Profitable Mean Reversion after Large Price Drops: A story of Day and Night in the S&P 500, 400 Mid Cap and 600 Small Cap Indices

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Abstract

The motivation for this paper is to show the usefulness of the information contained in the open-to-close (day) and close-to-open (night) periods compared to the more frequently used close-to-close period. To show this we construct two versions of a contrarian strategy, where the worst performing shares during the day (resp. night) are bought and held during the night (resp. day).

We show that the strategies presented here generate a significant alpha and their returns cannot be solely explained by the factors derived from Fama and French (1993) 3-factor model and a modified 5-factor model introduced by Carhart (1997).

Even after we account for the bid-ask bounce effect the returns generated are significant and consistent. The information ratios of the two strategies mentioned for the entire period 2000-2010 vary between *1.59* and *6.70* depending on the capitalization of stocks. Overall, we show that opening prices contain information that is not generally fully utilized yet. The strategy proposed uses this information to add value and extract a significant alpha which cannot be explained by market factors

Keywords

Price shock, overreaction, delayed reaction, contrarian profits, multi-factor models

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1. INTRODUCTION

The motivation for this study is the existence of contrarian returns which have been diminishing recently, see e.g. Khandani and Lo (2007). Many papers investigate the profitability of the contrarian/mean reverting strategies, or strategies of buying losers and selling winners. But all those papers calculate returns from close-to-close and do not take opening prices into account. To our knowledge there are no papers investigating the profitability of the contrarian strategy - where the holding period is close-to-open (night) or open-to-close (day) instead of a standard close-to-close period.

The existence of contrarian profits can be partly explained by the overreaction hypothesis, see e.g. Lo and MacKinlay (1990). A negative autocorrelation in returns is the common assumption for most overreaction theories, Lo and MacKinlay (1990). Yet there are also overreaction theories that try to explain the contrarian profits exclusively after large price falls, see e.g. Choi and Jayaraman (2009). This is a weaker condition as returns do not even have to be negatively autocorrelated. There only has to be contrarian profits after large price declines. In this paper we focus exclusively on this situation and investigate whether in conjunction with the non-standard holding periods (either day or night) one might obtain an "edge" over other more traditional strategies.

The rest of the paper is organized as follows. In section 2, we present the literature review, section 3 describes the data used and section 4 presents the contrarian strategy. Section 5 gives the performance results of the contrarian strategy and presents them by decile, by year and proves that the strategy is profitable even after the inclusion of the bid-ask bounce. In section 6 we try to explain the contrarian profits by multi-factor models and section 7 concludes.

2. LITERATURE REVIEW

2.1. Predictability of returns

There are various studies on the short- and long-term predictability of stock market returns [e.g. Thaler and De Bondt (1985), Kim *et al.* (1991)]. One of the first studies on the long-term predictability of the individual stock market returns is described in Thaler and De Bondt (1985). They divide the companies into two groups, extreme winners and extreme losers, and compare their performance. They form 2 portfolios (consisting of *n* worst and *n* best performing stocks) based on the past 3-year performance. The portfolios are subsequently rebalanced every 3 years. 3 years after the portfolio formation they show that the portfolios consisting of the past losers beat the past winners by 25%. The outperformance continues as late as 5 years after the portfolios have been formed.

Fama (1997) provides an extensive literature review on long-term market inefficiencies, nevertheless the author states a few reasons why those papers do not invalidate the existence of the efficient market hypothesis. The most important one according to Fama (1997, p. 6) is that most anomalies are "shaky" and tend "to disappear when reasonable alternative approaches are used to measure them".

Money managers and hedge funds are more interested in exploiting the short-term anomalies as opposed to the long-term ones because they need to report investment

results (e.g. information ratios[1]) to investors every month or every week. It also takes much less time to test the short-term anomaly in practice, as one needs to test it during much shorter time frames which partly motivates our decision to look at the short-term market reversal anomaly instead of the longer-term one.

2.2. Contrarian strategies

There are two main ways of exploiting the predictability of short-term returns, which are referred to as the contrarian and momentum strategies. Contrarian strategies benefit from the overreaction to an isolated event, which results in the trend reversal and contrarian signs of return after the event as opposed to during the event itself. On the other hand, momentum strategies benefit from slowly spreading news about the event among investors, which results in the same sign of returns after the event as during the event, see Forner and Marhuenda (2003).

McInish *et al.* (2008) look at the performance of the simple momentum and contrarian strategies in the seven Pacific-Basin capital markets during 1990-2000. They find that the contrarian profits are persistent and profitable only in Japan, and momentum profits are persistent and profitable in Japan and Hong Kong. In the remainder of this paper however, we focus exclusively on the contrarian strategies.

Serletis and Rosenberg (2009) calculate the Hurst exponent for the four major US stock market indices during 1971-2006 and find that the returns display anti-persistent or mean reverting behaviour.

Leung (2009) investigates the return behaviour of the US stocks during 1963-2007. In his study the shares are first ordered based on past returns and then on market capitalization. He finds significant short- and long-term mean reverting behaviour of the returns.

2.3. Overreaction hypothesis

It is important to understand the precise source of the returns when devising a strategy. The overreaction hypothesis states that extreme movements in the stock prices are followed by moves in the opposite direction that partly offset the initial move. The original extreme move is caused by the overreaction to firm-specific news. However, as in Lo and MacKinlay (1990, p. 116), “a well-articulated equilibrium theory of overreaction with sharp empirical implications has yet to be developed”.

Bali *et al.* (2008) test the non-linear mean reverting behaviour as an alternative hypothesis to the existence of the random walk and find that the speed of the mean reversion is higher during periods of large falls in prices.

As to the possibility to profit from extreme price moves, it is enough that stocks that fell the most during any day bounce back during the subsequent period. They do not have to bounce back after all the falls and thus do not even have to be negatively autocorrelated. Therefore a possibility to profit from extreme price movements caused by the overreaction in individual stock market prices is a weaker condition to fulfil than the existence of the mean reverting behaviour.

[1] In this paper the information ratio is calculated as the ratio of annualized return to annualized standard deviation, see Appendix a.

2.4. Stock returns following large price declines

Gaunt and Nguyen (2008) look at the behaviour of Australian stocks after 5% or more daily declines. The results suggest that there is a short-term price reversal after the sharp price decline. Market microstructure (bid-ask bounce) plays an important role in the short-term price reversal (more on this below). The target stocks continue to underperform the stock market index during the following 100 days.

Mazouz *et al.* (2009) use the constituents of the FTSE-ALL Index in the period 1992-2003. They take the average bid-ask price into account in order to account for a bid-ask bounce and find a continuation of the return behaviour in the direction of the shock. Thus, the study finds significant positive returns after a shock of more than 5% and significant negative returns after a negative shock of the same magnitude, which is in contrast with Choi and Jayaraman (2009).

2.5. Bid-ask bounce effect

The bid-ask bounce is an illusionary effect of a share price change, when there is actually none. This occurs as the trades occur once at a bid and once at an ask price. This bears important conclusions upon the short term contrarian strategy. If the last transaction of the day has occurred at a bid, the first trade the next trading day at an ask and the bid-ask spread is large for a share, it might seem that there was a significant rebound when there was actually none. In such case the entire profitability of the contrarian strategy would be attributable to the existence of a wide bid-ask spread.

Morse and Ushman (1983) found significant increases in the bid-ask spreads on the day of a large price change in stocks. Park (1995) looked at the influence of the bid-ask bounce on the next day's returns after large price changes. Instead of closing prices, the author used the average bid-ask price. As a result, previously reported profitability of a simple strategy based on the price reversal in the close-to-close period was not found any more after taking TC into account.

Because of the existence of the bid-ask bounce we also show the profitability of a simple reversal strategy based upon close-to-close returns and compare its results with our alternative strategies based on different trading frequencies. With the latter, we obtain much larger and more consistent profits. As a result even if the entire profit of the close-to-close price reversal strategy is due to the bid-ask bounce and is not achievable in practice, our strategy can still be profitable due to the far superior returns achieved.

2.6. Opening gaps and periodic market closures

De Gooijer *et al.* (2009) try to predict the home market opening price by taking into account the overnight price pattern of the foreign markets. They find the existence of non-linear relationships.

Cliff *et al.* (2008) decompose the market returns of the S&P Index stocks between day (open-to-close) and night (close-to-open). They investigate the period 1993-2006 and find that the night returns are strongly positive and the day returns are very close to 0. They find that the night returns are consistently higher than the day returns, and this holds across days of the week, weeks of the months and months of the year. The effect is partly driven by the higher opening prices which decline during the first trading hour of the session. However, they state that there is not a general

consensus in the literature whether returns are higher over the trading or non-trading periods. Cliff *et al.* (2008, p. 2) affirm that the impact of the periodical market closes "on the first moment of stock returns is still not fully understood". This also partly motivates our decision to look at the contrarian returns during the trading and non-trading part of the session and see whether they differ from the contrarian profits in the entire session (close-to-close).

Hong and Wang (2000) investigate how market closures affect investor behaviour. They find a U-shaped return pattern in the mean and volatility of returns over the trading periods, more volatile open-to-open returns than close-to-close returns and contrary to Cliff *et al.* (2008) higher returns during the trading periods than during the non-trading periods.

3. RELATED FINANCIAL DATA AND TRANSACTION COSTS

3.1. Data sources

In this paper we use the stocks that constituted the three indices - the S&P 500 Index, the S&P 400 MidCap Index and the S&P 600 SmallCap Index - on 12th February 2010. The data span from 30th May 2000 to 12th February 2010, which amounts to 2353 trading days. We use the opening and closing prices that have automatically been adjusted for dividends and stock splits by Bloomberg. If a particular share does not have a price recorded on certain days (e.g. because it was not listed back then yet), our universe is smaller on these dates.

The price at which the first transaction on a particular day was recorded is the opening price, and the price at which the last transaction on a particular day was recorded is the closing price. Thus, we have trade prices at our disposal and will not consider bid-ask spread in the paper. (However, we show later that our strategy would not be affected by a bid-ask bounce effect). Nevertheless, we take into account TC of *0.05%* of the transacted amount one way. This is a level charged for an individual investor[2].

While it is possible to trade after hours on the US markets, after-hours trading introduces lower liquidity and therefore higher bid-ask spreads. In practice our strategy would preferably be traded in a modified form. One would not wait for a closing price to make decision, but would execute the transaction a few seconds before the market closes, basing one's decision on that particular price. While it is possible that such a procedure might deteriorate our results as reported in this paper, it is improbable that a significant part of the profit would be sacrificed by such a procedure.

3.2. Day and night return characteristics

In this section we present the equally weighted return of the constituent shares of the 3 indices during the day and during the night. The aim is to investigate the differences in returns which might exist in exclusive daily or nightly ownership of the constituent shares as already mentioned in Cliff *et al.* (2008) or Hong and Wang (2000).

[2] For instance see http://interactivebrokers.com/en/p.php?f=commission&ib_entity=llc where the fee is USD 0.0035 per share, which amounts to 0.05% if the nominal value of share is USD 7. Note that the fee decreases proportionally as the nominal value of the share increases.

First, for each share considered we calculate two different return series as:

$$R_1 = \ln(P_D^C / P_D^O) \tag{1}$$

$$R_2 = \ln(P_{D+1}^O / P_D^C) \tag{2}$$

where P_D^C is the closing price of share on day D and P_D^O is the opening price of share on day D. From Equation (2), P_{D+1}^O is the opening price on day D+1 and P_D^C is the closing price on day D.

Subsequently we calculate an equally weighted average daily return across all the shares belonging to the index (either S&P 500, 400 MidCap or 600 SmallCap) as:

$$\bar{R}_1 = \frac{\sum_1^n R_1}{n} \tag{3}$$

$$\bar{R}_2 = \frac{\sum_1^n R_2}{n} \tag{4}$$

where R_1 is the return series of any share calculated as in Equation (1), n is the number of shares in any particular index and $\bar{R}_1$ is an equally weighted average daily return for the constituent stocks of the index. R_2 is the return series of a share calculated as in Equation (2) and $\bar{R}_2$ is an equally weighted average daily return.

In such a way we obtain two return distributions for each of the three indices, thus altogether 6 return distributions.

Index & Period	S&P 500 O-C	S&P 500 C-O	S&P 400 MidCap O-C	S&P 400 MidCap C-O	S&P 600 SmallCap O-C	S&P 600 SmallCap C-O
Avg Return	0.007%	0.007%	0.044%	-0.022%	0.040%	-0.022%
Median Return	0.051%	0.040%	0.086%	0.007%	0.068%	-0.007%
Maximum Return	7.40%	5.64%	8.24%	6.23%	9.14%	5.19%
Minimum Return	-9.50%	-7.30%	-9.27%	-8.24%	-10.61%	-9.14%
St. Dev.	0.0124	0.0071	0.0134	0.0066	0.0145	0.0066
Number of Up Periods	1339	1374	1383	1296	1341	1249
Number of Down Periods	1194	1158	1150	1236	1192	1283
Avg Gain in Up Periods (ex TC)	0.79%	0.40%	0.88%	0.36%	1.00%	0.38%
Avg Loss in Down Periods (ex TC)	-0.87%	-0.46%	-0.97%	-0.42%	-1.04%	-0.41%

Table 1. Trading statistics for various indices. The strategy buys an equal proportion of all the constituent shares in the index and holds them during the Open-Close or Close-Open period only, respectively.

In Table 1 just above we can see the descriptive statistics of holding the equal proportion of shares of the mentioned indices either only during night (close-open) or only during day (open-close).

The mean return of the strategy that buys all the shares that belong to the S&P 500 Index in equal proportion on open of day D and sells them on close of day D is *0.007%* (without TC). The generated return would not survive any reasonable level of TC. The maximum and minimum daily returns are *7.4%* and *-9.5%*, respectively, over the period considered. The mean return of buying the shares belonging to the

S&P 500 Index in equal proportion on close of day D and selling them on open of day D+1 is also *0.007%* (without TC), similar to the one shown in the first column. Maximum and minimum daily returns are *5.6%* and *-7.3%* respectively over the period considered. Thus, the average return of holding the shares during day and night is very similar for the constituent stocks of S&P 500 Index and is slightly positive for both.

In columns 3 and 4 we show the return distribution of the equally weighted constituent shares of the S&P 400 MidCap Index with holding periods during day and night, respectively. The average return for daily holding period is *0.0443%*, a bigger number than was the case for the S&P 500 Index, but still too low to be profitable after the inclusion of TC. The average return for holding the shares only during the night is *-0.0215%*. Thus, the daily returns are positive and overnight negative for the S&P 400 MidCap Index constituents.

In columns 5 and 6 we show the return distribution of the equally weighted constituent shares of the S&P 600 SmallCap Index. It is similar in magnitude to the one observed on the constituent shares of the S&P 400 MidCap Index (see columns 3 and 4) and amounts to *0.04% and -0.02%*, respectively.

In summary, we obtain results in line with Hong and Wang (2000) as daily returns are higher than night returns for the 2 of the 3 indices investigated. However, daily returns are not sufficiently large so that the investor can try to be invested exclusively during the day. The existence of TC of *0.05%* would deem such an intent as unprofitable. However, the difference between the returns during day and night might mean that a shorter holding period (either day or night) will make the strategy of buying extreme losers more profitable compared to holding them during entire session (24 hours).

4. TRADING STRATEGY

Our strategies attempt to exploit the mean reverting behaviour of the largest losers either during the day or night.

The first version of the strategy (version 1) buys *n* worst performing shares during the close-to-open period (decision period) where close is the closing price today and open the opening price tomorrow. The shares are bought at the market open tomorrow for the opening price, held and sold for the closing price tomorrow. The shares are equally weighted in the portfolio.

The second version of the strategy (version 2) buys *n* worst performing shares during the open-to-close period (decision period). The shares are bought when the market closes, and held until the next day's market open. They are subsequently sold for the opening price. The shares are equally weighted in the portfolio.

For comparison we also present the benchmark strategy which consists of buying *n* worst shares during an entire session [close (D) - close (D+1)]. The shares are bought on close (D+1) and held until the next day's close (D+2). Although the benchmark strategy only executes transactions at close, it will have the same amount of transactions as both versions of the strategy described just before. The only difference is the length of the holding period, where it is the entire session for

the benchmark strategy (24 hours) and either day or night (7.5 hours or 16.5 hours) for our 2 versions. For instance, for daily strategy, we buy shares at the market open, and sell them at the market close. Thus, during entire market session (24 hours) we have made 2 transactions (buy and sell). The same applies for the benchmark strategy, where the shares are bought at the close, and sold at the subsequent market close.

One of the reasons we investigate two daily sub-periods is potentially more difficult tradability around the market opening time. Although we dispose of the first and last traded price during the day, it might be impossible to consistently execute transactions at the official market opening price as is well-known among practitioners. Therefore, by testing the two versions of the strategy, we can prove that at least one of them is profitable in practice. The first benefits from lower than recorded opening price, and the second from higher than recorded opening price. If both versions of the strategy prove profitable in the backtests, we have shown that in real trading at least one of them will be making money. In a real trading, consistently lower/higher opening prices than the ones we used will make version 1 more/less and version 2 less/more profitable.

5. STRATEGY PERFORMANCE

5.1. Strategy performance by decile

In Table 2 below we summarize the trading statistics of version 1 of the strategy. The table contains the strategy applied to the constituent stocks of the S&P 600 SmallCap Index. The performance is divided into 10 deciles. The first decile contains the stocks with the largest decline during the decision period. The tenth decile contains the stocks with the best performance during the decision period. Thus the first decile will probably not contain the same shares during two consecutive holding periods. This would only occur if the same shares were the worst during two consecutive decision periods. Furthermore, stocks in all deciles are equally weighted.

The first 3 deciles are profitable even after TC (information ratio after TC is above *0*). Next, we only focus on the first 2 deciles, as these offer attractive return characteristics for investors. Although information ratios for the first 2 deciles are very attractive (*6.7* and *2.0* after TC), the strategy is still very volatile, maximum drawdowns being around *48%* and *39%*, respectively. Nevertheless, this is more than compensated by annualized returns of *215%* and *53%*. It might be worth exploring the short selling of the tenth decile stocks as information ratios decline consistently from the first to the tenth decile. However, buying the first decile stocks is profitable on its own and there might be constraints to short selling some shares in practice. Therefore we chose not to explore this option in the paper, although it might clearly improve the characteristics of the strategy.

The first decile is profitable not only because of higher average gains in up periods than losses in down periods (*1.74%* vs. *-1.16%*), but also because of more frequent up periods than down periods (*1844* vs. *689*). As one moves towards the tenth decile, the number of up periods falls in such a way that the tenth decile has almost the opposite ratio of up vs. down periods compared to the first decile. Also the

average gain in up periods is smaller (*1.13%*) than the average loss in down periods (*-1.59%*) for the tenth decile stocks.

Decile	1	2	3	4	5	6	7	8	9	10
Information Ratio (ex TC)	7.49	2.98	1.56	0.76	0.39	-0.13	-0.63	-1.25	-2.47	-5.69
Information Ratio (incl. TC)	6.70	2.01	0.51	-0.34	-0.74	-1.27	-1.74	-2.34	-3.47	-6.53
Cumulative Return (incl. TC)	2157%	528%	121%	-78%	-166%	-283%	-395%	-546%	-880%	-1974%
Annualised Return (incl. TC)	215%	53%	12%	-8%	-17%	-28%	-39%	-54%	-88%	-196%
Annualised Volatility (incl. TC)	32.0%	26.1%	23.8%	23.0%	22.5%	22.1%	22.5%	23.2%	25.2%	30.1%
Maximum Daily Profit (ex TC)	21.6%	14.5%	12.0%	10.5%	9.0%	8.2%	8.5%	8.6%	9.1%	8.2%
Maximum Daily Loss (ex TC)	-13.6%	-14.3%	-11.8%	-11.8%	-9.4%	-10.1%	-10.6%	-10.7%	-11.3%	-13.5%
Maximum Drawdown (ex TC)	48%	39%	52%	61%	52%	99%	182%	318%	665%	1761%
Maximum Drawdown Duration (ex TC)	54	144	280	289	315	1579	2502	2525	2530	2530
Number of Up Periods (ex TC)	1844	1551	1451	1375	1317	1283	1233	1187	1102	849
Number of Down Periods (ex TC)	689	982	1082	1158	1215	1250	1300	1346	1431	1684
Avg Return (ex TC)	0.95%	0.31%	0.15%	0.07%	0.03%	-0.01%	-0.06%	-0.12%	-0.25%	-0.68%
Avg Gain in Up Periods (ex TC)	1.74%	1.21%	1.05%	0.99%	0.98%	0.95%	0.98%	1.00%	1.04%	1.13%
Avg Loss in Down Periods (ex TC)	-1.16%	-1.11%	-1.06%	-1.03%	-0.99%	-1.00%	-1.04%	-1.10%	-1.24%	-1.59%

Table 2. Version 1 of the strategy applied to the constituent stocks of the S&P 600 SmallCap Index. Decision period is from today's close to the next day's open and holding period from the next day's open to the next day's close. The results are divided into deciles. The first decile contains the worst performing shares during the decision period, the tenth decile the best ones.

In Table 3 below we show the performance of version 2 of the strategy. Thus this time, compared to Table 2, the decision and holding periods are swapped. The decision period is the day and the holding period is the night. The table contains the results of applying the strategy to the constituent stocks of the S&P 600 SmallCap Index. Again, we divided the performance into deciles. The first decile contains the worst performing shares during the decision period.

Decile	1	2	3	4	5	6	7	8	9	10
Information Ratio (ex TC)	5.46	2.72	1.69	0.51	-0.26	-1.06	-1.61	-2.53	-3.13	-5.03
Information Ratio (incl. TC)	4.06	0.66	-0.64	-1.94	-2.76	-3.56	-3.95	-4.69	-4.98	-6.21
Cumulative Return (incl. TC)	734%	81%	-70%	-201%	-279%	-361%	-427%	-550%	-681%	-1336%
Annualised Return (incl. TC)	73%	8%	-7%	-20%	-28%	-36%	-43%	-55%	-68%	-133%
Annualised Volatility (incl. TC)	18.0%	12.2%	10.8%	10.3%	10.1%	10.1%	10.8%	11.7%	13.6%	21.4%
Maximum Daily Profit (ex TC)	9.5%	5.2%	4.3%	4.9%	4.9%	4.6%	5.1%	5.6%	6.5%	7.7%
Maximum Daily Loss (ex TC)	-7.0%	-6.7%	-6.6%	-6.5%	-7.8%	-9.0%	-10.5%	-12.0%	-14.5%	-21.6%
Maximum Drawdown (ex TC)	11%	16%	24%	37%	51%	125%	190%	308%	436%	1084%
Maximum Drawdown Duration (ex TC)	44	126	296	819	1848	2525	2531	2531	2520	2531
Number of Up Periods (ex TC)	1722	1479	1427	1319	1218	1157	1117	1062	1035	931
Number of Down Periods (ex TC)	810	1053	1105	1213	1314	1374	1415	1470	1497	1601
Avg Return (ex TC)	0.39%	0.13%	0.07%	0.02%	-0.01%	-0.04%	-0.07%	-0.12%	-0.17%	-0.43%
Avg Gain in Up Periods (ex TC)	0.82%	0.54%	0.45%	0.40%	0.39%	0.37%	0.38%	0.39%	0.41%	0.46%
Avg Loss in Down Periods (ex TC)	-0.53%	-0.43%	-0.42%	-0.40%	-0.38%	-0.39%	-0.42%	-0.48%	-0.57%	-0.94%

Table 3. Version 2 of the strategy applied to the constituent stocks of the S&P 600 SmallCap Index. Decision period is from today's open to today's close and holding period is from today's close to the next day's open. The results are divided into deciles. The first decile contains the worst performing shares during decision period, the tenth decile the best ones.

As shown in Table 3, the information ratios without TC in the first 4 deciles are very attractive. However, when TC are taken into account, only the first two deciles remain profitable. Again, there is a clear structure present in the table across deciles, as was the case in Table 2. Profitability constantly decreases, when we move towards the higher deciles. Information ratios (both with and without TC) for most deciles were more attractive in Table 2 than in Table 3. Furthermore we only compare the trading statistics of the first two deciles, as only these are suitable for trading. The strategy presented in Table 3 is less volatile than the one presented in Table 2, as its annualised volatility is lower for the first two deciles (*18.0%* and *12.2%*

vs. *32.0%* and *26.1%*). This is also confirmed by a smaller spread for the first 2 deciles between the maximum daily profit (*9.5%* and *5.2%*) and maximum daily loss (*-7.0%* and *-6.7%*) than in Table 2. Also the maximum drawdown is significantly lower for the first two deciles in Table 3 (*11%* and *16%*) than in Table 2 (*48%* and *39%*). However, the edge of the second strategy variation seems to be smaller, as the average daily return is *0.39%* compared to *0.95%* for the first decile stocks and only *0.13%* compared to *0.31%* for the second decile stocks. However, both versions of the strategy are profitable for the first 2 deciles when applied to the constituent stocks of the S&P 600 SmallCap Index.

Furthermore, we describe the results for S&P 400 MidCap and S&P 500 Index, however corresponding tables are included in Appendices b-e. In Table 11 in Appendix b we present the results of version 1 of the strategy (same as in Table 2) applied to the constituent stocks of the S&P 400 MidCap Index. The information ratios without TC are lower than in Table 2 for the first five deciles. From decile 6 until 10 the information ratios are higher in Table 11. This means that the overreaction is not as strong for mid cap stocks as it was for small caps. The stocks that fell the most in the decision period do not subsequently rise so strongly and on the other hand stocks that rose in the decision period do not fall as sharply as was the case for small cap stocks. The information ratios with TC for the first 2 deciles are *3.98* and *1.03* compared to *6.70* and *2.01* from Table 2.

In Table 12 in Appendix c we show the performance of version 2 of the contrarian strategy applied to the constituent stocks of the S&P 400 MidCap Index. Again, its performance is worse compared to version 1 applied to the same universe of stocks (for comparison see Table 11). The information ratios (both with and without TC) are higher in Table 11 than in Table 12. On the other hand, volatility is significantly lower for version 2 of the strategy (*16.6%* compared to *28.5%* for the first decile stocks). This is also confirmed by a lower maximum drawdown (*13%* compared to *60%* for the first decile stocks). When we compare version 2 of the strategy applied to the small (Table 3) and mid cap (Table 12) stocks, the small cap universe offers better investment characteristics for the first 5 deciles. Thus, again as was the case for version 1 of the strategy, the overreaction is stronger for small cap stocks than it is for mid cap stocks.

In Table 13 in Appendix d we present the results of applying version 1 of the strategy to the constituent stocks of the S&P 500 Index. When we focus on the first decile results, we can see that the strategy is still profitable and although the information ratios are worse than in the case of small and mid cap stocks, they are still attractive for investors. The information ratios after TC for the first decile stocks for small, mid and large cap stocks are *6.70*, *3.98* and *1.85*.

Finally, in Table 14 in Appendix e we present version 2 of the strategy applied to the constituent stocks of the S&P 500 Index. The only decile that is profitable is the first decile and that is why we will exclusively focus on it. Surprisingly and unlike in the previous two cases (application of version 2 of the strategy to small and mid cap stocks), version 2 of the strategy seems to offer better investment characteristics for the big cap stocks than version 1. Information ratios (both with and without TC) are bigger in Table 14 than in Table 13. The maximum drawdown for version 2 is only *14.0%* and the annualized volatility *17.7%*. Version 2 of the strategy applied to the

large cap stocks is even more attractive than it was when applied to the mid cap stocks (information ratio with TC of *3.24* vs. *1.59* as in Table 12).

5.2. Strategy performance by year

In Table 4 below we show the information ratios of the benchmark strategy (close-to-close) by year. Only the most profitable stocks, the first decile stocks, are shown. It can be seen from the table that when applied to the constituent stocks of the S&P 500 Index, the strategy did not perform well in the time period investigated. The best performance was achieved on the constituent stocks of the S&P 600 Small Cap Index. The information ratios achieved in the period 2000-2006 are positive, nevertheless, from 2007 it was not consistently profitable any more. Results are gradually worse for the S&P 400 MidCap Index and S&P 500 Index constituents.

	Information Ratio (incl. TC)		
Year	**S&P 600 SmallCap Index**	**S&P 400 MidCap Index**	**S&P 500 Index**
2000	2.88	1.38	-0.44
2001	2.32	0.39	-0.23
2002	1.23	-0.36	-0.16
2003	2.85	1.77	0.58
2004	2.51	1.60	-0.01
2005	0.88	1.18	-0.28
2006	0.98	-0.42	-0.60
2007	-0.60	-1.05	-1.62
2008	-1.22	-0.92	-0.90
2009	0.95	1.23	1.67
2010	-4.53	-3.86	-2.87

Table 4. A breakdown of the performance of the benchmark strategy by year. The strategy is applied to the constituent stocks of the 3 indices and information ratios reported here correspond to the first decile stocks in each index.

In Table 5 below, the information ratios of version 1 of the strategy are shown by year. Again we only show the result for the first decile stocks. We can see that it achieved high information ratios during most years. The 2010 readings should be interpreted with care, as our dataset finishes on 12th February 2010. However, there seems to be a general tendency of decreasing information ratios as we move towards 2010 from 2000.

	Information Ratio (incl. TC)		
Year	**S&P 600 SmallCap Index**	**S&P 400 MidCap Index**	**S&P 500 Index**
2000	14.59	9.85	2.72
2001	17.05	8.56	4.26
2002	14.10	4.52	2.15
2003	16.92	8.36	4.28
2004	12.32	7.55	4.09
2005	7.27	4.20	1.72
2006	3.65	3.38	1.48
2007	1.38	2.19	0.83
2008	0.83	0.61	0.06
2009	1.63	2.17	1.47
2010	-1.22	-0.31	-0.89

Table 5. A breakdown of the performance of the version 1 of the strategy by year. The strategy is applied to the constituent stocks of the 3 indices and information ratios reported here correspond to the first decile stocks in each index.

In Table 6 below we show the breakdown of information ratios by year for version 2 of the strategy. Although there seems to be a tendency of decreasing information

ratios as one moves towards 2010, recent years still show quite a strong performance.

	Information Ratio (incl. TC)		
Year	S&P 600 SmallCap Index	S&P 400 MidCap Index	S&P 500 Index
2000	8.09	3.98	1.85
2001	6.83	2.64	2.67
2002	6.60	1.21	3.20
2003	6.49	2.86	5.89
2004	6.35	3.06	7.28
2005	3.07	2.54	9.35
2006	0.67	-1.18	4.72
2007	1.27	0.37	4.34
2008	0.60	-0.22	1.14
2009	2.64	1.54	3.21
2010	1.77	0.67	1.11

Table 6. A breakdown of the performance of the version 2 of the strategy by year. The strategy is applied to the constituent stocks of the 3 indices and information ratios reported here correspond to the first decile stocks in each index.

We conclude that although in recent years the strategy (both version 1 and 2) seems to have lost some power, we certainly see scope to still exploit this inefficiency in the future.

5.3. Bid-ask bounce

The results of our strategy should also be immune to an inclusion of a bid-ask spread. According to Park (1995), the profitability of a mean reversion strategy disappears once the average bid-ask price is used instead of a closing price. In other words the author states that the most significant part of the close-to-close contrarian strategy is caused by the bid-ask bounce and is not achievable in practice.

There is no reason to suppose that our strategy's bid-ask spread should be on average higher than the one in the close-to-close strategy (where the close-to-close period is the decision period and the subsequent close-to-close the holding period). Thus, if we can show that the profitability of our strategy is well in excess of the simple contrarian strategy where the returns are calculated from close-to-close, we have shown that our strategy is profitable even if we include the bid-ask spread. Thus, all the excess return of our strategy compared to the close-to-close strategy should be practically achievable in the US stock market.

In Table 7 below we show the excess returns of the two versions of our strategy over the close-to-close strategy (benchmark strategy). The table only contains the results for the first decile stocks and thus the most profitable ones. The results are still very attractive, with the information ratios including TC ranging from *1.35* to *5.87*. Returns are positive and significant in all cases.

Constituent stocks of	S&P 600 SmallCap		S&P 400 MidCap		S&P 500	
Version	1	2	1	2	1	2
Information Ratio (ex TC)	5.89	3.86	3.84	2.08	2.10	4.06
Information Ratio (incl. TC)	5.87	3.23	3.74	1.35	2.00	3.40
Cumulative Return (incl. TC)	1897%	474%	1068%	192%	593%	627%
Annualised Return (incl. TC)	188%	46%	106%	19%	59%	63%
Avg Return (ex TC)	0.75%	0.18%	0.42%	0.07%	0.23%	0.25%

Table 7. The excess returns of the 1st decile stocks of various indices over the contrarian strategy when the holding and decision period is close-to-close. Both versions of our strategies are shown. All the

statistics have been calculated as the difference between our strategies and the close-to-close benchmark strategy.

6. MULTI-FACTOR MODELS

Here we show how much of our strategy's return is attributable to style factors. We use a classical CAPM model by Sharpe (1964), see Equation (5) below, Fama and French (1992) 3-factor model, see Equation (6) below, and an adjusted Carhart's [Carhart (1997)] 5 factor model, where we add the reversion as the 5th factor, see Equation (7) below:

$$r^s{}_t - r^f{}_t = \alpha + \beta(r^m{}_t - r^f{}_t) + \varepsilon_t \quad (5)$$

$$r^s{}_t - r^f{}_t = \alpha + \beta_1(r^m{}_t - r^f{}_t) + \beta_2 SMB_t + \beta_3 HML_t + \varepsilon_t \quad (6)$$

$$r^s{}_t - r^f{}_t = \alpha + \beta_1(r^m{}_t - r^f{}_t) + \beta_2 SMB_t + \beta_3 HML_t + \beta_4 MOM_t + \beta_5 REV_t + \varepsilon_t \quad (7)$$

In Table 8 just below, the detailed description of the factors used in Equations (5), (6) and (7) can be found.

Factor[3]	Description
$r^s{}_t$	return of a given strategy on day t
$r^f{}_t$	risk-free return (calculated as the one-month Treasury bill rate)
$r^m{}_t$	market return on all NYSE, AMEQ and NASDAQ stocks (from CRSP)
ε_t	residual of the regression on day t
SMB_t	A Fama-French factor calculated using the 6 portfolios formed on size and book-to-market. It is the average return of the three small portfolios minus the average return of the three big portfolios calculated as: $SMB = \frac{1}{3}(Small\_Value + Small\_Neutral + Small\_Growth) - \frac{1}{3}(Big\_Value + Big\_Neutral + Big\_Growth)$ (8)
HML_t	A Fama-French factor calculated as the average of the two value portfolios minus the average of the two growth portfolios: $HML = \frac{1}{2}(Small\_Value + Big\_Value) - \frac{1}{2}(Small\_Growth + Big\_Growth)$ (9)
MOM_t	A Fama-French obtained from 4 portfolios formed at the beginning of every month *M*. The portfolios are based on the size and previous (*M-2* to *M-12*) months total return. Thus, all the shares have been divided into 1 of the 4 groups: small cap high return, big cap high return, small cap low return and big cap low return. The prior month return (*M-1*) is excluded from the calculation due to a well known reversion in momentum portfolios. $MOM = \frac{1}{2}(Small\_HighRET + Big\_HighRET) - \frac{1}{2}(Small\_LowRET + Big\_LowRET)$ (10)
REV_t	A short term reversion Fama-French factor constructed using 4 portfolios which are formed based on size and prior 1 month returns. The REV_t factor is calculated as follows: $REV = \frac{1}{2}(Small\_LowRET + Big\_LowRET) - \frac{1}{2}(Small\_HighRET + Big\_HighRET)$ (11)

Table 8. Description of the factors used in Equations (5), (6) and (7).

[3] Market return, risk-free rate and all the subsequent factors (*HML, SMB, MOM* and *REV*) used in this section have been downloaded from the website: http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html. (Accessed on 3rd May 2010). All the factors are calculated daily based on monthly rebalanced portfolios.

In Table 9 below we present the results of applying the regressions based on the models described just above to version 1 of the strategy on the constituent stocks of the S&P 600 SmallCap Index. The regressions were only applied to the first decile stocks in all cases analysed in this section. The explanatory power of all the models is quite high (*0.45* for CAPM and *0.60* for both 3- and 5-factor models). All the models estimate similar and significant alpha of around *0.76%*. This shows that version 1 of our strategy indeed adds value. Also note that Carhart's regression properly identifies our strategy as a contrarian one, where β_4 (the momentum factor) is a negative *-0.12* and β_5 (the reversion factor) is a positive *0.07.*

	α	β_1	β_2	β_3	β_4	β_5
CAPM						
coefficient	0.0079	0.88				
t-stat	29.42	44.83				
p-value	0.00	0.00				
R-squared	0.45					
Fama-French 3 factor model						
coefficient	0.0076	0.87	1.13	0.35		
t-stat	32.75	52.11	28.98	10.36		
p-value	0.00	0.00	0.00	0.00		
R-squared	0.60					
Carhart + Reversion						
coefficient	0.0076	0.80	1.15	0.33	-0.12	0.07
t-stat	32.74	39.17	29.48	9.49	-5.31	2.83
p-value	0.00	0.00	0.00	0.00	0.00	0.00
R-squared	0.60					

Table 9. 3 different factor models applied to the returns generated by the version 1 of the strategy applied to the constituent stocks of the S&P 600 SmallCap Index. The regressions were only applied to the first decile stocks.

In Table 10 below we present the results of applying the regression models to version 2 of the strategy to the constituents stocks of the S&P 600 SmallCap Index. The explanatory power of all the models is very similar (R-squared of *0.19* for all of them) and lower than in case of version 1 (Table 9). All the models estimate similar and significant alpha of around *0.2%*. Although the estimated alpha is smaller than the one obtained with version 1, it is still positive and significant. Thus, both versions of the strategy seem to add value when applied to the constituent stocks of the S&P 600 SmallCap Index and there is a significant alpha which cannot be explained by market factors.

	α	β_1	β_2	β_3	β_4	β_5
CAPM						
coefficient	0.002	0.26				
t-stat	15.90	23.95				
p-value	0.00	0.00				
R-squared	0.19					
Fama-French 3 factor model						
coefficient	0.002	0.26	-0.03	0.07		
t-stat	15.80	23.98	-1.07	3.16		
p-value	0.00	0.00	0.28	0.00		
R-squared	0.19					
Carhart + Reversion						
coefficient	0.002	0.24	-0.02	0.07	-0.02	0.03
t-stat	15.60	18.13	-0.86	3.14	-1.40	2.09
p-value	0.00	0.00	0.39	0.00	0.15	0.03
R-squared	0.19					

Table 10. 3 different factor models applied to the returns generated by the version 2 of the strategy applied to the constituent stocks of the S&P 600 SmallCap Index. The regressions were only applied to the first decile stocks.

We also analyse the strategy results (both version 1 and 2) when applied to the constituent stocks of the S&P 400 MidCap and S&P 500 Indices. The results can be found in the Appendices f-i. Here we summarize that for all the shares in question and both versions of the strategy, alpha is significant and positive. Alphas generated by versions 1 and 2 of the strategy when applied to the constituent stocks of the S&P 400 MidCap Index are *0.4%* and *0.1%*, respectively. Alphas of the 2 versions when applied to the constituent stocks of the S&P 500 Index are both *0.2%*. This further confirms that both versions of our strategy add value as they extract a significant alpha which cannot be explained by market factors.

7. CONCLUDING REMARKS

In this article we show two modified versions as an alternative to a well-known contrarian strategy of buying losers and selling winners. Both versions only buy shares and no short selling is required. *N* worst performing shares during the day (resp. the night) are bought and held during the subsequent night (resp. day) in equal proportion. We investigate the behaviour of these 2 simple versions of the strategy from 30th May 2000 until 12th February 2010 on the constituent stocks of the S&P 500, S&P 400 MidCap and S&P 600 SmallCap Index.

The 2 versions of the strategy are more profitable than its well-known version (close-to-close as decision and holding periods). Their returns cannot be solely explained by the factors from either the 3-factor model of Fama and French (1993) or a modified 5-factor version of the model of Carhart (1997). Both versions of the proposed strategy prove profitable even in the recent period and are able to create a significantly positive alpha. The information ratios after the inclusion of TC over an entire sample period range from *1.59* to *6.70* depending on the universe of the stocks in question. We also show that the results are immune to the consideration of the bid-ask spread and that opening prices contain information that is not fully utilized yet. Overall, the strategy proposed uses this information to add value and extract a significant alpha which cannot be explained by market factors.

APENDICES:

a. Calculation of the trading statistics

Annualised Return

$$R^A = 252 * \frac{1}{N} \sum_{t=1}^{N} R_t$$

with R_t *being the daily return*

Annualised Volatility

$$\sigma^A = \sqrt{252} * \sqrt{\frac{1}{N-1} * \sum_{t=1}^{N} \left(R_t - \overline{R}\right)^2}$$

Information Ratio

$$IR = \frac{R^A}{\sigma^A}$$

Maximum negative value of $\sum (R_t)$ *over the period*

Maximum Drawdown

$$MD = \underset{i=1,\cdots,t;t=1,\cdots,N}{Min} \left(\sum_{j=i}^{t} R_j \right)$$

b. Application of version 1 of the strategy to constituents of the S&P 400 Mid Cap

Decile	1	2	3	4	5	6	7	8	9	10
Information Ratio (ex TC)	4.86	2.10	1.47	0.70	0.36	-0.10	-0.41	-0.65	-1.41	-2.76
Information Ratio (incl. TC)	3.98	1.03	0.31	-0.50	-0.88	-1.34	-1.65	-1.85	-2.50	-3.66
Cumulative Return (incl. TC)	1141%	245%	68%	-105%	-180%	-274%	-338%	-390%	-581%	-1034%
Annualised Return (incl. TC)	114%	24%	7%	-10%	-18%	-27%	-34%	-39%	-58%	-103%
Annualised Volatility (incl. TC)	28.5%	23.6%	21.8%	20.9%	20.2%	20.3%	20.4%	21.0%	23.2%	28.1%
Maximum Daily Profit (ex TC)	18.0%	12.7%	10.8%	9.2%	8.1%	7.5%	8.0%	7.6%	8.8%	9.3%
Maximum Daily Loss (ex TC)	-11.6%	-10.8%	-10.7%	-9.1%	-10.6%	-9.8%	-9.7%	-8.7%	-11.1%	-11.5%
Maximum Drawdown (ex TC)	60%	60%	45%	49%	44%	90%	144%	189%	381%	821%
Maximum Drawdown Duration (ex TC)	72	140	164	413	698	2047	2278	2381	2501	2530
Number of Up Periods (ex TC)	1701	1502	1469	1376	1340	1310	1271	1245	1167	1132
Number of Down Periods (ex TC)	832	1031	1064	1157	1193	1223	1262	1288	1366	1401
Avg Return (ex TC)	0.55%	0.20%	0.13%	0.06%	0.03%	-0.01%	-0.03%	-0.05%	-0.13%	-0.31%
Avg Gain in Up Periods (ex TC)	1.37%	1.02%	0.92%	0.88%	0.86%	0.84%	0.85%	0.89%	0.97%	1.07%
Avg Loss in Down Periods (ex TC)	-1.12%	-1.01%	-0.97%	-0.92%	-0.90%	-0.92%	-0.92%	-0.97%	-1.07%	-1.42%

Table 11. Version 1 of the strategy applied to the constituent stocks of the S&P 400 MidCap Index. Decision period is from today's close to the next day's open and holding period from the next day's open to the next day's close. The results are divided into deciles. The first decile contains the worst performing shares during the decision period, the tenth decile the best ones.

c. Application of version 2 of the strategy to constituents of the S&P 400 Mid Cap

Decile	1	2	3	4	5	6	7	8	9	10
Information Ratio (ex TC)	3.10	1.66	0.74	0.26	-0.28	-1.02	-1.44	-1.97	-2.53	-3.00
Information Ratio (incl. TC)	1.59	-0.48	-1.63	-2.20	-2.85	-3.55	-3.87	-4.25	-4.51	-4.40
Cumulative Return (incl. TC)	265%	-57%	-174%	-227%	-281%	-355%	-404%	-473%	-576%	-798%
Annualised Return (incl. TC)	26%	-6%	-17%	-23%	-28%	-35%	-40%	-47%	-57%	-79%
Annualised Volatility (incl. TC)	16.6%	11.8%	10.6%	10.3%	9.8%	10.0%	10.4%	11.1%	12.7%	18.0%
Maximum Daily Profit (ex TC)	8.4%	5.0%	5.0%	7.4%	6.6%	5.9%	7.0%	5.1%	7.4%	7.8%
Maximum Daily Loss (ex TC)	-7.5%	-7.7%	-7.0%	-6.8%	-7.2%	-8.1%	-9.2%	-10.8%	-12.7%	-18.0%
Maximum Drawdown (ex TC)	13%	26%	39%	42%	52%	112%	157%	222%	327%	550%
Maximum Drawdown Duration (ex TC)	83	304	554	836	1265	2525	2513	2526	2531	2531
Number of Up Periods (ex TC)	1547	1433	1389	1323	1274	1232	1184	1108	1111	1103
Number of Down Periods (ex TC)	985	1099	1143	1209	1258	1300	1348	1424	1421	1429
Avg Return (ex TC)	0.20%	0.08%	0.03%	0.01%	-0.01%	-0.04%	-0.06%	-0.09%	-0.13%	-0.22%
Avg Gain in Up Periods (ex TC)	0.71%	0.48%	0.40%	0.38%	0.35%	0.33%	0.33%	0.36%	0.38%	0.48%
Avg Loss in Down Periods (ex TC)	-0.59%	-0.44%	-0.42%	-0.39%	-0.37%	-0.39%	-0.41%	-0.44%	-0.52%	-0.75%

Table 12. Version 2 of the strategy applied to the constituent stocks of the S&P 400 MidCap Index. Decision period is from today's open to today's close and holding period is from today's close to the next day's open. The results are divided into deciles. The first decile contains the worst performing shares during the decision period, the tenth decile the best ones.

d. Application of version 1 of the strategy to constituents of the S&P 500 Index

Decile	1	2	3	4	5	6	7	8	9	10
Information Ratio (ex TC)	2.71	1.88	1.35	0.83	0.43	-0.08	-0.55	-0.92	-1.24	-3.69
Information Ratio (incl. TC)	1.85	0.76	0.10	-0.51	-0.94	-1.47	-1.93	-2.23	-2.42	-4.63
Cumulative Return (incl. TC)	544%	170%	19%	-96%	-173%	-268%	-355%	-432%	-521%	-1243%
Annualised Return (incl. TC)	54%	17%	2%	-10%	-17%	-27%	-35%	-43%	-52%	-124%
Annualised Volatility (incl. TC)	29.3%	22.3%	20.0%	18.8%	18.4%	18.1%	18.3%	19.3%	21.4%	26.7%
Maximum Daily Profit (ex TC)	15.5%	11.1%	9.0%	7.8%	8.4%	7.5%	7.3%	7.8%	8.4%	7.6%
Maximum Daily Loss (ex TC)	-13.7%	-10.1%	-8.7%	-8.4%	-7.5%	-8.0%	-8.8%	-8.9%	-13.9%	-15.3%
Maximum Drawdown (ex TC)	60%	55%	44%	43%	48%	89%	150%	213%	299%	997%
Maximum Drawdown Duration (ex TC)	78	231	150	204	491	2047	2381	2530	2530	2530
Number of Up Periods (ex TC)	1546	1482	1463	1390	1361	1294	1254	1242	1222	998
Number of Down Periods (ex TC)	987	1051	1070	1143	1172	1239	1279	1291	1311	1535
Avg Return (ex TC)	0.31%	0.17%	0.11%	0.06%	0.03%	-0.01%	-0.04%	-0.07%	-0.11%	-0.39%
Avg Gain in Up Periods (ex TC)	1.24%	0.94%	0.82%	0.78%	0.76%	0.75%	0.76%	0.77%	0.84%	1.00%
Avg Loss in Down Periods (ex TC)	-1.14%	-0.92%	-0.87%	-0.81%	-0.81%	-0.80%	-0.82%	-0.88%	-0.99%	-1.29%

Table 13. Version 1 of the strategy applied to the constituent stocks of the S&P 500 Index. Decision period is from today's close to the next day's open and holding period from the next day's open to the next day's close. The results are divided into deciles. The first decile contains the worst performing shares during the decision period, the tenth decile the best ones.

e. Application of version 2 of the strategy to constituents of the S&P 500 Index

Decile	1	2	3	4	5	6	7	8	9	10
Information Ratio (ex TC)	4.67	1.25	0.64	0.10	-0.31	-0.56	-1.02	-1.25	-1.57	-1.73
Information Ratio (incl. TC)	3.24	-0.79	-1.67	-2.38	-2.80	-3.03	-3.43	-3.46	-3.48	-3.05
Cumulative Return (incl. TC)	577%	-98%	-183%	-243%	-285%	-311%	-360%	-397%	-461%	-585%
Annualised Return (incl. TC)	57%	-10%	-18%	-24%	-28%	-31%	-36%	-39%	-46%	-58%
Annualised Volatility (incl. TC)	17.7%	12.3%	10.9%	10.2%	10.2%	10.2%	10.5%	11.4%	13.2%	19.1%
Maximum Daily Profit (ex TC)	7.6%	4.7%	4.1%	4.3%	4.9%	5.5%	5.1%	5.5%	8.0%	10.1%
Maximum Daily Loss (ex TC)	-9.3%	-7.4%	-7.3%	-7.1%	-6.4%	-7.1%	-7.8%	-9.0%	-11.1%	-15.5%
Maximum Drawdown (ex TC)	14%	28%	38%	49%	51%	68%	119%	149%	214%	338%
Maximum Drawdown Duration (ex TC)	52	464	540	1083	1917	2513	2513	2531	2519	2515
Number of Up Periods (ex TC)	1798	1426	1389	1334	1293	1291	1235	1238	1211	1218
Number of Down Periods (ex TC)	734	1106	1143	1198	1239	1241	1297	1294	1321	1314
Avg Return (ex TC)	0.33%	0.06%	0.03%	0.00%	-0.01%	-0.02%	-0.04%	-0.06%	-0.08%	-0.13%
Avg Gain in Up Periods (ex TC)	0.75%	0.49%	0.42%	0.38%	0.37%	0.36%	0.36%	0.38%	0.42%	0.57%
Avg Loss in Down Periods (ex TC)	-0.70%	-0.49%	-0.44%	-0.42%	-0.41%	-0.42%	-0.43%	-0.48%	-0.54%	-0.78%

Table 14. Version 2 of the strategy applied to the constituent stocks of the S&P 400 MidCap Index. Decision period is from today's open to today's close and holding period is from today's close to the next day's open. The results are divided into deciles. The first decile contains the worst performing shares during the decision period, the tenth decile the best ones.

f. 3 different factor models applied to the returns generated by the version 1 of the strategy applied to the constituent stocks of the S&P 400 MidCap Index. The regressions were only applied to the first decile stocks

	α	β_1	β_2	β_3	β_4	β_5
CAPM						
coefficient	0.004	0.88				
t-stat	18.48	52.51				
p-value	0.00	0.00				
R-squared	0.53					
Fama-French 3 factor model						
coefficient	0.0040	0.87	0.75	0.26		
t-stat	19.03	57.28	21.13	8.65		
p-value	0.00	0.00	0.00	0.00		
R-squared	0.61					
Carhart + Reversion						
coefficient	0.0040	0.81	0.76	0.23	-0.14	0.02
t-stat	19.18	43.57	21.52	7.23	-6.53	0.80
p-value	0.00	0.00	0.00	0.00	0.00	0.42
R-squared	0.61					

g. 3 different factor models applied to the returns generated by the version 2 of the strategy applied to the constituent stocks of the S&P 400 MidCap Index. The regressions were only applied to the first decile stocks

	α	β_1	β_2	β_3	β_4	β_5
CAPM						
coefficient	0.001	0.30				
t-stat	5.94	27.38				
p-value	0.00	0.00				
R-squared	0.24					
Fama-French 3 factor model						
coefficient	0.001	0.30	-0.09	0.07		
t-stat	5.93	27.48	-3.39	2.99		
p-value	0.00	0.00	0.00	0.00		
R-squared	0.24					
Carhart + Reversion						
coefficient	0.001	0.30	-0.08	0.07	-0.01	0.02
t-stat	5.81	21.75	-3.27	3.06	-0.32	1.33
p-value	0.00	0.00	0.00	0.00	0.75	0.18
R-squared	0.24					

h. 3 different factor models applied to the returns generated by the version 1 of the strategy applied to the constituent stocks of the S&P 500 Index. The regressions were only applied to the first decile stocks

	α	β_1	β_2	β_3	β_4	β_5
CAPM						
coefficient	0.002	0.93				
t-stat	8.26	54.23				
p-value	0.00	0.00				
R-squared	0.55					
Fama-French 3 factor model						
coefficient	0.0018	0.93	0.34	0.23		
t-stat	7.79	55.32	8.63	7.06		
p-value	0.00	0.00	0.00	0.00		
R-squared	0.57					
Carhart + Reversion						
coefficient	0.0018	0.87	0.34	0.19	-0.13	-0.01
t-stat	7.97	42.78	8.80	5.60	-5.61	-0.62
p-value	0.00	0.00	0.00	0.00	0.00	0.54
R-squared	0.57					

i. 3 different factor models applied to the returns generated by the version 2 of the strategy applied to the constituent stocks of the S&P 500 Index. The regressions were only applied to the first decile stocks

	α	β_1	β_2	β_3	β_4	β_5
CAPM						
coefficient	0.002	0.36				
t-stat	13.05	28.21				
p-value	0.00	0.00				
R-squared	0.25					
Fama-French 3 factor model						
coefficient	0.002	0.36	-0.14	0.06		
t-stat	13.15	28.36	-4.61	2.33		
p-value	0.00	0.00	0.00	0.02		
R-squared	0.26					
Carhart + Reversion						
coefficient	0.002	0.34	-0.13	0.07	-0.02	0.06
t-stat	12.88	21.54	-4.32	2.69	-0.89	3.39
p-value	0.00	0.00	0.00	0.01	0.37	0.00
R-squared	0.26					

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