.4 Structure of the thesis

In order to answer the research problem posed in part 1.3, the structure of this thesis will be organized as follows:

- In Chapter 2 we begin by presenting 130/30 strategies as a phenomenon and the related literature.
- In Chapter 3 we discuss the theoretical framework for the active extension strategies. First, this includes background of the two stock ranking methods, namely the momentum and the contrarian strategies. Secondly we present theoretical background of the risk and performance measures.
- In Chapter 4 we present the underlying hypotheses for the empirical part.
- Chapter 5 presents the methodology used to analyze the data.
- In Chapter 6 we display the empirical findings of our study.
- In Chapter 7 we have the concluding remarks and possible ideas for future research.

1.5 Limitations

In order to create different hypothetical management skills, we used momentum and contrarian strategies to construct the portfolios. Regarding the 130/30 portfolio, the weights of the underperformers will be equally redistributed among the remaining stocks within the long portfolio. In the case of the long-only portfolio we will invest solely in the top 70% of stocks. In this way we do not assume that the portfolio manager picks every single stock accurately but at least a majority of them. It is further not our purpose to find the optimal momentum/contrarian strategies, but rather to use them as an example for comparing different manager skills. Therefore at no point we attempt to optimize the weights for our portfolios. As mentioned before, the most active extension strategies in practice follow quantitative approaches, hence we disregard for the purpose of our thesis value based stock selection strategies.

2. Theoretical and empirical background on 130/30s

In the first chapter we gave a brief introduction to the concept of 130/30 investment strategies. In this part of the thesis we present the related and previous literature regarding the strategy as well as provide the reader with a more extensive overall representation.

2.1 The general concept of the 130/30 portfolio

Active extension funds are sometimes viewed as a type of hedge fund strategy due to the relaxation from the long-only constraint. In the other hand, these funds take positions only in equities and do not invest in the wide range of assets that some hedge funds invest in and have return characteristics that are closer to long-only funds than market neutral funds. They have a 100% net exposure to equities at all times and are typically benchmarked to a market index. Table 1 demonstrates the key differences between the 130/30 portfolios, long-only portfolios and long-short hedge funds.

	Long-Only	***130/30***	***Market Neutral***
Investment Style	Relative return	Relative return	Absolute return
Benchmark	Market Index	Market index	Riskfree rate
Net exposure	100 %	100 %	0 %
Gross exposure	100 %	160 %	Depends on amount long/short
Average beta	1.0	1.0	0
Short-Selling	No	30 %	Depends on amount long/short
Assets under management	$63,7tril.	$53,3bil	$2.48tril.
Management Fee	30-80 bp	60-150 bp	> 150 bp
Performance Fee	0 %	0-20%	15-40%

Table 1 Comparison of similar equity management strategies (Tabb and Johnson, 2007)

To clarify the idea behind 130/30 asset class, it is necessary to present a simple comparison between the long-only, the 130/30, and the market neutral investment strategies.

Say the portfolio manager has the initial 1000 € to invest, with the DAX (30 stocks) as his investment universe. The fund policy requires from the portfolio manager to identify the top 21 (70%) performers. In this case, the long-only manager invests 1000 € in these 21 equities. Hence the net investment is of course 1000 €; the market exposure is 100% and the beta close to 1.0. In the 130/30 strategy, the portfolio manager also invests 1000 € in the 21 top performers, but additionally, shorts 300 € of the bottom 9 stocks. The proceeds are then re-invested in the 21 top stocks. Therefore the net investment remains 1000 €, the beta remains close or at 1.0 and the market exposure at 100%, but the gross market exposure shifts to 160% (130% long, 30% short). Albeit the higher gross investment (160% vs. 100%), the new portfolio should incorporate similar risks and portfolio structure as the long-only portfolio. The market neutral long-short portfolio is constructed by shorting the bottom 9 stocks for 300 € and invest in the top 21 performers. Therefore from a theoretical point of view, the 130/30 portfolio contains two different portfolios, namely a long-only and a market neutral (Figure 1).

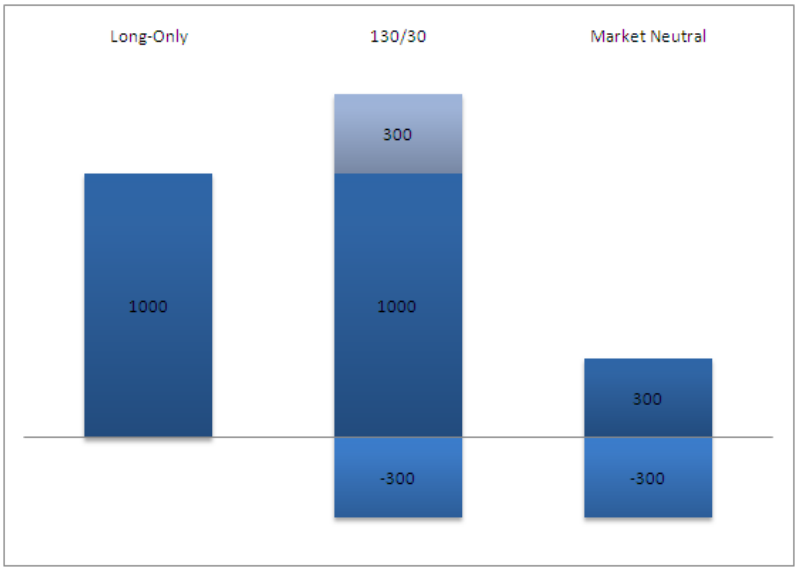

Figure 1 Comparison of active strategies

2.2 Theoretical benefits and risks of the 130/30 strategies

We now present the benefits and risks that arise with the active extension strategy from a theoretical point of view.

2.2.1 Benefits

In theory, there are several reasons for managers to exercise the active extension strategy and invest their money and abilities to the short side. When the manager has the possibility of short selling, it allows him a larger variety of investment opportunities and offers extended chances to display investment views (Figure 2). This extended selection of investment opportunities should improve the efficient frontier and the set of optimal portfolios in a mean-variance framework. Hence, if the investor has an ex-ante investment model which creates excess returns, an increase in the ability to express investment views should increase the expected excess returns. Allowing short-selling permits managers to increase the potential size of active underweight positions they can take.

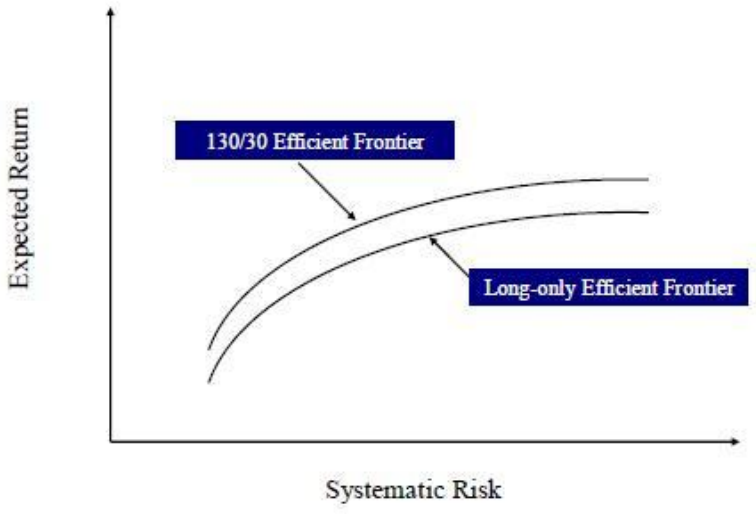

Figure 2 Hypothetical 130/30 Efficient Frontier (Standard & Poor's)

Blitz (2008) names three reasons for the potential over-performance of active-enhanced portfolios. These will be discussed below:

Improved ability to implement negative views on stocks: In order to outperform the benchmark, it is important to underweight stocks with a lower expected return. Nevertheless, this can be difficult with a short-selling constraint. As an example let's consider the German steel producer company Salzgitter AG. It has the weight of 0.54% in the DAX index (weighting accurate at start of September 21st 2009). If the long-only manager assumes for example a negative return of 50% for Salzgitter ceteris paribus, the only instrument applicable is not to invest in it at all. Therefore by investing in everything else but Salzgitter, he can just outperform the benchmark by 0.27%. Considering the same example, a 130/30 manager can underweight Salzgitter by, for example 10%, by taking a short position of 9.46% (due to original weight of 0.54%). In this case the contribution of this tactical allocation is 5%.

Improved ability to implement positive views on stocks: The author uses the example of the MSCI World to explain the small-cap bias. The MSCI World consists of 4000 stocks, where the largest 2000 companies (large caps) are weighed with 90% and the remaining 2000 companies (small caps) with only 10%. If a long-only manager has the policy to underweight 50%, he is forced to concentrate at least 40% of this underweighting in large caps. This is because the small cap segments allows just 10% space. This unequal distribution of the underweights has also implications for the selection of the overweights. For instance, if the both segments of the market provide a comparable number of opportunities, the natural choice would be to distribute the overweights evenly over these two segments (i.e. 25% each). Nevertheless this would lead to a large net overweight in small-caps at the expense of an underweight in large-caps.

Improved diversification possibilities: Consider a quantitative manager, who has two main goals. First he wants to reach a high tracking error by overweighting the expected overperformer and simultaneously underweighting the expected underperformer. Secondly he is interested to diversify away the stock-specific risk. These two goals are contradicting for a long-only manager, because the aim for a higher tracking error level

implies taking larger and more concentrated positions. Thus, long-only portfolios become increasingly exposed to stock-specific risk. Alternatively, a 130/30 investor can use the extra space both in the long and the short side to reach higher tracking error levels whilst remaining well diversified.

2.2.2 Risks

According to Cazalet (2007) the major risks involved within this strategy can be categorized as market risk, shorting, and leverage. Commonly the instances that are applying the active-extension strategy are using the equity part of their portfolio to do so. Intuitively the assumption is that the beta (market risk) of a 130/30 investment is comparable to its long-only counterpart. The systematic exposures of the short side are sought to be traded off with the gained leverage in the long positions. Therefore with efficient risk handling tools, the active-extension strategy can theoretically be applied without substantial differences in beta (market risk) compared to its long-only counterpart.

The skill of the manager in the area of 130/30 strategies is of special importance, since his stock selection skill will be leveraged. Compared to a long-only manager a 130/30 the gross exposures are larger. This phenomenon was observable in 2006. When the active extension strategies started gaining popularity, many managers jumped in the bandwagon as they too wanted to be a part of the growing phenomenon. These so called "me-too" managers didn't perhaps possess adequate knowledge about selecting the correct stocks for the 130/30 portfolios.

Possible insights into potential short positions and experience in managing a portfolio with short constraints should be the primary consideration of a 130/30 manager. Krusen et al (2008) stress that short-selling is more than just the opposite of having a long position. For the manager it requires experience in both, implementation and relationships with the prime brokerage. Theoretically there are no restrictions as to how much the price

of the stock that is shorted could go up. Hence a portfolio constructed and maintained using systematic risk controls is also an important consideration. Another issue concerns the capacity and related possible short sell constraints. There is a certain threshold that the amount of short selling cannot exceed. This threshold is given by the availability of shares to short. Another risk related to shorting is the so-called counterpart risk. That became clear with the collapses of the investment banks Bear Sterns and Lehman Brothers. It had a negative impact on the 130/30 strategies, exposing them to counterparty risk.

2.3 Previous studies on relaxing the long-only constraints

The Modern Portfolio Theory introduced by Markowitz (1952) presents two characteristics of a portfolio; its reward (desirable property) and its risk (undesirable property). Since then it has been widely acknowledged that short selling constrains have a strong (negative) influence on optimal portfolio composition.

There are several studies regarding the evidence that the active extension is beneficial. One of the first studies concerning the relaxation from the long-only constraint was introduced by Grinold (1989), who introduced the "fundamental law of active management" equation as follows:

$$IR = IC\sqrt{N}$$

where IR is the information ratio of the portfolio, IC the information coefficient given by the correlation of forecasted stock returns with realized security returns, and N as the number of stocks in the investment universe. The intuition here is that returns are a function of information level, breadth of investment universe and portfolio risk. He acknowledges that the fundamental law is approximate in nature.

Grinold and Kahn (2000) demonstrated that a portfolio's efficiency is enhanced, as measured by the information ratio (IR), when the active extension to the long-only

portfolio is introduced. Furthermore, they found out that fully leveraged long-short strategies outperform the long-only portfolios at most when the universe of assets is extensive. This is the case even when the strategy has high active risk or when the asset volatility is low. They continue by explaining that the long-only constraint includes a negative bias, since the investor can only underweight large-cap stocks by a certain amount, in other words creating a "size-bias"; which affects both the return and the risk. For all the reasons mentioned above, the most vital argument for introducing short-selling is portfolio efficiency, which naturally is a consequence of the possibility of shorting the stocks with negative expectations.

Clarke et al. (2002) studied the active extensions by running Monte Carlo simulations on portfolios constructed of stocks of the S&P 500 to find out the effects of different constraints regarding portfolio performance. These constraints were: size-neutrality, value-growth neutrality, sector neutrality, the long-only constraint, and the maximum number of securities selected. They concluded that the most significant constraint is the long-only, which has the most power despite being one of the most ignored restrictions placed among portfolio managers.

Clarke et al. (2004) showed that the information ratios of stock portfolios can be improved by relaxing the long-only constraints. They compared the performance of portfolio manager who were running active extension strategies with their long only counterparts, by measuring the impact by the change in the portfolio transfer coefficient. The transfer coefficient in their case was the degree of information transfer from a security-ranking signal into active portfolio weights. Portfolio managers who run active extension funds generate higher information ratios compared to the long-only managers, at the same time being able to exploit the ranking signals for the composite stocks in their portfolios in a more efficient way. The marginal performance enhancement of increasing short-sales is found to be diminishing, with the performance increase from moving from long-only to 110/10 greater than that from moving from 110/10 to 120/20.

Jacobs and Levy (2007) discussed the advantages of the relaxation, as well as differences relative to equitized long/short approaches, of enhanced active portfolio construction. The

related benefits initiate from that greater latitude is given to portfolio managers to express their views in active weights, thereby improving the information efficiency should the manager possess investment insights. From the investor's point of view, this offers more enhanced portfolio efficiency.

Sorensen et al. (2007) studied the added costs associated with the portfolios with relaxed constraints. This included the leverage costs related to borrowing shares and the increased transaction costs from the higher turnover. They find out that the enhanced performance of the 130/30 strategies exceed the transaction costs in settings that are under reasonable assumptions. They also point out that portfolio mandated will have different tracking error targets and benchmarks, which indicates that the optimal information ratios can vary quite a bit , depending on the associated cost implementation and the strategy.

Johnson et al. (2007) investigated the performance of quantitatively based 130/30 strategies versus the long-only positions in U.S. large cap stocks and international indices as benchmarks, and found out that they outperform the long-only counterparts. They also noted that the managers who adopt the active extension strategies add value over both ends of the long and short tails of an alpha-generating model. The authors find that the simulated 130/30 portfolio returns an average annual Cumulative Average Gross Return (CAGR) of 11.0% compared to the long-only portfolio, which returns 7.6%. On a risk-adjusted basis, the returns as measured by the information ratio were higher for the 130/30 portfolio than the long-only portfolio.

Lo and Patel (2008) proposed a portfolio that is simultaneously passive and dynamic as a benchmark for the 130/30 products currently present on the market. The benchmark would be investable and act as a "look-ahead" index. This implies that it would use only prior information for the investing part and realized return for the "look ahead" to generate upper bounds on 130/30 performance. The index is based on a ten factor quantitative model, with the weights determined by a portfolio optimisation process.

Another fact supporting the relaxation from the long-only constraint was discovered by Montagu (2007). He found out that there exists declining dispersion across individual stock returns in the past decade. Clarke et al. (2008) argued that when higher correlations

between stocks are present, a larger number of active positions are needed to achieve the same level of performance. Going back to the model of Grinold (1989), less breadth is available as active positions are correlated with each other. To gain the same target level of overperformance, the investor needs to take larger active positions in times of high correlation between different stock returns.

2.4 Common misperceptions of the 130/30 strategies

Since the 130/30 investments are relatively new strategies, there still exists a remarkable amount of confusion about their features. One of common misperceptions regarding 130/30 investment strategies is that investors falsely assume that the 130/30 strategies are less risky in the bear markets. Nonetheless, despite that the design of these portfolios is to outperform the benchmark, the strategy does not offer smaller risks when the market is down.

According to some opinions, the active extension strategy has been punished by regulators unfairly due to this misinterpretation. (Sarkar, 2009)

In the article of Sarkar, (2009), Harindra de Silva, president of Analytic Investors LLC, Los Angeles, states that another misperception of the 130/30 funds is that they are treated as an alternative for hedge funds (e.g. as "hedge fund light") or somewhere in between mutual and hedge funds. Gehin (2007) explains that the term of hedge fund light stems from the fact that the level of shorting is in between a traditional long-only and a market neutral hedge fund. Nonetheless it is important to know that the motives for shorting are different; while a hedge fund shorts to hedge their exposures, the 130/30 funds short in order to extend the performance. Therefore Gehin (2007) concludes that the 130/30 do not fall somewhere in between, but at the same level as the long-only, in other words, aiming for the beta of 1. This misunderstanding could have been a reason for the warding off of investors previously investing in 130/30 strategies.

2.5 Regulations and costs

The regulatory framework that the active extension funds in Europe fall into is the UCITS III. First applied in 2001, it is a set of restrictive regulations upon the active extension funds that can be marketed to retail investors. According to the UCITS III, the total long positions of physical securities can reach the maximum of 100%. Nevertheless it is possible to increase the long positions up to 200% by using synthetic positions. Pledging securities in respect of margin requirements for derivative positions is allowed, providing the security meets certain liquidity requirements (Donohoe, 2006). The framework in addition prohibits physical short-selling, so short positions have to be taken using derivative positions to underweight securities. Therefore any short selling restrictions can be bypassed by the use of synthetic positions. In our thesis, we do not use derivatives, since results should be the same, no matter if constructed with equities or in by using derivatives.

Active extension strategies involve arguably exceeding costs to the long only. This is due to a larger amount of managed stocks as well as the costs of short-selling. Hence it also requires more research from the fund manager when seeking for the positive and negative outlooks of potential stocks. This in the other hand is more of an issue when the manager uses a fundamental approach rather than a quantitative (Sorensen et al, 2007).

As seen in Table 1, the higher costs of short selling are reflected in a higher management fee. The existing fee structures of the active extension funds resemble more the ones of hedge funds rather than long-only funds. (Tabb and Johnson, 2007) Additionally to the management fee, the 130/30 vehicles can include a 0-20 bp performance fee.

For the purpose of this thesis, we disregard increased costs, since we only seek to find out the fundamental value added by introducing the relaxation from the long-only constraint. The question whether this value added part would in practice be eliminated by the higher costs is beyond the scope of this thesis.

2.6 Recent developments and indexation

As the fund market in general has developed through time, has the 130/30 asset class gained popularity. It is therefore necessary to provide the reader with recent developments connected to the active-extension strategies.

Implemented first in the United States, the 130/30 equity funds are nowadays available also in the global stock universe with the most recent inclusion most of the emerging markets. One of the latest developments in the market is the application of the 130/30 strategy for bond investments. Blitz (2008) explains that the 130/30 corporate bond investments use credit default swaps for adding specific long and short exposures. Gastineau (2008) describes the advantages for a conservative investor by investing in a 130/30 product that uses different sector ETFs.

Another recent development is the indexation of the active-extension strategies. Important 130/30 indices are the ones provided by Standard & Poor's and Credit Suisse. How these index portfolios are constructed is described by Lo and Patel (2007) and Murphy (2007).

The 130/30 indices are also called "strategy indices", due to the index providers increasingly providing narrower subsets of market indices sometimes with components of active asset management. (Dash and Murphy, 2008). If the strategy provides enough transparency for anyone interested to understand and replicate the exposure they offer, it benefits the whole investment community since the exposure would lead to lower costs since such exposure could potentially be offered through linked investment products instead of comparable active management products.

For the purposes of our study, we will use the traditional market-cap weighted DAX index as the benchmark. Even though the active-extension indices could be used in theory, they involve an arbitrary choice of quantitative factors, and are commonly not accepted as benchmarks. Since we also compare the 130/30 strategies to long-only, we

need to have the passive alternative. Finally, it can be hard to justify how the active-extension indexes can proxy market risk in a better way than a commonly used and established market-cap weighted index can.

3. Theoretical framework of the applied concepts

In the previous chapter we discussed the properties of the 130/30 strategy and a provided a literature review concerning the 130/30 investing universe. In this chapter we present the theoretical framework for the concepts that we apply in this thesis. We want to find out whether an active extension is value adding and evaluate the connection to the portfolio managers' ability to distinguish the overperformer from the underperformer. For this purpose we apply two intuitive quantitative approaches to rank stocks; the momentum and the contrarian strategies. These both strategies will be explained in detail in this chapter. After this we discuss the different risk-reward measures.

3.1 Identification of the stock selection methods

In order to construct our portfolios, we need to rank the stocks according to their attractiveness. Former studies have employed a variety of techniques. For example Lo and Patel (2008) use a factor based alpha model which utilizes traditional and relative portfolio values; historical and expected growth; profit trends; size and momentum factors. On the other hand Johnson et al (2007) employ a ten-factor model which uses generic value and growth factor models. In our thesis we will concentrate on different momentum and contrarian strategies.

3.1.1 Efficient Market Hypothesis

A momentum/contrarian strategy that is able to generate excess returns is violating one of the most known economic hypothesis. The Efficient Market Hypothesis (EMH) developed by Fama (1970) states that security prices fully incorporate all the information. New information available is reflected instantaneously in the security prices. This implies that it is in average impossible for an investment strategy based solely on available

information to beat the market. Fama specified the different possible forms of market efficiency depending on the originality of the information that the price is based on.

1) In the weak form of market efficiency, security prices reflect the information that the past security prices convey. According to this, it is not possible to consistently earn abnormal returns using the information from the past, since price movements in the past cannot reflect the ones in the future. This excludes trend cycles or other predictable patterns in price movements and therefore it is impossible to have profitable technical trading strategies, since all information is already reflected in market prices. In this case the market prices follow a random walk.

2) In the semi-strong form of market efficiency, the security prices include all publicly available information on a company, such as annual reports, press releases, and stock issuances, together with the past information on security prices. In a semi-strong setting, efficient prices are expected to adjust immediately when new public information is published. Therefore investors cannot make predictions on future price movements by analyzing macroeconomic or firm-specific news since the market has already absorbed this information. This excludes systematic over- or under reaction.

3) The strong form of market efficiency declares that security prices reflect all relevant information on a company, including inside information. This means that an investor cannot profit from any information, since all information has already been priced by the market. In this case the investor can merely be lucky or unlucky, but never beat the market consistently.

The strong form of market efficiency is thought to be extreme by most researchers and acts more like a benchmark when observing the deviations from market efficiency (Fama, 1970). However, the common belief is that the markets exhibit at least the weak form of efficiency.

3.1.2 Momentum strategies

Momentum strategies try to generate abnormal returns by buying past winners and selling past losers. The underlying idea of that strategy is that stocks that have performed well in the past will also do well in the future and vice versa. Jegadeesh and Titman (1993) have been the first to prove and test this phenomenon. They explain the existence of the price momentum with delayed price reactions to firm-specific information. They also show that the momentum strategy of buying winners and selling losers yields abnormal returns, which cannot be explained by the conventional risk-return framework. In their view, underreaction to good or bad news is primarily attributable to the "price momentum." They employed decile portfolios created from performance ranked stocks and demonstrate that purchasing past winners will earn extensive subsequent returns even when risk is taken under consideration.

Jegadeesh and Titman (2001) and Chan et al. (1996) document that investors routinely underreact so that intelligent investors can exploit the momentum in stock prices at intermediate terms of 3 to 6 months by buying recent winners and selling recent losers, and consequently, earning risk-adjusted abnormal returns. Investors' underreaction to market news is attributed as the prime source of the price momentum. Lewellen (2002) argued against the underreaction hypothesis that price momentum is not due to underreaction of information, but instead that the focus is on the excess covariance between stocks which is the main cause to the price momentum. His findings show that stocks co-vary across industry, size and value factors.

Rouwenhorst (1998) used data from 12 different European countries including Germany between 1980 and 1995. He replicated the portfolios of Jegadeesh and Titman using the same holding periods and portfolio formation. His key finding was the significant difference in intermediate-term returns, which was over 1% a month after risk-adjustments, between the previous over and underperformers in an internationally diversified portfolio. Furthermore he suggested that the return continuation is more robust in smaller companies than larger companies and that the price momentum is possible to

trace back to a common price momentum factor, since there exists correlation of relative strength strategies between the European and American stock markets.

Moskowitz and Grinblatt (1999) demonstrated that momentum trading is profitable, but subject more to the industry momentum than the momentum in individual stocks. They used data between 1963 and 1995 using American stock prices. The authors argued that from the industry momentum follows that relative strength strategies are more risky than expected earlier, since previous winners and losers tend to be combined within same industries. The explanation was that behavioral patterns within investing creates the herding effect which is why industrial momentum appears.

Grundy and Martin (2001) found momentum in American stocks between 1926 and 1995, by applying a straight forward approach of selecting stocks that were overperforming and shorting the underperformers based on the total return of individual stocks. They found out that the risk adjusted monthly return was 1.3%. An additional finding was that a momentum strategy that selects stocks on the basis of formation period stock-specific returns are more profitable than selecting stocks on the basis of total returns. Fama and French (1993) with their three factor model and the two factor model can decompose the stock returns into stock-specific and factor returns.

3.1.3 Contrarian strategies

The contrarian strategies work in a similar way to the momentum strategies but instead of taking long positions in stocks that have previously performed above par, in the contrarian strategy, the manager goes long in the past loser stocks vis-à-vis going short in the well performing ones. The contrarian strategy implies that a manager expects the stocks to revert their previous performance. It can also be implemented by the 130/30 manager in the same way as the momentum strategy in composing the portfolios.

De Bondt and Thaler (1985) conducted a study concerning the profitability of the contrarian investment strategy. The research showed evidence to significant long term

price reversal of stock prices. Taking a 3-6 year past performance as the base for the study, the winners and the losers were allocated to different portfolios. The study showed that the loser stocks tended to outperform the winners significantly 36 months after the formation of the portfolio. They explained that this phenomenon was mainly due to investor behavior. Furthermore the finding suggested that as investors overreact to both negative and positive market news; it affects stock prices and causes a long-term stock price reversal. So when the news is negative, the stocks are over-sold and when positive, they are over-bought. The study therefore challenged Markowitz's "Efficient Market Hypothesis".

Lo and Mackinley (1990) found out that an alternative explanation for successful contrarian strategies is the existence of positive cross-autocorrelation among stocks in portfolios. The authors suggest that in the long run stocks will move in the same direction but at different speeds, e.g. given a certain period stock A moves up while stock B moves down. The contrarian manager would therefore short stock A and buy stock B. As they should both revert to mean, it theoretically should generate excess returns.

Lakonishok et al (1994) explained that the contrarian strategy is successful since investors consistently overestimate the value of glamour stocks relative to value stocks creating a "suboptimal" investor behavior. According to them, expectational errors happen due to individual investors overweighting recent information. In addition the authors assert that institutional investors could invest in so-called glamour stocks since they seem to be viable investment, justifiable for shareholders, and because their time horizon is too short for the three to five years necessary for the value firms to rebound.

3.2 Performance and risk measures

This sub-chapter will provide only a short introduction to the performance and risk measures considering the different portfolios.

3.2.1 Risk Measures

The risk in the 130/30 fund industry has been commonly measured in terms of market risk (beta). However investors can also be interested in the absolute risk measures. Our objective is to measure risk of our portfolios using standard deviation and Value at Risk (VaR). VaR is also called as a downside risk measure[1].

In practice, standard deviation is an accurate risk measure in cases of normal distribution. However, if this is not the case the standard deviation as a risk measure can be misleading. VaR in the other hand can be seen as subject on two arbitrarily chosen parameters, the confidence level that indicates the probability that the outcome is not worse than the calculated VaR. This could be any value between 0 and 1. The other parameter is the holding period which indicates the time until measuring the portfolio performance. VaR is a widely used standard risk measure in equity markets where return distributions show small probabilities of large losses. (Dowd, 2002)

The VaR is calculated for our purposes using the Cornish-Fisher expansion (1937) to get a better approximation of the shape of the true distribution. Zangari (1996), Campbell et al. (2001) and Favre and Galeano (2002) introduced this modified VaR calculation that takes the higher moments (skewness, the directionality or tilt of the returns and kurtosis, the measurement of the "fat-tailed" nature of the returns) of non-normal distributions into account.

3.2.2 Conventional risk-adjusted performance measures

The Sharpe ratio is a measure which reveals if a portfolio's returns are due to smart investment decisions or as a result of excess risk. Sharpe ratios are frequently used both in academia and in practice. Nonetheless the SR as a risk measure involves some commonly known limitations. Sharpe (1994) and Lo (2002) stated that the Sharpe ratios

[1] A downside risk measure is defined as: "An assessment as to the extent that a security could decline in value - considering all possible factors that could affect the security's market price." (Dowd, 2002)

are non-comparable when calculated for different investment horizons. Sharpe ratios are also inappropriate risk measures when returns are not normally distributed (Götzmann et al., 2002). The information ratio is very similar to the Sharpe Ratio. The difference between these two ratios is that the IR uses the tracking error instead of the excess returns. In other words, while the SR uses the excess return of an asset against the riskfree rate, the IR compares the active return vis-à-vis a benchmark index. SR = IR when the benchmark is a risk free asset (Grinold and Khan, 2000).

By taking the VaR (calculated with Cornish-Fisher approach) instead of the standard deviation as a risk measure, we have normality no longer as an assumption. This method is known as reward-to-VaR. Gordon et al. (2003) demonstrated that, under normality, the reward-to-VaR ratio gives the same ranking for the risk adjusted performance as the Sharpe ratio. They also proofed that under non-normality the ranking differs from the Sharpe ratio.

However, the abovementioned risk-adjusted measures have major drawbacks. They both assume that there is a clear relation between return and risk. For example the Sharpe ratio requires questionable assumptions about the investor´s utility curves (quadratic utility curve). Also the reward-to-VaR assumes that the risk and the return are proportionally interrelated. Hence it has the same consequences for the investors' utility if either the return elevates by 20% or the risk goes down by 20%. The second drawback is that it is unclear how to rank negative results. A more negative risk-adjusted performance could be because of more negative return (undesirable) or because of lower risk (desirable) (Opdyke, 2007).

3.3 The Omega ratio

The drawbacks with the Sharpe ratio and the reward-to-VaR can be avoided by applying the Omega ratio. This relatively new way of measuring the risk-reward distributions of assets or portfolios was developed by Keating and Shadwick (2002a, 2002b). The Omega

ratio makes use of the full return distribution and relies on very general hypothesis about risk and return preferences: to be able to rank portfolios, the only assumption necessary is that "more" is preferred to "less" ("non-satiation"). Therefore the Omega ratio can evaluate and rank portfolios unambiguously. All information that is known regarding the risk and return of a portfolio is employed within this measure. Compared to traditional portfolio theory, where distributions are described by mean and standard deviation only, it considers all distribution momentums, including skewness and kurtosis. Hence it can also be considered as the successor to the Jensen's Alpha or as a more accurate measure to the Sharpe ratio. The Omega can be interpreted as a sort of probability-weighted ratio of gains over losses at a given level of expected return. The Omega ratio is as follows:

$$\Omega(r) = \frac{\int_{r}^{b} (1 - F(x))dx}{\int_{a}^{r} F(x)dx}$$

where (a,b) is the interval of returns and F is the cumulative distribution of returns. For any return level r, the number Ω(r) is the probability weighted ratio of gains to losses, relative to the threshold r. Figure 3 explains the concept of the Omega ratio graphically. The upper area part (returns above the threshold level) is divided by the lower area (returns below the threshold level). The higher the Omega value is, the more it is preferred. Omega treats upside and downside risk differently, thus noticing the theoretical criticism of mean-variance theorem.

The Ω function is a monotone decreasing function of the cumulative distribution of returns from [a, b] to [0, ∞[. The function itself is differentiable and its first order derivative is always negative. As defined by Cascon et al (2002), the Ω function that is more risky is flatter than the distribution of a less risky Ω. At the mean return, the Ω function takes the value of 1; this is the only stage as at this point, the total probability of weighted gains equals to the probability of weighted losses. The authors state that in

cases of normally distributed returns, or when the higher moments are not significant, the Ω tends to agree with the more conventional performance measures (e. g. Sharpe ratio).

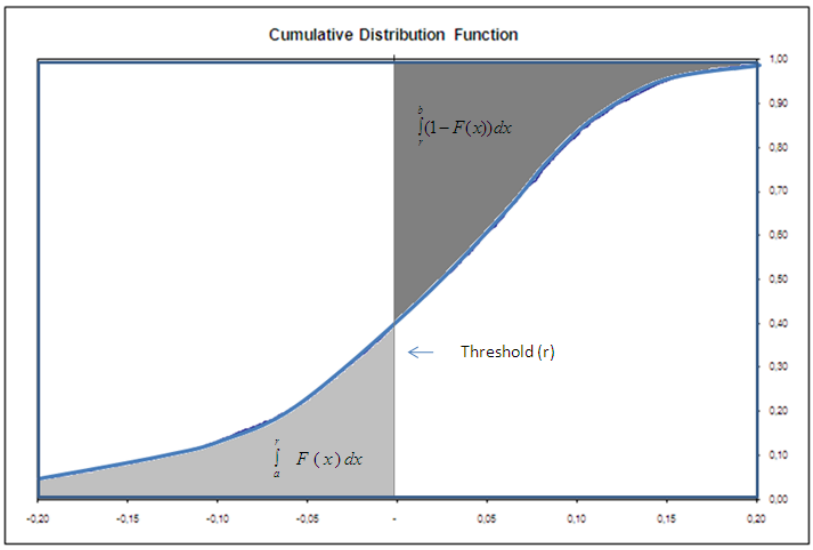

Figure 3 The Omega ratio

Omega is often come across in the context of hedge funds. Various formulas for Omega are in circulation. Many versions work with numerical approximations, therefore results might not be necessarily the same even when using the different version of Omega. Furthermore they are comparable only for equal time horizons. To clarify the superior properties of the Omega ratio, we illustrated the following examples:

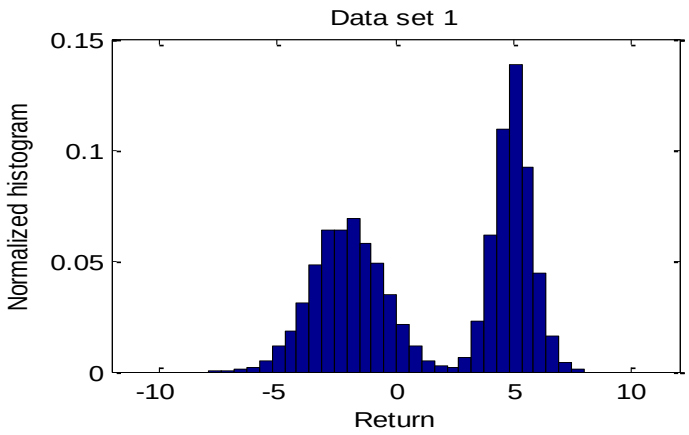

Figure 4 Return Histogram, Example data set 1

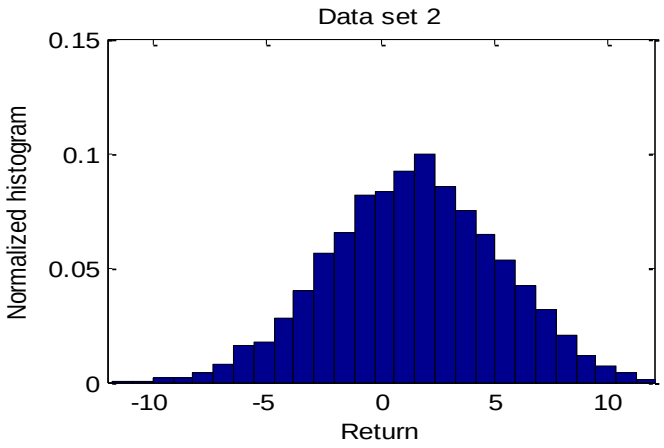

Figure 5 Return Histogram, Example data set 2

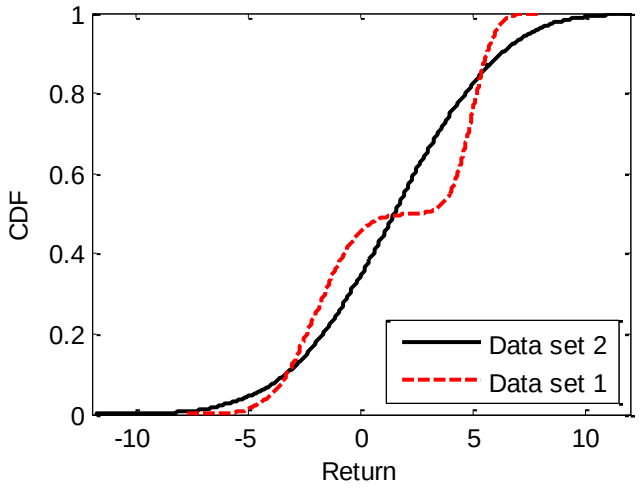

Figure 6 CDF of data set returns

The investor has two investment opportunities; Data set 1 and Data set 2. As we see in Figure 4, Data set 1 has two peaks. This could be an investment that is sensitive to a certain event. If the event takes place, the returns around the left peak are more likely to occur. Otherwise without the event, the returns around the right peak are more realistic. However the investment opportunity in Data set 2 (see Figure 5) is not affected by this event. Which of the two investment alternatives is more attractive regarding the risk-reward performance? The Sharpe ratio does not provide any solution, since the mean as well as the standard deviation of the two strategies are identical. Hence we have to consider the CDF in Figure 6. If we set the threshold to 0, Data set 2 would have the

higher Omega ratio and would be therefore the preferred investment possibility. In contrary, if the threshold is set to be something else than 0, the ranking can change. This allows the investors to choose the threshold level according to their preferences and therefore find the superior investment regarding their purpose (whether it is a hedge instrument, investment, or a bet).

4. Hypotheses

In order to give a valid set of results it is important to clarify the hypothesis for conducting the analysis at this stage. The latter two chapters provided a theoretical background for the analysis; we will now provide further motivations for the purposes of our study. The hypotheses for our study are as follows:

Hypothesis 1

Managers with higher skill levels (Green) can exploit the relaxation of the long-only constraint. This implies that the 130/30 provides higher Ω values than their long-only counterpart, as they utilize the manager's informational advantage

Hypothesis 2

The managers with insignificant stock selection skills (Yellow) do not lower their Ω value by the introduction of the active extension relative to the long-only.

Hypothesis 3

Managers that execute poor stock selection (Red) can profit from a hedging effect when introducing the active extension. Therefore the negative implication in terms of Ω values should be limited.

Hypothesis 4

Different threshold levels for the Ω lead to different optimal decisions regarding the choice of the portfolio. This implies that an investor who is more concerned about a loss beyond -1% for example will prefer a different portfolio strategy than an investor with the threshold of 0%.

Hypothesis 5

The risk-return characteristics of the 130/30 portfolios should be similar to the long-only rather than to the market neutral. While 130/30 sells short a proportion to increase its performance, a market neutral sells short for hedging reasons. Therefore the expression "hedge fund light" is invalid.

5. Data and methodology

The previous chapters provided the theoretical background for the purposes of this thesis based on a vast earlier literature review. In this chapter we present the data and methodology needed to answer the initial question whether the 130/30 is value adding or just a marketing hype.

5.1 Data

Our analysis is based on the DAX 30 index, which consists of the 30 largest stocks traded in the Frankfurt stock exchange, operated by the Deutsche Börse in Germany. The DAX is a value weighted index and is unadjusted for dividends. It consists of stocks with the largest volume of trading on the Frankfurt Stock Exchange. The equities use free float shares in the index calculation. The Base date for the DAX is 30 December, 1987 and it was started from a base value of 1,000. The Xetra system calculates the index after every 1 second since January 1, 2006. To circumvent any survivorship bias in our results and to allow our strategies to choose only stocks which were included in the DAX in any given month, we exactly reconstruct the index based on the official website of the DAX. Short selling was first allowed in Germany in 1989 and has been standard practices since then. (Bris et al, 2003) We decided to employ data from the past 20 years, more specifically the time period of Jan 1st 1990 - April 30th, 2010. We get the first results for the 3month momentum obviously 3 months after the start of our data and henceforth. For comparison reasons we regard the period of Jan 1st 1991 - May 1st 2009.

The data used in the empirical analysis is obtained from the DataStream database. The data has been cross-checked against Reuters in order to verify the accuracy of the data used. We used the total return indices since they are adjusted for dividend payouts, stock splits and other capital restructurings. In order to have a viable study, we take in to consideration any new entries and delistings that occurred during the sample period. This also avoids us from having the problem with survivorship bias, and therefore should

provide us with accurate results. If a stock is delisted during the holding period, we assume that the portfolio manager keeps the stock until the end the holding period, if the stock exists till the end of the corresponding period. Otherwise in the case of a merger we assume that the holder accepts the buyer's offer.

5.2 Manager skill

In Table 2 we rank the stock selecting success according to different manager skills. The skill is measured as the difference between the annualized mean returns (average long positions – average short positions). Note that the long positions are the ones that the manager predicted to overperform and the short positions are the ones that were predicted to underperform. If the difference is positive, the manager was in average able to distinguish outperformers from underperformers and vice versa. We further on apply a T-test (at a 95% confidence interval) to find out whether the difference is significant or not. For the t-test the independent two sample (with unequal variance and unequal sample size) means-test is applied. The formula is as follows:

$$T = \frac{X - Y}{\sqrt{\frac{S_1^2}{m} + \frac{S_2^2}{n}}}$$

X and Y are the mean sample averages of the long and the short position, respectively. S_1 and S_2 are the corresponding standard deviations of the samples and *m* and *n* are the number of observations. The resulting t-score is compared to certain critical values of a student t distribution table to determine the t-score's statistical significance.

Strategy	Long Positions	Short Positions	Difference	T-Test
12-3Momentum	8,04 %	5,61 %	2,43 %	2,05 %
12-12Momentum	8,49 %	6,34 %	2,15 %	0,03 %
9-12Momentum	8,34 %	6,47 %	1,86 %	0,13 %
12-9Momentum	8,19 %	6,55 %	1,65 %	1,07 %
3-12Momentum	7,97 %	6,40 %	1,57 %	0,40 %
9-9Momentum	8,09 %	6,56 %	1,53 %	1,57 %
6-12Momentum	8,11 %	6,59 %	1,52 %	0,59 %
3-6contrarian	7,60 %	6,20 %	1,40 %	3,55 %
12-6Momentum	7,95 %	6,79 %	1,17 %	9,16 %
6-9Momentum	7,82 %	6,80 %	1,02 %	6,99 %
9-3Momentum	7,75 %	6,82 %	0,93 %	21,46 %
9-6Momentum	7,83 %	6,90 %	0,93 %	14,23 %
3-9contrarian	7,65 %	6,77 %	0,88 %	8,71 %
12-12contrarian	8,13 %	7,43 %	0,70 %	10,05 %
6-3contrarian	7,23 %	6,61 %	0,62 %	27,10 %
6-6contrarian	7,68 %	7,17 %	0,51 %	25,25 %
3-9Momentum	7,50 %	7,06 %	0,43 %	25,94 %
3-3contrarian	6,68 %	6,36 %	0,32 %	37,50 %
3-3Momentum	6,60 %	6,31 %	0,30 %	39,70 %
6-3Momentum	7,06 %	6,86 %	0,21 %	42,82 %
12-9contrarian	7,80 %	7,70 %	0,10 %	43,71 %
9-3contrarian	7,46 %	7,61 %	-0,15 %	44,10 %
3-12contrarian	7,46 %	7,79 %	-0,33 %	27,61 %
3-6Momentum	7,02 %	7,46 %	-0,44 %	29,68 %
6-6Momentum	7,38 %	7,84 %	-0,46 %	28,79 %
12-6contrarian	7,50 %	8,05 %	-0,55 %	23,26 %
9-12contrarian	7,68 %	8,26 %	-0,58 %	14,51 %
6-12contrarian	7,40 %	8,44 %	-1,04 %	2,93 %
6-9contrarian	7,18 %	8,33 %	-1,14 %	3,58 %
9-9contrarian	7,32 %	8,49 %	-1,17 %	3,15 %
12-3contrarian	7,04 %	8,22 %	-1,18 %	11,85 %
9-6contrarian	7,18 %	8,54 %	-1,35 %	3,73 %

Table 2 Ranking based on manager skill

By following the magnitude of the differences as well as the t-test statistics in Table 1, we can now categorize the different strategies according to our criteria, hence:

- The managers that in average make successful selections on a significant level
- The managers that in average make insignificant stock selection results.
- The managers that in average continuously makes misforecasts in stock selections on a significant level

Table 3 summarizes the different managerial skills to either “green”, “yellow”, or “red” according to the abovementioned criteria.

Successful Manager Skill	*Insignificant Manager Skill*	*Poor Manager Skill*
12-3Momentum	12-6Momentum	6-12Contrarian
12-12Momentum	6-9Momentum	6-9Contrarian
9-12Momentum	9-3Momentum	9-9Contrarian
12-9Momentum	9-6Momentum	9-6Contrarian
3-12Momentum	3-9Contrarian	
9-9Momentum	12-12Contrarian	
6-12Momentum	6-3Contrarian	
3-6Contrarian	6-6Contrarian	
	3-9Momentum	
	3-3Contrarian	
	3-3Momentum	
	6-3Momentum	
	12-9Contrarian	
	9-3Contrarian	
	3-12Contrarian	
	3-6Momentum	
	6-6Momentum	
	12-6Contrarian	
	9-12Contrarian	
	12-3Contrarian	

Table 3 Categorization of Manager Skill performance

5.3 Portfolio constructions

The first step to evaluate the relative performance of the 130/30 portfolios as well as the long-only, and the market neutral counterparts is to construct the momentum and contrarian portfolios constituting of the stocks within the DAX index. Throughout the sample period, the portfolio actively selects the winners and the losers of the previous momentum/ contrarian and re-invests for the next period.

As discussed in the literature review of this thesis, evidence exists that stocks with high (low) returns over periods of 3 to 12 months continue to have high (low) returns over subsequent 3 to 12 month periods. All in all, we construct portfolios applying 32 different stock selection strategies – 16 momentum and 16 contrarian, composed using all the

different observation periods (3, 6, 9, 12 months) with using each possible holding period (3, 6, 9, 12 months). We use daily data to be able to capture the distributional properties of the returns more accurately. The momentum/contrarian strategies are based on the stocks' past total returns. The stocks are ranked at the end of each day based on their past performance.

All the active portfolios (130/30, long only, long-short) are using the same investment policy. The manager has to identify the 21 stocks that will outperform, and the 9 stocks that will underperform. We decided to create short positions of 9 stocks, since that is exactly 30% of the whole index. This has the advantage that we are able to equally sell short these 9 stocks while constructing the 130/30 portfolios.

The portfolio returns (R_{pt}) are calculated following the example of Lo and Patel (2008) as:

$$R_{pt} = \sum_{i=1}^{n} \frac{P_{it-1}S_{it-1}}{\sum_{j=1}^{n} P_{jt-1}S_{jt-1}} R_{it}$$

where R_{it} the total return of stock i for the time period t; S_{it-1} number of shares i at time t-1; P_{it-1}price per share i at time t-1.

In order to make the different portfolio returns comparable, we annualize them and calculated their excess returns. As the riskfree rate, we use the interbank interest rate for the corresponding time horizon. Although it is important to stress, that we do not use the excess returns for the long-short market neutral portfolio, since it already is a "zero investment" (entirely financed by its short positions).

5.3.1 130/30 Portfolio

As for all our actively managed portfolios, the first step is to identify the 21 overperformers and the 9 underperformers. We construct the 130/30 portfolios by

redistributing the weights of the 9 worst performers equally to the entire portfolio. The redistribution is not only done by investing in the top past performers, since we do not essentially assume that the best performer in the past will do so in the next period. If the stock entered the index during the holding period, depending on the momentum, the portfolio does not necessarily need to consist of 30 stocks but less, e.g. 28-29. In such a case we remain long in the 21 top stocks and short in the outstanding stocks. Nevertheless it is important to note that the relation of long-short positions is always 130/30. This implies that in the case above, the fewer stocks in short positions are shorted over-proportionally.

5.3.2 Long-only Portfolio

While constructing the long-only portfolio, we distribute the invested amount equally to the 70% best performers (21 out of 30 stocks). The bottom 30% performers are completely excluded from the portfolio. Hence our long-only portfolio is different from its benchmark. The weights are equally distributed (this means that larger companies are underweighted vis-à-vis to the benchmark and small companies are overweighted). The long-only portfolio should perform better than its benchmark index based on the assumption that momentum/contrarian strategies work.

5.3.3 Market neutral long short Portfolio

In order to construct a market neutral portfolio, we sell short the 9 worst performers and redistribute that money equally among the 21 best performers. We decided to keep the relation 21 long – 9 short to make sure that the differences in the risk-return characteristics change only because of different weightings and not because of different stock selections. We should bear in mind that the 9 shorted positions have together the same weight as all the 21 long position together. This makes it a zero investment.

5.3.4 The equally weighted Portfolio

We benchmark our constructed portfolio not only against the index, but also against an equally weighted portfolio. This is done in order to disregard possible benefits arising from a "size bias". The equally weighted portfolio includes all and solely the constituents of the DAX index at any period time. As the name already suggest, the weights are equally distributed in the 30 stocks. If the equally weighted portfolio performs better than the value weighted DAX, we can assume that the smaller companies in average generated higher returns than the larger ones.

5.4 Return distribution

The returns will be calculated according to the strategies described in detail above using excess returns. To discover the entire risk faced by investors, we evaluate the return distribution by taking into consideration all the moments of the different portfolios.

In order to apply the Omega ratio as the risk performance measure, we have to calculate the cumulative distribution function (CDF) for the portfolio excess returns. The CDF is approximated by using the Trapezium rule for non uniform intervals as follows:

$$\int ydx \approx \frac{1}{2}\sum(x_i - x_{i-1})(y_i + y_{i-1})$$

where x_i are the returns of portfolio i and y_i is the F(x).

5.5 Risk measures of the different portfolio strategies

Former research regarding the 130/30 portfolios have applied often relative risk measures such as beta. However, since the recent financial crisis, more and more investors become aware of the absolute risk involved. This means that the concern is more about how much

money the investor looses, than how risky it is compared to the benchmark index. Therefore in addition to the standard deviation, we will also use the Value-at-Risk (VaR). For the VaR we apply the Cornish-Fisher expansion. The main advantage of this approach is that we try to let the return data speak for themselves as much as possible, and use the recent empirical distribution of the returns – not the normal distribution – to estimate our risk measures. The Cornish-Fisher VaR (sometimes called mVaR) is calculated as follows:

$$z_{cf} = q_p + \frac{(q_p^2 - 1)S}{6} + \frac{(q_p^3 - 3q_p)K}{24} - \frac{(2q_p^3 - 5q_p)S^2}{36}$$

giving us

$$CFVaR = -\bar{R} - \sigma z_{cf}$$

where *qp* is the *p*% confidence (in this thesis 5%) quantile of the distribution, *S* is the skewness and *K* is the kurtosis of the return series. In a portfolio context, the moments may be calculated utilizing either the historical returns of the whole portfolio (i.e. univariate), or by using a multivariate estimate of the moments for a more accurate representation of the portfolio VaR. Cornish-Fisher VaR will give a larger loss estimate than traditional VaR when returns are negatively skewed or highly kurtotic fat-tailed), and, conversely, will give a smaller loss magnitude when returns are positively skewed or leptokurtotic.

Cornish-Fisher VaR collapses to traditional mean-VaR when returns are normally distributed. This measure is now widely cited and used in the literature, and is usually referred to as "Modified VaR" or "Modified Cornish-Fisher VaR".

5.6 Risk-adjusted performance measures

A risk-adjusted performance does not only take return, but also risk into account. We will discuss the three applied risk measures briefly below. The main focus will be on the Omega ratio.

5.6.1 The Sharpe ratio

The Sharpe ratio builds on the Markowitz mean-variance paradigm, which says that the mean and the variance of returns are sufficient statistics for characterizing an investment portfolio. It measures the risk-adjusted returns and is defined as follows:

$$SR = \frac{r_i - r_f}{\sigma_i}$$

where r_i is the return of portfolio i, r_f is the risk-free rate, and σ_i is the standard deviation of portfolio i. A drawback regarding the application of the Sharpe ratio as a performance measure for our study is the fact that it assumes normality.

5.6.2 Reward-to-VaR

The methodology of reward to VaR is introduced by Dowd (2000). The formula replaces standard deviation as the denominator with VaR:

$$EROVaR = \frac{r_i - r_f}{VaR_{0.05}(i)} \quad (7)$$

where $VaR_{0.05}$ represents the Value at Risk of the portfolio return i at the significance level of 5%. This performance measure has the advantage that it just takes the downside

risk, but not the upside risk into consideration. For the VaR, we used the Cornish Fisher method described in the theoretical part of this thesis.

5.6.3 The Omega Ratio

The Omega ratio incorporates all the information regarding the risk and the reward of a portfolio. Mathematically it is presented as following:

$$\Omega(r) = \frac{\int_{r}^{b}(1-F(x))dx}{\int_{a}^{r}F(x)dx}$$

where (a,b) is the interval of returns and F is the cumulative distribution of returns. For any return level r, the number Ω(r) is the probability weighted ratio of gains to losses, relative to the threshold r. The Omega ratio enables to take into consideration all of the moments of the distribution while the SR only takes the first two moments that effect on the risk measure. For any investor, returns below its specific loss threshold are considered as losses and returns above as gains. A higher value of Omega is always preferred to a lower value regardless of the distribution.

5.7 Reliability and validity of the method

The raw data for this thesis was collected from DataStream, which is a commonly used source for acquiring financial data. In order to have a realistic view of the historical performance and to prevent us of having the survivorship bias, we have taken into account the exits and entries that have occurred in the DAX index throughout the sample period.

The calculations are conducted by applying standard econometric models and rules. The correctness of these methods was double-checked to prevent mistakes and they were run systematically.

The secondary data, such as newspaper articles can be considered more speculative than factual. Even so, the importance of them as giving theory supporting background information is necessary.

Validity as a term expects us to find out whether the analysis really extracts the intended information. The theoretical framework and the hypothesis set should provide valid results of the initial research questions. We will refer back to this part in the summary of Chapter 6.

6. Empirical results

In this section of the thesis, we discuss the results obtained from the different frameworks. We have performed empirical analysis that allows us to compare the different equity asset classes using momentum/contrarian strategies. First we present the overall performance of all the possible portfolios. Secondly we analyze the risk-adjusted performance for different manager skill levels. This will be done by using different risk measures, namely the volatility and the Cornish-Fisher Var (CF VaR). The related ratios (Sharpe ratio, reward-to-VaR) will be applied, but the main focus will be on the superior risk-adjusted measure, the Omega ratio. Thirdly we divided the sample period into five time frames, in order to test the robustness of our results as well as to investigate possible differences between bull and bear markets.

6.1 Performance of portfolios

In this subchapter we analyze how the relaxation from the long-only constraint affects the performance of our 32 momentum/contrarian strategies. For this purpose we built 64 portfolios (32 130/30 and 32 long-only). Table 4 presents a comparison between the long-only and the 130/30 strategies. The 130/30 portfolios underperform in average compared to its long-only counterparts in terms of average annualized mean returns with 7.23% to 7.60% respectively. This implies that if an investor is unable to determine the skill of a manager ex-ante, he would in average benefit more from investing in long-only. Additionally, the standard deviation between the different 130/30 strategies is larger compared to the long-only, hence the likelihood of outlying portfolios is greater within the 130/30 category.

Strategy	*Average Annualized Mean Return*	*Standard deviation*	*Bottom portfolio*	*Median portfolio*	*Top portfolio*
Long-only	7,60 %	0,46 %	6,60 %	7,63 %	8,49 %
130/30	7,23 %	0,69 %	6,10 %	7,26 %	8,61 %

Table 4 Return of all portfolios (combined)

Figure 7 displays the return series as indices (100 basis points as of Jan 1991). The red dashed lines indicate the 130/30 portfolios based on the 32 different strategies. The black dashed lines represent the corresponding long-only portfolios. By looking at the graph, it is visible that the standard deviation between the different 130/30 strategies is larger than in the long-only. The outlying portfolios at the low performing end of the scale are frequently 130/30 portfolios, while the positive outliers consist of both, 130/30 and long-only portfolios. Furthermore, the median of the 130/30 (denoted as the solid red line) performs worse over the whole time period than the median of its long-only counterpart (solid black line). Initially this is rather surprising, since the vast majority of the previous studies concerning 130/30 strategies have found that 130/30 strategies generate in average higher returns resulting from the relaxation from the long-only. An interesting finding is that the equally weighted portfolios outperform its benchmark index DAX. This implies that there exists a size effect. Naturally in an equally weighted portfolio the larger companies are underweighted and the smaller overweighted in relation to the DAX.

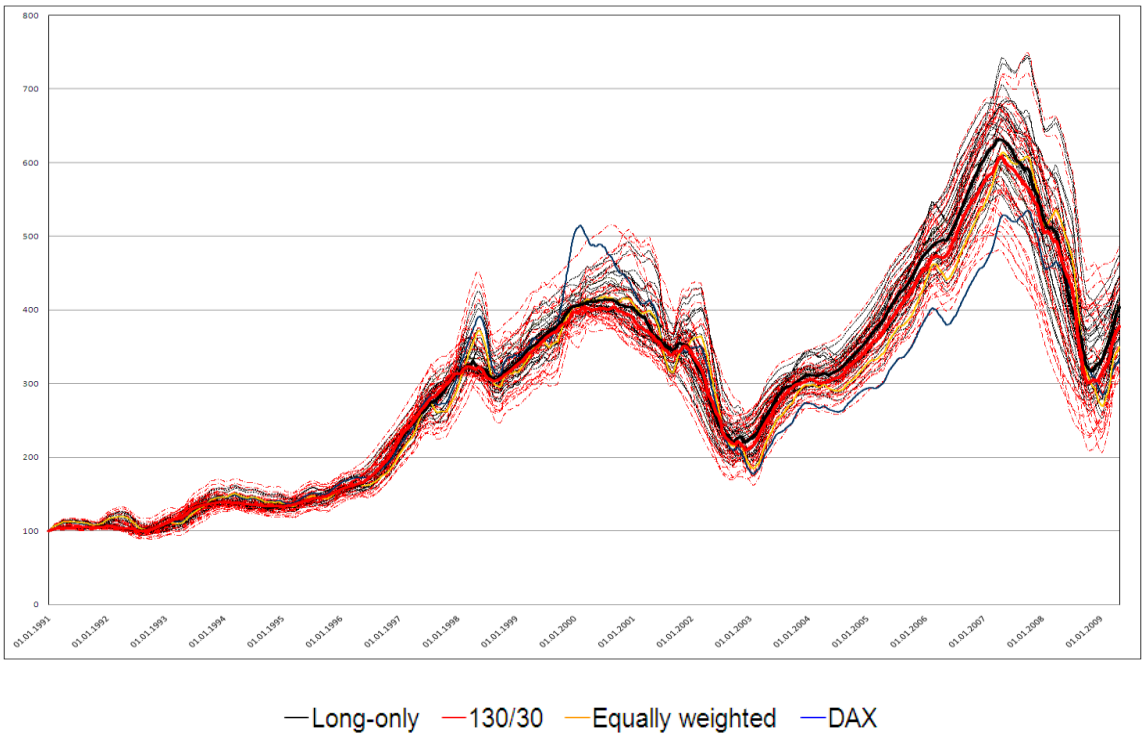

Figure 7. Portfolio returns as indices. Jan 1991-Apr 2009

The best performing portfolio during the entire sample period was the 130/30 12-12 momentum portfolio, while the worst performer was the 130/30 3-3 momentum portfolio. The higher deviation of active-extension strategies could be a result caused by the leveraged part, which implies to more incorporated risk. Furthermore the higher deviation between different 130/30 portfolios could denote that the investor is more exposed to the managers' level of skill when investing in such strategies. Therefore the proceeding step in our analysis is the breakdown of the overall results into the three different categories of manager skill as mentioned before. Later on in this chapter we divide the results to different time frames in order to test for the robustness of our results.

6.2 Risk-adjusted performance of "Green" zone managers

In Table 5 we present the results for the returns of the different 130/30 and long-only portfolios, which fall into the "Green" category, hence the top performing manager skill. The manager who uses the 12-12 momentum strategy is most successful in the portfolio construction when it comes to generating returns using the active-extension strategy. At the first glance, it seems surprising that a manager who in average chooses the right stocks (mean return from long position > mean returns from short position) does not always profit from the relaxation from the long-only constraint. However the success of a portfolio with a long and a short position also depends on the timing of the construction of the portfolio. To clarify, let us consider two stocks: A and B. Assume the investor buys at time t stock A for 100 € and sells short stock B for 50 €. At time t+1 stock A is worth 110 € (performance 10% increase), while stock B went down to 40 € (decrease 20%). At time t+2, stock A increased its value to 150 € (increase 36% from t+1) and stock B increased to 72 € (increase of 80% from t+1). Over the whole period of time the long position in average gave the return of 23%, while the short position generated 30% in returns. Therefore one could assume that the combined long-short portfolio would underperform the long-only. However, if we regard the combined long-short portfolio, the net investment was 50 € (100 € - 50 €) at time t, increased to 70 € (110 € - 40 €) at

time t+1, and finally to 78 € (150 € - 72 €) at time t+2. This results in an average return of 26% and therefore the long-short investment outperforms the long-only.

Strategy	*Long-only*	*130/30*
12-3Momentum	8,04 %	7,91 %
12-12Momentum	8,49 %	8,61 %
9-12Momentum	8,34 %	8,37 %
12-9Momentum	8,19 %	8,07 %
3-12Momentum	7,97 %	8,04 %
9-9Momentum	8,09 %	7,98 %
6-12Momentum	8,11 %	8,12 %
3-6Contrarian	7,60 %	7,70 %
Average	8,10 %	8,10 %
St.Dev.	0,26 %	0,28 %

Table 5 Performance of the "Green" zone managers

From Table 5 we can observe that only in 5 cases the manager using the 130/30 can outperform the long-only manager that is using the same portfolio construction in terms of average returns.

A more accurate analysis of the risk-return characteristics requires a closer look to the return distributions of the corresponding pairs (long-only, 130/30). We further on compare the returns to the market neutral portfolios. We should bear in mind that the market neutral portfolio is a zero-investment. To make all the asset classes comparable, from now on we base our risk-return analysis on excess returns.

6.2.1 Case example: 12-3 momentum strategy

Figure 8 displays the risk and returns of the different 12-3 momentum strategies. To make a clear structure for the analysis and empirical findings, as well as giving the reader an exhaustive example of one single strategy we will present the 12-3 momentum portfolio as a case example of the analysis' of the different portfolios. The descriptive statistics and analysis about the entire "Green" zone will follow after the break down of this example.

Measured by the standard deviation the 130/30 portfolio implies the least risk of all the 12-3 momentum portfolios (see Figure 8). Hence according to the Sharpe ratio the 130/30 would be slightly more attractive as an investment than the long-only and significantly better than the other alternatives. However as described in the theoretical part, the Sharpe ratio incorporates only the mean return and the standard deviation in order to rank portfolios.

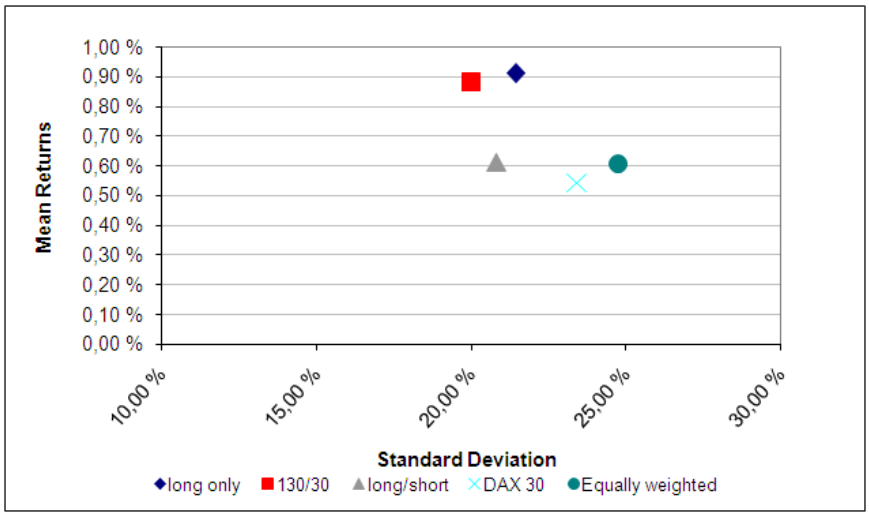

Figure 8 Mean return and Standard deviation of different 12-3 momentum strategies.

Alternatively the Cornish-Fisher VaR is a more accurate risk measure than the standard deviation, since it also includes the skewness and the kurtosis. In Figure 9 we show the corresponding risk-return relationship measured by the mean return and the Cornish-Fisher VaR.

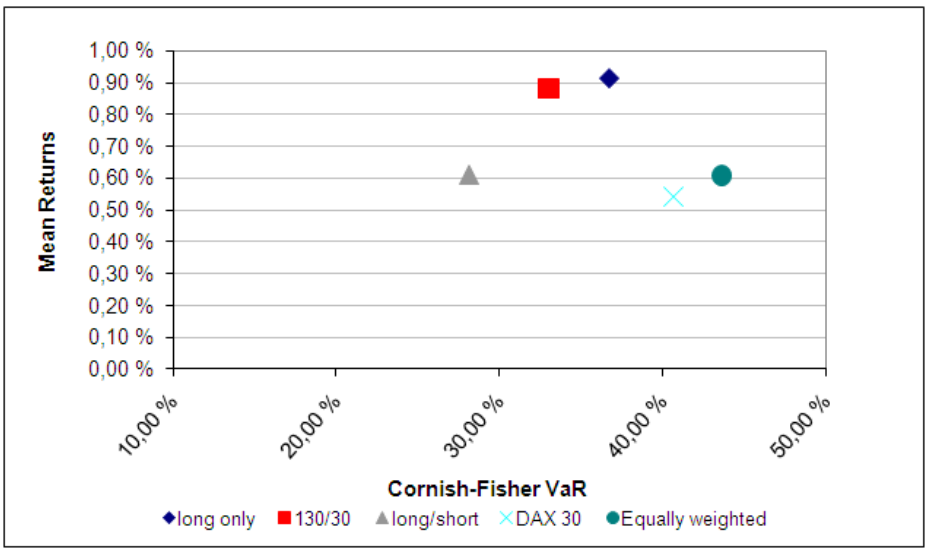

Figure 9 Mean return and the Cornish-Fisher VaR of different 12-3 momentum strategies.

An obvious finding from Figure 9 is that the long-short market neutral portfolio implies the least risk. The other portfolio positions remain relatively unchanged. The change of the market neutral is caused by the fact that its returns are positively skewed. The reason for this is that the leveraged part can act simultaneously as a hedge.

The reward-to-VaR introduced by Artzner et al. (1997) measures the mean returns in relation to VaR in order to rank stocks. Nonetheless this ratio has to be carefully interpreted, since the relation between return and VaR is vague. More precisely it relies on the assumption of a linear relationship. We see in Figure 9 that the 130/30 and the long-only are close to each other, while the long-only is better in terms of return, the 130/30 is less risky.

An even more accurate method to measure the risk reward performance for different asset classes is the Omega ratio. In Figure 10, we present the cumulative distribution function (CDF) of the different 12-3 momentum strategies. The CDF is used to calculate the Omega ratios for different threshold levels (rt). Fundamentally the Omega ratio is the weighted gain/loss ratio relative to rt. As the reward to VaR, it also uses all of the information in return series, instead of simple calculations of figures, such as the mean and the variance. For our intention, we set the threshold level initially to 0. This is

because we analyze excess returns and assume that the investor is concerned about returns that are below the riskfree interest rate. By observing the CDF, we can determine that the long-only, the 130/30, the DAX, and the equally weighted portfolios follow similar patterns. In the other hand, the long-short market neutral portfolio is significantly different. For example we see that the Omega ratio, with a rt of -10% would favor the long-short market neutral portfolio, while the Omega ratio of 5% would favor other alternatives.

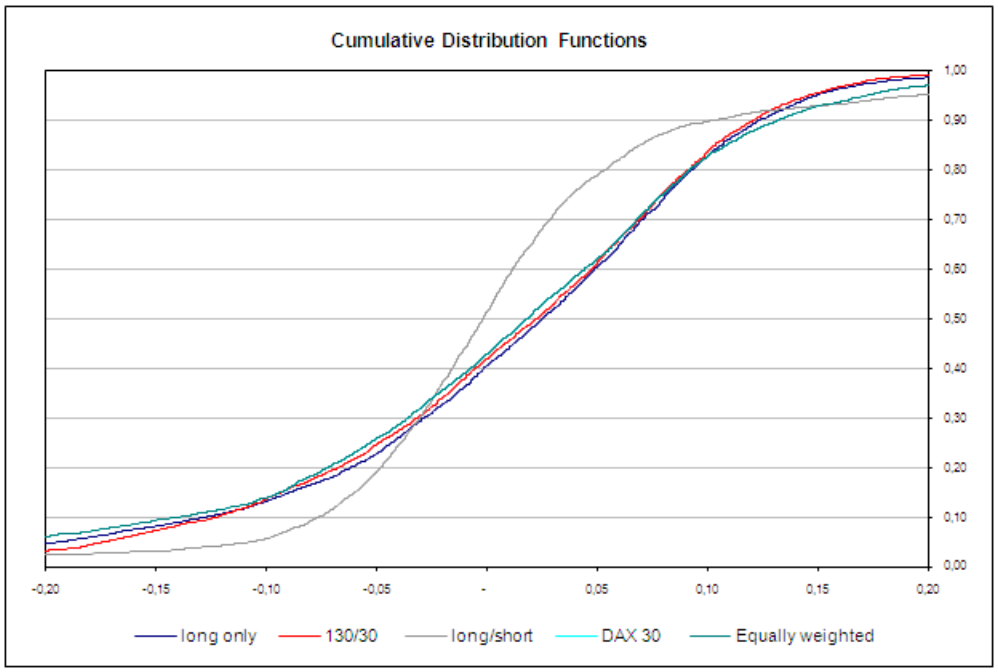

Figure 10 CDF of 12-3 Momentum Strategy

For further judgment, we need to consider Figure 11 where we present the log-Omega values for different threshold levels. Again, we see that the long-short market neutral portfolio would be superior for negative threshold levels. Nevertheless around our critical rt (0) the long only and the 130/30 portfolios are dominating, while the DAX and the equally weighted provide poor results. This indicates that the portfolio manager "12-3 momentum" outperforms its benchmark regardless of its strategy choice (long only or 130/30).

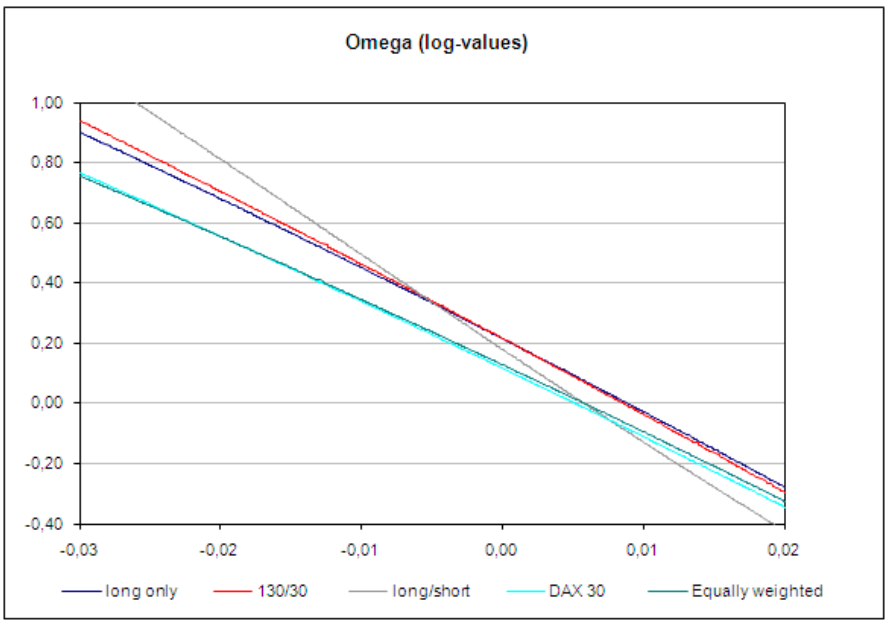

Figure 11 Omega values for different threshold levels rt (log)

6.2.2 Summary of the "Green" zone managers

The analysis in part 6.2.1 is conducted for all the possible managers' stock selection strategies. The results of the "Green" zone manager skills are summarized in Table 6. Seven out of total eight portfolio selection strategies showed that the 130/30 provides superior Omega values compared to its counterparts. The Sharpe ratio based ranking provides similar results as the Omega ratio. The reward-to-VaR gives the same results when it comes to the best performers but rankings of the other strategies diverge slightly.

The superior results for the 130/30 are not just due to a higher return, but also because of a lower level of VaR vis-à-vis the long-only equivalent. All the strategies using the momentum approach provide smaller VaR scores for the 130/30 than the long-only. This implies that the active-extension acts partly as a hedge. The market neutral long-short portfolio has significantly lower VaR than rest of the asset classes. This is in line with the fact that long-only market neutral investments in practice are often used as hedge instruments. To reinstate, theoretically the 130/30 portfolios contain a long-only and a

market neutral long-short investment. If both of these parts are efficiently combined, the amount of risk can be reduced and therefore the risk-adjusted performance will increase.

Portfolio	Strategy	Mean Return	St.Dev.	Skewness	Kurtosis	SR	CF VaR	Reward to VaR	Omega	Omega Rank
12-3M	Long-Only	3,65 %	0,21	-1,04	1,90	0,170	36,69 %	0,100	1,240	2.
	130/30	3,53 %	0,20	-0,76	1,12	0,176	33,00 %	0,107	1,240	1.
	Market Neutral	2,44 %	0,21	0,13	6,83	0,117	28,12 %	0,087	1,199	3.
	Equally Weighted	2,43 %	0,25	-1,04	2,86	0,098	43,63 %	0,056	1,138	4.
12-12M	Long-Only	4,04 %	0,25	-0,72	0,23	0,162	41,73 %	0,096809	1,479	2.
	130/30	4,16 %	0,23	-0,47	-0,12	0,177	37,58 %	0,110708	1,530	1.
	Market Neutral	2,15 %	0,16	0,38	2,68	0,131	22,16 %	0,096814	1,467	3.
	Equally Weighted	3,26 %	0,27	-0,87	0,63	0,120	47,55 %	0,068586	1,345	4.
9-12M	Long-Only	3,89 %	0,25	-0,73	0,22	0,157	41,78 %	0,093	1,465	2.
	130/30	3,93 %	0,23	-0,49	-0,14	0,169	37,50 %	0,105	1,503	1.
	Market Neutral	1,86 %	0,16	0,41	3,04	0,113	22,21 %	0,084	1,392	3.
	Equally Weighted	3,26 %	0,27	-0,87	0,63	0,120	47,55 %	0,069	1,345	4.
12-9M	Long-Only	3,72 %	0,24	-0,84	0,71	0,153	41,57 %	0,090	1,388	2.
	130/30	3,60 %	0,23	-0,57	0,17	0,158	37,33 %	0,096	1,397	1.
	Market Neutral	1,65 %	0,18	0,19	4,44	0,094	24,71 %	0,067	1,275	4.
	Equally Weighted	3,10 %	0,27	-0,93	1,29	0,114	47,70 %	0,065	1,286	3.
3-12M	Long-Only	3,51 %	0,26	-0,87	0,54	0,135	44,99 %	0,078	1,392	2.
	130/30	3,59 %	0,25	-0,82	0,62	0,141	43,56 %	0,082	1,413	1.
	Market Neutral	1,57 %	0,14	0,20	3,77	0,110	19,90 %	0,079	1,362	3.
	Equally Weighted	3,26 %	0,27	-0,87	0,63	0,120	47,55 %	0,069	1,345	4.
9-9M	Long-Only	3,61 %	0,25	-0,88	0,88	0,147	42,12 %	0,086	1,375	2.
	130/30	3,50 %	0,23	-0,65	0,49	0,153	38,08 %	0,092	1,385	1.
	Market Neutral	1,53 %	0,17	-0,18	4,35	0,092	25,23 %	0,061	1,262	4.
	Equally Weighted	3,10 %	0,27	-0,93	1,29	0,114	47,70 %	0,065	1,286	3.
6-12M	Long-Only	3,66 %	0,25	-0,83	0,52	0,144	43,58 %	0,084	1,423	2.
	130/30	3,66 %	0,24	-0,72	0,55	0,150	40,92 %	0,090	1,443	1.
	Market Neutral	1,52 %	0,15	0,01	3,08	0,101	22,26 %	0,068	1,325	4.
	Equally Weighted	3,26 %	0,27	-0,87	0,63	0,120	47,55 %	0,069	1,345	3.
3-6C	Long-Only	3,19 %	0,28	-0,89	2,43	0,116	47,26 %	0,068	1,249	1.
	130/30	3,29 %	0,29	-0,85	2,92	0,114	49,24 %	0,067	1,246	2.
	Market Neutral	0,89 %	0,13	0,18	4,69	0,068	18,82 %	0,047	1,134	4.
	Equally Weighted	2,96 %	0,27	-0,98	2,22	0,112	46,48 %	0,064	1,232	3.
DAX	3 Month	2,38 %	0,26	-0,75	0,06	0,090	46,18 %	0,051	1,124	
	6 Month	2,38 %	0,26	-0,75	0,06	0,090	46,18 %	0,051	1,170	
	9 Month	2,38 %	0,26	-0,75	0,06	0,090	46,18 %	0,051	1,205	
	12 Month	2,38 %	0,26	-0,75	0,06	0,090	46,18 %	0,051	1,242	

Table 6 "Green" zone descriptive statistics

From the "Green" zone, the only single 130/30 portfolio that has a higher VaR than its long-only counterpart, is the 3-6 contrarian portfolio (VaRs 49.24% and 47.26% respectively). This is also the only strategy in the "Green" zone that provides a lower Omega value for the 130/30 than the long-only. The portfolio manager can increase the excess return (from 3.19% to 3.29%) due to the relaxation from the long-only constraint, but in the meantime also increases the level of risk substantially. In this case we can conclude that the long-only and the market neutral long-short portfolios are not combined efficiently. All the portfolios except the market neutral long only in each strategy are negatively skewed. A negative skewness indicates that there exists a higher frequency of large negative returns, more specifically larger downside risk. Not taking this into consideration would in our case lead to an underestimation of the risk level. Furthermore the kurtosis is higher for our portfolio than for a normal distribution, which is due to fat

tails. As observed from table 6 we see that the skewness and kurtosis values for the market neutral portfolios are significantly different from the other portfolios. Therefore the Sharpe ratio is an inadequate measure when it comes to comparing different asset classes.

6.2.3 Summary of the "Yellow" zone managers

The "Yellow" category of manager skill level is where the largest number of different momentum/contrarian strategies fall into. As mentioned, this category includes strategies that do not significantly perform either better or worse, regarding the differences between the long and the short positions. In Table 7, we present the statistics of the "Yellow" zone portfolios (categorization as per the T-test statistics, Table 2). In this category, the performance in terms of mean returns of the long-only exceeds the 130/30 in each portfolio.

As in the "Green zone" in this category several managers are able to reduce their VaR due to the relaxation from the long only constraint, namely the 12-6 Momentum, the 6-9 Momentum, the 9-3 Momentum, the 9-6 Momentum, 3-3 Momentum, the 6-3 Momentum, the 3-6 Momentum and the 6-6 Momentum. However none of these risk reductions result in a superior Sharpe ratio, reward-to-VaR or Omega value for the 130/30 strategies compared to its long only counterpart. Hence we conclude that in the "yellow" zone the investor is always better off choosing the long only option instead of the 130/30. Furthermore it is visible in Table 7 that in some cases the equally weighted portfolio outperforms both of the actively managed portfolios. This is a strong indicator that the portfolio manager is not able to execute a prudent stock selection. Again the long only market neutral portfolios provide the least risk (in terms of VaR). However, the "yellow" zone managers are not able to exploit this by combining it with a long only in order to create higher Omega values.

Portfolio	Strategy	Mean Return	St.Dev.	Skewness	Kurtosis	SR	CF VaR	Reward to VaR	Omega	Omega Rank
12-6M	Long-Only	3,545 %	0,235	-0,921	1,273	0,151	40,203 %	0,088	1,311	1.
	130/30	3,162 %	0,218	-0,625	0,428	0,145	36,203 %	0,087	1,288	2.
	Market Neutral	1,173 %	0,190	0,060	6,292	0,062	27,333 %	0,043	1,138	4.
	Equally Weighted	2,964 %	0,266	-0,980	2,221	0,112	46,478 %	0,064	1,232	3.
6-9M	Long-Only	3,342 %	0,255	-0,977	1,159	0,131	44,551 %	0,075	1,330	1.
	130/30	3,175 %	0,246	-0,895	1,061	0,129	42,628 %	0,074	1,324	2.
	Market Neutral	1,015 %	0,150	-0,590	4,935	0,068	24,552 %	0,041	1,181	4.
	Equally Weighted	3,095 %	0,272	-0,930	1,285	0,114	47,698 %	0,065	1,286	3.
9-3M	Long-Only	3,356 %	0,223	-1,140	2,305	0,151	38,893 %	0,086	1,212	1.
	130/30	2,894 %	0,210	-0,929	1,627	0,138	36,081 %	0,080	1,188	2.
	Market Neutral	0,932 %	0,191	-0,421	6,447	0,049	30,158 %	0,031	1,068	4.
	Equally Weighted	2,434 %	0,247	-1,036	2,857	0,098	43,625 %	0,056	1,138	3.
9-6M	Long-Only	3,421 %	0,239	-0,969	1,517	0,143	41,360 %	0,083	1,295	1.
	130/30	3,030 %	0,225	-0,743	0,908	0,135	37,999 %	0,080	1,271	2.
	Market Neutral	0,929 %	0,180	-0,181	7,186	0,052	26,955 %	0,034	1,113	4.
	Equally Weighted	2,964 %	0,266	-0,980	2,221	0,112	46,478 %	0,064	1,232	3.
3-9C	Long-Only	3,176 %	0,278	-0,786	1,287	0,114	47,737 %	0,067	1,291	1.
	130/30	3,131 %	0,289	-0,668	1,523	0,108	48,803 %	0,064	1,281	3.
	Market Neutral	0,141 %	0,134	0,324	2,801	0,011	19,813 %	0,007	1,019	4.
	Equally Weighted	3,095 %	0,272	-0,930	1,285	0,114	47,698 %	0,065	1,286	2.
12-12C	Long-Only	3,685 %	0,291	-0,869	0,796	0,126	50,570 %	0,073	1,378	1.
	130/30	3,491 %	0,316	-0,874	1,021	0,110	55,296 %	0,063	1,331	3.
	Market Neutral	0,617 %	0,152	0,448	1,523	0,041	21,927 %	0,028	1,110	4.
	Equally Weighted	3,262 %	0,273	-0,867	0,634	0,120	47,554 %	0,069	1,345	2.
6-3C	Long-Only	2,839 %	0,267	-0,851	3,243	0,106	45,384 %	0,063	1,154	1.
	130/30	2,507 %	0,294	-0,741	3,966	0,085	49,379 %	0,051	1,124	3.
	Market Neutral	0,003 %	0,171	-0,372	10,149	0,000	26,311 %	0,000	0,988	4.
	Equally Weighted	2,434 %	0,247	-1,036	2,857	0,098	43,625 %	0,056	1,138	2.
6-6C	Long-Only	3,269 %	0,279	-0,774	2,213	0,117	47,244 %	0,069	1,249	1.
	130/30	3,093 %	0,296	-0,569	2,333	0,105	48,784 %	0,063	1,222	3.
	Market Neutral	0,126 %	0,143	1,063	6,934	0,009	16,753 %	0,008	1,009	4.
	Equally Weighted	2,964 %	0,266	-0,980	2,221	0,112	46,478 %	0,064	1,232	2.
3-9M	Long-Only	3,022 %	0,263	-1,078	1,447	0,115	46,970 %	0,064	1,287	1.
	130/30	2,755 %	0,261	-1,132	1,756	0,105	47,045 %	0,059	1,261	3.
	Market Neutral	0,435 %	0,137	-0,832	4,158	0,032	24,071 %	0,018	1,075	4.
	Equally Weighted	3,095 %	0,272	-0,930	1,285	0,114	47,698 %	0,065	1,286	2.
3-3C	Long-Only	2,291 %	0,270	-1,041	3,417	0,085	47,767 %	0,048	1,119	2.
	130/30	1,947 %	0,299	-1,045	3,950	0,065	53,127 %	0,037	1,091	3.
	Market Neutral	0,288 %	0,153	-0,285	5,746	0,019	24,269 %	0,012	1,018	4.
	Equally Weighted	2,434 %	0,247	-1,036	2,857	0,098	43,625 %	0,056	1,138	1.
3-3M	Long-Only	2,213 %	0,229	-1,087	2,083	0,097	41,032 %	0,054	1,131	2.
	130/30	1,711 %	0,221	-0,941	1,435	0,077	39,630 %	0,043	1,099	3.
	Market Neutral	0,298 %	0,172	-0,096	7,294	0,017	25,905 %	0,012	1,017	4.
	Equally Weighted	2,434 %	0,247	-1,036	2,857	0,098	43,625 %	0,056	1,138	1.
6-3M	Long-Only	2,672 %	0,227	-1,146	2,440	0,118	40,409 %	0,066	1,162	1.
	130/30	2,039 %	0,220	-0,986	2,035	0,093	39,089 %	0,052	1,122	3.
	Market Neutral	0,203 %	0,185	-0,205	8,042	0,011	28,293 %	0,007	1,008	4.
	Equally Weighted	2,434 %	0,247	-1,036	2,857	0,098	43,625 %	0,056	1,138	2.
12-9C	Long-Only	3,324 %	0,294	-0,929	1,682	0,113	51,330 %	0,065	1,295	1.
	130/30	2,896 %	0,323	-0,912	2,006	0,090	56,784 %	0,051	1,236	3.
	Market Neutral	0,048 %	0,163	0,576	3,250	0,003	22,869 %	0,002	1,001	4.
	Equally Weighted	3,095 %	0,272	-0,930	1,285	0,114	47,698 %	0,065	1,286	2.
9-3C	Long-Only	3,068 %	0,275	-0,973	3,518	0,112	47,320 %	0,065	1,163	1.
	130/30	2,495 %	0,307	-0,876	3,889	0,081	52,778 %	0,047	1,118	3.
	Market Neutral	-0,354 %	0,171	0,366	5,622	-0,021	24,666 %	-0,014	0,960	4.
	Equally Weighted	2,434 %	0,247	-1,036	2,857	0,098	43,625 %	0,056	1,138	2.
3-12C	Long-Only	3,007 %	0,278	-0,806	0,719	0,108	48,418 %	0,062	1,312	2.
	130/30	2,633 %	0,289	-0,732	0,839	0,091	50,046 %	0,053	1,263	3.
	Market Neutral	-1,228 %	0,137	-0,223	3,407	-0,090	23,631 %	-0,052	0,775	4.
	Equally Weighted	3,262 %	0,273	-0,867	0,634	0,120	47,554 %	0,069	1,345	1.
3-6M	Long-Only	2,609 %	0,255	-1,087	1,954	0,102	45,665 %	0,057	1,206	2.
	130/30	2,033 %	0,252	-1,065	1,908	0,081	45,617 %	0,045	1,157	3.
	Market Neutral	-0,436 %	0,145	-0,804	7,326	-0,030	25,266 %	-0,017	0,929	4.
	Equally Weighted	2,964 %	0,266	-0,980	2,221	0,112	46,478 %	0,064	1,232	1.
6-6M	Long-Only	2,972 %	0,252	-1,151	2,123	0,118	45,062 %	0,066	1,241	1.
	130/30	2,339 %	0,246	-1,113	2,009	0,095	44,340 %	0,053	1,188	3.
	Market Neutral	-0,464 %	0,148	-1,599	9,801	-0,031	27,948 %	-0,017	0,929	4.
	Equally Weighted	2,964 %	0,266	-0,980	2,221	0,112	46,478 %	0,064	1,232	2.
12-6C	Long-Only	3,090 %	0,290	-1,009	2,989	0,106	50,713 %	0,061	1,230	2.
	130/30	2,420 %	0,323	-1,014	3,586	0,075	57,075 %	0,042	1,160	3.
	Market Neutral	-0,591 %	0,171	0,019	7,479	-0,034	26,105 %	-0,023	0,920	4.
	Equally Weighted	2,964 %	0,266	-0,980	2,221	0,112	46,478 %	0,064	1,232	1.
9-12C	Long-Only	3,238 %	0,292	-0,859	0,800	0,111	50,998 %	0,063	1,325	2.
	130/30	2,672 %	0,316	-0,846	0,990	0,085	55,876 %	0,048	1,244	3.
	Market Neutral	-0,813 %	0,155	0,098	2,257	-0,052	25,211 %	-0,032	0,863	4.
	Equally Weighted	3,262 %	0,273	-0,867	0,634	0,120	47,554 %	0,069	1,345	1.
12-3C	Long-Only	2,652 %	0,273	-1,048	3,750	0,097	47,811 %	0,055	1,141	1.
	130/30	1,744 %	0,308	-1,028	4,330	0,057	54,642 %	0,032	1,081	3.
	Market Neutral	-1,304 %	0,171	0,135	4,912	-0,076	27,124 %	-0,048	0,884	4.
	Equally Weighted	2,434 %	0,247	-1,036	2,857	0,098	43,625 %	0,056	1,138	2.
DAX	3 Month	2,378 %	0,263	-0,752	0,062	0,090	46,184 %	0,051	1,124	
	6 Month	2,378 %	0,263	-0,752	0,062	0,090	46,184 %	0,051	1,170	
	9 Month	2,378 %	0,263	-0,752	0,062	0,090	46,184 %	0,051	1,205	
	12 Month	2,378 %	0,263	-0,752	0,062	0,090	46,184 %	0,051	1,242	

Table 7 "Yellow" zone descriptive statistics

6.2.4 Summary of the "Red" zone managers

The "red" zone contains manager strategies that have selected in average underperforming stocks. Therefore it is not a surprise that the 130/30 portfolios do not only have smaller mean returns than the long-only and the equally weighted portfolio, but also provides the highest VaR value for all the "red" zone strategies. Consequently the 130/30 perform significantly weaker in terms of Omega than its long only counterparts and the equally weighted portfolios. Even the size benefits described in Chapter 6.1 vis-à-vis the DAX disappear.

Portfolio	Strategy	Mean Return	St.Dev.	Skewness	Kurtosis	SR	CF VaR	Reward to VaR	Omega	Omega Rank
6-12C	Long-Only	2,95 %	0,29	-0,82	0,72	0,10	50,08 %	0,06	1,30	2.
	130/30	2,30 %	0,30	-0,76	0,82	0,08	53,56 %	0,04	1,22	3.
	Market Neutral	-1,60 %	0,15	0,07	3,49	-0,11	24,67 %	-0,06	0,74	4.
	Equally Weighted	**3,26 %**	**0,27**	**-0,87**	**0,63**	**0,12**	**47,55 %**	**0,07**	**1,34**	**1.**
6-9C	Long-Only	2,71 %	0,29	-0,88	1,58	0,09	50,10 %	0,05	1,24	2.
	130/30	2,01 %	0,30	-0,82	1,88	0,07	53,69 %	0,04	1,17	3.
	Market Neutral	-1,69 %	0,15	0,26	4,13	-0,11	24,04 %	-0,07	0,75	4.
	Equally Weighted	**3,10 %**	**0,27**	**-0,93**	**1,29**	**0,11**	**47,70 %**	**0,06**	**1,29**	**1.**
9-9C	Long-Only	2,85 %	0,29	-0,88	1,45	0,10	51,14 %	0,06	1,25	2.
	130/30	2,09 %	0,32	-0,82	1,65	0,07	56,10 %	0,04	1,17	3.
	Market Neutral	-1,34 %	0,16	0,59	3,13	-0,09	23,41 %	-0,06	0,81	4.
	Equally Weighted	**3,10 %**	**0,27**	**-0,93**	**1,29**	**0,11**	**47,70 %**	**0,06**	**1,29**	**1.**
9-6C	Long-Only	2,77 %	0,29	-0,96	2,81	0,10	50,32 %	0,06	1,20	2.
	130/30	1,89 %	0,32	-0,94	3,38	0,06	55,94 %	0,03	1,12	3.
	Market Neutral	-1,65 %	0,17	0,26	6,12	-0,10	25,65 %	-0,06	0,81	4.
	Equally Weighted	**2,96 %**	**0,27**	**-0,98**	**2,22**	**0,11**	**46,48 %**	**0,06**	**1,23**	**1.**
DAX	3 Month	2,38 %	0,26	-0,75	0,06	0,09	46,18 %	0,05	1,12	
	6 Month	2,38 %	0,26	-0,75	0,06	0,09	46,18 %	0,05	1,17	
	9 Month	2,38 %	0,26	-0,75	0,06	0,09	46,18 %	0,05	1,21	
	12 Month	2,38 %	0,26	-0,75	0,06	0,09	46,18 %	0,05	1,24	

Table 8 "Red" zone descriptive statistics

6.3 Exposure to manager skill

In 6.2, we discussed the risk-return characteristics of the different categories that were based on the initial research criteria. A key finding was that 130/30 portfolios are only potentially value adding for the "Green" zone portfolios. In Figure 12 we compare the long-only and the 130/30 with a 12 month holding period (any x-12 strategy). On the X-axis, we present the manager skills in terms of the differences between the long and the short mean returns (as described in Chapter 5.2). The Y-axis presents the related Omega

values of the portfolios. An interesting finding is that, the 130/30 portfolios only outperform the long-only when the manager skills are high. On the other hand, the worse the manager skills are, the larger the difference between the long-only and the corresponding 130/30 portfolio is. This implies that a 130/30 investor is more exposed to managers' stock selecting skill than the long-only investor.

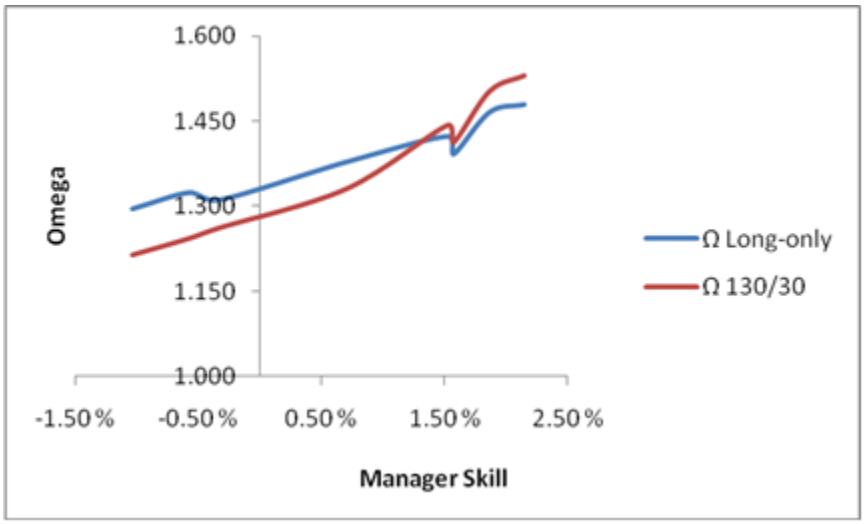

Figure 12 Omega Ratio for different manager skills

One can argue that benefits from the 130/30 strategy exists in the "Green" zone. Therefore an investor should only invest in portfolios within this category. However in practice judging the manager skills ex-ante could be fairly challenging. For this reason we divided the sample time in different time frames in order to investigate potential patterns.

6.4 Bull/ Bear Analysis

In order to have robust results we decided to analyze the performance of the portfolios within 5 different sub-periods, 1991-1995, 1996-1999, 2000-2002, 2003-2007, 2008-2009. The split was made to cover for the different approximate bull and bear markets (see figure 13). This allows us to analyze the performance of the strategies with the

different financial events (such as the recent market turmoil) and their impacts. Evaluating the robustness makes it possible to identify any potential differences in the profitability of the momentum/contrarian strategies in these sub-periods or a tilting towards one of them.

Figure 13 DAX Index and separation to Bull/Bear

Table 9 displays the ranked manager skills over the whole sample size as well as over different time frames. The rankings of categorizations upon our criteria vary between the time frames quite dramatically. The robustness of the manager skills seems therefore questionable. None of the stock selecting strategies were able to provide superior manager skills for all the time periods. It is also unclear, which strategies dominate in the bull or the bear markets consistently. This supports our assumption that it is nearly impossible to distinguish "Green", "Yellow", and "Red" strategies ex-ante.

Another finding is that more portfolio managers are able to distinguish outperformers from underperformers in bear than in bull markets. However, once again this finding is not of much help for determining the right strategies ex-ante. In the bear market between 2000-2002 (dotcom bubble), the momentum strategies were dominant in the "Green" zone while in the latest crisis, 2008-2009 (subprime) the dominant strategies were the contrarians.

	1991-2009			1991-1995 Bull			1996-1999 Bull			2000-2002 Bear			2003-2007 Bull			2008-2009 Bear		
Portfolio	*Difference*	*T-test*	*Ranking*	*Difference*	*T-test*	*Ranking*	*Difference*	*T-test*	*Ranking*	*Difference*	*T-test*	*Ranking*	*Difference*	*T-test*	*Ranking*	*Difference*	*T-test*	*Ranking*
12-3Momentum	2,43 %	2,05 %	1	-2,50 %	2,19 %	29	0,77 %	34,57 %	11	15,25 %	0,00 %	1	-0,25 %	43,45 %	13	7,32 %	20,62 %	14
12-12Momentum	2,15 %	0,03 %	2	-1,20 %	1,87 %	23	0,62 %	18,51 %	13	8,94 %	0,00 %	8	2,30 %	1,46 %	2	3,42 %	21,05 %	18
9-12Momentum	1,86 %	0,13 %	3	-0,46 %	21,25 %	22	-0,43 %	26,78 %	18	9,14 %	0,00 %	7	1,52 %	7,73 %	4	2,40 %	28,78 %	19
12-9Momentum	1,65 %	1,07 %	4	-1,25 %	2,86 %	24	0,64 %	22,51 %	12	9,87 %	0,00 %	5	-0,50 %	29,83 %	14	5,13 %	18,06 %	16
3-12Momentum	1,57 %	0,40 %	5	0,31 %	29,07 %	17	0,87 %	11,23 %	10	5,12 %	0,02 %	12	2,25 %	1,50 %	3	-2,15 %	29,98 %	23
9-9Momentum	1,53 %	1,57 %	6	0,01 %	49,30 %	18	0,37 %	33,47 %	15	9,33 %	0,00 %	6	-0,72 %	22,03 %	15	1,61 %	38,62 %	21
6-12Momentum	1,52 %	0,59 %	7	-0,02 %	48,41 %	19	-0,19 %	39,38 %	16	6,82 %	0,00 %	9	2,49 %	0,94 %	1	-3,12 %	22,70 %	25
3-6Contrarian	1,40 %	3,55 %	8	1,86 %	1,49 %	8	-2,72 %	1,17 %	24	3,23 %	3,76 %	16	-0,86 %	18,26 %	16	16,46 %	0,25 %	4
12-6Momentum	1,17 %	9,16 %	9	-1,85 %	1,40 %	27	0,37 %	38,15 %	14	12,17 %	0,00 %	2	-1,96 %	2,95 %	21	1,96 %	39,14 %	20
6-9Momentum	1,02 %	6,99 %	10	-0,06 %	46,48 %	20	1,36 %	6,20 %	8	6,11 %	0,03 %	11	0,80 %	19,44 %	8	-6,61 %	10,75 %	28
9-3Momentum	0,93 %	21,46 %	11	-3,07 %	0,75 %	30	1,66 %	20,94 %	6	11,19 %	0,07 %	3	-0,17 %	45,70 %	11	-5,20 %	27,18 %	27
9-6Momentum	0,93 %	14,23 %	12	-1,83 %	1,53 %	26	0,91 %	23,32 %	9	10,90 %	0,00 %	4	-1,18 %	12,60 %	18	-3,17 %	32,53 %	26
3-9Contrarian	0,88 %	8,71 %	13	1,28 %	2,64 %	11	-3,85 %	0,00 %	29	2,63 %	4,12 %	17	-1,06 %	11,22 %	17	16,91 %	0,02 %	3
12-12Contrarian	0,70 %	10,05 %	14	3,31 %	0,00 %	2	1,99 %	0,41 %	5	-3,02 %	0,79 %	27	-2,61 %	0,45 %	24	7,81 %	1,04 %	12
6-3Contrarian	0,62 %	27,10 %	15	3,80 %	0,11 %	1	-4,81 %	0,74 %	31	-0,81 %	38,42 %	21	-3,66 %	0,27 %	29	24,30 %	0,02 %	1
6-6Contrarian	0,51 %	25,25 %	16	1,85 %	1,69 %	9	-2,45 %	2,15 %	22	-1,94 %	14,61 %	23	-2,93 %	0,10 %	25	22,82 %	0,00 %	2
3-9Momentum	0,43 %	25,94 %	17	-0,30 %	32,30 %	21	2,36 %	0,46 %	4	3,27 %	2,39 %	15	0,31 %	36,72 %	10	-8,53 %	4,89 %	29
3-3Contrarian	0,32 %	37,50 %	18	1,61 %	9,15 %	10	-6,07 %	0,08 %	32	3,60 %	9,31 %	14	0,96 %	23,42 %	7	4,91 %	22,99 %	17
3-3Momentum	0,30 %	39,70 %	19	-3,88 %	0,10 %	32	5,99 %	0,14 %	1	1,69 %	30,54 %	20	-0,19 %	44,90 %	12	-2,44 %	38,40 %	24
6-3Momentum	0,21 %	42,82 %	20	-3,38 %	0,33 %	31	2,70 %	9,06 %	2	6,69 %	2,71 %	10	1,00 %	25,15 %	6	-11,47 %	8,19 %	30
12-9Contrarian	0,10 %	43,71 %	21	2,61 %	0,00 %	3	-0,74 %	20,91 %	19	-3,39 %	1,21 %	29	-2,31 %	0,37 %	23	10,07 %	1,06 %	8
9-3Contrarian	-0,15 %	44,10 %	22	2,55 %	1,77 %	4	-3,43 %	4,07 %	26	-1,76 %	26,35 %	22	-1,99 %	7,14 %	22	10,07 %	6,16 %	9
3-12Contrarian	-0,33 %	27,61 %	23	1,04 %	3,50 %	13	-3,53 %	0,00 %	27	1,85 %	7,12 %	19	-3,09 %	0,08 %	27	9,56 %	0,37 %	10
3-6Momentum	-0,44 %	29,68 %	24	-2,46 %	0,17 %	28	2,49 %	2,62 %	3	2,51 %	11,31 %	18	1,09 %	14,20 %	5	-13,99 %	1,49 %	31
6-6Momentum	-0,46 %	28,79 %	25	-1,73 %	2,04 %	25	1,61 %	10,70 %	7	4,04 %	2,59 %	13	0,63 %	26,73 %	9	-16,15 %	0,73 %	32
12-6Contrarian	-0,55 %	23,26 %	26	2,19 %	0,39 %	5	-2,23 %	3,92 %	20	-4,87 %	0,38 %	31	-1,58 %	4,61 %	19	7,81 %	7,36 %	13
9-12Contrarian	-0,58 %	14,51 %	27	2,02 %	0,01 %	7	-0,23 %	37,47 %	17	-3,38 %	0,34 %	28	-3,77 %	0,01 %	30	6,89 %	2,17 %	15
6-12Contrarian	-1,04 %	2,93 %	28	1,04 %	3,45 %	12	-2,35 %	0,06 %	21	-2,61 %	1,82 %	25	-4,35 %	0,00 %	32	11,03 %	0,07 %	7
6-9Contrarian	-1,14 %	3,58 %	29	0,89 %	9,02 %	14	-3,90 %	0,00 %	30	-2,83 %	2,96 %	26	-3,96 %	0,00 %	31	13,84 %	0,10 %	5
9-9Contrarian	-1,17 %	3,15 %	30	0,77 %	11,60 %	15	-2,48 %	0,25 %	23	-4,30 %	0,19 %	30	-2,99 %	0,03 %	26	9,39 %	1,70 %	11
12-3Contrarian	-1,18 %	11,85 %	31	2,05 %	4,07 %	6	-3,67 %	3,16 %	28	-2,60 %	17,42 %	24	-1,66 %	10,53 %	20	-0,84 %	44,78 %	22
9-6Contrarian	-1,35 %	3,73 %	32	0,61 %	23,25 %	16	-3,13 %	0,69 %	25	-4,99 %	0,31 %	32	-3,13 %	0,05 %	28	11,45 %	1,88 %	6
Total by Category	*Green*	*Yellow*	*Red*	*Green*	*Yellow*	*Red*	*Green*	*Yellow*	*Red*	*Green*	*Yellow*	*Red*	*Green*	*Yellow*	*Red*	*Green*	*Yellow*	*Red*
	8	20	4	12	10	10	4	15	13	16	8	8	3	12	17	12	17	3

Table 9 Categorization of manager skill within different time frames

While the categorization for the manager skills changes over time, the relation between Omega and the level of manager skills remains the same. In Figure 14 we present the Omega ratios for the different manager skills divided into bull and bear markets. In the graphs we see a similar pattern as of the whole sample we presented earlier in Figure 12. According to this, a 130/30 strategy is only value adding when the manager is highly skilled in selecting stocks. Therefore the Omega ratio seems to be more or less an increasing function of the manager skill level. However, the time period between 2000 – 2002 (Bear) looks like an exception. Not only is the Omega value a decreasing function of manager skill, it also shows better performance for poor manager skill levels. Reason enough to dig deeper into this period of time. Figure 15 shows the returns of all the strategies between this bear market. The DAX was the worst performer with an annualized average return of -34%, while the most strategies generated around -20%. This implies that the larger companies were underperforming compared to the smaller to a considerably large extent. There exists also a high standard deviation between the different strategies.

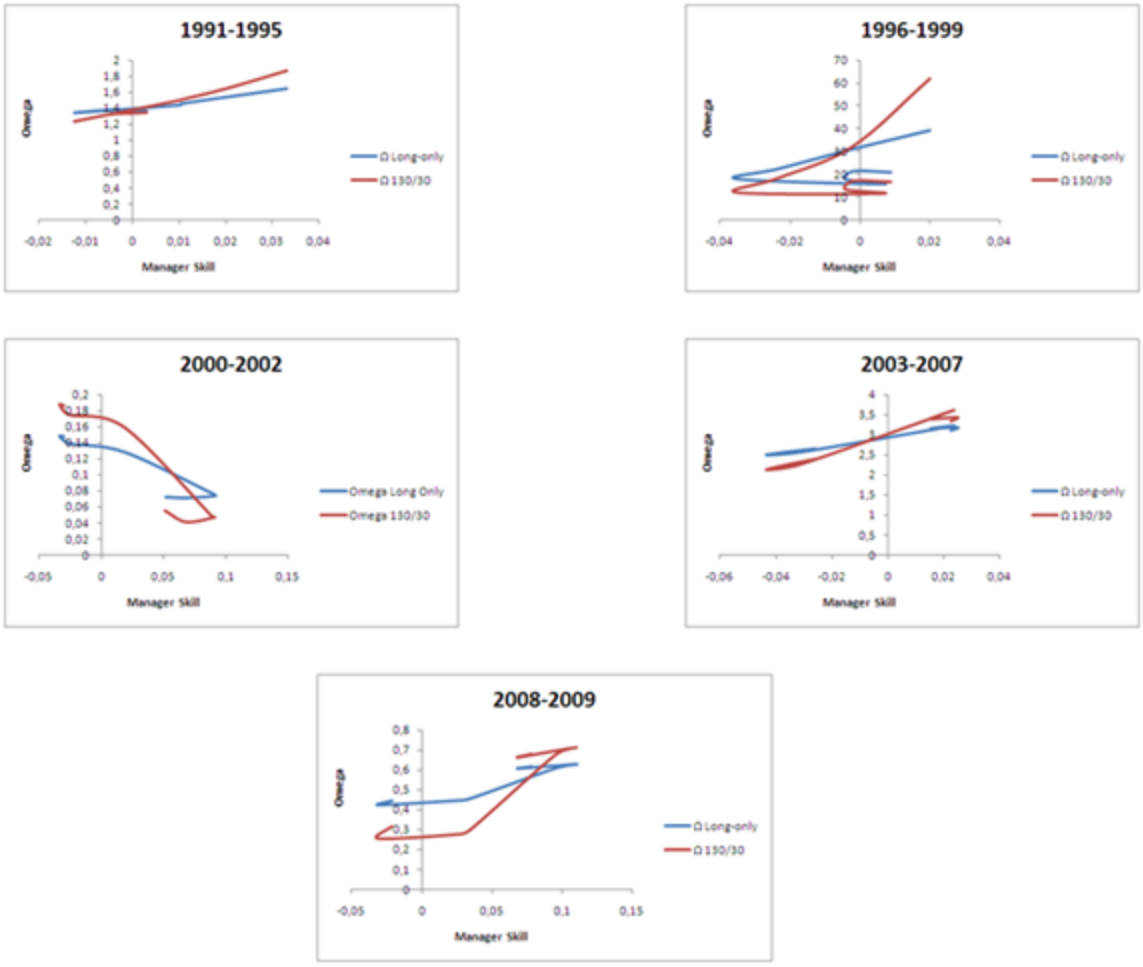

Figure 14 Omega Ratio for different manager skills

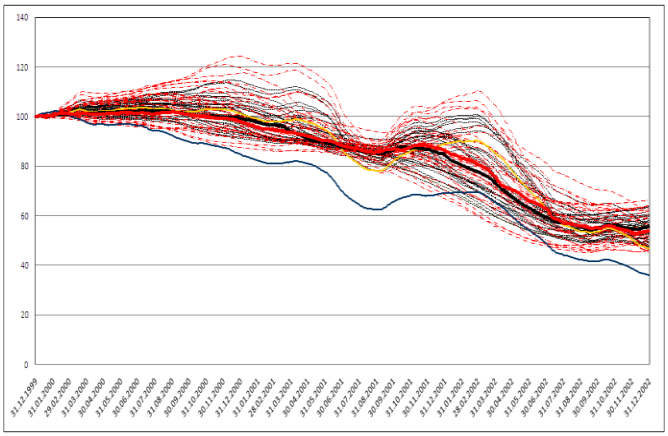

Figure 15 Bear 2000-2002 portfolio distributions

For the purpose of the contradicting behavior of the Omega values in 2000-2002, we investigate the case of the worst stock selecting manager during this time frame, the 9-6 contrarian manager. This strategy selected stocks that in average had an annualized return of -27.74% versus the managers short positions that generated -22.75%. The resulting 130/30 portfolio had an average annualized return of -30.01%. In terms of risk, the VaR of the 130/30 portfolio was with 96.47% significantly higher than the one of its long-only counterpart. However this lower return and higher risk resulted in a higher Omega value. At the first glance this seems opposing, but can be explained. Both mean returns are far from the threshold level of zero, so the probability to reach this threshold is close to impossible. In these circumstances more risk is preferable because it increases the probability of reaching the threshold level. This ambivalent phenomenon is already reflected in the Sharpe ratio. In the 9-6 contrarian case the 130/30 portfolio provides a Sharpe ratio of -0.83, while the long-only has a Sharpe ratio of -0.90. As in the Sharpe ratios the rule of thumb is that the larger is more preferable, the 130/30 should be the superior one. Nevertheless the interpretation of negative risk-adjusted return measures remains controversial. (Opdyke, 2007)

The advantage of the Omega ratio is that it is more flexible because the threshold level can be set according to the market condition.

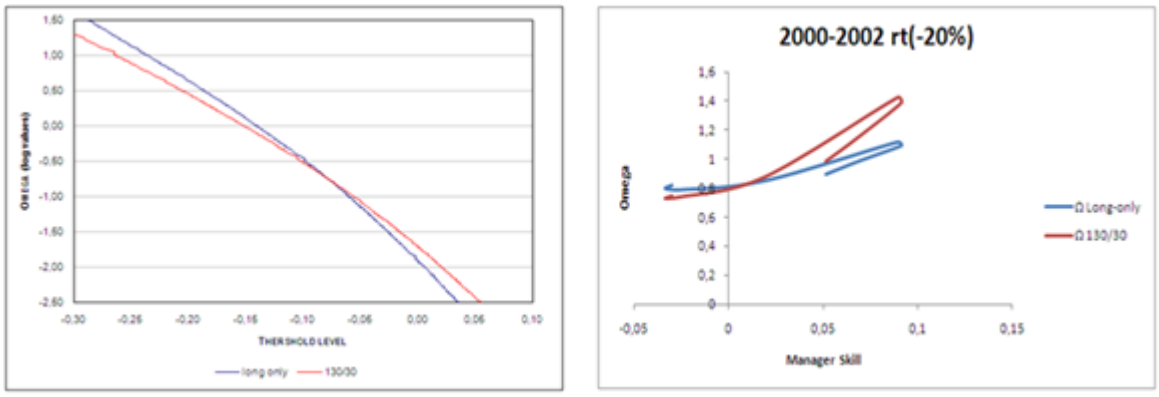

Figure 16 Omega and threshold levels 2000-2002, rt -20%

In Figure 16 we see the Omega value for the 9-6 contrarian strategy as a function of the threshold level for the period 2000-2002. We see that the long-only portfolio outperforms its 130/30 counterpart for threshold levels below -10% and vice versa. For the long-only to reach a (too) high threshold level is more unrealistic. This is comparable with a situation in the casino. If a gambler has his last 100 € to invest, and sets his threshold level to 250 €, the otherwise preferable "safer" bet for a roulette color is inferior vis-à-vis a bet for a single number. Even though the investor ends up in 36 out of 37 cases with 0 €, he has a probability to meet his threshold level, while this is not possible with betting on a single color. This shows that an adjustment of the threshold level in some cases is desirable. It is unrealistic to assume a threshold of zero in a bear market situation. A more appropriate threshold level is the average return of all the strategies, in our case approximately -20%. Figure 16 presents the relation between the Omega value and manager skills for a threshold level of -20%. By adjusting the threshold level, we show that the patterns of the 9-6 contrarian strategies can be "normalized". This leads to the conclusion that a threshold level of 0 is good in the long run, while some adjustments can be required in the short run.

Ω Values

		1991-1995	1996-1999	2002-2002(0)	2000-2002(-20%)	2003-2007	2008-2009			1991-1995	1996-1999	2002-2002(0)	2000-2002(-20%)	2003-2007	2008-2009
3-3Momentum	Long	1,033	3,642	0,159	10,155	3,707	0,272	3-3Contrarian	Long	1,176	2,849	0,273	5,372	3,506	0,429
	130/30	0,922	3,797	0,132	14,116	3,592	0,169		130/30	1,195	2,272	0,340	4,189	3,248	0,464
	Market-neutral	0,545	1,823	1,112	230,210	0,977	0,920		Market-neutral	1,224	0,517	1,361	349,431	1,132	1,599
3-6Momentum	Long	1,065	6,121	0,093	2,576	5,853	0,292	3-6Contrarian	Long	1,246	5,322	0,147	2,233	5,120	0,492
	130/30	0,964	5,789	0,090	2,777	6,058	0,163		130/30	1,310	4,380	0,195	2,121	4,648	0,562
	Market-neutral	0,553	1,431	1,349	826,526	1,231	0,437		Market-neutral	1,417	0,605	1,642	7498,276	0,786	3,268
3-9Momentum	Long	1,195	11,916	0,061	1,266	4,705	0,333	3-9Contrarian	Long	1,294	9,321	0,114	1,228	4,331	0,528
	130/30	1,157	10,759	0,062	1,319	4,694	0,198		130/30	1,356	6,789	0,150	1,243	4,009	0,610
	Market-neutral	0,911	1,582	1,539	59,059	1,072	0,525		Market-neutral	1,300	0,442	1,537	4048,901	0,731	5,600
3-12Momentum	Long	1,362	20,972	0,072	0,896	3,115	0,444	3-12Contrarian	Long	1,440	18,097	0,128	0,849	2,566	0,609
	130/30	1,350	16,547	0,055	0,984	3,338	0,317		130/30	1,508	11,894	0,160	0,873	2,278	0,676
	Market-neutral	1,123	1,230	1,929	30,061	1,700	0,832		Market-neutral	1,245	0,377	1,357	632,592	0,420	3,909
6-3Momentum	Long	1,080	3,548	0,182	13,661	4,134	0,229	6-3Contrarian	Long	1,285	3,012	0,266	5,404	3,306	0,504
	130/30	0,981	3,448	0,170	33,494	4,323	0,106		130/30	1,383	2,374	0,313	4,121	2,839	0,607
	Market-neutral	0,600	1,272	1,453	218,726	1,128	0,661		Market-neutral	1,729	0,579	1,041	167,044	0,574	3,292
6-6Momentum	Long	1,128	6,570	0,101	2,597	6,068	0,260	6-6Contrarian	Long	1,285	5,455	0,144	2,087	4,762	0,534
	130/30	1,045	6,508	0,105	2,808	6,396	0,103		130/30	1,348	4,449	0,175	1,862	4,025	0,643
	Market-neutral	0,668	1,266	1,568	663,767	1,137	0,415		Market-neutral	1,312	0,644	0,882	374,947	0,551	7,909
6-9Momentum	Long	1,225	12,256	0,061	1,441	4,895	0,319	6-9Contrarian	Long	1,293	10,192	0,121	1,104	4,008	0,526
	130/30	1,199	11,539	0,048	1,648	4,942	0,156		130/30	1,332	7,238	0,155	0,994	3,387	0,600
	Market-neutral	0,982	1,318	1,909	54,651	1,200	0,655		Market-neutral	1,115	0,411	0,795	81,737	0,387	5,394
6-12Momentum	Long	1,371	21,434	0,071	0,985	3,193	0,422	6-12Contrarian	Long	1,457	22,451	0,139	0,788	2,486	0,627
	130/30	1,341	17,003	0,041	1,149	3,436	0,256		130/30	1,511	18,236	0,175	0,736	2,131	0,712
	Market-neutral	0,992	0,951	2,094	29,147	1,784	0,780		Market-neutral	1,245	0,472	0,805	45,899	0,329	7,383
9-3Momentum	Long	1,131	3,712	0,209	12,753	4,177	0,233	9-3Contrarian	Long	1,285	3,291	0,274	5,329	3,475	0,467
	130/30	1,035	3,649	0,214	26,571	4,245	0,094		130/30	1,333	2,750	0,323	4,074	2,982	0,524
	Market-neutral	0,627	1,155	1,813	177,122	0,982	0,849		Market-neutral	1,465	0,641	0,979	1295,070	0,769	1,809
9-6Momentum	Long	1,143	6,423	0,112	3,356	5,562	0,274	9-6Contrarian	Long	1,237	5,744	0,149	1,940	4,726	0,497
	130/30	1,058	6,231	0,115	4,375	5,295	0,107		130/30	1,240	4,442	0,181	1,599	3,899	0,556
	Market-neutral	0,606	1,151	2,365	414,102	0,806	0,884		Market-neutral	1,100	0,527	0,717	83,739	0,576	2,819
9-9Momentum	Long	1,257	11,000	0,064	1,650	4,703	0,328	9-9Contrarian	Long	1,300	12,022	0,130	1,087	4,116	0,512
	130/30	1,240	9,519	0,049	2,153	4,587	0,155		130/30	1,324	9,975	0,172	0,945	3,525	0,568
	Market-neutral	1,004	1,086	2,328	78,568	0,863	1,086		Market-neutral	1,183	0,517	0,761	30,167	0,523	3,614
9-12Momentum	Long	1,378	17,993	0,073	1,097	3,164	0,445	9-12Contrarian	Long	1,541	30,906	0,148	0,796	2,554	0,607
	130/30	1,328	13,281	0,047	1,394	3,401	0,277		130/30	1,653	31,979	0,188	0,726	2,239	0,663
	Market-neutral	0,841	0,896	2,368	33,098	1,447	1,184		Market-neutral	2,001	0,707	0,806	14,442	0,382	4,179
12-3Momentum	Long	1,147	3,467	0,228	18,257	3,884	0,243	12-3Contrarian	Long	1,268	3,344	0,276	5,291	3,386	0,438
	130/30	1,066	3,265	0,246	74,698	3,796	0,106		130/30	1,305	2,802	0,324	3,910	2,962	0,469
	Market-neutral	0,649	1,077	2,044	179,814	0,975	1,216		Market-neutral	1,392	0,613	0,929	125,704	0,805	1,186
12-6Momentum	Long	1,148	5,896	0,119	3,761	5,522	0,281	12-6Contrarian	Long	1,319	6,160	0,155	1,945	4,903	0,486
	130/30	1,062	5,303	0,128	5,583	5,188	0,108		130/30	1,400	5,045	0,197	1,575	4,199	0,533
	Market-neutral	0,590	1,060	2,369	602,607	0,720	1,072		Market-neutral	1,901	0,583	0,760	51,821	0,732	2,514
12-9Momentum	Long	1,203	9,921	0,068	1,737	4,852	0,342	12-9Contrarian	Long	1,417	13,999	0,135	1,122	4,165	0,517
	130/30	1,124	7,978	0,059	2,351	4,890	0,176		130/30	1,554	13,549	0,183	0,974	3,632	0,577
	Market-neutral	0,628	1,133	2,307	82,776	0,895	1,289		Market-neutral	2,722	0,667	0,829	18,257	0,605	4,242
12-12Momentum	Long	1,341	15,888	0,076	1,122	3,228	0,455	12-12Contrarian	Long	1,650	39,046	0,148	0,820	2,650	0,616
	130/30	1,244	11,438	0,048	1,430	3,593	0,299		130/30	1,875	62,070	0,187	0,744	2,401	0,679
	Market-neutral	0,611	1,164	2,264	37,959	1,796	1,279		Market-neutral	4,176	1,187	0,831	12,285	0,446	4,496

Table 10 Summary of Omega values for different time frames

In Table 10, we present the Omega values of all actively managed portfolios for the different time frames. For the time period between 2000 and 2002, we applied two different Omega threshold levels. We can see that the 130/30 performed relatively weak when the markets were going up. In 1996-1999 for example, 3 out of 32 generated higher Omegas than the long-only equivalents. On the contrary, during the recent market turmoil 16 130/30 portfolios outperformed the long-only. We can therefore conclude that during the bull markets, the active extension is more of a burden while in bear markets it can act partly as a hedge. Nevertheless the level of hedging is not comparable with the one of a market neutral long short portfolio. These funds generate their absolute highest Omega values in bear markets, while 130/30 generate only relatively higher Omega values. In absolute terms the Omega values for 130/30 are higher in bull markets than in bear markets.

6.5 Summary of the results

In Chapter 4 we presented the underlying hypotheses for that we tested analyzed in Chapter 5. Now we summarize the main findings.

The first hypothesis stated that the "Green" zone managers can exploit the active-extension strategies by generating higher Omega values for the 130/30 portfolios than the long-only by utilizing informational advantage. The Omega values for the whole sample period January 1991 – April 2009, were higher than the long-only, when the manager was successful in the stock selection process. Hence seven out of total eight portfolio selection strategies showed that the 130/30 provides superior Omega values compared to its counterparts. The Omega based ranking provides similar results as the Sharpe ratio. The reward-to-VaR gives the same results when it comes to the best performers but rankings of the other strategies diverge slightly. We can therefore conclude that Hypothesis 1 is confirmed.

Hypothesis 2 requires that managers possessing insignificant stock selection skills (yellow) do not lower their Ω value by the introduction of the active extension relative to the long-only. As in our analysis not a single case provided proof for this, in contrary the performance was weaker as none resulted in a superior Sharpe ratio, reward-to-VaR or Omega value. Hence we conclude that in the "Yellow" zone the investor is always better off choosing the long only option instead of the 130/30 and therefore reject Hypothesis 2.

Hypothesis 3 requires that managers who have poor stock selection skills can profit from a hedging effect when introducing the active extension. Therefore the negative implication in terms of Ω values should be limited. All of the four "Red" zone 130/30 portfolios imply a higher standard deviation as well as a higher VaR than the long-only and the equally weighted alternatives. This higher risk levels combined with relatively worse performance make the 130/30 the least attractive option in this category. Hypothesis 3 is therefore rejected.

For Hypothesis 4 we expected that different threshold levels lead to optimal decisions regarding the choice of the portfolio. The extreme case in favor of this hypothesis was presented in 6.4, where we considered the bear market in 2000-2002. With the threshold level of 0 the 130/30 was often preferred, while a more realistic threshold of -20% was in favor of the long-only. Therefore we can confirm Hypothesis 4.

Hypothesis 5 required the risk-return characteristics of the 130/30 portfolios to be similar to the long-only rather than to the market neutral. Comparing the CDFs we can observe that the 130/30 follows similar patterns as its long-only counterpart. Furthermore the 130/30 are, like the long only funds, negatively skewed. On the other hand the market neutral portfolios are mostly positive skewed and have fat tails. The market neutral long only funds provide high Omega values in bear markets due to its hedging effect. Due to these differences in risk-return characteristics, we conclude that the expression "hedge fund light" is invalid, and the risk return characteristics are similar to the one of a long-only fund. We can hence confirm Hypothesis 5.

As we set criteria on the validity and reliability of the research in the end of Chapter 4, we now want to refer back to them. The testing-retesting process was of great importance to get as reliable and objective results as possible. We used an intuitive momentum /contrarian model that are well established by academics and practitioners. This mitigated the possible effect of data snooping biases tempted by searching through the entire space of trading rules for the performing strategies. No attempt of tampering the results was made. The validity of the results and analysis is in line with the hypothesis and methodology as proven.

7. Conclusions

In this thesis we studied the performance of active extension portfolios constructed by using momentum/contrarian strategies. As a benchmark for our empirical part, we applied the German DAX 30 market index. Fundamentally, the difference between the 130/30 and the long-only asset classes is the relaxation from the long-only constraint. The main implication of this study is to find out whether the 130/30 strategy is value adding, in comparison to other actively managed asset classes. We also examined the consequences of the fund managers stock selecting skills. The prudency of these strategies was measured using the "superior" performance measure, Omega ratio, as the main risk-adjusted performance measure. Furthermore, we measured the performance also using the Sharpe ratio and the reward-to-VaR. To test the for the robustness of our study, we divided the whole sample (Jan 1991- Apr 2009) into five different time frames to find out the behavior of the different strategies covered in this thesis in bull and bear markets.

Overall, the active extension portfolios that were simulated underperformed in relation to the equivalent long-only portfolios but outperformed the benchmark index DAX for the sample period. The outperformance over the DAX is through a size bias rather than good stock selecting skill. We found out, that there is no superior stock selecting strategy that fits into all time frames and market situations. Therefore it is fairly challenging to determine the manager skills ex-ante. One of the key findings is that 130/30 funds are more exposed to the manager skill. Only 7 out of 32 strategies were able to implement the relaxation from the long-only constraint effectively and generate higher Omega values when considering the entire sample period. Another interesting finding was that the 130/30 performed relatively poor in bull markets. For example in 1996-1999, only 3 out of 32 generated higher Omegas than the long-only counterpart. In contrast, during the recent crisis 16 130/30 portfolios outperformed the long-only counterparts. We can therefore conclude that during the bull markets, the active extension is rather a burden while in bear markets it can act partly as a hedge. Nevertheless the level of hedging is not comparable with the one of a market neutral long short portfolio. These funds generate

their absolute highest Omega values in bear markets, while 130/30 generate only relatively higher Omega values. In absolute terms the Omega values for 130/30 are higher in a bull markets than in a bear markets.

As discussed in the literature review of this paper, previous literature has shown that the active extension strategies are in most cases value adding. However we cannot support this on the basis of our empirical results. Overall, the shorting option hardly increases the value of portfolio from the long only. The divergence between the study conducted in this thesis and previous studies are due to several different reasons. First of all, the investment universe in our study is relatively small and well diversified. Studies using a broader investment universe (such as the MSCI World or Russell 1000) have more possibilities to under- or overweight smaller companies when it comes short selling. Secondly previous studies have already used an optimized portfolio strategy and implemented then the active extension ex-post. Our approach is based on the assumption that it is impossible to determine the optimal stock selecting strategy ex-ante. Thirdly, the benchmark index used in this study (DAX) performed worse than the equally weighted portfolio. This implies that the large companies performed in average worse than the smaller ones. The 130/30 seems to be more beneficial if the small companies in average perform worse than the larger companies. This is because with the short selling part, we can undervalue small companies to a much further extent (even to a negative extent).

The results of this study suggest to a potential investor to choose the long only alternative as long as the fund managers stock selecting skills are unknown. Even if known, taking the higher management fee and performance fee into consideration, the benefits seem to be marginal or nonexistent. Therefore we conclude that the active extension is not value adding for the investor. Our findings lead to an assumption, that the hype in 130/30 funds is more driven by an extensive marketing vehicle than by its intrinsic capability of generating higher returns.

Further studies could be done by applying the same methods to different investment universes. This would lead to a more robust analysis of the risk-adjusted performance of

130/30 funds. Further research could also use other stock selecting strategies, than momentum and contrarian strategies. An interesting investigation would be if there is any relationship between size biased performance and the success of active extension.

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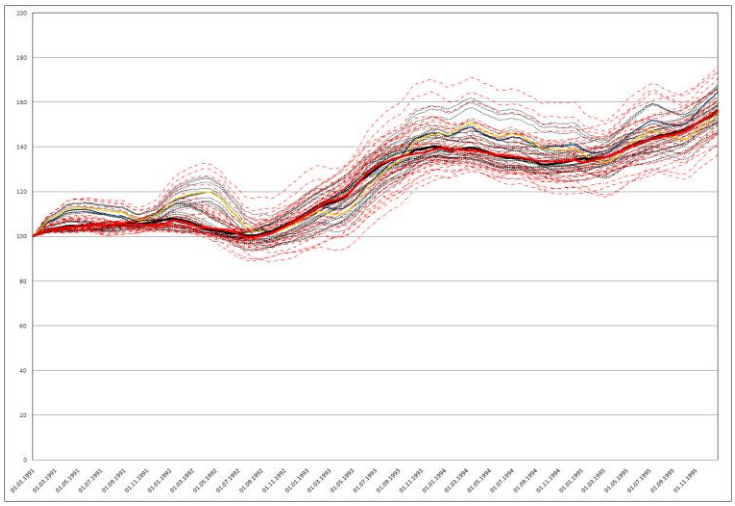
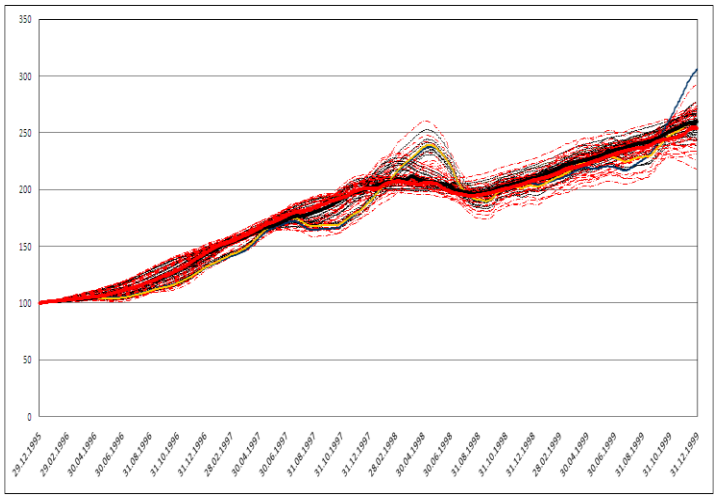
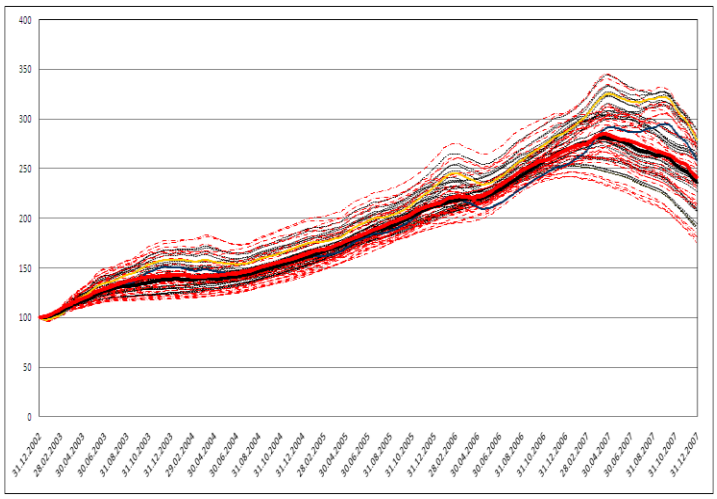
Appendix



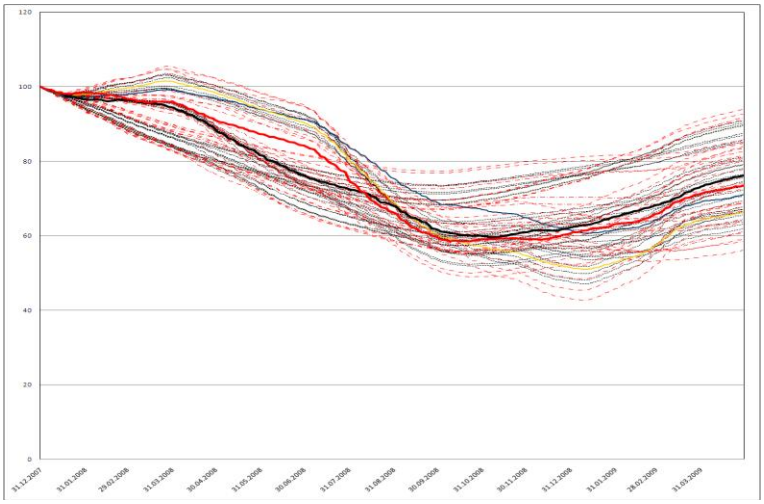
Appendix A. Return distribution1991-1995



Appendix B. Return distribution1996-1999



Appendix C. Return distribution 2003-2007



Appendix D. Return distribution 2008-2009

	3-3Momentum				3-6Momentum				3-9Momentum				3-12Momentum			
	Long	Short	130/30	market-neutral	Long	Short	130/30	market-neutral	Long	Short	130/30	market-neutral	Long	Short	130/30	market-neutral
Annualized Excess Return	0.375%	4.257%	-0.940%	-3.882%	0.538%	2.994%	-0.317%	-2.456%	1.211%	1.507%	1.025%	-0.297%	1.849%	1.540%	1.854%	0.309%
Annualized Standard Deviation	14.584%	17.444%	14.603%	8.544%	15.042%	15.235%	15.723%	7.510%	14.247%	14.321%	14.871%	7.041%	14.279%	14.345%	14.847%	6.731%
Sample Skewness	-0.371	-0.070	-0.411	0.561	-0.408	0.075	-0.527	0.175	0.128	0.172	0.141	0.350	0.088	0.477	0.001	0.250
Sample Kurtosis	0.165	0.036	0.221	2.087	-0.064	-0.296	0.111	0.478	-0.769	-0.188	-0.636	0.360	-1.000	-0.193	-0.893	0.097
Sharpe ratio	0.026	0.244	-0.064	-0.454	0.036	0.197	-0.020	-0.327	0.085	0.105	0.069	-0.042	0.129	0.107	0.125	0.046
CF VaR	25.064%	24.772%	26.554%	16.171%	25.919%	21.834%	28.416%	14.361%	21.926%	21.398%	23.029%	11.114%	21.570%	20.111%	22.831%	10.265%
Reward to VaR	0.015	0.172	-0.035	-0.240	0.021	0.137	-0.011	-0.171	0.055	0.070	0.045	-0.027	0.086	0.077	0.081	0.030
Omega	1.033	1.354	0.922	0.545	1.065	1.409	0.964	0.553	1.195	1.255	1.157	0.911	1.362	1.309	1.350	1.123

	6-3Momentum				6-6Momentum				6-9Momentum				6-12Momentum			
	Long	Short	130/30	market-neutral	Long	Short	130/30	market-neutral	Long	Short	130/30	market-neutral	Long	Short	130/30	market-neutral
Annualized Excess Return	0.933%	4.308%	-0.233%	-3.375%	1.030%	2.763%	0.388%	-1.733%	1.373%	1.430%	1.262%	-0.058%	1.855%	1.878%	1.754%	-0.023%
Annualized Standard Deviation	15.147%	16.551%	15.670%	8.661%	15.087%	15.505%	15.736%	7.734%	14.036%	14.718%	14.480%	6.936%	13.994%	14.976%	14.337%	6.951%
Sample Skewness	-0.446	0.153	-0.565	-0.005	-0.290	-0.143	-0.313	-0.039	0.170	0.021	0.206	0.215	0.107	0.469	0.029	0.054
Sample Kurtosis	0.214	0.059	0.388	0.944	-0.083	-0.092	0.147	0.188	-0.776	-0.363	-0.628	0.027	-0.974	-0.548	-0.842	-0.431
Sharpe ratio	0.062	0.260	-0.015	-0.390	0.068	0.178	0.025	-0.224	0.098	0.097	0.087	-0.008	0.133	0.125	0.122	-0.003
CF VaR	25.779%	22.176%	28.306%	17.472%	25.031%	23.394%	26.821%	14.512%	21.253%	22.802%	21.883%	11.035%	21.013%	20.871%	21.955%	11.410%
Reward to VaR	0.036	0.194	-0.008	-0.193	0.041	0.118	0.014	-0.119	0.065	0.063	0.058	-0.005	0.088	0.090	0.080	-0.002
Omega	1.080	1.379	0.981	0.600	1.128	1.367	1.045	0.668	1.225	1.234	1.199	0.982	1.371	1.361	1.341	0.992

	9-3Momentum				9-6Momentum				9-9Momentum				9-12Momentum			
	Long	Short	130/30	market-neutral	Long	Short	130/30	market-neutral	Long	Short	130/30	market-neutral	Long	Short	130/30	market-neutral
Annualized Excess Return	1.471%	4.537%	0.411%	-3.065%	1.106%	2.940%	0.467%	-1.833%	1.504%	1.493%	1.419%	0.011%	1.850%	2.309%	1.620%	-0.459%
Annualized Standard Deviation	14.804%	17.281%	14.902%	8.353%	14.639%	15.948%	14.803%	6.594%	13.651%	15.421%	13.704%	6.748%	13.694%	15.626%	13.693%	6.794%
Sample Skewness	-0.341	-0.071	-0.350	0.482	-0.246	-0.228	-0.204	0.147	0.108	0.251	0.136	0.160	0.113	0.488	0.058	-0.059
Sample Kurtosis	0.076	0.145	0.097	0.922	-0.167	-0.004	-0.070	0.893	-0.775	-0.420	-0.623	0.079	-0.998	-0.599	-0.821	0.281
Sharpe ratio	0.099	0.263	0.028	-0.367	0.076	0.184	0.032	-0.278	0.110	0.097	0.104	0.002	0.135	0.148	0.118	-0.068
CF VaR	24.261%	24.188%	25.522%	15.489%	24.037%	24.311%	24.748%	12.311%	20.742%	22.887%	20.763%	10.770%	20.510%	21.352%	20.930%	11.710%
Reward to VaR	0.061	0.188	0.016	-0.198	0.046	0.121	0.019	-0.149	0.073	0.065	0.068	0.001	0.090	0.108	0.077	-0.039
Omega	1.131	1.388	1.035	0.627	1.143	1.379	1.058	0.606	1.257	1.232	1.240	1.004	1.378	1.448	1.328	0.841

	12-3Momentum				12-6Momentum				12-9Momentum				12-12Momentum			
	Long	Short	130/30	market-neutral	Long	Short	130/30	market-neutral	Long	Short	130/30	market-neutral	Long	Short	130/30	market-neutral
Annualized Excess Return	1.597%	4.097%	0.733%	-2.500%	1.142%	2.991%	0.501%	-1.849%	1.199%	2.454%	0.748%	-1.254%	1.685%	2.882%	1.243%	-1.197%
Annualized Standard Deviation	14.378%	17.145%	14.209%	7.525%	14.513%	15.846%	14.637%	6.464%	13.371%	15.686%	13.121%	6.055%	13.561%	15.714%	13.408%	6.347%
Sample Skewness	-0.342	0.033	-0.338	0.205	-0.299	-0.032	-0.293	0.300	0.011	0.401	-0.072	-0.065	0.077	0.492	-0.030	0.166
Sample Kurtosis	-0.011	0.184	-0.006	0.598	-0.272	0.015	-0.188	1.112	-0.824	-0.576	-0.799	1.552	-1.007	-0.712	-0.952	0.797
Sharpe ratio	0.111	0.239	0.052	-0.332	0.079	0.189	0.034	-0.286	0.090	0.156	0.057	-0.207	0.124	0.183	0.093	-0.189
CF VaR	23.421%	23.882%	23.974%	14.346%	24.020%	23.216%	24.826%	11.778%	20.976%	21.700%	21.315%	11.138%	20.598%	20.927%	21.184%	11.234%
Reward to VaR	0.068	0.172	0.031	-0.174	0.048	0.129	0.020	-0.157	0.057	0.113	0.035	-0.113	0.092	0.138	0.059	-0.107
Omega	1.147	1.349	1.066	0.649	1.148	1.406	1.062	0.590	1.203	1.399	1.124	0.628	1.341	1.566	1.244	0.611

	3-3contrarian				3-6contrarian				3-9contrarian				3-12contrarian			
	Long	Short	130/30	market-neutral	Long	Short	130/30	market-neutral	Long	Short	130/30	market-neutral	Long	Short	130/30	market-neutral
Annualized Excess Return	2.028%	0.419%	2.371%	1.328%	1.934%	-0.022%	2.282%	1.450%	1.886%	0.409%	1.979%	0.865%	2.066%	1.026%	2.288%	0.639%
Annualized Standard Deviation	15.574%	15.268%	16.508%	8.903%	14.596%	16.194%	14.833%	7.756%	13.723%	15.378%	13.830%	7.585%	13.804%	15.405%	13.926%	7.768%
Sample Skewness	-0.119	-0.417	0.036	-0.086	-0.052	-0.593	0.130	-0.430	0.230	0.010	0.337	-0.903	0.372	-0.065	0.534	-0.599
Sample Kurtosis	-0.019	0.220	-0.113	1.574	-0.341	0.259	-0.356	1.470	-0.681	-0.555	-0.488	2.999	-0.733	-0.864	-0.414	1.874
Sharpe ratio	0.130	0.027	0.144	0.151	0.126	-0.001	0.154	0.187	0.123	0.027	0.143	0.114	0.150	0.067	0.164	0.082
CF VaR	24.119%	26.386%	24.655%	13.088%	22.491%	29.174%	21.675%	12.000%	20.170%	25.017%	19.557%	12.984%	19.352%	24.865%	18.553%	13.113%
Reward to VaR	0.084	0.016	0.096	0.101	0.082	-0.001	0.105	0.121	0.084	0.016	0.101	0.067	0.107	0.041	0.123	0.049
Omega	1.176	1.035	1.195	1.224	1.246	0.998	1.310	1.417	1.294	1.058	1.356	1.300	1.440	1.175	1.508	1.245

	6-3contrarian				6-6contrarian				6-9contrarian				6-12contrarian			
	Long	Short	130/30	market-neutral	Long	Short	130/30	market-neutral	Long	Short	130/30	market-neutral	Long	Short	130/30	market-neutral
Annualized Excess Return	3.095%	-0.705%	4.101%	3.397%	2.100%	0.250%	2.528%	1.262%	1.655%	0.767%	1.824%	0.374%	2.173%	1.132%	2.390%	0.664%
Annualized Standard Deviation	15.155%	16.372%	15.615%	8.189%	14.510%	16.849%	14.621%	8.431%	13.627%	15.616%	13.682%	7.823%	13.844%	15.337%	14.050%	7.890%
Sample Skewness	-0.122	-0.527	0.006	0.103	-0.198	-0.319	-0.136	-0.447	0.094	0.182	0.075	-0.635	0.335	-0.030	0.430	-0.680
Sample Kurtosis	-0.120	0.545	-0.172	1.278	-0.336	0.166	-0.351	1.038	-0.684	-0.575	-0.486	1.101	-0.956	-0.650	-0.851	1.288
Sharpe ratio	0.204	-0.043	0.263	0.415	0.145	0.015	0.173	0.150	0.121	0.049	0.133	0.048	0.157	0.074	0.170	0.084
CF VaR	22.391%	29.820%	21.613%	9.624%	22.673%	28.901%	22.187%	13.469%	20.583%	24.287%	20.528%	13.673%	19.524%	24.429%	19.200%	13.568%
Reward to VaR	0.138	-0.024	0.190	0.353	0.093	0.009	0.114	0.094	0.080	0.032	0.089	0.027	0.111	0.046	0.124	0.049
Omega	1.285	0.947	1.383	1.729	1.285	1.027	1.348	1.312	1.293	1.108	1.332	1.115	1.457	1.198	1.511	1.245

	9-3contrarian				9-6contrarian				9-9contrarian				9-12contrarian			
	Long	Short	130/30	market-neutral	Long	Short	130/30	market-neutral	Long	Short	130/30	market-neutral	Long	Short	130/30	market-neutral
Annualized Excess Return	3.166%	0.614%	3.808%	2.345%	1.837%	1.227%	1.927%	0.395%	1.735%	0.966%	1.883%	0.539%	2.588%	0.570%	3.096%	2.102%
Annualized Standard Deviation	15.619%	15.331%	16.435%	8.222%	15.083%	15.032%	15.686%	7.551%	14.101%	14.354%	14.574%	7.481%	14.811%	13.574%	15.468%	7.978%
Sample Skewness	-0.188	-0.277	-0.092	-0.288	-0.279	-0.063	-0.255	-0.489	0.195	0.088	0.276	-0.942	0.386	-0.152	0.516	-0.254
Sample Kurtosis	0.114	-0.052	0.121	0.940	-0.183	-0.177	-0.152	0.944	-0.643	-0.646	-0.486	2.067	-0.858	-0.883	-0.729	0.787
Sharpe ratio	0.203	0.040	0.232	0.285	0.122	0.082	0.123	0.051	0.123	0.067	0.129	0.072	0.177	0.042	0.200	0.263
CF VaR	23.315%	25.803%	23.616%	11.685%	24.202%	23.823%	25.039%	12.909%	20.853%	22.473%	21.069%	13.293%	20.058%	22.582%	20.235%	11.462%
Reward to VaR	0.136	0.024	0.161	0.201	0.076	0.052	0.077	0.030	0.083	0.043	0.089	0.041	0.129	0.025	0.153	0.183
Omega	1.285	1.051	1.333	1.465	1.237	1.155	1.240	1.100	1.300	1.151	1.324	1.183	1.541	1.106	1.653	2.001

	12-3contrarian				12-6contrarian				12-9contrarian				12-12contrarian			
	Long	Short	130/30	market-neutral	Long	Short	130/30	market-neutral	Long	Short	130/30	market-neutral	Long	Short	130/30	market-neutral
Annualized Excess Return	2.988%	0.918%	3.480%	2.004%	2.362%	0.177%	2.953%	2.168%	2.360%	-0.249%	3.075%	2.771%	3.030%	-0.281%	3.932%	3.622%
Annualized Standard Deviation	15.566%	14.439%	16.499%	7.511%	14.929%	14.716%	15.394%	5.892%	14.387%	13.295%	15.071%	6.110%	14.676%	13.098%	15.539%	6.972%
Sample Skewness	-0.204	-0.265	-0.140	-0.041	-0.200	-0.371	-0.153	-0.213	0.274	-0.219	0.393	0.345	0.405	-0.344	0.544	0.695
Sample Kurtosis	0.282	-0.249	0.513	-0.042	-0.242	0.052	-0.197	-0.207	-0.713	-0.762	-0.618	-0.047	-0.855	-0.641	-0.676	0.723
Sharpe ratio	0.191	0.064	0.211	0.267	0.158	0.012	0.192	0.368	0.164	-0.019	0.204	0.454	0.206	-0.021	0.253	0.519
CF VaR	23.439%	23.973%	24.143%	10.446%	23.104%	25.526%	23.092%	7.900%	20.375%	23.135%	20.180%	6.674%	19.633%	23.246%	19.356%	6.308%
Reward to VaR	0.127	0.038	0.144	0.192	0.102	0.007	0.128	0.274	0.116	-0.011	0.152	0.415	0.154	-0.012	0.203	0.574
Omega	1.268	1.082	1.305	1.392	1.319	1.022	1.400	1.901	1.417	0.962	1.554	2.722	1.650	0.949	1.875	4.176

Appendix E. Descriptive statistics 1991-1995

	3-3Momentum				3-6Momentum				3-9Momentum				3-12Momentum			
	Long	Short	130/30	market-neutral	Long	Short	130/30	market-neutral	Long	Short	130/30	market-neutral	Long	Short	130/30	market-neutral
Annualized Excess Return	22.026%	16.039%	23.445%	5.990%	20.999%	18.509%	21.400%	2.491%	21.110%	18.753%	21.543%	2.358%	20.126%	19.253%	20.167%	0.873%
Annualized Standard Deviation	21.071%	24.450%	21.652%	14.016%	19.194%	22.193%	19.971%	13.553%	16.680%	19.053%	17.526%	11.911%	15.982%	16.871%	17.077%	10.725%
Sample Skewness	-1.430	-0.497	-1.341	0.966	-0.641	0.086	-0.711	0.762	-0.534	0.057	-0.652	0.393	-0.249	-0.028	-0.307	0.309
Sample Kurtosis	3.131	0.983	2.910	2.102	0.187	-0.178	0.273	1.655	0.222	-0.387	0.284	1.358	-0.558	-0.741	-0.554	0.444
Sharpe ratio	1.045	0.656	1.083	0.427	1.094	0.834	1.072	0.184	1.266	0.984	1.229	0.198	1.259	1.141	1.181	0.081
CF VaR	19.049%	27.034%	18.415%	12.397%	13.838%	17.533%	15.183%	16.283%	8.690%	12.431%	10.290%	15.552%	7.453%	8.887%	9.572%	15.715%
Reward to VaR	1.156	0.593	1.273	0.483	1.517	1.056	1.409	0.153	2.429	1.509	2.094	0.152	2.700	2.167	2.107	0.056
Omega	3.642	2.328	3.797	1.823	6.121	4.751	5.789	1.431	11.918	8.826	10.759	1.582	20.972	19.159	16.547	1.230

	6-3Momentum				6-6Momentum				6-9Momentum				6-12Momentum			
	Long	Short	130/30	market-neutral	Long	Short	130/30	market-neutral	Long	Short	130/30	market-neutral	Long	Short	130/30	market-neutral
Annualized Excess Return	21.497%	18.793%	21.815%	2.704%	21.329%	19.721%	21.509%	1.608%	21.012%	19.654%	21.203%	1.357%	20.087%	20.279%	19.854%	-0.191%
Annualized Standard Deviation	21.359%	24.726%	22.473%	16.456%	18.898%	22.889%	18.853%	12.598%	16.846%	18.056%	17.723%	10.590%	16.047%	16.398%	17.004%	9.435%
Sample Skewness	-1.346	-0.560	-1.111	1.685	-0.608	0.003	-0.624	0.581	-0.362	-0.274	-0.310	0.261	-0.170	-0.094	-0.153	-0.008
Sample Kurtosis	2.873	0.821	2.440	3.942	0.084	-0.149	-0.053	0.716	0.026	-0.356	-0.139	0.127	-0.564	-0.799	-0.525	-0.071
Sharpe ratio	1.006	0.760	0.971	0.164	1.141	0.862	1.141	0.128	1.247	1.089	1.196	0.128	1.252	1.237	1.168	-0.020
CF VaR	19.933%	25.253%	20.816%	14.446%	12.492%	17.981%	12.722%	16.782%	8.376%	11.553%	9.529%	15.341%	7.258%	7.398%	9.025%	15.747%
Reward to VaR	1.084	0.744	1.058	0.187	1.707	1.097	1.691	0.096	2.508	1.701	2.225	0.089	2.767	2.742	2.200	-0.012
Omega	3.548	2.600	3.448	1.272	6.570	4.802	6.508	1.266	12.256	9.637	11.539	1.318	21.434	23.791	17.003	0.951

	9-3Momentum				9-6Momentum				9-9Momentum				9-12Momentum			
	Long	Short	130/30	market-neutral	Long	Short	130/30	market-neutral	Long	Short	130/30	market-neutral	Long	Short	130/30	market-neutral
Annualized Excess Return	22.065%	20.408%	22.103%	1.656%	21.199%	20.289%	21.214%	0.910%	20.933%	20.567%	20.861%	0.366%	20.254%	20.686%	19.939%	-0.432%
Annualized Standard Deviation	20.754%	25.792%	21.188%	15.622%	19.064%	21.282%	19.679%	11.663%	17.344%	18.613%	18.576%	9.736%	16.688%	15.186%	18.174%	9.624%
Sample Skewness	-1.360	-0.591	-1.131	0.967	-0.531	-0.238	-0.467	0.592	-0.369	-0.364	-0.326	0.346	-0.197	-0.081	-0.207	-0.135
Sample Kurtosis	2.904	1.081	2.415	2.103	0.003	0.054	-0.250	0.762	-0.162	0.250	-0.372	0.273	-0.597	-0.571	-0.576	-0.446
Sharpe ratio	1.063	0.791	1.043	0.106	1.112	0.953	1.078	0.078	1.207	1.238	1.123	0.038	1.214	1.362	1.097	-0.045
CF VaR	18.155%	25.615%	18.012%	18.830%	12.929%	16.113%	13.784%	16.064%	9.427%	8.353%	11.518%	14.621%	8.319%	4.817%	11.219%	16.715%
Reward to VaR	1.215	0.797	1.227	0.088	1.640	1.259	1.539	0.057	2.221	2.462	1.811	0.025	2.435	4.295	1.777	-0.026
Omega	3.712	2.789	3.649	1.155	6.423	5.429	6.231	1.151	11.000	13.225	9.519	1.086	17.993	35.748	13.281	0.896

	12-3Momentum				12-6Momentum				12-9Momentum				12-12Momentum			
	Long	Short	130/30	market-neutral	Long	Short	130/30	market-neutral	Long	Short	130/30	market-neutral	Long	Short	130/30	market-neutral
Annualized Excess Return	21.185%	20.419%	21.071%	0.766%	20.992%	20.624%	20.845%	0.368%	21.082%	20.440%	21.033%	0.642%	20.568%	19.946%	20.551%	0.623%
Annualized Standard Deviation	21.269%	22.832%	22.335%	13.558%	19.612%	19.897%	20.785%	11.681%	18.030%	15.520%	20.034%	11.099%	17.095%	14.563%	18.955%	10.175%
Sample Skewness	-1.435	-0.618	-1.318	1.192	-0.716	0.124	-0.782	0.855	-0.615	0.155	-0.747	-0.045	-0.361	0.234	-0.497	-0.175
Sample Kurtosis	3.330	1.070	3.036	1.868	0.354	-0.118	0.435	1.367	0.373	-0.321	0.625	-0.123	-0.328	-0.874	-0.015	-0.090
Sharpe ratio	0.996	0.894	0.943	0.057	1.070	1.037	1.003	0.032	1.169	1.317	1.050	0.058	1.203	1.370	1.084	0.061
CF VaR	20.219%	20.491%	21.931%	16.089%	14.922%	11.452%	17.539%	15.539%	11.460%	4.501%	15.706%	17.783%	9.374%	3.288%	13.217%	16.633%
Reward to VaR	1.048	0.996	0.961	0.048	1.407	1.801	1.189	0.024	1.840	4.541	1.339	0.036	2.194	6.066	1.555	0.037
Omega	3.487	3.181	3.265	1.077	5.896	6.665	5.303	1.060	9.921	20.669	7.978	1.133	15.888	73.307	11.438	1.164

	3-3contrarian				3-6contrarian				3-9contrarian				3-12contrarian			
	Long	Short	130/30	market-neutral	Long	Short	130/30	market-neutral	Long	Short	130/30	market-neutral	Long	Short	130/30	market-neutral
Annualized Excess Return	18.358%	24.431%	16.066%	-7.746%	19.435%	22.158%	18.350%	-3.582%	19.206%	23.058%	17.742%	-5.463%	18.777%	22.304%	17.424%	-5.901%
Annualized Standard Deviation	22.605%	21.329%	24.869%	17.623%	20.408%	18.349%	22.201%	13.728%	17.974%	15.893%	20.087%	15.270%	16.369%	16.271%	17.977%	16.340%
Sample Skewness	-1.060	-1.002	-0.832	-1.807	-0.343	-0.462	-0.256	-0.845	-0.248	-0.378	-0.188	-0.572	-0.104	-0.130	-0.069	-0.801
Sample Kurtosis	2.348	2.005	1.585	7.242	0.019	-0.068	-0.183	1.764	-0.012	-0.281	-0.187	0.543	-0.741	-0.377	-0.845	1.430
Sharpe ratio	0.812	1.145	0.646	-0.440	0.952	1.208	0.827	-0.261	1.069	1.451	0.884	-0.358	1.147	1.371	0.969	-0.361
CF VaR	24.080%	15.455%	29.597%	42.130%	16.070%	10.381%	19.841%	28.784%	11.610%	4.835%	16.384%	32.800%	8.876%	5.182%	12.803%	35.827%
Reward to VaR	0.762	1.581	0.543	-0.184	1.209	2.135	0.925	-0.124	1.654	4.769	1.083	-0.167	2.115	4.304	1.361	-0.165
Omega	2.849	4.138	2.272	0.517	5.322	7.647	4.380	0.605	9.321	20.369	6.789	0.442	18.097	31.092	11.894	0.377

	6-3contrarian				6-6contrarian				6-9contrarian				6-12contrarian			
	Long	Short	130/30	market-neutral	Long	Short	130/30	market-neutral	Long	Short	130/30	market-neutral	Long	Short	130/30	market-neutral
Annualized Excess Return	19.045%	23.950%	16.959%	-7.454%	19.944%	22.397%	18.878%	-3.593%	19.298%	23.200%	17.770%	-6.265%	18.374%	21.734%	18.370%	-4.558%
Annualized Standard Deviation	22.352%	22.657%	24.898%	21.818%	20.494%	18.624%	22.490%	15.582%	17.472%	17.356%	19.316%	17.604%	16.233%	16.912%	17.729%	17.280%
Sample Skewness	-0.868	-0.981	-0.501	-2.136	-0.334	-0.404	-0.202	-0.738	-0.242	-0.271	-0.131	-1.208	0.030	-0.427	0.157	-1.281
Sample Kurtosis	1.865	2.444	0.755	8.332	0.034	-0.154	-0.177	2.191	-0.241	-0.238	-0.620	2.468	-0.763	-0.599	-0.949	4.031
Sharpe ratio	0.852	1.053	0.681	-0.342	0.973	1.203	0.839	-0.230	1.105	1.337	0.920	-0.356	1.193	1.285	1.036	-0.264
CF VaR	22.077%	18.206%	27.041%	51.055%	15.654%	10.372%	19.473%	31.632%	10.707%	6.742%	14.959%	39.900%	7.443%	8.289%	10.335%	37.334%
Reward to VaR	0.863	1.310	0.627	-0.146	1.274	2.159	0.969	-0.113	1.802	3.441	1.188	-0.157	2.603	2.621	1.777	-0.122
Omega	3.012	3.734	2.374	0.579	5.455	7.807	4.449	0.644	10.192	16.404	7.238	0.411	22.451	20.592	18.236	0.472

	9-3contrarian				9-6contrarian				9-9contrarian				9-12contrarian			
	Long	Short	130/30	market-neutral	Long	Short	130/30	market-neutral	Long	Short	130/30	market-neutral	Long	Short	130/30	market-neutral
Annualized Excess Return	20.283%	23.715%	18.735%	-5.667%	19.741%	22.873%	18.309%	-5.900%	19.989%	22.472%	18.924%	-4.463%	20.315%	20.549%	20.007%	-1.897%
Annualized Standard Deviation	21.991%	22.972%	23.898%	19.063%	19.636%	21.400%	21.435%	19.994%	17.195%	17.856%	19.699%	16.547%	15.663%	17.628%	18.457%	16.111%
Sample Skewness	-1.037	-0.927	-0.716	-1.527	-0.388	-0.264	-0.266	-1.503	-0.131	-0.594	0.095	-0.953	0.042	-0.379	0.212	-1.672
Sample Kurtosis	2.237	2.429	1.293	3.633	0.038	-0.467	-0.365	3.705	-0.198	-0.134	-0.475	2.479	-0.715	-0.405	-0.814	4.544
Sharpe ratio	0.922	1.032	0.784	-0.297	1.005	1.089	0.854	-0.295	1.162	1.259	1.012	-0.270	1.297	1.153	1.216	-0.118
CF VaR	20.932%	18.623%	24.582%	43.060%	14.649%	14.106%	18.698%	44.979%	8.999%	9.794%	11.506%	34.637%	5.490%	10.789%	6.331%	33.727%
Reward to VaR	0.969	1.273	0.762	-0.132	1.348	1.822	0.979	-0.131	2.221	2.295	1.645	-0.129	3.700	1.905	3.160	-0.056
Omega	3.291	3.748	2.750	0.841	5.744	6.411	4.442	0.527	12.022	11.880	9.975	0.517	30.906	14.029	31.979	0.707

	12-3contrarian				12-6contrarian				12-9contrarian				12-12contrarian			
	Long	Short	130/30	market-neutral	Long	Short	130/30	market-neutral	Long	Short	130/30	market-neutral	Long	Short	130/30	market-neutral
Annualized Excess Return	19.701%	23.370%	18.070%	-6.352%	20.119%	22.344%	18.979%	-4.909%	20.684%	21.422%	20.145%	-2.785%	21.004%	19.012%	21.394%	0.886%
Annualized Standard Deviation	21.154%	23.895%	22.650%	19.311%	19.432%	21.366%	21.108%	20.604%	16.481%	19.489%	17.408%	16.591%	15.121%	19.015%	15.235%	13.290%
Sample Skewness	-1.005	-1.040	-0.592	-1.567	-0.271	-0.438	-0.055	-2.079	-0.135	-0.663	0.089	-1.132	-0.035	-0.361	0.118	-0.327
Sample Kurtosis	2.271	2.526	1.046	3.833	-0.020	-0.056	-0.426	6.611	-0.209	0.162	-0.483	2.772	-0.786	-0.402	-0.882	0.254
Sharpe ratio	0.931	0.978	0.798	-0.329	1.035	1.046	0.899	-0.238	1.255	1.099	1.157	-0.168	1.389	1.000	1.404	0.067
CF VaR	19.762%	21.288%	22.368%	44.327%	13.324%	15.403%	16.256%	46.552%	7.124%	14.078%	8.218%	34.081%	4.258%	14.320%	3.437%	22.113%
Reward to VaR	0.997	1.098	0.808	-0.143	1.510	1.451	1.168	-0.105	2.903	1.522	2.451	-0.082	4.933	1.328	6.222	0.040
Omega	3.344	3.477	2.802	0.613	6.180	6.087	5.045	0.583	13.999	8.757	13.549	0.667	39.046	10.131	62.070	1.187

Appendix F. Descriptive statistics 1996-1999

	3-3Momentum				3-6Momentum				3-9Momentum				3-12Momentum			
	Long	Short	130/30	market-neutral	Long	Short	130/30	market-neutral	Long	Short	130/30	market-neutral	Long	Short	130/30	market-neutral
Annualized Excess Return	-29.252%	-30.946%	-29.634%	1.694%	-26.401%	-29.907%	-26.110%	2.506%	-23.840%	-27.114%	-23.386%	3.274%	-20.945%	-26.068%	-20.126%	5.122%
Annualized Standard Deviation	24.115%	39.783%	21.717%	21.612%	23.984%	33.157%	22.735%	15.667%	24.849%	31.387%	24.721%	18.297%	22.495%	33.638%	21.312%	18.944%
Sample Skewness	-0.715	-0.833	-0.638	0.543	-0.621	-0.629	-0.623	0.695	-0.783	-0.247	-0.858	-0.203	-0.460	0.249	-0.761	-0.110
Sample Kurtosis	-0.068	1.531	-0.314	1.831	0.211	0.594	0.114	1.084	-0.244	-0.070	0.024	-0.081	0.057	-0.514	0.620	-0.454
Sharpe ratio	-1.213	-0.778	-1.365	0.078	-1.101	-0.872	-1.148	0.160	-0.959	-0.864	-0.946	0.201	-0.931	-0.775	-0.944	0.270
CF VaR	73.614%	104.049%	69.260%	29.629%	69.802%	88.721%	67.306%	19.705%	70.066%	80.916%	69.715%	24.487%	60.767%	79.340%	59.283%	26.802%
Reward to VaR	-0.397	-0.297	-0.428	0.057	-0.378	-0.326	-0.388	0.127	-0.340	-0.335	-0.335	0.134	-0.345	-0.329	-0.339	0.191
Omega	0.159	0.309	0.132	1.112	0.093	0.159	0.090	1.349	0.061	0.142	0.062	1.539	0.072	0.155	0.055	1.929
	6-3Momentum				6-6Momentum				6-9Momentum				6-12Momentum			
	Long	Short	130/30	market-neutral	Long	Short	130/30	market-neutral	Long	Short	130/30	market-neutral	Long	Short	130/30	market-neutral
Annualized Excess Return	-26.869%	-33.563%	-26.006%	6.694%	-25.406%	-29.445%	-24.691%	4.039%	-22.607%	-28.715%	-21.576%	6.107%	-20.124%	-26.940%	-18.989%	6.816%
Annualized Standard Deviation	23.083%	42.729%	19.880%	24.675%	24.905%	32.594%	24.278%	16.058%	23.370%	36.212%	21.886%	20.244%	21.843%	36.414%	19.892%	21.160%
Sample Skewness	-0.619	-0.899	-0.336	0.630	-0.797	-0.337	-0.962	0.327	-0.885	-0.305	-1.072	0.177	-0.669	0.281	-1.316	-0.213
Sample Kurtosis	-0.106	1.008	-0.671	0.769	0.666	-0.196	1.231	-0.033	0.030	-0.559	0.610	-0.145	0.673	-0.847	2.715	-0.941
Sharpe ratio	-1.164	-0.785	-1.308	0.271	-1.020	-0.903	-1.017	0.252	-0.967	-0.793	-0.986	0.302	-0.921	-0.740	-0.955	0.322
CF VaR	88.773%	113.232%	80.829%	29.937%	71.374%	86.237%	70.229%	20.871%	66.555%	91.762%	63.477%	26.229%	59.721%	84.515%	57.404%	29.652%
Reward to VaR	-0.391	-0.296	-0.428	0.231	-0.356	-0.341	-0.352	0.194	-0.340	-0.313	-0.340	0.233	-0.337	-0.319	-0.331	0.230
Omega	0.182	0.299	0.170	1.453	0.101	0.177	0.105	1.558	0.061	0.162	0.048	1.909	0.071	0.173	0.041	2.094
	9-3Momentum				9-6Momentum				9-9Momentum				9-12Momentum			
	Long	Short	130/30	market-neutral	Long	Short	130/30	market-neutral	Long	Short	130/30	market-neutral	Long	Short	130/30	market-neutral
Annualized Excess Return	-25.098%	-36.291%	-22.915%	11.194%	-23.118%	-34.015%	-20.953%	10.897%	-21.286%	-30.612%	-19.517%	9.326%	-19.243%	-28.386%	-17.701%	9.142%
Annualized Standard Deviation	23.683%	42.863%	20.570%	24.468%	22.530%	40.436%	20.385%	24.249%	21.949%	39.805%	19.060%	22.749%	20.250%	40.419%	18.783%	24.495%
Sample Skewness	-0.790	-0.680	-0.820	0.196	-0.581	-0.887	-0.645	0.894	-0.851	-0.421	-1.003	0.191	-0.302	-0.038	-0.365	-0.023
Sample Kurtosis	0.239	0.361	-0.139	0.131	0.267	0.639	0.478	0.528	0.036	-0.640	0.660	-0.648	-0.318	-0.724	-0.378	-1.208
Sharpe ratio	-1.060	-0.847	-1.114	0.457	-1.026	-0.841	-1.028	0.449	-0.970	-0.769	-1.024	0.410	-0.950	-0.702	-1.055	0.373
CF VaR	88.966%	114.386%	80.279%	27.621%	83.828%	109.588%	57.859%	22.243%	62.373%	101.223%	55.676%	27.146%	54.386%	95.902%	47.222%	31.905%
Reward to VaR	-0.364	-0.317	-0.380	0.405	-0.363	-0.310	-0.362	0.490	-0.341	-0.302	-0.351	0.344	-0.354	-0.298	-0.375	0.287
Omega	0.209	0.284	0.214	1.813	0.112	0.168	0.115	2.365	0.064	0.158	0.049	2.328	0.073	0.169	0.047	2.368
	12-3Momentum				12-6Momentum				12-9Momentum				12-12Momentum			
	Long	Short	130/30	market-neutral	Long	Short	130/30	market-neutral	Long	Short	130/30	market-neutral	Long	Short	130/30	market-neutral
Annualized Excess Return	-22.932%	-38.183%	-19.932%	15.251%	-22.181%	-34.348%	-19.786%	12.167%	-20.860%	-30.733%	-19.084%	9.873%	-19.097%	-28.035%	-17.715%	8.937%
Annualized Standard Deviation	22.186%	46.362%	18.255%	28.633%	21.673%	42.304%	18.724%	25.759%	21.351%	41.559%	18.063%	24.807%	19.813%	41.857%	18.010%	26.004%
Sample Skewness	-0.622	-0.857	-0.263	0.580	-0.488	-0.839	-0.350	0.778	-0.762	-0.525	-0.685	0.379	-0.248	-0.171	-0.278	0.188
Sample Kurtosis	0.010	0.707	-0.472	0.374	0.259	0.516	0.357	0.176	-0.104	-0.641	0.117	-0.670	-0.156	-0.879	-0.100	-1.245
Sharpe ratio	-1.034	-0.824	-1.092	0.533	-1.023	-0.812	-1.057	0.472	-0.977	-0.739	-1.057	0.398	-0.964	-0.670	-1.106	0.344
CF VaR	83.173%	124.416%	51.472%	26.762%	80.624%	113.002%	52.268%	24.153%	60.405%	105.598%	52.105%	28.544%	53.121%	99.640%	45.324%	33.086%
Reward to VaR	-0.363	-0.307	-0.387	0.570	-0.366	-0.304	-0.379	0.504	-0.345	-0.291	-0.366	0.346	-0.360	-0.281	-0.391	0.270
Omega	0.228	0.280	0.246	2.044	0.119	0.186	0.128	2.369	0.068	0.161	0.059	2.307	0.076	0.172	0.048	2.264
	3-3contrarian				3-6contrarian				3-9contrarian				3-12contrarian			
	Long	Short	130/30	market-neutral	Long	Short	130/30	market-neutral	Long	Short	130/30	market-neutral	Long	Short	130/30	market-neutral
Annualized Excess Return	-28.740%	-32.342%	-28.889%	4.952%	-26.191%	-29.424%	-25.709%	3.734%	-23.989%	-26.820%	-23.837%	2.420%	-21.755%	-23.810%	-21.801%	1.478%
Annualized Standard Deviation	33.724%	17.894%	40.088%	20.401%	29.262%	20.809%	32.905%	13.780%	28.148%	23.491%	30.896%	12.473%	26.648%	23.198%	28.882%	12.846%
Sample Skewness	-0.762	-0.478	-0.802	0.023	-0.579	-0.711	-0.580	0.480	-0.628	-0.548	-0.637	0.592	0.037	-0.380	0.162	0.872
Sample Kurtosis	0.628	-0.206	0.844	0.238	0.514	0.456	0.700	0.428	-0.072	-0.365	0.226	0.264	-0.438	0.410	-0.469	0.901
Sharpe ratio	-0.852	-1.828	-0.716	0.243	-0.895	-1.414	-0.781	0.271	-0.852	-1.133	-0.765	0.194	-0.816	-1.018	-0.748	0.115
CF VaR	90.711%	63.845%	102.583%	28.379%	78.644%	67.464%	84.577%	16.856%	75.134%	68.954%	79.668%	15.862%	65.552%	64.019%	68.052%	16.068%
Reward to VaR	-0.317	-0.507	-0.280	0.174	-0.333	-0.436	-0.304	0.222	-0.319	-0.386	-0.297	0.153	-0.332	-0.369	-0.317	0.092
Omega	0.273	0.070	0.340	1.361	0.147	0.044	0.195	1.642	0.114	0.046	0.150	1.537	0.128	0.063	0.160	1.357
	6-3contrarian				6-6contrarian				6-9contrarian				6-12contrarian			
	Long	Short	130/30	market-neutral	Long	Short	130/30	market-neutral	Long	Short	130/30	market-neutral	Long	Short	130/30	market-neutral
Annualized Excess Return	-29.063%	-28.252%	-30.334%	0.600%	-27.213%	-25.271%	-28.198%	-0.905%	-25.259%	-22.429%	-26.765%	-1.679%	-22.875%	-20.261%	-24.395%	-1.568%
Annualized Standard Deviation	33.464%	19.010%	39.735%	20.118%	29.105%	21.930%	32.277%	12.602%	29.847%	20.654%	34.218%	15.182%	29.154%	19.186%	33.694%	16.956%
Sample Skewness	-0.827	-0.509	-0.812	-0.081	-0.492	-1.069	-0.424	0.123	-0.489	-1.176	-0.423	0.435	0.112	-1.244	0.237	0.676
Sample Kurtosis	0.814	0.095	1.240	0.638	-0.004	1.587	-0.133	-0.000	-0.474	1.368	-0.464	-0.040	-0.667	2.799	-0.793	-0.232
Sharpe ratio	-0.868	-1.486	-0.763	0.030	-0.935	-1.152	-0.874	-0.072	-0.846	-1.086	-0.782	-0.111	-0.785	-1.056	-0.724	-0.092
CF VaR	90.982%	62.141%	104.367%	32.701%	79.026%	66.827%	85.150%	21.195%	78.647%	62.191%	87.359%	24.744%	70.297%	56.955%	78.066%	26.155%
Reward to VaR	-0.319	-0.455	-0.291	0.018	-0.344	-0.378	-0.331	-0.043	-0.321	-0.361	-0.308	-0.068	-0.325	-0.356	-0.312	-0.060
Omega	0.266	0.129	0.313	1.041	0.144	0.072	0.175	0.882	0.121	0.034	0.155	0.795	0.139	0.032	0.175	0.805
	9-3contrarian				9-6contrarian				9-9contrarian				9-12contrarian			
	Long	Short	130/30	market-neutral	Long	Short	130/30	market-neutral	Long	Short	130/30	market-neutral	Long	Short	130/30	market-neutral
Annualized Excess Return	-28.879%	-27.119%	-30.364%	-0.341%	-27.742%	-22.748%	-30.006%	-3.200%	-25.398%	-21.102%	-27.682%	-2.542%	-22.896%	-19.520%	-25.056%	-1.944%
Annualized Standard Deviation	33.571%	19.620%	39.419%	19.944%	30.934%	18.313%	36.268%	16.172%	31.643%	16.975%	37.816%	18.452%	30.995%	15.737%	37.600%	20.159%
Sample Skewness	-0.752	-0.411	-0.717	0.272	-0.672	-0.339	-0.707	-0.052	-0.531	-0.710	-0.463	0.245	-0.082	-0.413	-0.066	0.301
Sample Kurtosis	0.273	0.271	0.199	-0.175	0.205	0.284	0.168	-0.676	-0.612	0.154	-0.742	-0.869	-0.613	-0.253	-0.802	-1.032
Sharpe ratio	-0.860	-1.382	-0.770	-0.017	-0.897	-1.242	-0.827	-0.198	-0.803	-1.243	-0.732	-0.138	-0.739	-1.240	-0.666	-0.096
CF VaR	90.718%	61.513%	102.688%	31.658%	84.129%	54.489%	96.470%	30.260%	82.433%	52.230%	95.268%	31.920%	74.984%	47.281%	88.215%	33.776%
Reward to VaR	-0.318	-0.441	-0.298	-0.011	-0.330	-0.417	-0.311	-0.108	-0.308	-0.404	-0.291	-0.080	-0.305	-0.413	-0.284	-0.058
Omega	0.274	0.162	0.323	0.979	0.149	0.088	0.181	0.717	0.130	0.033	0.172	0.761	0.148	0.025	0.188	0.806
	12-3contrarian				12-6contrarian				12-9contrarian				12-12contrarian			
	Long	Short	130/30	market-neutral	Long	Short	130/30	market-neutral	Long	Short	130/30	market-neutral	Long	Short	130/30	market-neutral
Annualized Excess Return	-28.360%	-25.764%	-30.333%	-1.281%	-27.352%	-22.477%	-29.829%	-3.139%	-24.894%	-21.505%	-27.154%	-1.998%	-22.506%	-19.488%	-24.629%	-1.698%
Annualized Standard Deviation	33.859%	18.741%	40.635%	21.683%	31.726%	17.103%	38.106%	18.643%	32.214%	16.865%	39.253%	20.514%	31.047%	15.991%	37.948%	20.432%
Sample Skewness	-0.856	0.060	-0.907	0.026	-0.704	0.042	-0.759	-0.081	-0.612	-0.256	-0.573	0.052	-0.162	-0.220	-0.177	0.057
Sample Kurtosis	0.553	-0.633	0.704	-0.189	0.220	0.351	0.214	-0.987	-0.540	-0.380	-0.680	-1.143	-0.667	-0.277	-0.903	-1.176
Sharpe ratio	-0.838	-1.375	-0.746	-0.059	-0.862	-1.314	-0.783	-0.166	-0.773	-1.275	-0.692	-0.097	-0.725	-1.219	-0.649	-0.093
CF VaR	91.431%	58.512%	106.429%	36.877%	85.442%	50.289%	100.135%	34.602%	83.594%	50.579%	99.390%	35.905%	75.407%	46.866%	89.829%	35.463%
Reward to VaR	-0.310	-0.456	-0.285	-0.035	-0.320	-0.447	-0.298	-0.091	-0.298	-0.425	-0.276	-0.055	-0.298	-0.416	-0.275	-0.048
Omega	0.276	0.191	0.324	0.929	0.155	0.099	0.197	0.760	0.135	0.042	0.183	0.829	0.148	0.038	0.187	0.831

Appendix G. Descriptive statistics 2000-2002

	3-3Momentum				3-6Momentum				3-9Momentum				3-12Momentum			
	Long	Short	130/30	market-neutral	Long	Short	130/30	market-neutral	Long	Short	130/30	market-neutral	Long	Short	130/30	market-neutral
Annualized Excess Return	17.490%	17.679%	17.152%	-0.189%	17.047%	15.956%	17.164%	1.091%	14.616%	14.301%	14.475%	0.315%	11.661%	9.409%	12.101%	2.252%
nnualized Standard Deviation	15.950%	21.255%	15.746%	11.784%	15.963%	20.515%	15.627%	10.218%	18.213%	22.600%	17.914%	10.675%	23.659%	29.017%	22.920%	10.864%
Sample Skewness	-0.712	0.555	-0.911	-0.963	-0.457	0.242	-0.533	-0.725	-1.002	0.082	-1.217	-0.972	-1.725	-1.539	-1.663	-0.077
Sample Kurtosis	1.085	3.710	0.975	4.570	0.196	2.445	-0.033	2.537	0.922	1.408	1.294	2.428	3.108	3.383	2.838	0.543
Sharpe ratio	1.097	0.832	1.089	-0.016	1.068	0.778	1.098	0.107	0.802	0.633	0.808	0.029	0.493	0.324	0.528	0.207
CF VaR	11.470%	12.234%	12.266%	21.508%	11.158%	15.355%	10.830%	17.199%	19.841%	21.708%	20.217%	19.480%	36.039%	47.732%	33.923%	15.736%
Reward to VaR	1.525	1.445	1.398	-0.009	1.528	1.039	1.585	0.063	0.737	0.659	0.716	0.016	0.324	0.197	0.357	0.143
Omega	3.707	3.227	3.592	0.977	5.853	4.182	6.058	1.231	4.705	3.894	4.694	1.072	3.115	2.270	3.338	1.700

	6-3Momentum				6-6Momentum				6-9Momentum				6-12Momentum			
	Long	Short	130/30	market-neutral	Long	Short	130/30	market-neutral	Long	Short	130/30	market-neutral	Long	Short	130/30	market-neutral
Annualized Excess Return	18.319%	17.318%	18.352%	1.001%	17.278%	16.647%	17.300%	0.631%	14.869%	14.072%	14.902%	0.796%	11.825%	9.339%	12.304%	2.486%
nnualized Standard Deviation	15.381%	22.169%	14.579%	11.658%	15.940%	20.463%	15.372%	9.145%	17.906%	22.657%	17.357%	10.017%	23.234%	30.288%	22.145%	11.715%
Sample Skewness	-0.506	-0.054	-0.609	-0.143	-0.431	0.080	-0.511	-0.813	-0.882	-0.137	-1.017	-1.035	-1.609	-1.811	-1.445	0.436
Sample Kurtosis	0.723	3.281	0.084	2.495	0.234	1.931	-0.174	1.686	0.545	1.362	0.357	1.503	2.533	4.428	1.685	1.633
Sharpe ratio	1.191	0.781	1.259	0.086	1.084	0.814	1.125	0.069	0.830	0.621	0.859	0.079	0.509	0.308	0.556	0.212
CF VaR	8.895%	18.029%	8.023%	18.068%	10.761%	15.757%	10.198%	15.630%	18.611%	23.452%	18.196%	18.119%	34.692%	51.490%	31.583%	14.912%
Reward to VaR	2.060	0.961	2.288	0.055	1.606	1.056	1.697	0.040	0.799	0.600	0.819	0.044	0.341	0.181	0.390	0.167
Omega	4.134	2.933	4.323	1.128	6.068	4.361	6.396	1.137	4.895	3.803	4.942	1.200	3.193	2.231	3.436	1.784

	9-3Momentum				9-6Momentum				9-9Momentum				9-12Momentum			
	Long	Short	130/30	market-neutral	Long	Short	130/30	market-neutral	Long	Short	130/30	market-neutral	Long	Short	130/30	market-neutral
Annualized Excess Return	18.402%	18.569%	17.961%	-0.168%	16.657%	17.837%	16.041%	-1.180%	14.446%	15.167%	13.966%	-0.721%	11.588%	10.068%	11.780%	1.521%
nnualized Standard Deviation	15.144%	23.602%	14.292%	13.770%	15.687%	21.124%	15.187%	11.053%	17.610%	23.361%	16.849%	11.013%	23.070%	30.900%	21.679%	11.832%
Sample Skewness	-0.634	0.411	-0.729	-1.189	-0.612	0.641	-0.719	-1.735	-0.937	0.088	-1.007	-1.609	-1.641	-1.808	-1.497	0.712
Sample Kurtosis	0.776	3.928	0.246	5.827	0.179	2.588	-0.152	4.339	0.433	1.881	0.171	3.622	2.561	4.658	1.836	3.502
Sharpe ratio	1.215	0.787	1.257	-0.012	1.063	0.844	1.056	-0.107	0.820	0.649	0.829	-0.066	0.502	0.326	0.543	0.129
CF VaR	8.985%	15.568%	8.294%	25.488%	11.667%	11.814%	11.937%	23.218%	18.759%	21.791%	18.187%	22.531%	34.751%	51.831%	31.381%	14.609%
Reward to VaR	2.071	1.193	2.165	-0.007	1.428	1.510	1.344	-0.051	0.770	0.696	0.768	-0.032	0.333	0.194	0.375	0.104
Omega	4.177	3.093	4.245	0.982	5.562	5.158	5.295	0.806	4.703	4.241	4.587	0.853	3.164	2.297	3.401	1.447

	12-3Momentum				12-6Momentum				12-9Momentum				12-12Momentum			
	Long	Short	130/30	market-neutral	Long	Short	130/30	market-neutral	Long	Short	130/30	market-neutral	Long	Short	130/30	market-neutral
Annualized Excess Return	17.751%	18.004%	17.257%	-0.253%	16.308%	18.272%	15.414%	-1.964%	14.527%	15.024%	14.109%	-0.497%	11.852%	9.557%	12.307%	2.295%
nnualized Standard Deviation	15.153%	23.199%	14.666%	14.211%	15.403%	21.615%	14.862%	11.884%	17.562%	23.492%	16.746%	11.168%	23.397%	29.906%	22.262%	10.890%
Sample Skewness	-0.781	0.527	-0.872	-1.252	-0.601	0.609	-0.681	-1.410	-0.958	0.133	-1.029	-1.505	-1.688	-1.677	-1.583	0.219
Sample Kurtosis	0.900	3.687	0.476	4.761	0.189	2.317	-0.170	2.890	0.622	1.622	0.556	3.339	2.877	4.190	2.515	2.933
Sharpe ratio	1.171	0.776	1.177	-0.018	1.059	0.845	1.037	-0.165	0.827	0.640	0.843	-0.044	0.507	0.320	0.553	0.211
CF VaR	10.087%	14.857%	10.148%	26.902%	11.495%	12.400%	11.826%	25.135%	18.613%	21.960%	17.807%	22.414%	35.241%	49.773%	32.144%	14.293%
Reward to VaR	1.760	1.212	1.701	-0.009	1.419	1.474	1.303	-0.078	0.780	0.684	0.792	-0.022	0.336	0.192	0.383	0.161
Omega	3.884	3.110	3.796	0.975	5.522	5.107	5.188	0.720	4.852	4.052	4.890	0.895	3.228	2.235	3.593	1.796

	3-3contrarian				3-6contrarian				3-9contrarian				3-12contrarian			
	Long	Short	130/30	market-neutral	Long	Short	130/30	market-neutral	Long	Short	130/30	market-neutral	Long	Short	130/30	market-neutral
Annualized Excess Return	17.860%	16.901%	17.931%	0.960%	16.471%	17.334%	16.028%	-1.394%	14.234%	15.289%	13.748%	-1.502%	10.081%	13.174%	8.953%	-3.992%
nnualized Standard Deviation	18.553%	15.045%	20.480%	11.555%	17.710%	16.661%	18.937%	11.373%	19.941%	18.442%	21.111%	11.406%	25.888%	24.082%	26.850%	11.778%
Sample Skewness	0.058	-0.796	0.363	1.826	0.028	-0.572	0.293	0.942	-0.343	-1.177	-0.047	0.894	-1.549	-1.863	-1.363	0.291
Sample Kurtosis	2.195	1.256	2.726	7.042	1.475	-0.058	2.127	3.113	0.886	1.097	1.025	3.385	2.830	3.929	2.386	0.789
Sharpe ratio	0.963	1.123	0.876	0.083	0.930	1.040	0.846	-0.123	0.714	0.829	0.651	-0.132	0.392	0.547	0.333	-0.339
CF VaR	11.536%	10.687%	12.478%	9.709%	11.999%	12.694%	12.713%	16.163%	20.111%	20.321%	20.829%	16.465%	40.850%	35.705%	43.375%	22.188%
Reward to VaR	1.548	1.581	1.437	0.099	1.373	1.365	1.261	-0.086	0.708	0.752	0.660	-0.091	0.247	0.369	0.206	-0.180
Omega	3.508	3.820	3.248	1.132	5.120	5.521	4.648	0.786	4.331	4.830	4.009	0.731	2.566	3.600	2.278	0.420

	6-3contrarian				6-6contrarian				6-9contrarian				6-12contrarian			
	Long	Short	130/30	market-neutral	Long	Short	130/30	market-neutral	Long	Short	130/30	market-neutral	Long	Short	130/30	market-neutral
Annualized Excess Return	16.976%	20.633%	15.716%	-3.825%	16.198%	19.126%	15.134%	-3.536%	13.445%	17.401%	12.061%	-4.943%	9.803%	14.155%	8.269%	-5.446%
nnualized Standard Deviation	18.213%	15.172%	19.814%	9.768%	18.036%	16.034%	19.475%	11.220%	19.969%	17.987%	21.313%	11.775%	25.968%	23.469%	27.421%	12.059%
Sample Skewness	-0.095	-0.735	0.089	1.026	-0.023	-0.601	0.205	0.832	-0.454	-0.870	-0.240	0.657	-1.620	-1.685	-1.498	0.544
Sample Kurtosis	2.021	1.043	2.359	3.814	1.205	0.103	1.545	2.313	1.010	0.596	1.202	2.195	3.205	3.075	3.126	0.814
Sharpe ratio	0.932	1.360	0.793	-0.392	0.898	1.193	0.777	-0.315	0.673	0.967	0.568	-0.420	0.377	0.603	0.302	-0.452
CF VaR	12.735%	7.020%	15.436%	16.108%	13.155%	9.839%	15.153%	18.678%	21.491%	16.159%	23.910%	21.506%	41.900%	32.974%	45.614%	23.181%
Reward to VaR	1.333	2.939	1.018	-0.237	1.231	1.944	0.999	-0.189	0.626	1.077	0.504	-0.230	0.234	0.429	0.181	-0.235
Omega	3.306	5.021	2.839	0.574	4.762	6.864	4.025	0.551	4.008	6.323	3.387	0.387	2.486	4.009	2.131	0.329

	9-3contrarian				9-6contrarian				9-9contrarian				9-12contrarian			
	Long	Short	130/30	market-neutral	Long	Short	130/30	market-neutral	Long	Short	130/30	market-neutral	Long	Short	130/30	market-neutral
Annualized Excess Return	17.897%	19.891%	17.008%	-2.486%	16.054%	19.184%	14.839%	-3.951%	13.751%	16.743%	12.588%	-3.898%	10.015%	13.783%	8.632%	-5.196%
nnualized Standard Deviation	18.668%	15.954%	20.779%	13.377%	18.367%	15.784%	20.348%	13.532%	20.383%	17.678%	22.190%	13.890%	25.613%	24.788%	26.635%	13.621%
Sample Skewness	0.189	-1.080	0.499	0.705	0.104	-0.840	0.369	1.121	-0.277	-1.193	0.043	1.397	-1.387	-2.088	-1.027	0.989
Sample Kurtosis	2.096	1.318	2.391	2.645	1.543	0.258	2.154	2.844	1.106	1.031	1.494	3.310	2.489	4.543	1.844	2.069
Sharpe ratio	0.959	1.247	0.819	-0.187	0.874	1.215	0.729	-0.292	0.675	0.947	0.567	-0.281	0.391	0.556	0.324	-0.381
CF VaR	11.012%	10.469%	13.139%	20.995%	13.045%	10.252%	15.572%	20.817%	20.902%	17.483%	22.981%	19.811%	39.992%	37.390%	41.431%	22.967%
Reward to VaR	1.625	1.900	1.295	-0.119	1.231	1.871	0.953	-0.190	0.658	0.958	0.548	-0.197	0.250	0.369	0.208	-0.226
Omega	3.475	4.185	2.982	0.769	4.726	6.817	3.899	0.576	4.116	5.763	3.525	0.523	2.554	3.661	2.239	0.382

	12-3contrarian				12-6contrarian				12-9contrarian				12-12contrarian			
	Long	Short	130/30	market-neutral	Long	Short	130/30	market-neutral	Long	Short	130/30	market-neutral	Long	Short	130/30	market-neutral
Annualized Excess Return	17.391%	19.051%	16.618%	-1.953%	16.418%	17.997%	15.658%	-2.157%	13.980%	16.269%	12.984%	-3.060%	10.365%	12.979%	9.317%	-4.126%
nnualized Standard Deviation	18.657%	14.989%	20.881%	13.025%	18.514%	15.173%	20.682%	14.173%	20.603%	17.287%	22.588%	14.567%	25.304%	25.745%	26.070%	14.309%
Sample Skewness	0.147	-1.138	0.508	1.502	0.213	-0.862	0.553	1.339	-0.203	-1.298	0.174	1.706	-1.312	-2.203	-0.875	0.907
Sample Kurtosis	2.190	1.526	2.722	4.494	1.493	0.427	2.092	3.501	1.067	1.553	1.489	4.152	2.267	5.229	1.529	2.732
Sharpe ratio	0.932	1.271	0.796	-0.150	0.887	1.186	0.757	-0.152	0.678	0.941	0.575	-0.210	0.410	0.504	0.357	-0.288
CF VaR	11.696%	9.624%	13.482%	16.108%	12.349%	10.333%	14.134%	18.621%	20.659%	17.448%	22.369%	17.968%	38.707%	40.417%	38.866%	22.980%
Reward to VaR	1.487	1.980	1.233	-0.121	1.330	1.742	1.108	-0.116	0.676	0.932	0.580	-0.170	0.268	0.321	0.240	-0.180
Omega	3.386	4.285	2.962	0.805	4.903	6.378	4.199	0.732	4.165	5.811	3.632	0.605	2.650	3.377	2.401	0.446

Appendix H. Descriptive statistics 2003-2007

	3-3Momentum				3-6Momentum				3-9Momentum				3-12Momentum			
	Long	Short	130/30	market-neutral	Long	Short	130/30	market-neutral	Long	Short	130/30	arket-neut	Long	Short	130/30	market-neutral
Annualized Excess Return	-36.945%	-34.502%	-41.043%	-2.443%	-33.765%	-19.773%	-40.775%	-13.991%	-27.585%	-19.057%	-32.361%	-8.529%	-15.689%	-13.535%	-18.320%	-2.153%
nnualized Standard Deviation	36.860%	67.847%	30.939%	39.849%	47.312%	70.308%	41.891%	32.538%	47.467%	68.183%	42.268%	29.603%	41.549%	64.189%	36.810%	31.085%
Sample Skewness	-0.155	0.392	-0.246	-0.335	0.055	0.339	0.010	-0.547	0.188	0.486	0.031	-0.425	0.160	0.053	0.124	0.377
Sample Kurtosis	-0.166	-0.081	-0.040	0.391	-1.199	-0.706	-0.758	0.201	-1.447	-1.286	-1.037	-0.640	-1.638	-1.087	-1.287	0.002
Sharpe ratio	-1.002	-0.509	-1.327	-0.061	-0.714	-0.281	-0.973	-0.430	-0.581	-0.279	-0.766	-0.288	-0.378	-0.211	-0.498	-0.069
CF VaR	99.320%	138.564%	94.091%	71.382%	112.002%	129.579%	110.215%	72.237%	104.513%	123.359%	102.409%	61.061%	83.507%	119.580%	78.529%	49.923%
Reward to VaR	-0.372	-0.249	-0.436	-0.034	-0.301	-0.153	-0.370	-0.194	-0.264	-0.154	-0.316	-0.140	-0.188	-0.113	-0.233	-0.043
Omega	0.272	0.527	0.169	0.920	0.292	0.623	0.163	0.437	0.333	0.597	0.198	0.525	0.444	0.621	0.317	0.832

	6-3Momentum				6-6Momentum				6-9Momentum				6-12Momentum			
	Long	Short	130/30	market-neutral	Long	Short	130/30	market-neutral	Long	Short	130/30	arket-neut	Long	Short	130/30	market-neutral
Annualized Excess Return	-39.588%	-28.115%	-46.935%	-11.474%	-34.716%	-18.566%	-43.239%	-16.150%	-27.220%	-20.607%	-32.110%	-6.613%	-16.032%	-12.909%	-19.291%	-3.123%
nnualized Standard Deviation	36.737%	67.390%	31.195%	40.822%	44.636%	74.714%	35.789%	35.717%	44.417%	73.706%	35.871%	34.425%	39.521%	66.969%	32.268%	32.370%
Sample Skewness	-0.447	0.698	-0.763	-0.691	-0.011	0.430	-0.084	-0.895	0.269	0.380	0.273	-0.398	0.193	0.105	0.290	0.046
Sample Kurtosis	-0.101	0.081	0.144	0.926	-1.248	-0.895	-0.905	-0.039	-1.542	-1.297	-1.253	-0.704	-1.698	-1.266	-1.463	-0.467
Sharpe ratio	-1.078	-0.417	-1.505	-0.281	-0.778	-0.248	-1.208	-0.452	-0.613	-0.280	-0.895	-0.192	-0.406	-0.193	-0.598	-0.096
CF VaR	104.607%	125.045%	104.551%	85.485%	109.404%	133.517%	103.620%	83.429%	98.243%	135.689%	89.213%	67.499%	80.220%	122.786%	70.640%	56.269%
Reward to VaR	-0.378	-0.225	-0.449	-0.134	-0.317	-0.139	-0.417	-0.194	-0.277	-0.152	-0.360	-0.098	-0.200	-0.105	-0.273	-0.055
Omega	0.229	0.599	0.106	0.661	0.260	0.663	0.103	0.415	0.319	0.592	0.156	0.655	0.422	0.648	0.256	0.780

	9-3Momentum				9-6Momentum				9-9Momentum				9-12Momentum			
	Long	Short	130/30	market-neutral	Long	Short	130/30	market-neutral	Long	Short	130/30	arket-neut	Long	Short	130/30	market-neutral
Annualized Excess Return	-38.207%	-33.010%	-43.940%	-5.197%	-31.251%	-28.086%	-36.828%	-3.165%	-25.137%	-26.744%	-28.263%	1.607%	-14.453%	-16.851%	-16.348%	2.397%
nnualized Standard Deviation	34.894%	71.713%	26.939%	43.200%	41.363%	82.294%	29.753%	44.247%	42.031%	79.309%	31.069%	40.127%	38.141%	70.126%	29.427%	35.212%
Sample Skewness	-0.307	0.433	-0.662	-0.611	0.037	0.271	0.047	-0.534	0.299	0.342	0.407	-0.469	0.159	0.153	0.256	-0.158
Sample Kurtosis	-0.092	-0.128	0.184	0.302	-1.214	-1.034	-0.671	-0.536	-1.529	-1.344	-1.113	-0.935	-1.670	-1.328	-1.382	-0.620
Sharpe ratio	-1.095	-0.460	-1.631	-0.120	-0.756	-0.341	-1.238	-0.072	-0.598	-0.337	-0.910	0.040	-0.379	-0.240	-0.556	0.068
CF VaR	98.649%	142.201%	92.977%	83.165%	99.882%	158.791%	85.784%	82.870%	91.955%	151.538%	76.411%	70.309%	76.749%	131.024%	63.419%	57.533%
Reward to VaR	-0.387	-0.232	-0.473	-0.062	-0.313	-0.177	-0.429	-0.038	-0.273	-0.176	-0.370	0.023	-0.188	-0.129	-0.258	0.042
Omega	0.233	0.564	0.094	0.849	0.274	0.566	0.107	0.884	0.328	0.535	0.155	1.086	0.445	0.589	0.277	1.184

	12-3Momentum				12-6Momentum				12-9Momentum				12-12Momentum			
	Long	Short	130/30	market-neutral	Long	Short	130/30	market-neutral	Long	Short	130/30	arket-neut	Long	Short	130/30	market-neutral
Annualized Excess Return	-34.373%	-41.689%	-37.432%	7.316%	-29.860%	-31.818%	-34.311%	1.958%	-24.201%	-29.334%	-26.434%	5.133%	-14.052%	-17.473%	-15.495%	3.421%
nnualized Standard Deviation	32.316%	76.651%	23.291%	49.663%	40.066%	84.629%	27.504%	46.976%	41.715%	80.563%	30.551%	41.548%	38.096%	69.471%	29.190%	33.638%
Sample Skewness	-0.284	0.310	-0.493	-0.474	0.034	0.243	0.084	-0.524	0.293	0.334	0.419	-0.451	0.141	0.226	0.229	-0.478
Sample Kurtosis	-0.118	-0.174	-0.133	-0.059	-1.281	-1.047	-0.941	-0.655	-1.573	-1.289	-1.211	-0.752	-1.664	-1.387	-1.412	-0.731
Sharpe ratio	-1.064	-0.544	-1.607	0.147	-0.745	-0.376	-1.247	0.042	-0.580	-0.364	-0.865	0.124	-0.369	-0.252	-0.531	0.102
CF VaR	90.159%	161.253%	78.950%	80.899%	98.422%	166.937%	79.426%	82.652%	90.629%	156.218%	73.733%	68.980%	76.472%	129.199%	62.434%	56.810%
Reward to VaR	-0.381	-0.259	-0.474	0.090	-0.310	-0.191	-0.432	0.024	-0.267	-0.188	-0.359	0.074	-0.184	-0.135	-0.248	0.060
Omega	0.243	0.506	0.106	1.216	0.281	0.533	0.108	1.072	0.342	0.506	0.176	1.289	0.455	0.577	0.299	1.279

	3-3contrarian				3-6contrarian				3-9contrarian				3-12contrarian			
	Long	Short	130/30	market-neutral	Long	Short	130/30	market-neutral	Long	Short	130/30	arket-neut	Long	Short	130/30	market-neutral
Annualized Excess Return	-33.587%	-38.496%	-33.094%	7.513%	-24.206%	-40.666%	-20.729%	14.411%	-19.769%	-36.676%	-16.059%	15.289%	-11.692%	-21.251%	-9.719%	10.087%
nnualized Standard Deviation	49.865%	36.720%	54.968%	21.766%	56.447%	52.665%	59.919%	23.248%	55.941%	51.694%	59.024%	20.972%	50.415%	43.020%	53.850%	20.038%
Sample Skewness	0.132	0.052	0.090	0.359	0.206	-0.221	0.146	-0.512	0.394	-0.234	0.387	0.143	0.167	0.027	0.112	-0.714
Sample Kurtosis	-0.070	0.225	-0.012	0.817	-1.075	-0.449	-0.930	3.124	-1.519	-0.605	-1.486	-0.233	-1.509	-1.186	-1.418	4.083
Sharpe ratio	-0.674	-1.048	-0.602	0.345	-0.429	-0.772	-0.346	0.620	-0.353	-0.709	-0.272	0.729	-0.232	-0.494	-0.180	0.503
CF VaR	113.845%	98.221%	122.158%	25.699%	114.972%	131.025%	117.948%	25.650%	107.134%	125.712%	108.320%	18.467%	93.752%	92.722%	98.134%	25.111%
Reward to VaR	-0.295	-0.392	-0.271	0.292	-0.211	-0.310	-0.176	0.562	-0.185	-0.292	-0.148	0.828	-0.125	-0.229	-0.099	0.402
Omega	0.429	0.263	0.464	1.599	0.492	0.240	0.562	3.268	0.528	0.217	0.610	5.600	0.609	0.317	0.676	3.909

	6-3contrarian				6-6contrarian				6-9contrarian				6-12contrarian			
	Long	Short	130/30	market-neutral	Long	Short	130/30	market-neutral	Long	Short	130/30	arket-neut	Long	Short	130/30	market-neutral
Annualized Excess Return	-28.066%	-52.367%	-22.554%	22.681%	-22.367%	-45.186%	-17.000%	23.046%	-20.507%	-34.346%	-17.608%	16.452%	-11.154%	-22.180%	-8.662%	13.112%
nnualized Standard Deviation	49.759%	38.865%	54.854%	29.286%	58.746%	44.203%	63.364%	25.910%	58.721%	41.160%	64.119%	23.994%	51.433%	38.250%	55.449%	19.842%
Sample Skewness	0.505	-1.132	0.705	0.977	0.308	-0.293	0.368	1.148	0.324	0.274	0.289	0.654	0.202	0.109	0.187	0.735
Sample Kurtosis	0.017	0.701	0.127	1.247	-1.044	-0.950	-0.967	0.839	-1.421	-1.582	-1.370	-0.569	-1.523	-1.530	-1.465	-0.280
Sharpe ratio	-0.564	-1.347	-0.411	0.774	-0.381	-1.022	-0.268	0.889	-0.349	-0.834	-0.275	0.686	-0.217	-0.580	-0.156	0.661
CF VaR	102.614%	127.257%	101.280%	16.212%	115.057%	122.337%	115.754%	10.149%	113.315%	100.134%	119.544%	18.692%	94.367%	85.102%	98.551%	15.342%
Reward to VaR	-0.274	-0.412	-0.223	1.399	-0.194	-0.369	-0.147	2.271	-0.181	-0.343	-0.147	0.880	-0.118	-0.261	-0.088	0.855
Omega	0.504	0.113	0.607	3.292	0.534	0.140	0.643	7.909	0.526	0.188	0.600	5.394	0.627	0.271	0.712	7.383

	9-3contrarian				9-6contrarian				9-9contrarian				9-12contrarian			
	Long	Short	130/30	market-neutral	Long	Short	130/30	market-neutral	Long	Short	130/30	arket-neut	Long	Short	130/30	market-neutral
Annualized Excess Return	-32.766%	-42.831%	-31.744%	13.482%	-25.868%	-37.314%	-24.395%	15.574%	-21.788%	-31.183%	-20.158%	13.309%	-12.269%	-19.157%	-10.988%	10.491%
nnualized Standard Deviation	53.619%	28.668%	61.877%	31.899%	61.289%	38.606%	69.040%	30.150%	59.014%	40.204%	64.659%	25.583%	52.268%	35.985%	57.065%	21.265%
Sample Skewness	0.243	-0.422	0.279	1.075	0.231	-0.411	0.199	0.869	0.407	-0.068	0.435	0.790	0.226	0.009	0.235	0.813
Sample Kurtosis	-0.060	-0.516	-0.066	0.979	-1.040	-0.614	-0.941	0.368	-1.482	-1.127	-1.465	-0.604	-1.531	-1.528	-1.495	-0.408
Sharpe ratio	-0.611	-1.494	-0.513	0.423	-0.422	-0.967	-0.353	0.517	-0.369	-0.776	-0.312	0.520	-0.235	-0.532	-0.193	0.493
CF VaR	117.329%	93.615%	128.690%	28.050%	123.930%	105.663%	135.374%	26.013%	113.677%	99.007%	120.275%	23.107%	96.483%	79.371%	102.734%	19.542%
Reward to VaR	-0.279	-0.458	-0.247	0.481	-0.209	-0.353	-0.180	0.599	-0.192	-0.315	-0.168	0.576	-0.127	-0.241	-0.107	0.537
Omega	0.467	0.127	0.524	1.809	0.497	0.152	0.556	2.819	0.512	0.197	0.568	3.614	0.607	0.294	0.663	4.179

	12-3contrarian				12-6contrarian				12-9contrarian				12-12contrarian			
	Long	Short	130/30	market-neutral	Long	Short	130/30	market-neutral	Long	Short	130/30	arket-neut	Long	Short	130/30	market-neutral
Annualized Excess Return	-35.266%	-34.421%	-37.431%	3.836%	-26.853%	-34.659%	-26.435%	13.624%	-21.635%	-31.703%	-19.851%	14.576%	-12.041%	-19.852%	-10.539%	11.525%
nnualized Standard Deviation	53.152%	27.853%	61.576%	31.292%	61.955%	34.531%	70.360%	30.798%	59.772%	37.265%	65.948%	26.460%	52.622%	34.481%	57.609%	22.626%
Sample Skewness	0.245	-0.508	0.286	1.009	0.215	-0.142	0.200	1.070	0.375	0.175	0.392	0.912	0.250	-0.037	0.286	0.842
Sample Kurtosis	-0.087	-0.089	-0.140	0.766	-1.050	-1.190	-0.988	0.571	-1.451	-1.466	-1.426	-0.554	-1.562	-1.468	-1.555	-0.636
Sharpe ratio	-0.663	-1.236	-0.608	0.123	-0.433	-1.004	-0.376	0.442	-0.362	-0.851	-0.301	0.551	-0.229	-0.576	-0.183	0.509
CF VaR	119.092%	84.155%	133.875%	37.699%	126.278%	93.664%	139.574%	26.769%	115.230%	92.243%	122.762%	22.051%	98.485%	77.948%	102.374%	20.325%
Reward to VaR	-0.296	-0.409	-0.280	0.102	-0.213	-0.370	-0.189	0.509	-0.188	-0.344	-0.162	0.661	-0.125	-0.255	-0.103	0.567
Omega	0.438	0.181	0.469	1.186	0.486	0.154	0.533	2.514	0.517	0.172	0.577	4.242	0.616	0.256	0.679	4.496

Appendix I. Descriptive statistics 2008-2009