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# Momentum Equity Strategies: Are Certain Firm-Specific Variables Crucial in Achieving Superior Performance in Short Term Holding Periods?

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**Abstract**

In this study we analyze the performance of variable-oriented momentum strategies, in order to detect alternatives which offer higher returns, compared to the simple price momentum strategies, for no significantly extra risk, in the very short run. Portfolios are constructed using twenty firm specific variables, of U.S. stocks traded in NYSE, NASDAQ and AMEX for a full six year period starting on March of 2002. We calculate a volatility-reward (VR) ratio for each observation, treated as a performance measure, and we apply Principal Component Analysis (PCA) on their series in order to detect the variables which contribute mostly in enhancing the performance of simple momentum strategies. Our findings suggest that short term investors could significantly benefit from momentum strategies if they take into account past firm specific information, which indirectly indicates a market underreaction to various announcements related to firms' EPS. In particular, top analysts' EPS estimate revisions followed by low P/E and high ROE contribute the most in producing momentum portfolios of superior performance, compared to a simple price momentum strategy.

**Keywords:** Equity Strategies, Momentum, Short-term stock returns
**JEL Classification Codes:** G11, G12, G14

## 1. Introduction and Review of Relevant Literature

The profitability of trading strategies has been thoroughly examined over the past decades by researchers and practitioners. *DeBond & Thaler* (1985, 1987) and *Lehman* (1990) find that stocks which have performed poorly in the past, demonstrate excess future returns. In particular contrarian strategies are profitable in the long run, due to overreaction of stock market participants. *Lo & MacKinlay* (1990) find that contrarian strategies are profitable, however rejecting stock market overreaction as a possible explanation of their source of profitability. Moreover, they find a lead-lag effect as the returns of large capitalization stocks lead those of small capitalization stocks.

*Jegadeesh & Titman* (1993) observe short term continuations in stock prices and introduce momentum strategies. In particular, selling stocks with bottom past performance ("losers") and buying stocks with top past performance ("winners") offers significant excess returns (for a holding period of 3 to 12 months), which is consistent with underreaction to firm specific information (as in *Chan et al*, 1996, *Barber et al*, 2001). In addition, they document significantly higher returns for the winners' portfolios, compared to losers, around quarterly earnings announcements during the first few months after the formation date. Lastly, they argue that the volatility of return based strategies is injected in the markets through their very function: buying winners and selling losers causes prices to overreact, as prices move away from their long run values. Their findings are reinforced by *Jegadeesh and Titman* (2001), who update their previous database and conclude to the same results.

Apart from underreaction and overreaction, an alternative explanation for momentum can be found in the cross sectional characteristics of stock returns, (*Lehman*, 1990, *Conrad & Kaul*, 1998), however *Jegadeesh & Titman* (2002) argue against it. In any case, research has been focused on explaining abnormal returns through firm specific variables. *Fama & French* (1992), reviewing the literature, document positive relations between size, earnings per share (E/P), book-to-market equity, leverage and average stock returns. They find that through 1963 to 1990, size and book-to-market equity are able to explain the cross sectional variation in average stock returns associated with the aforementioned variables. *Fama & French* (1993) introduce their three factor model (hereafter FF3F) in order to examine the factors which explain the profitability of trading strategies. *Carhart* (1995, 1997) enhances the FF3F model by adding an additional factor to capture momentum returns on mutual funds. The extra factor is statistically significant while the explanatory power of the 4 factor model proposed is notably increased, compared to the FF3F model.

*Chan et al* (1998)**,** examine various factors which affect stock returns. They document that macroeconomic factors, contrary to other studies, have no influence on returns, except for the default premium. The most important factor among the three largest stock markets (USA, UK and Japan) is size, while book-to-market and dividend yield have significant explanatory power. Technical variables (based on past returns) are mainly responsible for large spreads in returns and, lastly, three statistical factors are detected (through PCA), the first of which explains most of the variance, capturing the market factor. However, they suggest that the high standard deviation observed within factors is not necessarily associated with large premiums in stock returns. Their major finding is the documentation of seasonal patterns in trading styles, as value strategies perform well at the beginning of the year while momentum strategies perform well at the end of the year. *Fama & French* (1996)**,** attempting to explain asset pricing anomalies, examine their linkage with various variables and conclude that:

i. Big (small) distressed companies have the lowest (highest) mean stock returns.
ii. Stocks of NYSE produce strong positive relations between average returns and book-to-market equity (BE/ME), E/P, CF/P, while past sales growth is negatively related to future returns, as in *Lakonishok et al* (1994). Moreover, they infer that firms with low (high) BE/ME, E/P, CF/P are evidence of strong (weak) stocks while high (low) sales rank firms [1] imply stocks with low (high) future returns.
iii. The CAPM anomalies described above can be largely explained by the FF3F model except for momentum returns.

In any case, the behavior of stock prices is a result of investors' reaction to the available information in the market, including the expectations and forecasts of the experts as well as their feedback after certain events. *Chan et al* (1996)**,** verifying underreaction as an explanation of momentum profitability, observe that firms with recent positive earnings surprises persistently outperform (for at least 6 months) firms with negative earnings surprises, while analysts delay to incorporate past earning surprises in their forecasts. Their most striking evidence is that stocks with bottom past performance demonstrate above average return continuations for a subsequent period of up to three years. *Barber et al* (2001), who use the Zacks Investment Research database (i.e. the one used

[1] As estimated by the weighted average of the annual sales growth ranks for the prior 5 years.

in this paper), empirically verify the lagged response of the market as they construct portfolios on a momentum strategy based on security analyst recommendations. They review their portfolio on a daily basis, which yields fewer returns the greater the revision period is and attribute it to semistrong form of market efficiency. However, *Hong et al* (2000) argue that low analyst coverage is related with higher performance of momentum strategies, while, after controlling for firm size, analyst coverage has a greater impact on past losers compared to past winners.

Recent studies have been conducted for other countries than USA, which confirm that the profitability of momentum strategies is evident internationally. In UK, *McKnight & Hou* (2006) find that momentum is negatively related to firm size, analyst coverage, and book-to-market. *Galariotis et al* (2007) argue that the profitability of trading strategies in UK cannot be explained by seasonality, size, or a single factor risk model, while contrarian profits can be described through the FF3F model. *Naranjo & Porter* (2007)**,** who use a dataset of 22 developed and 18 emerging markets, argue that including emerging markets in an international portfolio offers significant diversification benefits. *Balvers & Wu* (2006), construct an empirical model which allows for combining both momentum and contrarian strategies. Their results indicate that among 18 developed equity markets their strategy outperforms both simple momentum and contrarian strategies.

Excess returns of trading strategies are associated with the risk inherent in the time varying characteristics of the factors which explain these returns. Following this rationale, *Wu* (2002), shows that conditioning on past information significantly enhances the explanatory power of the FF3F model, while it sets feasible the incorporation of both short term momentum and long term reversals. Their findings suggest that momentum and contrarian profits cannot be explained by the same risk factor. Moreover, *Tai* (2003) fits a multivariate GARCH-M model in a version of ICAPM and finds that positive abnormal returns represent premiums for bearing extra risk, as calculated through the forecasted volatility within the factors of the FF3F model plus an extra factor which captures short term momentum.

In this study, we examine the performance of momentum based trading strategies, in terms of a volatility-reward measure, for a six year period starting on March 2002. Portfolios are constructed through the Zacks Investment Research database by selecting twenty firm-specific variables which are commonly used by analysts and academics and using a statistically-oriented selection procedure. We take into consideration the time varying characteristics of portfolio returns, as documented in the literature, and we employ the GARCH in mean model to calculate the forecasted volatility of the return difference series of each strategy from its benchmark. A volatility-reward measure is introduced to assess strategies and conclude to the most statistically stable and profitable strategies. In the last part, we apply Principal Component Analysis (PCA) on the strategies which satisfy the criteria set, in order to distinguish the factors which better explain the performance of variable-oriented momentum strategies.

The paper offers an alternative view of momentum strategies as it examines their returns over ultra short holding periods, given five different momentum definitions. It is the first study which simultaneously takes into account such a large sample of firm-specific variables as well as the associated volatility. The motivation of this paper is summarized in the following question: *Are there strategies based on price momentum which offer higher returns in ultra short holding periods, but without involving statistically significant excess volatility?*

The structure of the paper is as follows: section 2 describes the data and method used, while in section 3 the empirical results are presented and analyzed. Section 4 concludes the paper and draws guidelines for future research.

# 2. Data and Method

## 2.1. Portfolio Formation and Backtesting

The portfolio formation and backtesting procedure has been conducted through the *Research Wizard* platform by *Zacks Investment Research*[2]. The specific platform facilitates the procedure of historical portfolio formation and price performance measurement of equally weighted stock portfolios by applying a wide selection of screening criteria, while it has been recently used in *Barber et al* (2001). The *Research Wizard* database includes all US stocks listed in NYSE, NASDAQ and AMEX for a period of six years, updated on a weekly basis.

The full sample in the present study is dated from March 2002 to February 2008 which is deemed adequate for investment analysis, given the scope of the paper for examining momentum strategies over short term holding periods. The period represents almost a full stock market cycle for the post September-11th era[3]. All U.S. listed firms have been included except for thinly traded stocks [4] and low priced stocks [5]- which is common practice in investment strategy studies - since these sub-groups of stocks could potentially cause aberrations to the performance measurement of the momentum portfolios due to their erratic stock price behavior. We assume no trading costs as we focus on the effect of firm specific variables on momentum portfolio returns and not on their profitability.

Zacks Investment Research claims that its database does not suffer from any look-ahead bias, however Zacks also notes that survivorship bias[6] could be present. Yet, we assess that the impact of survivorship bias in our sample active universe is negligible[7].

### 2.1.1. Momentum Definition

Portfolios are primarily formed by securities which have performed the highest price continuations (momentum) over certain periods. Specifically, momentum portfolios consist of stocks in active universe with the top 10% price performance during the past 4, 12 and 24 weeks (denoted as 4w, 12w and 24w respectively) while two additional considerations of past price performance are employed. That is, we use two linear combinations of the three aforementioned periods: a combination using weights analogous to the time length of each period (i.e. 10%, 30% and 60% for the 4, 12 and 24 week periods respectively) and an equally weighted combination (i.e. 1/3 for each period). The first combination suggests that investors place more weight on price continuations of stocks of firms which are top performers for more extended periods while the latter implies that investors equally consider the returns of momentum strategies with respect to the three look-back periods. As a convention, each of the five specifications of momentum return calculations will be referenced under the notation "momentum definition" 1 to 5, with the respective order presented above.

### 2.1.2. Examining Variables

For each momentum definition, we examine an extensive array of fundamental, firm-specific variables to assess the impact of each variable on the momentum strategies. After detecting the top 10% momentum performers, we extend the screening criteria conditioning on both upper 20% end (top quintile) and lower 20% end (bottom quintile) of the variables presented below:

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[2] See http://www.zacksrw.com/

[3] We start from March, in order to capture the effect of the first quarter earning announcements, while ending on February, that is, prior to announcements.

[4] Thinly-traded stocks defined as those with average daily volume for the last month of less than 50,000.

[5] Low-Priced stocks defined as those trading at less than $5

[6] Survivorship bias is a phenomenon, owing to stocks being deleted from the database altogether once the stock is delisted from the exchange. This has been proposed to cause an overestimation of returns assuming that the majority of delisted stocks are poor performing stocks of financially distressed firms.

[7] (a) Stocks in financial distress - which comprise the main source of return overestimation due to exclusion from the database - are commonly thinly-traded, low-priced and/or poor performing stocks prior to delisting. However, the first two groups have been excluded by definition from our active universe, while poor performing stocks are excluded from our portfolios as non-momentum stocks (b) The portfolios in our analysis are sizeable, comprising 42-77 equally weighted stocks with a median of 66 stocks thus, any overestimations caused by a few distressed momentum stocks being absent from our sample, are subdued.

**Table 1:** List of firm specific variables used for portfolio formation and examination

| | | | |
|---|---|---|---|
| 1 | Dividend Yield | 11 | Price-to-Sales |
| 2 | EPS Surprises (past 9 quarters) | 12 | Sales |
| 3 | EPS Estimate Revisions (past 4 weeks – EPS next 4 quarters) | 13 | Short Ratio (Number of stocks sold short-to-average trading volume of stocks) |
| 4 | EPS Estimate Revisions (past 12 weeks – EPS next 4 quarters) | 14 | Beta (CAPM coefficient) |
| 5 | Interest Coverage | 15 | Return on Equity |
| 6 | Market Capitalization | 16 | Return on Assets |
| 7 | Price-to-Earnings (Historical EPS past 4 quarters) | 17 | PEG Ratio (price-to-earnings-to-estimated EPS growth) |
| 8 | Price-to-Earnings (Estimated EPS next 4 quarters) | 18 | Asset Utilisation (Annual Sales-to-average book value of assets) |
| 9 | Price-to-Book Value | 19 | Analyst recommendation change (past 4 weeks) |
| 10 | Price-to-Cash Flow | 20 | Historical Annual EPS Growth (past 4 quarters) |

The size of the occurring variable oriented momentum portfolios ranges from 42 to 77 equally weighted stocks with a median of 66 stocks for the full sample period.

### 2.1.3. Holding Periods

The returns of portfolios constructed are examined within the scope of 5 different short-term holding periods which determine the frequency of rebalancing/updating the portfolios. Given the fixed length of the study period, each look-ahead term provides a different subset of return observations:

1. 1 week holding period (308 observations)
2. 2 weeks holding period (154 observations)
3. 4 weeks holding period (77 observations)
4. 12 weeks holding period (25 observations)
5. 24 weeks holding period (12 observations)

Thus, 25 price momentum portfolios are constructed using all combinations among the 5 momentum definitions and the 5 holding periods. Every simple momentum strategy is considered as a benchmark for the respective combination of look-back and holding periods of the variable-oriented portfolios formed. From each variable, 50 strategies are extracted (25 for each quintile), that is we consider 1,000 strategies stemming from the 20 firm-specific variables used. After the portfolio formation, we follow a three-step, statistically-oriented procedure in order to detect the highest performing strategies, as described in the following sections.

## 2.2. Examining Portfolio Returns

The return differences of the strategies from their corresponding benchmarks are calculated and those which offer positive excess returns over the respective benchmark are detected. We test whether the portfolio return series are stationary using the Augmented Dickey Fuller test (ADF) on levels for one lag. Stationarity implies that our data are properly selected and statistically adequate for econometric manipulations, as the probability distribution of the portfolio returns remains steady over time, demonstrating no trends or time-sensitive patterns.

Thereafter, we calculate the return differences of each variable-oriented strategy from the respective benchmark and test if they are significantly different from zero (i.e. if the positive or negative abnormal returns are significant), through a simple *t*-statistic measure. Significance implies that the variables used have a considerable effect on momentum, of either sign.

Lastly, we calculate the return differences between top and bottom quintiles with regard to the firm specific variables used in each variable-oriented momentum strategy and we infer for statistical significance using a t-test as previously. Rejection of the null hypothesis implies that the information for the implementation of the extra variable in the momentum strategy is distributed to the top and

bottom deciles. If all three criteria mentioned above are jointly satisfied we then proceed with the risk calculation and performance evaluation of the strategies, which is described in the next section.

### 2.3. Volatility of Trading Strategies

We employ the GARCH in mean (GARCH-M) model of *Engle, Lilian & Robins* (1987), which takes into consideration the time varying patterns of stock returns and allows for conditional variance to enter the mean (return) equation, thus acting as risk premium. According to *Campbell et al* (1997) this is the most suitable model for financial time series modeling. We extract the forecasted volatility of the return differences between the variables which pass the criteria set above and their respective benchmarks. We apply the model on very short holding periods (i.e. 1, 2 and 4 weeks) mainly to capture the effect of frequent portfolio rebalancing, which is a common practice by traders who follow time-sensitive momentum strategies.

The volatility analysis may have intuitive results as individuals prefer profitable portfolios which persistently offer lower risk. If this is the case, the probability to remain loyal to their strategies is higher and as long as their strategy (and to its extent, their expectations) are continuously confirmed, with a few deviations only, they will not exit earlier than the scheduled end of the holding period. Thus, we examine whether the addition of the firm specific variables in the short term momentum strategies helps towards this direction, offering excess returns for not significantly extra risk.

The test of significance on the GARCH-M term, serves exactly this purpose as it represents the change in the mean return (risk premium) required by investors as a compensation for the extra volatility (for every additional unit of risk). Thus, non-significance implies that the variable-oriented trading strategy examined is efficient because it is not required compensation for the significantly higher volatility injected due to the incorporation of the firm specific variable.

### 2.4. Performance Assessment

To evaluate the relative performance (compared to the benchmark) of each strategy we construct a volatility-reward (VR) ratio which is a dynamic version of the Sharpe Index, taking into consideration the forecasted volatility in each observation[8]. Specifically, for each portfolio rebalancing we calculate the VR Index as the ratio of excess returns (portfolio returns minus benchmark returns) over the forecasted volatility of the return differences for each observation. The VR ratio of the $j^{th}$ trading strategy in presented in the following equations:

$$VR_j = \frac{1}{N}\sum_{i=1}^{N}\left[\frac{R_p - R_b}{\sqrt{\sigma_t^2\left(R_p - R_b\right)}}\right], \text{ or } VR_j = \frac{1}{N}\sum_{i=1}^{N}\left[\frac{R_p - R_b}{Vol\left(R_p - R_b\right)}\right], \text{ or } VR_j = \frac{1}{N}\sum_{i=1}^{N} VR_i \qquad (1)$$

where $R_p$ and $Vol_p$ is the return and forecasted volatility of the trading strategy (variable-oriented ) portfolio, while $R_p$ and $Vol_p$ is the return and forecasted volatility of the benchmark (momentum) portfolio, respectively. The VR series for each variable oriented strategy are compared to their benchmark VR series, defined as the average values of the respective benchmark return series divided by their forecasted volatility. Therefore, if a trading strategy has an average VR ratio which is greater than the benchmark, then it is considered as a better strategy in terms of risk and performance, provided that the VR series are significantly greater than zero (we test it through a simple one tailed t-statistic measure).

The series of the VR ratios are tested for normality through the Jarque - Bera statistic, ensuring that statistical inference is applicable and that more safe conclusions can be extracted. The higher the value of the JB statistic, the more concentrated will be the returns of the strategies around their mean, implying that the probability of the investors' expectations be confirmed, regarding the performance of a portfolio, is higher compared to the case of non-normality. To characterize a variable-oriented momentum strategy better than its benchmark, in addition to the aforementioned conditions, we require

[8] As a convention, by saying performance the authors refer to the VR series of each strategy.

that the VR series are stationary (i.e. that there is no trend) through the ADF test. To sum up, we follow a selection procedure which requires the following:

i. All return series and their differentials from the benchmark are normally distributed and stationary.
ii. The strategies offer (statistically) significantly greater returns than the respective benchmark.
iii. The return differentials between top quintile and bottom quintile within the variable-oriented momentum strategies are statistically significant.
iv. The VR series are normally distributed, stationary and significantly greater than zero.
v. The VR ratio of the strategy is greater (on average) than the VR ratio of the benchmark.

### 2.5. Extracting the Components of Portfolio Performance

The last part of the study is focused on detecting the diversity of the strategies which passed the criteria set in the previous section as well as on analyzing the components of their performance. We apply the Principal Component Analysis (PCA) technique with Varimax Rotation on the VR series of the successful strategies for each holding period. We examine whether the components of the risk-reward relations among strategies are time sensitive or if they are due to the firm specific variables. To test this we observe whether the different momentum definitions of each strategy are correlated with a particular factor or not. If the first applies, then we can detect the firm specific variables which contribute mostly to the performance of the variable-oriented momentum strategies.

The results of PCA will be used to propose the most profitable trading strategies in the very short run from the initial sample of 200 variable-oriented momentum strategies and 5 simple momentum strategies, for each holding period (i.e. in total 615 strategies for the 1, 2 and 4 week holding periods). We have set strict selection criteria in order to exclude strategies which are not suitable for safe statistical inference, in our effort to detect only a few strategies which persistently offer greater and less risky returns compared to the respective benchmark. Another interesting point is that the proposed strategies are required to be highly correlated with the primary factors extracted from PCA. Due to the fact that Varimax Rotation is used, the correlation matrix of the components extracted (i.e. with eigenvalues greater than 1) will be orthogonal, implying that the strategies associated with these factors will be uncorrelated. Thus, they can be considered, in terms of portfolio diversification, as independent profitable investment strategies.

## 3. Empirical Results

The strategy returns have been analyzed and processed as described in the method section. The results are presented in three sections; each corresponding to the respective step of the procedure followed to assess the portfolios constructed and conclude to the best performers. Appendix I informatively presents the returns, the return differences from the benchmark and the top minus bottom return differences of the strategies examined.

### 3.1. Returns of Trading Strategies

All return series (momentum returns, return differences from benchmark and top minus bottom returns) are, as expected, stationary and normally distributed. In the sample under examination, simple momentum strategies appear to produce aggregate excess returns[9] of 2.97% relative to the overall market universe, which is an expected outcome given the existing literature on momentum[10]. Yet, the return differences between these two large groups of stocks is weak overall, in terms of statistical significance[11], and it is more pronounced for the 2 longer holding periods of 12 and 24 weeks.

[9] That is, the average value of the annualized returns over all holding periods and momentum definitions
[10] See *Jegadeesh &Titman* (1993)
[11] The only simple momentum strategy which recorded statistically significant differences from the overall stock universe (at merely the 10% level - see Appendix table Ib) is the third momentum definition (24 weeks look-back period) given a 12 weeks holding period

Therefore, this makes the case for examining the possibility of enhancing the simple momentum strategy by controlling for some variables more appealing.

### 3.1.1. Introducing Variables into Momentum Portfolios

By further downsizing momentum portfolios to the top and bottom quintile with regard to the 20 aforementioned firm-specific variables, it becomes apparent that certain subsets consistently outperform the overall momentum universe portfolio while other subsets consistently exhibit inferior returns. To acquire a broad indication of the effect of each variable on portfolio returns, we have constructed Table 2 (for further analysis see Appendix I), which illustrates the aggregate returns[12] of each strategy in descending order as well as the simple price momentum strategies (i.e. the average of benchmark portfolios).

**Table 2:** Average annualized returns of variable-oriented momentum strategies

| Momentum Strategy | Aggregate Annualised Returns | Momentum Strategy | Aggregate Annualised Returns |
|---|---|---|---|
| P/CF Bottom | 28,18% | EPS Growth 4Q Hist. Bottom | 15,51% |
| EPS Est. Rev. 4W Top | 27,96% | Market Cap. Top | 15,48% |
| EPS Est. Rev. 12W Top | 27,71% | **Price Momentum (Benchmark)** | **14,76%** |
| P/S Bottom | 25,54% | Dividend Yield Bottom | 14,63% |
| P/E 4Q Hist. EPS Bottom | 25,38% | PEG Ratio Bottom | 14,58% |
| P/E 4Q Est. EPS Bottom | 25,34% | Analyst Recom. Ch. 4W Bottom | 13,32% |
| ROE Top | 25,32% | P/E 4Q Hist. EPS Top | 12,24% |
| Asset Utilization Top | 23,07% | P/BV Top | 12,24% |
| Interest Coverage Bottom | 21,77% | **Overall Market Universe** | **11,79%** |
| Sales Top | 21,69% | P/E 4Q Est. EPS Top | 11,12% |
| EPS Surprises 9Q Top | 20,82% | Beta Top | 10,03% |
| ROA Top | 20,07% | P/CF Top | 9,96% |
| Analyst Recom. Ch. 4W Top | 20,04% | EPS Surprises 9Q Bottom | 8,72% |
| Dividend Yield Top | 19,69% | Short Ratio Top | 7,62% |
| Short Ratio Bottom | 19,32% | EPS Est. Rev. 4W Bottom | 7,05% |
| P/BV Bottom | 19,21% | Asset Utilization Bottom | 6,89% |
| EPS Growth 4Q Hist. Top | 18,98% | EPS Est. Rev. 12W Bottom | 5,52% |
| Beta Bottom | 18,69% | ROA Bottom | 5,36% |
| PEG Ratio Top | 18,24% | ROE Bottom | 4,88% |
| Interest Coverage Top | 17,60% | Sales Bottom | 4,29% |
| Market Cap. Bottom | 17,43% | P/S Top | 4,20% |

As observed in Table 2, highest return generating momentum portfolios are found among: bottom price-to-cash flow, top estimate revisions, bottom price-to-sales, bottom price-to-earnings (in both historical and estimated terms) and top ROE, whereas lowest return generating momentum portfolios are found among top price-to-sales, bottom sales, bottom ROE and ROA, bottom estimate revisions and bottom asset utilization.

### 3.1.2. The Impact of Holding Period

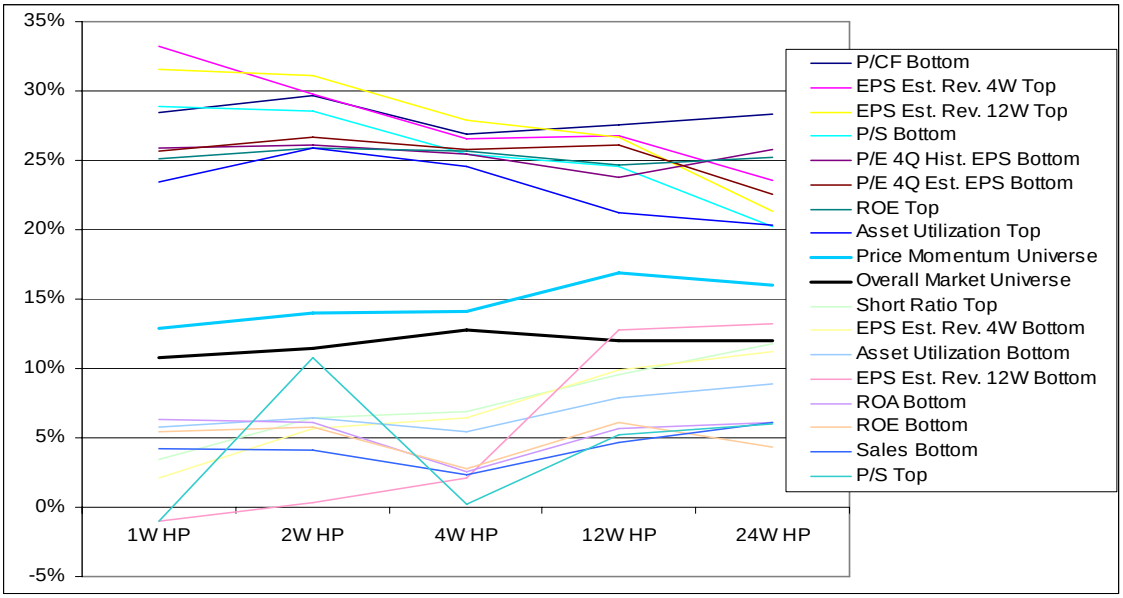
With regard to the holding period, the returns of the top return momentum portfolios (top 8 variable-oriented strategies in aggregate terms)[13] overall deteriorate by increasing holding period as opposed to the returns of the bottom return momentum portfolios (bottom 8 variable oriented strategies in aggregate terms) and the returns of the simple momentum strategies which improve by increasing holding period. This observation provides evidence of an overreaction-correction mechanism as firm specific information becomes older (see Figure 1). In that respect the top 8 strategies record maximum returns around one to two weeks of holding period, whereas the bottom 8 strategies recorded maximum

[12] Aggregate annualized returns are calculated as the mean annualized returns of each strategy across all holding periods and all momentum definitions. The sole purpose of this metric is to provide a broad indication and does not have any statistical inference value.

[13] Strategies as ranked by aggregate returns in Table 2

returns at 24 weeks. Furthermore, certain firm-specific variables appear to produce momentum portfolios with much more time sensitive returns (i.e. EPS Surprises and EPS Estimate Revisions) as opposed to other variables that yield more consistent portfolio returns across increasing holding period (i.e. ROE, price-to-cash flow, price-to-earnings).

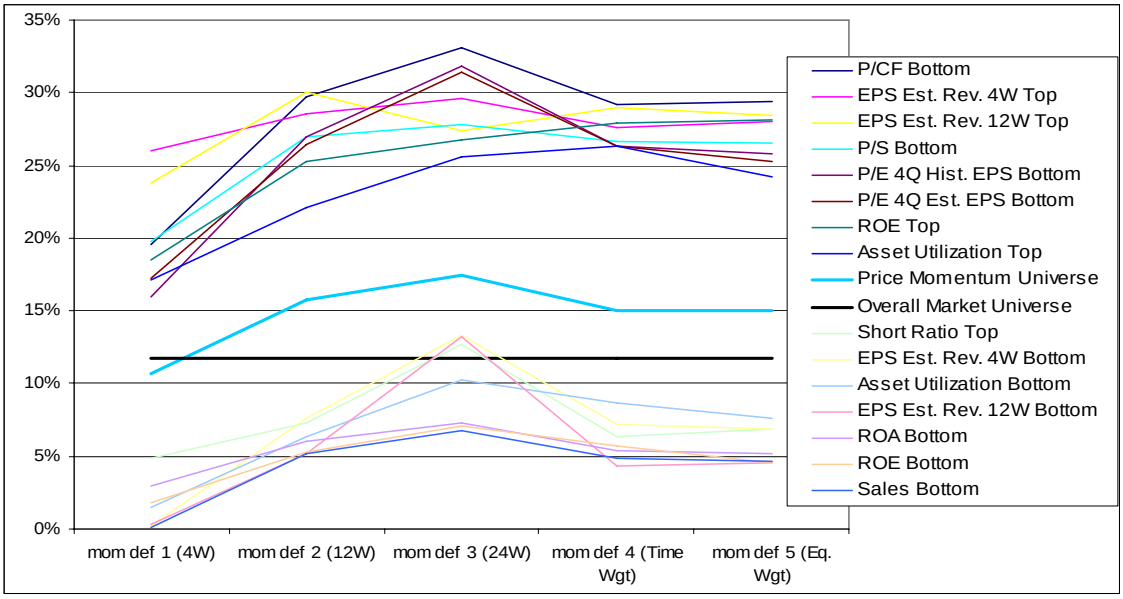
**Figure 1:** Annualised Returns for Top 8 vs Bottom 8 Strategies Aggregated by Holding Period




### 3.1.3. The Impact of Momentum Definition

With regard to the momentum definition, returns of trading strategies appear to have similar behavior. In particular, the longer the look back period, the higher the portfolio returns for the vast majority of variable oriented momentum strategies. In that respect, the 3rd momentum definition (24-week look-back period) yields higher returns relative to the remainder four momentum definitions (see Figure 2) and conversely the shortest momentum definition (4 weeks) demonstrates inferior results compared to all other definitions. The two composite definitions of momentum (mom def 4 & 5) yield lower returns than 24w in the vast majority of cases and largely similar returns relative to the 12-weeks look-back period (mom def 2).

**Figure 2:** Annualized Returns for Top 8 vs Bottom 8 Strategies Aggregated by Momentum Definition




### 3.1.4. Return Differences from Benchmark and Top Quintile Minus Bottom Quintile

The magnitude and consistency of the returns of each variable-oriented strategy, relative to the momentum universe portfolio, varies considerably across variables and depends on holding period and momentum definition (for further analysis see Appendix I). It is worth mentioning that in the case of 2-weeks holding period, although large excess returns are observed, yet in most cases they fail to be statistically significant (mainly due to their failure to pass the normality test). This insignificance could be due to various factors (such as heteroskedasticity of stock returns, observation of extreme values, reversals etc), however it is beyond the scope of the study to detect and analyze them.

Excess returns (both positive and negative) of certain variable oriented strategies appear to be statistically significant in more cases compared to other strategies. A momentum investor, during the period of study, had a higher probability of outperforming the momentum universe by choosing among stocks of top EPS estimate revisions, bottom price-to-cash flow, bottom price-to-earnings, bottom price-to-sales and top ROE and definitely avoiding stocks of bottom estimate revisions, bottom sales, bottom ROE and top P/S.

The full impact of each firm specific variable on momentum portfolios constructed is revealed once the return differences between top quintile minus bottom quintile within each variable are taken into account. Their statistical significance varies considerably among firm specific variables and depends on holding period and momentum definition. However, a few firm specific variables appear to produce consistently high and statistically significant differences in portfolio returns overall. Top minus bottom EPS estimate revisions (12W second by 4W) recorded exceptionally wide differences (especially of up to 4W holding period and through the shorter and composite definitions of momentum). Return on Equity also produced relatively large and statistically significant differences regardless of holding period or momentum definition (with the exception of "mom def 1"). Sales (especially for 2, 4 and 12 weeks of holding period) and price-to-sales (especially for 1 and 4 weeks of holding period) also stand out as firm specific variables generating sizable and statistically significant return differences. It should be noted that top minus bottom EPS surprises also exhibited relatively large and statistically significant differences in portfolio returns but only for holding periods of 1 and 2 weeks, indicating that the variable is very time sensitive, suggesting in turn that investors rush to incorporate the relevant information in stock prices.

Not surprisingly, beta, market capitalization and price-to-book value (i.e. the FF3F model components) produce weak results, being statistically inadequate to be further analyzed for volatility and performance. This is on the same wavelength with Fama & French (1996) and Carhart (1995,

1997), who find that momentum returns cannot be adequately explained by the FF3F model which also applies in the very short term (1, 2 and 4 weeks).

We have to note at this point that not all strategies are further processed for volatility analysis. In particular, when examining a momentum definition of a variable-oriented strategy we require that all of the five holding periods within each definition (or at least 4 in some cases), yield statistically significant results. For example, we do not process the Top Peg Ratio variable which returns significant results only in the 3rd and 4th momentum definition[14]. Thus, we can better explain the effect of each financial variable on momentum returns, leaving aside time sensitive components.

### 3.2. Volatility Analysis and Performance Assessment

The results of volatility analysis are presented in the tables of Appendix II. No GARCH-M term appears significant, implying that variable-oriented strategies involve no significantly extra risk compared to simple momentum strategies. That is, investors require no extra compensation for the additional risk of the firm-specific variables used in the strategies and they are satisfied with the excess returns. The strategies which present the lower levels of volatility for the 1 week holding period strategies are EPS surprises (top), EPS estimate revisions (top of both 4 weeks and 12 weeks) as well as analyst recommendations. For the 2 weeks holding period we distinguish EPS estimate revisions, while for the 4 weeks, apart from estimate revisions, low volatility is found on sales (top). With regard to the volatility-reward (VR) ratios calculated, the highest performing strategies for the 1 week holding period strategies are EPS surprises (top) and EPS estimate revisions (top of both 4 weeks and 12 weeks).

The returns of trading strategies are associated with higher volatility as holding period increases which can possibly be attributed to the uncertainty inherent in the longer periods or to volatility shocks. However, *French et al* (1987) suggest that volatility shocks are acquainted with an increase in future expected returns. In a parallel sense we agree with *French et al* (1987) because we find that the volatility-reward (VR) ratio is also ascending, which is attributed to the fact that positive excess returns are associated with proportionally lower volatility compared to negative return differences from the benchmark. Moreover, as both holding period and look-back period increase, this divergence seems to grow, implying that positive excess returns have a greater impact (compared to negative returns) on the performance of trading strategies.

A possible explanation is that the expectations of investors become stronger as time increases while not only their expectations are confirmed, but they are overly compensated for their risk exposure, which justifies the insignificant GARCH-M terms. In addition, it is implied a slow reaction of the market to firm specific information. This is in accordance with *Chan et al* (1996) who document that analysts revise their forecasts with a lag, as well as with *Barber et al* (2001) who evidence sluggish market response to news.

After the calculation of the values of the VR ratios, a second group of criteria is set, so that the strategies which perform significantly better than their benchmark are discerned. As described in the method section, we require that the VR series are (i) significantly greater than zero (one tailed), (ii) normally distributed (we accept values of the JB test greater than 6, which corresponds to a significance level of 95%) and (iii) stationary (we accept a 99% significance level of the ADF test). This filtering ensures that the superior performance (compared to the benchmark) of the strategies selected from this procedure is explained through the same probability distribution (i.e. the normal distribution), which does not change over the time (due to stationarity).

We find that all VR ratio series are stationary at a 99% level and normally distributed at a rate of 40% on average (it is 67.27%, 23.33% and 20% for 1 week, 2 weeks and 4 weeks of holding periods respectively). The strategies which satisfy all criteria are presented in the last column of the table in

[14] Following this practice, 17 out of the 1,000 trading strategies are not examined although yielding significant results for different holding periods. More information upon request by the authors.

Appendix II, denoted as "accept"[15]. Out of the 1,000 strategies analyzed, about 135 (13.5%) pass the first set of criteria, of which 52 (38.5%) pass the second set. In particular, 36 out of 55 (65.45%) strategies are acceptable in the 1 week holding period group, 8 out of 30 strategies (26.67%) pass in the 2 weeks holding period while 8 out of 50 (16%) are acceptable in the 4 weeks holding period. We observe that the acceptance rate declines with the holding period, mainly due to the fact that they fail the normality test.

Our results suggest that the portfolios constructed by stocks with the top 20% of EPS estimate revisions for the next year, taking into account the information of the past 4 weeks, yields strong statistically acceptable results for all short term holding periods (i.e. 1 week, 2 weeks and 4 weeks). All specifications of the benchmark price momentum strategies are rejected, while only the 3rd definition (24 weeks) is acceptable in the case of the 2 weeks holding period. Moreover, the 1st momentum definition (4 weeks) yields no significant results for all holding periods, suggesting that price momentum over the past 4 weeks carries no statistically acceptable information on performance. The other profitable strategies have acceptable results for either two different holding periods (e.g top of EPS estimate revisions for the past 12 weeks, bottom P/E of past 4 quarter EPS and top ROE) or only for the 1 week holding period (top EPS surprises over the past 9 quarters, bottom P/S, top asset utilization as well as top analyst recommendation changes during the past 4 weeks).

### 3.3. Components of Portfolio Performance

In this section the results of the PCA technique are analyzed, which has been applied to the series of the returns, the return differences from the benchmark, the volatility of return differences and the volatility-reward ratios (the results are presented in Appendix III). The method has been applied on each holding period, taking into consideration all momentum definitions within each period simultaneously. This is done in order to examine whether the performance of trading strategies is attributed to the firm specific variables employed or to past information regarding each strategy (that is, the momentum definition), as well as to distinguish the variables which have the largest impact on the performance of trading strategies.

The factors extracted have eigenvalues over 1, while the Kaiser-Meyer-Olkin test of sampling adequacy returns values higher than 0.5 which is the minimum acceptance bound. The largest portion of variability within volatility and VR ratios is attributed among the first two or three components (except for the case of returns), implying that there is more than one group of variables explaining the volatility or performance patterns of momentum strategies. Moreover, the strategies which are highly correlated with these primal components could be either used simultaneously for diversification purposes or separately under the conception of different trading philosophies, as he components extracted are uncorrelated.

The PCA on return series demonstrates one factor which explains 90.23%, 91.58%, 89.77% of the variability in each holding period, respectively. For the 1 week holding period, an additional factor exists, explaining an additional 1.9% of variability. In the 2 weeks holding period there is only one factor, while for the 4 weeks holding period there are two extra factors which contribute 4,44% on the explained variability in total. Thus it is considered that only one common factor exists in each case, i.e. the returns of the momentum portfolios. Regarding the return differences from the benchmark, the common component of strategies, i.e. price momentum returns, is highly correlated with the 5th, 3rd, and 6th component of each holding period respectively.

The results of the PCA on the VR ratios of trading strategies, which are characterized as acceptable through the selection procedure, are processed through the Principal Component Analysis method with Varimax Rotation to extract the components which explain performance within each holding period. We find that all momentum definitions, for each variable per holding period are concentrated around one sole factor, demonstrating no time dependence (i.e. that various look-back

[15] Not all momentum definitions within each strategy satisfy the non-negativity or normality criteria, unlike with the first set of criteria, thus in the respective table it is reported VR ratios of which trading strategies are analyzed. We observe that more are the cases that the 2nd momentum definition passes all criteria (i.e. 13), in contrast with the 1st and the 5th definitions which have the smallest number of successes (i.e. 9)

periods of each variables explain different components of performance). An interesting point is that although the PCA, on the volatility series, demonstrates a time dependent behavior, the components of the VR ratios depend upon the firm specific variables used. This implies that the effect of excess returns has greater impact on the explanatory power of VR ratios, compared to their volatility.

The results of the acceptable VR ratios are presented in the last column of Appendix III[16]. We find 8 factors which explain the variability within the 36 strategies which are characterized as acceptable in the 1 week holding period group, 2 factors out of the 8 strategies in the 2 week holding period group and 3 factors out of the 8 variables in the 4 week holding period group.

We observe that the benchmark momentum strategies are not allocated in the first factor (in the 4 week holding period there are no values as it has not been accepted through the selection procedure), implying that within each holding period there are components which appear more significant in explaining portfolio performance compared to the simple price momentum strategies[17]. Our results suggest that EPS estimate revisions have the greatest explanatory power for each holding period, implying that they are the most important leaders of momentum strategies, which confirms the quotation of the Zacks' firm (from where the data were collected) that "*earnings estimate revisions are the most powerful force impacting stock prices*". This can be attributed to the findings of *Chan et al* (1996) who document that news for past earnings and analysts' forecasts are able to explain excess returns due to the fact that market reacts sluggishly, which is further supported by the fact that portfolios constructed on the basis of this firm specific variable yield greater returns the longer the look back and look ahead periods are. The rest trading strategies, which are allocated to lower ranked factors than the benchmark, are not deemed as unacceptable or as worse performers (compared to the respective benchmark), however their explanatory power regarding performance is relatively reduced.

## 4. Summary and Concluding Remarks

In this study we examine the effect of incorporating firm specific information on the performance of momentum trading strategies. The portfolios are constructed using the Zacks Investment Research platform, using stocks of firms traded in NYSE, NASDAQ and AMEX for a period of six years, starting on March of 2002.

The portfolios consist of non-thinly traded, non-low priced stocks, with the top 10% price momentum performance (that is, the momentum universe), using five momentum definitions, under five holding periods (the last two mainly for informative purposes). Twenty firm specific variables have been employed to further downsize the momentum universe portfolios, on the basis of the top and bottom quintile performers, with respect to each variable.

We set a few criteria of statistical adequacy in order to distinguish the trading strategies which are suitable to be further analyzed for volatility of their return differences from the universe momentum. A volatility-reward ratio is introduced in order to assess the performance of trading strategies which satisfy the criteria set, while afterwards a second set of criteria is applied in order to ensure that statistically sound conclusions can been drawn. Moreover, we apply the PCA technique in order to detect the strategies which have greater impact on the performance of momentum strategies

Our findings suggest that the returns of the benchmark strategies are on average lower in the very short run (i.e. 1 week HP, 2 weeks HP and 4 weeks HP), compared to the longer holding periods (i.e. 12 weeks HP and 24 weeks HP). However, when incorporating firm specific information in momentum strategies it becomes apparent that shorter holding periods enjoy higher returns (ie EPS surprises, EPS Estimate revisions). With regard to the momentum definition the longer look back period (i.e 24 weeks), in most cases, appears to enhance momentum portfolio returns, while conversely

[16] For comparison purposes we have added an additional column in Appendix III (i.e. VR Ratios) which presents the results of the PCA when applied on the non-filtered VR ratio series. Rankings significantly change due to the fact that most strategies included are not normally distributed.

[17] The strategies which perform better than the benchmark in the 1 week holding period are those which perform top EPS estimate revisions of the past 4 weeks, the bottom P/E with respect to the historical EPS of the past 4 quarters and the top ROE ratio. In the 2 and 4 weeks holding periods all other variables have greater explanatory power than the momentum benchmark.

the shortest look back period (i.e 4 weeks) appears in most cases to reduce momentum portfolio returns.

Apart from higher returns, higher performance is evident after the addition of firm specific variables. In particular, the relation between volatility and returns is higher in variable-oriented strategies, requiring no risk premium, due to the fact that all GARCH-M terms appear insignificant. Moreover, performance increases for longer holding periods, which is attributed to the fact that positive excess returns are associated with proportionally lower volatility compared to negative return differences from the benchmark.

The results of the PCA applied on return difference series and VR ratio series provide a good insight on this study. In particular, we find that excess returns are mainly due to the firm specific variables and not to time-specific components. Moreover, a few variables appear to be more informative within each holding period in terms of portfolio performance compared to the price momentum strategies, while for the 4 weeks holding period we find that momentum strategies are not acceptable (regarding the statistically oriented criteria set), mainly due to their failure to pass the normality test.

Out of all short term holding periods, we find that EPS estimate revisions over the past 4 weeks is the most important performance factor of momentum strategies. Moreover, for both 1 week and 4 weeks holding periods, bottom P/E of past 4 quarter EPS and return on equity (ROE) affect portfolio performance to a greater extent compared to simple momentum strategies.

The main finding of this paper is that certain firm specific information incorporated in a simple price momentum strategy provides significantly higher returns for short term investment horizons, for no significantly extra volatility, which indirectly casts doubt on market efficiency. A suggestion arising for investors is that frequent updating of information concerning EPS estimates revisions, may prove to be profitable, however, investors should weigh the trade-off relating to the extra transaction costs as a result of frequent portfolio rebalancing. A possible explanation of this phenomenon can be found in the underreaction of investors and analysts to firm specific information, as higher performance is associated with longer look-back periods. This is in accordance with *Chan et al* (1996) who document that analysts revise their forecasts with a lag, as well as with *Barber et al* (2001) who evidence sluggish market response to news.

Our study is by no means exhaustive and further research is required to ascertain various issues regarding the effect of firm specific variables on the performance of momentum strategies. An informative such issue, that can be further explored, relates to the persistent effect of underreaction to analysts' estimates revisions by market participants, which allows for consistently excess returns at lower than expected volatility. Does this relate to some form of "hidden" risk or is it another "market imperfection"?

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# Appendix I. Return Tables

**Table Ia:** Annualized Raw Returns of Price Momentum Portfolio (Benchmark) and Variable Oriented Momentum Portfolios (Top Quintile and Bottom Quintile)

| | Momentum Definition 1 (4W) Annualized Returns | | | | | Momentum Definition 2 (12W) Annualized Returns | | | | | Momentum Definition 3 (24W) Annualized Returns | | | | | Momentum Definition 4 (Time Wgt.) Annualized Returns | | | | | Momentum Definition 5 (Eq. Wgt.) Annualized Returns | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Strategy** | **1W HP** | **2W HP** | **4W HP** | **12W HP** | **24W HP** | **1W HP** | **2W HP** | **4W HP** | **12W HP** | **24W HP** | **1W HP** | **2W HP** | **4W HP** | **12W HP** | **24W HP** | **1W HP** | **2W HP** | **4W HP** | **12W HP** | **24W HP** | **1W HP** | **2W HP** | **4W HP** | **12W HP** | **24W HP** |
| Momentum Universe | 8.87% | 8.76% | 9.95% | 13.59% | 11.97% | 13.35% | 15.31% | 15.94% | 16.74% | 17.48% | 15.86% | 17.14% | 17.36% | 20.15% | 16.65% | 13.16% | 14.40% | 13.68% | 16.66% | 17.12% | 13.44% | 14.40% | 13.41% | 17.11% | 16.51% |
| Dividend Yield Top | 7.92% | 12.93% | 13.70% | 21.07% | 18.07% | 15.64% | 18.74% | 18.90% | 23.38% | 21.11% | 17.47% | 20.61% | 24.56% | 30.10% | 28.53% | 15.54% | 20.51% | 19.11% | 23.97% | 21.49% | 14.15% | 18.69% | 21.01% | 24.14% | 20.81% |
| Dividend Yield Bottom | 9.52% | 12.78% | 10.47% | 9.70% | 16.08% | 16.87% | 18.21% | 12.33% | 14.13% | 18.84% | 16.80% | 19.46% | 19.21% | 17.91% | 15.73% | 14.48% | 15.58% | 10.64% | 12.29% | 17.77% | 14.02% | 14.90% | 9.03% | 11.22% | 17.77% |
| EPS Surprises 9Q Top | 32.05% | 22.53% | 15.19% | 15.82% | 18.15% | 25.68% | 24.97% | 19.87% | 16.74% | 16.53% | 27.73% | 26.76% | 22.04% | 18.49% | 15.75% | 25.83% | 24.24% | 18.99% | 16.78% | 16.73% | 24.63% | 23.89% | 17.65% | 17.74% | 15.69% |
| EPS Surprises 9Q Bottom | -3.65% | -3.13% | 1.43% | 8.52% | 10.37% | 2.37% | 5.60% | 9.36% | 11.27% | 14.68% | 9.22% | 10.55% | 16.09% | 22.02% | 18.96% | 2.51% | 4.71% | 9.18% | 11.09% | 14.83% | 2.06% | 4.48% | 9.00% | 10.66% | 15.73% |
| EPS Est. Rev. 4W Top | 31.83% | 26.38% | 23.35% | 24.57% | 23.99% | 32.34% | 30.68% | 27.85% | 27.30% | 24.48% | 37.38% | 33.10% | 29.19% | 27.32% | 21.27% | 31.92% | 28.66% | 25.56% | 27.19% | 24.50% | 32.67% | 29.98% | 26.60% | 27.53% | 23.34% |
| EPS Est. Rev. 4W Bottom | -2.70% | -2.01% | -0.54% | 1.69% | 4.62% | 2.56% | 6.38% | 7.08% | 9.85% | 12.38% | 6.86% | 11.59% | 13.75% | 19.18% | 15.28% | 2.46% | 6.71% | 6.61% | 8.57% | 11.34% | 1.33% | 5.71% | 5.26% | 9.93% | 12.36% |
| EPS Est. Rev. 12W Top | 27.88% | 25.60% | 21.70% | 24.20% | 19.71% | 34.40% | 35.52% | 31.65% | 26.88% | 21.57% | 31.10% | 30.61% | 28.55% | 26.86% | 19.83% | 32.87% | 32.68% | 29.83% | 27.44% | 21.83% | 31.30% | 31.27% | 27.79% | 27.97% | 23.79% |
| EPS Est. Rev. 12W Bottom | -6.00% | -4.17% | -1.87% | 6.56% | 7.18% | -1.99% | -0.99% | 0.42% | 13.00% | 15.61% | 7.34% | 10.10% | 11.77% | 20.39% | 16.55% | -1.89% | -1.48% | -0.39% | 11.76% | 13.50% | -2.32% | -1.69% | 0.88% | 12.29% | 13.34% |
| Interest Coverage Top | 14.92% | 5.56% | 15.36% | 15.30% | 13.98% | 19.12% | 15.58% | 20.93% | 19.48% | 18.74% | 18.28% | 17.77% | 21.70% | 21.11% | 19.41% | 18.96% | 15.50% | 21.19% | 18.90% | 18.03% | 18.42% | 12.87% | 20.25% | 19.87% | 18.72% |
| Interest Coverage Bottom | 13.21% | 13.24% | 11.77% | 21.40% | 21.19% | 25.66% | 21.44% | 20.27% | 22.87% | 23.50% | 25.41% | 23.29% | 22.27% | 28.18% | 23.40% | 23.22% | 19.34% | 22.27% | 24.16% | 24.88% | 21.88% | 21.61% | 20.75% | 24.79% | 24.19% |
| Market Cap. Top | 2.32% | 14.06% | 7.36% | 17.62% | 9.48% | 11.96% | 20.23% | 15.86% | 21.11% | 15.53% | 14.96% | 19.08% | 17.60% | 21.72% | 18.24% | 10.84% | 19.87% | 15.51% | 21.64% | 14.50% | 6.28% | 21.40% | 13.81% | 22.08% | 13.82% |
| Market Cap. Bottom | 17.21% | 15.41% | 7.56% | 11.31% | 16.34% | 22.62% | 22.16% | 15.17% | 13.82% | 14.35% | 23.19% | 25.22% | 23.39% | 21.09% | 15.28% | 21.65% | 20.73% | 13.56% | 14.01% | 14.62% | 21.88% | 20.85% | 16.11% | 14.41% | 13.82% |
| P/E 4Q Hist. EPS Top | 8.64% | 9.73% | 9.25% | 15.40% | 14.35% | 11.47% | 13.62% | 13.33% | 11.67% | 14.04% | 10.50% | 11.14% | 12.33% | 14.18% | 12.05% | 11.36% | 13.05% | 12.60% | 12.39% | 14.81% | 9.30% | 12.27% | 11.06% | 13.34% | 14.23% |
| P/E 4Q Hist. EPS Bottom | 15.88% | 16.65% | 14.65% | 14.68% | 17.81% | 28.33% | 27.02% | 26.08% | 25.35% | 27.81% | 32.18% | 34.13% | 35.75% | 29.10% | 28.10% | 26.98% | 26.17% | 25.66% | 25.39% | 27.63% | 26.02% | 26.36% | 25.00% | 24.57% | 27.28% |
| P/E 4Q Est. EPS Top | 1.41% | 6.03% | 6.84% | 15.55% | 12.13% | 7.60% | 11.82% | 15.21% | 13.30% | 15.20% | 9.96% | 10.42% | 11.98% | 13.65% | 9.93% | 6.66% | 10.45% | 15.21% | 13.57% | 15.24% | 3.63% | 9.33% | 12.90% | 15.86% | 14.17% |
| P/E 4Q Est. EPS Bottom | 16.11% | 17.48% | 16.89% | 19.32% | 16.20% | 27.88% | 28.51% | 27.00% | 25.58% | 23.16% | 31.30% | 31.60% | 32.00% | 33.51% | 28.62% | 27.73% | 28.19% | 27.09% | 26.09% | 22.80% | 25.33% | 27.29% | 25.93% | 25.82% | 22.11% |
| P/BV Top | 14.31% | 13.43% | 9.46% | 12.39% | 7.53% | 10.80% | 13.87% | 10.97% | 12.56% | 16.06% | 11.83% | 13.62% | 10.97% | 14.61% | 11.07% | 11.23% | 13.60% | 10.80% | 12.88% | 15.94% | 8.86% | 12.38% | 9.71% | 12.52% | 14.72% |
| P/BV Bottom | 4.03% | 9.23% | 7.20% | 14.16% | 19.61% | 19.50% | 21.56% | 17.75% | 20.45% | 24.27% | 22.78% | 23.58% | 24.29% | 27.78% | 26.19% | 16.52% | 19.10% | 16.11% | 20.59% | 24.86% | 16.23% | 19.56% | 15.71% | 22.20% | 26.99% |
| P/CF Top | 6.60% | -3.52% | 8.21% | 16.48% | 12.36% | 9.83% | 1.87% | 9.73% | 13.30% | 17.16% | 8.29% | 4.36% | 13.66% | 17.27% | 15.59% | 9.44% | 1.53% | 9.13% | 13.26% | 16.71% | 7.45% | 1.43% | 9.29% | 13.72% | 15.94% |
| P/CF Bottom | 15.08% | 24.93% | 15.44% | 19.42% | 22.96% | 31.67% | 29.98% | 28.27% | 29.02% | 29.51% | 35.05% | 31.75% | 34.44% | 32.02% | 32.18% | 30.37% | 30.81% | 27.98% | 28.32% | 28.43% | 30.09% | 30.77% | 28.53% | 28.72% | 28.72% |
| P/S Top | -1.36% | 7.88% | -5.43% | 2.48% | -1.46% | -2.72% | 11.76% | 1.05% | 5.56% | 9.82% | 4.10% | 11.18% | 3.74% | 6.97% | 3.66% | -1.66% | 11.72% | 0.86% | 5.47% | 9.44% | -3.58% | 11.07% | 0.66% | 5.38% | 8.28% |
| P/S Bottom | 22.02% | 16.85% | 20.97% | 20.35% | 18.64% | 30.33% | 30.77% | 27.26% | 25.64% | 20.57% | 30.66% | 33.48% | 27.79% | 25.62% | 21.65% | 30.46% | 30.55% | 25.89% | 25.72% | 20.65% | 31.16% | 30.90% | 25.50% | 25.45% | 19.73% |
| Sales Top | 6.44% | 10.56% | 11.77% | 18.98% | 15.14% | 21.92% | 23.56% | 24.77% | 28.45% | 22.09% | 19.42% | 22.22% | 23.16% | 26.20% | 25.84% | 21.79% | 24.26% | 24.54% | 29.04% | 21.41% | 20.53% | 22.94% | 23.59% | 30.71% | 22.82% |
| Sales Bottom | 4.47% | 0.00% | -3.05% | -0.98% | -0.09% | 3.24% | 5.30% | 2.86% | 4.78% | 9.63% | 4.27% | 6.24% | 7.65% | 9.65% | 6.05% | 4.96% | 4.18% | 1.87% | 5.41% | 7.64% | 4.36% | 4.62% | 2.06% | 4.51% | 7.59% |
| Short Ratio Top | 1.74% | 4.22% | 3.43% | 9.46% | 5.55% | 1.34% | 5.44% | 6.39% | 8.35% | 14.83% | 11.91% | 13.48% | 13.24% | 13.34% | 11.55% | 0.14% | 4.27% | 5.75% | 7.41% | 14.13% | 1.91% | 4.82% | 5.72% | 9.41% | 12.57% |
| Short Ratio Bottom | 15.68% | 13.75% | 11.03% | 15.24% | 13.51% | 22.51% | 21.54% | 20.79% | 18.27% | 17.99% | 19.50% | 20.01% | 24.03% | 24.51% | 24.09% | 22.53% | 20.91% | 19.45% | 19.66% | 18.68% | 21.69% | 20.09% | 19.95% | 19.89% | 17.73% |
| Beta Top | 4.31% | 4.10% | 2.29% | 10.49% | 3.22% | 10.86% | 11.55% | 12.45% | 14.34% | 13.42% | 9.04% | 11.29% | 10.25% | 11.88% | 7.46% | 10.76% | 10.23% | 11.47% | 14.43% | 12.88% | 9.87% | 10.38% | 10.41% | 13.13% | 10.27% |
| Beta Bottom | 13.86% | 15.85% | 11.53% | 15.98% | 14.29% | 17.41% | 19.93% | 17.34% | 18.72% | 17.73% | 24.53% | 25.08% | 23.66% | 23.50% | 21.59% | 17.80% | 20.21% | 16.77% | 20.45% | 17.99% | 16.80% | 21.46% | 16.91% | 21.70% | 16.22% |
| ROE Top | 19.20% | 21.22% | 16.89% | 18.35% | 16.69% | 25.68% | 24.53% | 23.43% | 23.93% | 28.97% | 25.94% | 28.13% | 28.59% | 25.76% | 25.51% | 28.24% | 28.19% | 29.64% | 26.96% | 26.52% | 26.26% | 27.61% | 30.03% | 28.51% | 28.31% |
| ROE Bottom | 6.46% | 2.70% | -1.31% | 0.92% | 0.27% | 4.57% | 6.64% | 2.68% | 5.07% | 7.55% | 6.87% | 8.30% | 6.22% | 10.06% | 3.89% | 5.85% | 7.23% | 4.60% | 6.86% | 4.14% | 3.45% | 3.80% | 1.82% | 7.78% | 5.64% |
| ROA Top | 14.60% | 15.33% | 15.30% | 15.24% | 12.32% | 19.22% | 21.83% | 20.85% | 18.98% | 20.07% | 20.94% | 23.99% | 23.04% | 20.75% | 18.74% | 20.21% | 21.34% | 25.48% | 22.99% | 21.33% | 18.80% | 21.34% | 24.13% | 23.69% | 21.15% |
| ROA Bottom | 8.56% | 2.60% | -1.39% | 1.94% | 2.93% | 5.53% | 7.41% | 3.20% | 4.59% | 9.59% | 7.63% | 8.05% | 6.32% | 9.28% | 5.07% | 5.67% | 7.37% | 3.46% | 5.76% | 4.75% | 4.40% | 5.05% | 1.17% | 6.85% | 8.19% |
| PEG Ratio Top | 9.06% | 9.03% | 11.55% | 14.34% | 10.03% | 15.90% | 19.14% | 21.66% | 18.86% | 19.69% | 23.76% | 25.14% | 26.33% | 25.37% | 19.69% | 22.35% | 24.07% | 26.81% | 24.75% | 22.74% | 9.37% | 12.72% | 15.13% | 15.49% | 13.05% |
| PEG Ratio Bottom | 3.43% | 8.14% | 9.05% | 17.31% | 14.19% | 8.29% | 11.16% | 13.70% | 15.36% | 14.29% | 11.06% | 12.57% | 15.65% | 15.40% | 11.65% | 9.85% | 13.41% | 15.23% | 15.47% | 12.38% | 19.40% | 23.89% | 25.60% | 24.69% | 23.24% |
| Asset Utilization Top | 18.10% | 19.34% | 18.80% | 14.01% | 15.26% | 24.59% | 25.37% | 23.31% | 18.17% | 18.92% | 25.37% | 29.44% | 26.12% | 24.48% | 22.74% | 26.51% | 28.66% | 28.44% | 25.62% | 22.19% | 22.45% | 26.61% | 26.04% | 23.73% | 22.43% |
| Asset Utilization Bottom | 1.46% | -1.43% | -3.06% | 4.46% | 5.94% | 2.03% | 5.96% | 3.39% | 5.90% | 14.42% | 11.53% | 10.92% | 11.23% | 10.96% | 6.82% | 8.65% | 10.10% | 9.64% | 8.07% | 7.03% | 5.32% | 6.60% | 6.11% | 9.83% | 10.27% |
| Analyst Recom. Ch. 4W Top | 16.89% | 17.20% | 15.73% | 17.84% | 16.22% | 19.84% | 18.73% | 17.50% | 19.00% | 19.67% | 26.81% | 23.60% | 21.60% | 23.32% | 17.99% | 23.15% | 21.02% | 19.93% | 22.08% | 17.49% | 23.34% | 21.24% | 20.03% | 21.70% | 19.12% |
| Analyst Recom. Ch. 4W Bottom | -0.08% | 3.52% | 4.62% | 11.03% | 10.60% | 7.76% | 8.79% | 11.57% | 15.96% | 24.17% | 10.30% | 12.82% | 12.99% | 19.77% | 18.86% | 10.95% | 13.54% | 14.86% | 21.11% | 21.01% | 8.58% | 12.72% | 14.63% | 20.21% | 22.70% |
| EPS Growth 4Q Hist. Top | 16.80% | 17.67% | 17.14% | 15.47% | 9.68% | 20.25% | 22.94% | 21.05% | 19.85% | 17.79% | 21.32% | 23.39% | 20.01% | 20.67% | 18.24% | 18.60% | 20.13% | 20.61% | 20.73% | 18.30% | 18.68% | 21.26% | 19.29% | 18.80% | 15.71% |
| EPS Growth 4Q Hist. Bottom | 6.68% | 9.07% | 8.23% | 14.57% | 15.30% | 13.83% | 14.40% | 19.59% | 17.23% | 19.18% | 14.81% | 16.22% | 19.17% | 19.77% | 16.12% | 13.96% | 16.79% | 19.13% | 19.16% | 12.94% | 12.87% | 16.14% | 18.03% | 18.78% | 15.71% |

**Table Ib:** Annualized Return Differences between Variable Oriented Momentum Portfolios (Top Quintile and Bottom Quintile) and Price Momentum Portfolio (Benchmark)

| | Momentum Definition 1 (4W) Annualized Return Differnces | | | | | Momentum Definition 2 (12W) An. Ret. Differences | | | | | Momentum Definition 3 (24W) An. Ret. Differences | | | | | Momentum Definition 4 (Time Weig.) An. Ret. Differences | | | | | Momentum Definition 4 (Eq. Weig.) An. Ret. Differences | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Strategy** | **1W HP** | **2W HP** | **4W HP** | **12W HP** | **24W HP** | **1W HP** | **2W HP** | **4W HP** | **12W HP** | **24W HP** | **1W HP** | **2W HP** | **4W HP** | **12W HP** | **24W HP** | **1W HP** | **2W HP** | **4W HP** | **12W HP** | **24W HP** | **1W HP** | **2W HP** | **4W HP** | **12W HP** | **24W HP** |
| Momentum Universe | -2.09% | -1.97% | -0.71% | 1.46% | 0.02% | 1.94% | 3.96% | 4.74% | 4.35% | 5.20% | 4.20% | 5.62% | 6.04% | 7.49%* | 4.42% | 1.77% | 3.14% | 2.68% | 4.28% | 4.86% | 2.03% | 3.14% | 2.44% | 4.69% | 4.29% |
| Dividend Yield Top | -0.87% | 3.85% | 3.43% | 6.79% | 5.74% | 2.03% | 3.00% | 2.58% | 5.90%* | 3.33% | 1.39% | 2.98% | 6.22%* | 8.65%*** | 10.96%*** | 2.12% | 5.37% | 4.83% | 6.50%** | 4.01% | 0.63% | 3.76% | 6.77%* | 6.23%** | 3.96% |
| Dividend Yield Bottom | 0.59% | 3.71% | 0.47% | -3.52% | 3.87% | 3.12% | 2.53% | -3.14% | -2.32% | 1.25% | 0.81% | 1.99% | 1.60% | -1.94% | -0.85% | 1.17% | 1.03% | -2.70% | -3.88% | 0.60% | 0.51% | 0.44% | -3.90% | -5.21%* | 1.16% |
| EPS Surprises 9Q Top | 21.32%*** | 12.70%* | 4.80% | 2.03% | 5.81%* | 10.91%*** | 8.43% | 3.43% | 0.00% | -0.86% | 10.28%*** | 8.26% | 4.04% | -1.45% | -0.83% | 11.23%*** | 8.65% | 4.73%* | 0.10% | -0.36% | 9.89%*** | 8.34% | 3.78% | 0.56% | -0.76% |
| EPS Surprises 9Q Bottom | -11.52%*** | -10.96%* | -7.81%** | -4.60% | -1.51% | -9.70%*** | -8.47% | -5.73%** | -4.85%** | -2.56% | -5.74%** | -5.66% | -1.09% | 1.62% | 2.12% | -9.43%*** | -8.51% | -3.99% | -4.95%** | -2.10% | -10.05%*** | -8.71% | -3.93% | -5.71%*** | -0.72% |
| EPS Est. Rev. 4W Top | 21.12%*** | 16.26%** | 12.28%*** | 9.96%*** | 11.32%*** | 16.80%*** | 13.41%* | 10.40%*** | 9.39%*** | 6.43%** | 18.64%*** | 13.71%* | 10.21%*** | 6.23%* | 4.25% | 16.62%*** | 12.53%* | 10.56%*** | 9.37%*** | 6.78%** | 16.99%*** | 13.69%* | 11.75%*** | 9.24%*** | 6.30%** |
| EPS Est. Rev. 4W Bottom | -10.65% | -9.93% | -9.61%*** | -10.77%*** | -6.91%** | -9.54%*** | -7.78% | -7.73%*** | -6.11%** | -4.67%* | -7.79%*** | -4.77% | -3.11% | -0.85% | -1.26% | -9.47%*** | -6.76% | -6.28%** | -7.18%*** | -5.30%** | -10.71%*** | -7.64% | -7.26%** | -6.36%** | -3.82% |
| EPS Est. Rev. 12W Top | 17.49%*** | 15.54%** | 10.77%*** | 9.63%*** | 7.29%*** | 18.62%*** | 17.63%** | 13.71%*** | 9.02%*** | 3.76%* | 13.20%*** | 11.57% | 9.66%*** | 5.83% | 2.93% | 17.47%*** | 16.07%** | 14.36%*** | 9.59%*** | 4.33%** | 15.78%*** | 14.83%* | 12.81%*** | 9.63%*** | 6.71%** |
| EPS Est. Rev. 12W Bottom | -13.68%*** | -11.92%* | -10.83%*** | -6.37%*** | -4.51%** | -13.56%*** | -14.21%** | -13.53%*** | -3.32% | -1.71% | -7.37%** | -6.05% | -4.82%* | 0.21% | -0.09% | -13.33%*** | -13.95%** | -12.49%*** | -4.35% | -3.33%* | -13.93%*** | -14.13%** | -11.15%*** | -4.26%* | -2.92% |
| Interest Coverage Top | 5.57%** | -2.95% | 4.96% | 1.55% | 1.89% | 5.10%* | 0.24% | 4.36% | 2.43% | 1.16% | 2.10% | 0.54% | 3.74% | 0.83% | 2.54% | 5.14%* | 0.97% | 6.68%** | 1.99% | 0.83% | 4.40% | -1.34% | 6.09%** | 2.45% | 2.03% |
| Interest Coverage Bottom | 3.99% | 4.13% | 1.67% | 7.08%* | 8.68%*** | 10.89%*** | 5.35% | 3.78% | 5.45% | 5.53%** | 8.27%*** | 5.28% | 4.23% | 6.97%** | 6.22%** | 8.91%*** | 4.34% | 7.63%** | 6.66%* | 7.14%** | 7.45%** | 6.33% | 6.54%** | 6.81%* | 7.08%** |
| Market Cap. Top | -6.03%* | 4.89% | -2.37% | 3.66% | -2.35% | -1.23% | 4.29% | -0.07% | 3.89% | -1.78% | -0.77% | 1.67% | 0.20% | 1.36% | 1.47% | -2.06% | 4.80% | 1.63% | 4.42% | -2.40% | -6.33%* | 6.15% | 0.36% | 4.41% | -2.47% |
| Market Cap. Bottom | 7.67% | 6.13% | -2.19% | -2.06% | 4.11% | 8.20%* | 5.97% | -0.67% | -2.59% | -2.87% | 6.35% | 6.94% | 5.20% | 0.82% | -1.26% | 7.52% | 5.56% | -0.10% | -2.35% | -2.30% | 7.45% | 5.67% | 2.41% | -2.39% | -2.47% |
| P/E 4Q Hist. EPS Top | -0.22% | 0.90% | -0.64% | 1.64% | 2.23% | -1.66% | -1.48% | -2.27% | -4.50% | -3.15% | -4.64%* | -5.15% | -4.33% | -5.18%* | -4.23% | -1.59% | -1.19% | -0.96% | -3.79% | -2.12% | -3.66% | -1.87% | -2.09% | -3.34% | -2.10% |
| P/E 4Q Hist. EPS Bottom | 6.44%* | 7.28% | 4.30% | 0.99% | 5.50%* | 13.25%*** | 10.21% | 8.85%** | 7.65%* | 9.49%** | 14.13%*** | 14.59%** | 15.88%*** | 7.78%* | 10.56%** | 12.25%*** | 10.34% | 10.65%*** | 7.76%** | 9.66%** | 11.12%*** | 10.51% | 10.32%*** | 6.61% | 9.93%** |
| P/E 4Q Est. EPS Top | -6.87%** | -2.52% | -2.85% | 1.78% | 0.14% | -5.09%* | -3.04% | -0.64% | -3.05% | -2.08% | -5.10% | -5.78% | -4.64% | -5.65% | -6.18% | -5.76%** | -3.47% | 1.36% | -2.74% | -1.73% | -8.67%*** | -4.46% | -0.45% | -1.10% | -2.15% |
| P/E 4Q Est. EPS Bottom | 6.66%* | 8.05% | 6.36% | 5.20% | 3.98% | 12.85%*** | 11.52%* | 9.66%** | 7.85%** | 5.22% | 13.37%*** | 12.42%* | 12.64%*** | 11.61%*** | 11.04%*** | 12.91%*** | 12.12%* | 11.92%*** | 8.39%** | 5.22% | 10.50%*** | 11.33%* | 11.16%*** | 7.72%** | 5.16% |
| P/BV Top | 5.00% | 4.31% | -0.45% | -1.09% | -4.18% | -2.25% | -1.26% | -4.33% | -3.71% | -1.30% | -3.48% | -3.03% | -5.51% | -4.81% | -5.13% | -1.71% | -0.71% | -2.55% | -3.35% | -1.08% | -4.05% | -1.77% | -3.29% | -4.06% | -1.65% |
| P/BV Bottom | -4.46% | 0.44% | -2.52% | 0.52% | 7.19% | 5.44%* | 5.46% | 1.58% | 3.30% | 6.24% | 5.99%* | 5.53% | 5.98%* | 6.63%* | 8.79% | 2.98% | 4.13% | 2.17% | 3.50% | 7.12%* | 2.46% | 4.54% | 2.05% | 4.51% | 9.66%** |
| P/CF Top | -2.09% | -11.32% | -1.59% | 2.63% | 0.36% | -3.11% | -11.71% | -5.41%* | -3.05% | -0.29% | -6.55%** | -10.97% | -3.19% | -2.51% | -0.97% | -3.29% | -11.31% | -4.04% | -3.02% | -0.38% | -5.29%* | -11.40% | -3.67% | -3.00% | -0.52% |
| P/CF Bottom | 5.71%* | 14.92%** | 5.03% | 5.29% | 10.35%*** | 16.21%*** | 12.80%* | 10.77%*** | 10.92%** | 11.05%** | 16.62%*** | 12.55%* | 14.75%*** | 10.32%** | 14.33%*** | 15.25%*** | 14.42%* | 12.71%*** | 10.37%** | 10.41%** | 14.71%*** | 14.38%* | 13.47%*** | 10.30%** | 11.26%** |
| P/S Top | -9.41%*** | -0.81% | -14.09%*** | -10.06%*** | -12.61%*** | -14.20%*** | -3.09% | -12.98%*** | -9.91%** | -7.01% | -10.18%*** | -5.12% | -11.74%*** | -11.42%*** | -11.92%** | -13.12%*** | -2.35% | -11.38%*** | -9.93%** | -7.05% | -15.04%*** | -2.93% | -11.35%*** | -10.37%*** | -7.57%* |
| P/S Bottom | 12.09%*** | 7.46% | 10.10%** | 6.14% | 6.28%* | 15.02%*** | 13.48%** | 9.88%*** | 7.91%** | 2.84% | 12.81%*** | 14.04%** | 9.00%** | 4.75% | 4.61% | 15.33%*** | 14.19%** | 10.86%*** | 8.06%** | 3.24% | 15.66%*** | 14.50%** | 10.77%*** | 7.39%* | 2.97% |
| Sales Top | -2.24% | 1.67% | 1.67% | 4.89% | 2.98% | 7.58%** | 7.19% | 7.71%** | 10.41%*** | 4.24% | 3.08% | 4.36% | 5.01% | 5.25% | 8.47%*** | 7.65%** | 8.67% | 9.66%*** | 11.01%*** | 3.94% | 6.26%* | 7.50% | 9.07%*** | 12.07%*** | 5.81%* |
| Sales Bottom | -4.05% | -8.08% | -11.90%** | -13.19%*** | -11.33%*** | -8.94%** | -8.73% | -11.41%** | -10.60%** | -7.19% | -10.02%** | -9.36% | -8.37%* | -9.11%* | -9.73%** | -7.26%* | -8.98% | -10.48%** | -9.98%** | -8.69%* | -8.02%* | -8.59% | -10.10%** | -11.14%** | -8.21%* |
| Short Ratio Top | -6.57%** | -4.18% | -5.97%** | -3.74% | -6.04%*** | -10.62%*** | -8.60% | -8.32%** | -7.44%** | -2.42% | -3.42% | -3.14% | -3.55% | -5.91%* | -4.69% | -11.53%*** | -8.90% | -7.04%** | -8.20%*** | -2.74% | -10.19%*** | -8.42% | -6.85%** | -6.82%** | -3.63% |
| Short Ratio Bottom | 6.26% | 4.61% | 0.98% | 1.50% | 1.45% | 8.11%* | 5.44% | 4.23% | 1.36% | 0.47% | 3.15% | 2.46% | 5.75% | 3.78% | 6.86% | 8.31%** | 5.72% | 5.13% | 2.66% | 1.43% | 7.29%* | 5.00% | 5.82% | 2.47% | 1.12% |
| Beta Top | -4.20% | -4.30% | -7.02% | -2.81% | -8.22%** | -2.20% | -3.27% | -3.05% | -2.13% | -3.72% | -5.90% | -5.02% | -6.13% | -7.18%* | -8.45%* | -2.12% | -3.67% | -1.96% | -1.98% | -3.89% | -3.16% | -3.53% | -2.67% | -3.52% | -5.74%** |
| Beta Bottom | 4.59% | 6.55% | 1.44% | 2.17% | 2.18% | 3.59% | 4.03% | 1.22% | 1.76% | 0.23% | 7.51%* | 6.82% | 5.43% | 2.91% | 4.55% | 4.12% | 5.10% | 2.75% | 3.37% | 0.80% | 2.96% | 6.21% | 3.12% | 4.07% | -0.27% |
| ROE Top | 9.50%*** | 11.50%* | 6.36% | 4.32% | 4.44% | 10.91%*** | 8.05% | 6.54% | 6.39%** | 10.56%** | 8.73%** | 9.44% | 9.69%*** | 4.87% | 8.17%* | 13.37%*** | 12.12% | 14.19%*** | 9.16%** | 8.64%* | 11.32%*** | 11.61% | 14.80%*** | 10.11%** | 10.88%** |
| ROE Bottom | -2.22% | -5.58% | -10.31%** | -11.47%*** | -10.99%** | -7.76%* | -7.56% | -11.56%*** | -10.34%** | -9.08%** | -7.77%* | -7.59% | -9.61%** | -8.75%* | -11.72%*** | -6.47% | -6.30% | -8.06% | -8.69%* | -11.89%** | -8.83%** | -9.31% | -10.31%** | -8.25%* | -9.99%** |
| ROA Top | 5.26%* | 6.06% | 4.90% | 1.50% | 0.33% | 5.19%* | 5.69% | 4.29% | 1.99% | 2.38% | 4.40% | 5.88% | 4.90%* | 0.52% | 1.92% | 6.24% | 6.10% | 10.49%*** | 5.63%** | 3.87% | 4.73% | 6.10% | 9.55%*** | 5.83%** | 4.27% |
| ROA Bottom | -0.29% | -5.68% | -10.39%** | -10.55%*** | -8.50%* | -6.91% | -6.89% | -11.10%** | -10.77%** | -7.22%* | -7.12% | -7.81% | -9.52%** | -9.43%* | -10.64%** | -6.63% | -6.17% | -9.07%* | -9.67%* | -11.33%** | -7.99%* | -8.22% | -10.89%** | -9.08%** | -7.65% |
| PEG Ratio Top | 0.17% | 0.25% | 1.46% | 0.68% | -1.83% | 2.25% | 3.34% | 4.99% | 1.89% | 2.03% | 6.84%** | 6.87% | 7.74%** | 4.53% | 2.80% | 8.14%** | 8.50% | 11.68%*** | 7.19%** | 5.16% | -3.60% | -1.48% | 1.53% | -1.43% | -3.19% |
| PEG Ratio Bottom | -5.01%* | -0.57% | -0.82% | 3.37% | 2.09% | -4.47%* | -3.62% | -1.96% | -1.22% | -2.92% | -4.15% | -3.93% | -1.48% | -4.13% | -4.60% | -2.93% | -0.87% | 1.38% | -1.05% | -4.35% | 5.26%* | 8.34% | 10.86%*** | 6.72%* | 6.20%* |
| Asset Utilization Top | 8.49%** | 9.77% | 8.11%* | 0.38% | 3.09% | 9.94%*** | 8.77% | 6.43%* | 1.27% | 1.32% | 8.23%** | 10.56% | 7.56%** | 3.76% | 5.61% | 11.83%*** | 12.53%* | 13.13%*** | 7.96%*** | 4.66% | 7.96%** | 10.73% | 11.25%*** | 5.87%* | 5.46% |
| Asset Utilization Bottom | -6.82%* | -9.39% | -11.92%*** | -8.27%** | -5.67%* | -10.01%*** | -8.15% | -10.94%*** | -9.61%*** | -2.80% | -3.75% | -5.34% | -5.29% | -7.98%** | -9.03%* | -3.99% | -3.78% | -3.59% | -7.62%** | -9.25%* | -7.18%** | -6.85% | -6.50% | -6.44%** | -5.74%* |
| Analyst Recom. Ch. 4W Top | 7.38%*** | 7.79% | 5.29% | 3.85%* | 4.00%* | 5.74%** | 2.98% | 1.36% | 2.01% | 2.01% | 9.48%*** | 5.55% | 3.66% | 2.75% | 1.23% | 8.86%*** | 5.81% | 5.56%* | 4.82% | 0.34% | 8.75%*** | 6.01% | 5.89%* | 4.07% | 2.40% |
| Analyst Recom. Ch. 4W Bottom | -8.24%*** | -4.83% | -4.88% | -2.32% | -1.30% | -4.94%* | -5.68% | -3.81% | -0.69% | 6.15%* | -4.81%** | -3.71% | -3.77% | -0.33% | 2.03% | -1.96% | -0.76% | 1.05% | 3.96% | 3.57% | -4.30%* | -1.48% | 1.09% | 2.75% | 5.70%* |
| EPS Growth 4Q Hist. Top | 7.29%*** | 8.23% | 6.59%* | 1.71% | -2.15% | 6.10%** | 6.65% | 4.46% | 2.77% | 0.29% | 4.73% | 5.37% | 2.29% | 0.45% | 1.47% | 4.82% | 5.03% | 6.16% | 3.62% | 1.09% | 4.63% | 6.03% | 5.24% | 1.50% | -0.74% |
| EPS Growth 4Q Hist. Bottom | -2.02% | 0.29% | -1.58% | 0.89% | 3.13% | 0.42% | -0.79% | 3.19% | 0.43% | 1.56% | -0.91% | -0.79% | 1.56% | -0.33% | -0.49% | 0.71% | 2.10% | 4.85% | 2.22% | -3.84% | -0.51% | 1.53% | 4.11% | 1.48% | -0.74% |

**Note: "***" denotes statistical significance at the 1% level, "**" denotes statistical significance at the 5% level and "*" denotes statistical significance at the 10% level**

**Table Ic:** Annualized Return Differences between Top Quintile minus Bottom Quintile of Variable Oriented Momentum Portfolios

| Momentum Definition 1 (4W) Annualized Top minus Bottom Differential Returns | | | | | | Mom.Def.2 (12W) Ann. Top minus Bottom Diff. Returns | | | | | Mom.Def.3 (24W) Ann. Top minus Bottom Diff. Returns | | | | | Mom.Def. 4 (T.W.) Ann. Top minus Bottom Diff. Returns | | | | | Mom.Def. 5 (E.W.) Ann. Top minus Bottom Diff. Returns | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Strategy | 1W HP | 2W HP | 4W HP | 12W HP | 24W HP | 1W HP | 2W HP | 4W HP | 12W HP | 24W HP | 1W HP | 2W HP | 4W HP | 12W HP | 24W HP | 1W HP | 2W HP | 4W HP | 12W HP | 24W HP | 1W HP | 2W HP | 4W HP | 12W HP | 24W HP |
| Dividend Yield | -1.46% | 0.14% | 2.94% | 10.60%** | 1.83% | -1.06% | 0.46% | 5.89% | 8.37%* | 2.07% | 0.58% | 0.97% | 4.55% | 10.75%** | 11.86%** | 0.93% | 4.29% | 7.72% | 10.69%** | 3.41% | 0.12% | 3.31% | 11.06%** | 11.92%** | 2.78% |
| EPS Surprises 9Q | 37.02%*** | 26.44%*** | 13.58%*** | 6.86% | 7.38%* | 22.78%*** | 18.39%*** | 9.68%** | 5.03% | 1.72% | 16.97%*** | 14.73%*** | 5.19% | -3.03% | -2.92% | 22.76%*** | 18.69%*** | 9.05%** | 5.25% | 1.76% | 22.12%*** | 18.61%*** | 8.00%* | 6.56% | -0.04% |
| EPS Est. Rev. 4W | 35.46%** | 28.94%*** | 24.01%*** | 22.59%*** | 18.92%*** | 29.04%*** | 22.90%*** | 19.51%*** | 16.25%*** | 11.38%** | 28.61%*** | 19.36%*** | 13.71%*** | 7.12% | 5.55% | 28.76%*** | 20.63%*** | 17.87%*** | 17.50%*** | 12.43%** | 30.94%*** | 23.02%*** | 20.37%*** | 16.39%*** | 10.33%* |
| EPS Est. Rev. 12W | 35.99%*** | 31.01%*** | 23.99%*** | 16.82%*** | 12.09%*** | 37.11%*** | 36.86%*** | 31.11%*** | 12.65%** | 5.51%* | 22.16%*** | 18.71%*** | 15.15%*** | 5.61% | 3.02% | 35.42%*** | 34.64%*** | 30.33%*** | 14.41%*** | 7.79%*** | 34.40%*** | 33.50%*** | 26.69%*** | 14.36%*** | 9.78%** |
| Interest Coverage | 1.51% | -6.81% | 3.24% | -5.25% | -6.49% | -5.23% | -4.86% | 0.56% | -2.90% | -4.25% | -5.71% | -4.51% | -0.47% | -5.83% | -3.56% | -3.47% | -3.24% | -0.89% | -4.45% | -6.07% | -2.85% | -7.23% | -0.42% | -4.14% | -4.86% |
| Market Cap. | -12.74%* | -1.18% | -0.19% | 5.81% | -6.32% | -8.72% | -1.59% | 0.61% | 6.61% | 1.10% | -6.71% | -4.94% | -4.77% | 0.54% | 2.75% | -8.92% | -0.72% | 1.74% | 6.90% | -0.11% | -12.84%** | 0.46% | -2.01% | 6.92% | 0.00% |
| P/E 4Q Hist. EPS | -6.27% | -5.97%* | -4.75% | 0.64% | -3.17% | -13.19%*** | -10.64%*** | -10.28%** | -11.47%* | -12.02%* | -16.48%*** | -17.31%*** | -17.63%*** | -12.22%** | -13.98%** | -12.35%*** | -10.49%*** | -10.57%** | -10.90%* | -11.20%* | -13.33%*** | -11.25%*** | -11.33%** | -9.46%* | -11.42%* |
| P/E 4Q Est. EPS | -12.69%*** | -9.80%** | -8.70% | -3.29% | -3.75% | -15.93%*** | -13.11%*** | -9.45%* | -10.28%* | -7.10% | -16.33%*** | -16.25%*** | -15.47%*** | -15.83%** | -16.23%** | -16.57%*** | -13.96%*** | -9.52%* | -10.45%** | -6.75% | -17.38%*** | -14.24%*** | -10.53%** | -8.33% | -7.12% |
| P/BV | 9.89%* | 3.85% | 2.11% | -1.60% | -10.94% | -7.31% | -6.38% | -5.83% | -6.83% | -7.29% | -8.95%* | -8.12%* | -10.89%* | -10.88% | -13.28% | -4.55% | -4.65% | -4.63% | -6.67% | -7.90% | -6.36% | -6.05% | -5.24% | -8.28% | -10.76% |
| P/CF | -7.38% | -22.94%*** | -6.32% | -2.56% | -9.46% | -16.67%*** | -21.82%*** | -14.71%*** | -12.88%** | -10.71% | -19.92%*** | -20.99%*** | -15.79%*** | -11.88%** | -14.20%*** | -16.13%*** | -22.59%*** | -14.99%*** | -12.40%** | -10.21% | -17.48%*** | -22.64%*** | -15.24%*** | -12.32%** | -11.11%* |
| P/S | -19.22%*** | -7.72%* | -22.11%*** | -15.45%** | -18.25%** | -25.47%*** | -14.67%*** | -20.94%*** | -16.79%** | -9.70% | -20.42%*** | -16.88%*** | -19.14%*** | -15.59%** | -16.12%** | -24.73%*** | -14.56%*** | -20.20%*** | -16.92%** | -10.11% | -26.61%*** | -15.29%*** | -20.10%*** | -16.80%*** | -10.37% |
| Sales | 1.89% | 10.56%* | 15.24%** | 20.11%** | 15.24%** | 18.10%** | 23.56%*** | 21.36%** | 22.85%*** | 11.88% | 14.54%* | 22.22%** | 14.50%* | 15.44%* | 19.20%** | 16.05%** | 24.26%*** | 22.29%*** | 22.71%*** | 13.24%* | 15.51%** | 22.94%*** | 21.13%** | 25.35%*** | 14.66%* |
| Short Ratio | -12.09%** | -8.42%* | -6.90% | -5.18% | -7.43% | -17.34%*** | -13.34%*** | -12.08%* | -8.71% | -2.88% | -6.38% | -5.47% | -8.84% | -9.41% | -11.13% | -18.34%*** | -13.86%*** | -11.62%* | -10.65%* | -4.14% | -16.31%*** | -12.80%*** | -12.02%* | -9.11% | -4.72% |
| Beta | -8.41% | -10.20%* | -8.35% | -4.90% | -10.28% | -5.60% | -7.03% | -4.22% | -3.84% | -3.95% | -12.49%* | -11.11%** | -11.01%* | -9.86% | -12.68% | -6.00% | -8.36% | -4.59% | -5.21% | -4.67% | -5.95% | -9.19% | -5.62% | -7.36% | -5.48% |
| ROE | 11.98%* | 18.05%*** | 18.42%** | 17.31%*** | 16.39%*** | 20.21%*** | 16.83%*** | 20.25%*** | 18.17%** | 20.63%*** | 17.86%** | 18.37%*** | 21.17%*** | 14.61%* | 21.21%*** | 21.18%*** | 19.60%*** | 24.03%*** | 19.12%** | 21.91%*** | 22.06%*** | 22.98%*** | 27.74%*** | 19.60%** | 22.03%*** |
| ROA | 5.57% | 12.42%** | 16.91%** | 13.11%** | 9.25%* | 12.99%** | 13.46%** | 17.14%** | 13.91%** | 9.99%* | 12.38%* | 14.81%*** | 15.80%** | 10.73% | 13.32%** | 13.77%* | 13.05%** | 21.34%*** | 16.52%** | 16.18%*** | 13.81%* | 15.54%*** | 22.71%*** | 16.02%*** | 12.43%** |
| PEG Ratio | 5.44% | 0.83% | 2.30% | -2.63% | -3.88% | 7.04%* | 7.21%** | 7.08% | 3.14% | 5.03% | 11.45%** | 11.22%*** | 9.35%** | 8.94% | 7.59% | 11.40%** | 9.45%** | 10.17%** | 8.31%* | 9.74%* | -8.43%** | -9.08%*** | -8.48%** | -7.75%* | -9.08%* |
| Asset Utilization | 16.40%** | 21.06%*** | 22.49%*** | 9.24%* | 9.04%* | 22.12%*** | 18.37%*** | 19.31%*** | 11.75%** | 4.18% | 12.44%* | 16.77%*** | 13.51%* | 12.50%** | 15.38%** | 16.46%** | 16.93%*** | 17.28%** | 16.54%*** | 14.64%** | 16.29%** | 18.82%*** | 18.88%** | 12.94%** | 11.55%** |
| Analyst Recom. Ch. 4W | 16.99%*** | 13.24%*** | 10.65%*** | 6.28% | 5.33% | 11.23%*** | 9.16%*** | 5.36% | 2.71% | -4.00% | 15.00%*** | 9.60%*** | 7.69%** | 3.09% | -0.79% | 11.02%*** | 6.62%** | 4.46% | 0.83% | -3.17% | 13.62%*** | 7.59%** | 4.76% | 1.29% | -3.20% |
| EPS Growth 4Q Hist. | 9.50%** | 7.92%** | 8.29%* | 0.82% | -5.20% | 5.66% | 7.50%* | 1.24% | 2.33% | -1.26% | 5.69% | 6.21% | 0.71% | 0.78% | 1.96% | 4.08% | 2.88% | 1.26% | 1.38% | 5.03% | 5.16% | 4.43% | 1.09% | 0.02% | 0.00% |

**Note: "***" denotes statistical significance at the 1% level, "**" denotes statistical significance at the 5% level and "*" denotes statistical significance at the 10% level**

## Appendix II: Volatility Tables

The following tables present the results of the volatility analysis and portfolio assessment for each momentum definition and for the 1 week, 2 weeks and 4 weeks holding periods. The first two main columns document the mean value of the volatility and of the volatility-reward ratio (VR) series for each holding period (in the sub-columns), the third column provides the JB statistics of normality while the last column denotes if a strategy is acceptable or not, after the second group of statistical conditions are applied.

| Momentum Definition 1 (4W) | Mean Volatility | | | Mean VR Ratio | | | Jarque - Bera | | | Assessment | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Strategy* | *1w* | *2w* | *4w* | *1w* | *2w* | *4w* | *1w* | *2w* | *4w* | *1w* | *2w* | *4w* |
| Momentum Universe | 2.86% | 4.27% | 5.77% | 0.051 | 0.082 | 0.114 | 13.35 | 2.85 | 1.99 | Reject | Reject | Reject |
| EPS Surprises 9Q Top | 0.95% | | | 0.399*** | | | 7.71 | | | Accept | | |
| EPS Est. Rev. 4w Top | 0.96% | 1.41% | 2.28% | 0.390*** | 0.420*** | 0.488*** | 7.71 | 1.32 | 89.69 | Accept | Reject | Accept |
| EPS Est. Rev. 12w Top | 0.96% | 1.27% | 2.35% | 0.340*** | 0.576*** | 0.381*** | 17.42 | 32,360.23 | 75.12 | Accept | Accept | Accept |
| P/E 4Q Hist. EPS Bottom | 1.04% | | 2.43% | 0.109** | | 0.152* | 34.10 | | 2.17 | Accept | | Reject |
| P/E 4Q Est. EPS Bottom | 1.11% | 1.66% | 2.67% | 0.108** | 0.187** | 0.213** | 0.72 | 1.13 | 3.70 | Reject | Reject | Reject |
| P/CF Bottom | 1.08% | 1.49% | 2.54% | 0.104** | 0.184** | 0.330 | 2.29 | 0.12 | 10.64 | Reject | Reject | Reject |
| P/S Bottom | 1.18% | 1.69% | 2.42% | 0.178*** | 0.314*** | 0.348*** | 2.17 | 0.10 | 1.84 | Reject | Reject | Reject |
| Sales Top | | | 2.12% | | | 0.113 | | | 1.16 | | | Reject |
| ROE Top | 1.02% | | 2.54% | 0.170*** | | 0.272** | 27.94 | | 106.39 | Accept | | Accept |
| Asset Utilization Top | 1.11% | | 2.60% | 0.144*** | | 0.001 | 2.04 | | 7,440.33 | Reject | | Reject |
| Analyst Recom. Ch. 4w Top | 0.90% | | | 0.159*** | | | 1.61 | | | Reject | | |

**Note:** "***" denotes statistical significance at the 1% level, "**" denotes statistical significance at the 5% level and "*" denotes statistical significance at the 10% level

| Momentum Definition 2 (12W) | Mean Volatility | | | Mean VR Ratio | | | Jarque - Bera | | | Assessment | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Strategy* | *1w* | *2w* | *4w* | *1w* | *2w* | *4w* | *1w* | *2w* | *4w* | *1w* | *2w* | *4w* |
| Momentum Universe | 3.00% | 4.42% | 5.75% | 0,075* | 0,120* | 0,192** | 19.02 | 3.23 | 2.81 | Accept | Reject | Reject |
| EPS Surprises 9Q Top | 0.95% | | | 0.211*** | | | 65.90 | | | Accept | | |
| EPS Est. Rev. 4w Top | 0.98% | 1.33% | 2.24% | 0.303*** | 0.363*** | 0.328*** | 65.90 | 6.37 | 31.16 | Accept | Accept | Accept |
| EPS Est. Rev. 12w Top | 1.02% | 1.39% | 2.13% | 0.324*** | 0.472*** | 0.508*** | 20.40 | 7.87 | 0.18 | Accept | Accept | Reject |
| P/E 4Q Hist. EPS Bottom | 1.03% | | 2.34% | 0.228*** | | 0.588** | 27.07 | | 9,163.76 | Accept | | Accept |
| P/E 4Q Est. EPS Bottom | 1.14% | 1.70% | 2.49% | 0.207*** | 0.245*** | 0.279*** | 0.75 | 0.77 | 0.37 | Reject | Reject | Reject |
| P/CF Bottom | 1.06% | 1.63% | 2.11% | 0.259*** | 0.278*** | 0.729*** | 2.95 | 0.16 | 0.20 | Reject | Reject | Reject |
| P/S Bottom | 1.14% | 1.58% | 2.25% | 0.232*** | 0.283*** | 0.323*** | 11.96 | 2.73 | 0.11 | Accept | Reject | Reject |
| Sales Top | | | 2.24% | | | 0.264 | | | 4.78 | | | Reject |
| ROE Top | 1.05% | | 2.55% | 0.190*** | | 0.216** | 0.53 | | 10.45 | Reject | | Accept |
| Asset Utilization Top | 1.06% | | 2.31% | 0.183*** | | 0.241** | 22.50 | | 2.91 | Accept | | Reject |
| Analyst Recom. Ch. 4w Top | 0.90% | | | 0.115** | | | 15.14 | | | Accept | | |

**Note:** "***" denotes statistical significance at the 1% level, "**" denotes statistical significance at the 5% level and "*" denotes statistical significance at the 10% level

| Momentum Definition 3 (24W) | Mean Volatility | | | Mean VR Ratio | | | Jarque - Bera | | | Assessment | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Strategy* | *1w* | *2w* | *4w* | *1w* | *2w* | *4w* | *1w* | *2w* | *4w* | *1w* | *2w* | *4w* |
| Momentum Universe | 3.06% | 4.28% | 5.09% | 0.085* | 0.133* | 0.279** | 17.19 | 8.97 | 2.09 | Accept | Accept | Reject |
| EPS Surprises 9Q Top | 0.93% | | | 0.191*** | | | 12.40 | | | Accept | | |
| EPS Est. Rev. 4w Top | 0.90% | 1.29% | 1.96% | 0.371*** | 0.352*** | 0.407*** | 12.40 | 3.06 | 1.34 | Accept | Reject | Reject |
| EPS Est. Rev. 12w Top | 1.04% | 1.32% | 1.90% | 0.226*** | 0.320*** | 0.341*** | 32.51 | 13.19 | 2.86 | Accept | Accept | Reject |
| P/E 4Q Hist. EPS Bottom | 1.09% | | 2.53% | 0.256*** | | 0.511*** | 11.98 | | 13.94 | Accept | | Accept |
| P/E 4Q Est. EPS Bottom | 1.20% | 1.71% | 2.53% | 0.205*** | 0.273*** | 0.376*** | 2.40 | 20.01 | 0.51 | Reject | Accept | Reject |
| P/CF Bottom | 1.03% | 1.59% | 2.31% | 0.291*** | 0.317*** | 1.020*** | 2.79 | 0.93 | 2.00 | Reject | Reject | Reject |
| P/S Bottom | 1.08% | 1.55% | 2.02% | 0.214*** | 0.318*** | 0.347*** | 4.10 | 5.46 | 2.54 | Reject | Reject | Reject |
| Sales Top | | | 2.30% | | | 0.191 | | | 5.55 | | | Reject |
| ROE Top | 1.09% | | 2.15% | 0.162*** | | 0.354*** | 0.89 | | 1.79 | Reject | | Reject |
| Asset Utilization Top | 1.09% | | 2.32% | 0.143*** | | 0.260** | 6.69 | | 1.99 | Accept | | Reject |
| Analyst Recom. Ch. 4w Top | 0.86% | | | 0.198*** | | | 12.28 | | | Accept | | |

**Note:** "***" denotes statistical significance at the 1% level, "**" denotes statistical significance at the 5% level and "*" denotes statistical significance at the 10% level

| Momentum Definition 4 (Time Wgt.) | Mean Volatility | | | Mean VR Ratio | | | Jarque - Bera | | | Assessment | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Strategy* | *1w* | *2w* | *4w* | *1w* | *2w* | *4w* | *1w* | *2w* | *4w* | *1w* | *2w* | *4w* |
| Momentum Universe | 2.99% | 4.30% | 5.06% | 0.074* | 0.116* | 0.231** | 19.36 | 3.79 | 1.61 | Accept | Reject | Reject |
| EPS Surprises 9Q Top | 0.97% | | | 0.207*** | | | 53.89 | | | Accept | | |
| EPS Est. Rev. 4w Top | 0.96% | 1.36% | 1.27% | 0.312*** | 0.334*** | 0.815*** | 53.89 | 3.69 | 98.73 | Accept | Reject | Accept |
| EPS Est. Rev. 12w Top | 1.00% | 1.30% | 2.09% | 0.311*** | 0.442*** | 0.477*** | 15.58 | 7.11 | 0.77 | Accept | Accept | Reject |
| P/E 4Q Hist. EPS Bottom | 1.05% | | 2.28% | 0.209*** | | 0.395*** | 21.01 | | 2.19 | Accept | | Reject |
| P/E 4Q Est. EPS Bottom | 1.14% | 1.65% | 2.44% | 0.213*** | 0.274*** | 0.367*** | 0.64 | 7.11 | 0.05 | Reject | Accept | Reject |
| P/CF Bottom | 1.06% | 1.60% | 2.26% | 0.243*** | 0.299*** | 0.862*** | 2.36 | 0.49 | 1.22 | Reject | Reject | Reject |
| P/S Bottom | 1.11% | 1.49% | 2.18% | 0.238*** | 0.333*** | 0.352*** | 16.61 | 5.93 | 0.45 | Accept | Reject | Reject |
| Sales Top | | | 2.07% | | | 0.382 | | | 0.01 | | | Reject |
| ROE Top | 1.25% | | 2.12% | 0.200*** | | 0.520*** | 1.67 | | 1.93 | Reject | | Reject |
| Asset Utilization Top | 1.22% | | 2.32% | 0.171*** | | 0.488*** | 10.40 | | 2.39 | Accept | | Reject |
| Analyst Recom. Ch. 4w Top | 0.99% | | | 0.164*** | | | 12.29 | | | Accept | | |

**Note:** "***" denotes statistical significance at the 1% level, "**" denotes statistical significance at the 5% level and "*" denotes statistical significance at the 10% level

| Momentum Definition 5 (Eq. Wgt.) | Mean Volatility | | | Mean VR Ratio | | | Jarque - Bera | | | Assessment | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Strategy* | *1w* | *2w* | *4w* | *1w* | *2w* | *4w* | *1w* | *2w* | *4w* | *1w* | *2w* | *4w* |
| Momentum Universe | 3.02% | 4.28% | 5.53% | 0.076* | 0.116* | 0.183* | 18.75 | 3.81 | 2.09 | Accept | Reject | Reject |
| EPS Surprises 9Q Top | 1.00% | | | 0.176*** | | | 39.82 | | | Accept | | |
| EPS Est. Rev. 4w Top | 1.03% | 1.25% | 1.88% | 0.290*** | 0.392*** | 0.456*** | 39.82 | 11.14 | 0.30 | Accept | Accept | Reject |
| EPS Est. Rev. 12w Top | 1.02% | 1.29% | 2.03% | 0.283*** | 0.410*** | 0.443*** | 10.57 | 5.11 | 0.09 | Accept | Reject | Reject |
| P/E 4Q Hist. EPS Bottom | 1.03% | | 2.22% | 0.195*** | | 0.352*** | 9.45 | | 0.65 | Accept | | Reject |
| P/E 4Q Est. EPS Bottom | 1.17% | 1.68% | 2.43% | 0.162*** | 0.252*** | 0.345*** | 1.51 | 5.11 | 0.41 | Reject | Reject | Reject |
| P/CF Bottom | 1.19% | 1.52% | 2.22% | 0.204*** | 0.341*** | 0.920*** | 3.95 | 2.26 | 0.63 | Reject | Reject | Reject |
| P/S Bottom | 1.18% | 1.49% | 2.12% | 0.220*** | 0.326*** | 0.346*** | 12.08 | 3.56 | 0.52 | Accept | Reject | Reject |
| Sales Top | | | 2.03% | | | 0.363 | | | 0.29 | | | Reject |
| ROE Top | 1.03% | | 2.13% | 0.208*** | | 0.540*** | 0.61 | | 2.30 | Reject | | Reject |
| Asset Utilization Top | 1.08% | | 2.27% | 0.143*** | | 0.374*** | 17.15 | | 1.25 | Accept | | Reject |
| Analyst Recom. Ch. 4w Top | 0.94% | | | 0.170*** | | | 21.12 | | | Accept | | |

**Note:** "***" denotes statistical significance at the 1% level, "**" denotes statistical significance at the 5% level and "*" denotes statistical significance at the 10% level

## Appendix III: PCA Results

The following table presents the results of the Principal Component Analysis method with Varimax Rotation applied on the return differences of each strategy from the respective benchmark which passed the first set of criteria (second column), the volatility factors of these return differentials (second column), the performance components within these strategies (third column) and the performance components after extracting strategies which do not satisfy the criteria set. The numbers of the sub-table under the title factor allocation denote the order of the component which a strategy (or firm specific variable) explains, while negative signs next to numbers denote negative correlation of the component with the particular variable.

| | Return Differences | | | Volatility | | | VR Ratios | | | VR Ratios Accepted[7*] | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *1 Week[1*]* | *2 Weeks* | *4 Weeks[2*]* | *1 Week[3*]* | *2 Weeks[4*]* | *4 Weeks* | *1 Week[5*]* | *2 Weeks* | *4 Weeks[6*]* | *1 Week* | *2 Weeks* | *4 Weeks* |
| *Number of Variables (Strategies)* | *55* | *30* | *50* | *55* | *30* | *50* | *55* | *30* | *50* | *36* | *8* | *8* |
| *Number of Factors* | *11* | *6* | *9* | *7* | *6* | *11* | *11* | *6* | *11* | *8* | *2* | *3* |
| *KMO* | *0.856* | *0.856* | *0.716* | *0.924* | *0.832* | *0.632* | *0.865* | *0.862* | *0.662* | *0.824* | *0.631* | *0.628* |
| *Variability Explained* | *83.28%* | *84.84%* | *86.24%* | *82.67%* | *88.54%* | *85.64%* | *83.15%* | *84.84%* | *87.56%* | *85.57%* | *64.44%* | *80.71%* |
| **Component Analysis - Factor Allocation** | | | | | | | | | | | | |
| Momentum Universe | 5 | 3 | 6 | 1a | TD(1,2,3) | TD(1,2,9) | 4 | 1 | 3 | 3 (md 2,3,4,5) | 2 (md 3) | |
| EPS Surprises 9Q Top | 9 | | | 1d | | | 9 | | | 6 (md 1,2,3,4,5) | | |
| EPS Est. Rev. 4W Top | 4 | 2 | 9 | 3 | TD(1,2,4) | TD(2,3,10) | 5 | 2 | 6 | 1 (md 1,2,3,4,5) | 1a (md 2,5) | 1a (md 1,2,4) |
| EPS Est. Rev. 12W Top | 8 | 6 | 5 | 1f | TD(1,4,6) | TD(1,2,7) | 7 | 6 | 7 | 5 (md 1,2,3,4,5) | 1b (md 1,2,3,4) | 1b (md 1) |
| P/E 4Q Hist. EPS Bottom | 1b | | 8 | 1g | | TD(3,4) | 1b | | 10 | 2a (md 1,2,3,4,5) | | 3 (md 2,3) |
| P/E 4Q Est. EPS Bottom | 1a | 1 | 2b | 1c | 1 | TD(2,3,4) | 1a | 3 | 1b | | (-) 2b (md 3) | |
| P/CF Bottom | 2a | 5 | 2a | 1e | 2 | TD(1,6) | 3 | 5 | 4 | | | |
| P/S Bottom | 2b | 4 | 3 | TD(2,5) | 3 | 1b | 2b | 4 | 5 | 8 (md 2,4,5) | | |
| Sales Top | | | 4 | | | TD(3,5) | | | 1a | | | |
| ROE Top | 6 | | 1a | 2b | | TD(1,3,4,8) | 6 | | 2 | 2b (md 1) | | 2 (md 1,2) |
| Asset Utilization Top | 3 | | 1b | 2a | | 1a | 2a | | 8 | 4 (md 2,3,4,5) | | |
| Analyst Recom. Ch. 4W Top | 7 | | | 1b | | | 8 | | | 7 (md 2,3,4,5) | | |

*† TD stands for Time Dependence, i.e. the explanatory power of these variables is allocated to more than one factors, depending on the look back period*
*†† KMO stands for the Kaiser-Meyer-Olkin statistic which is a measure of sampling adequacy. Values lower than 0,5 are not acceptable while values over 0,9 are considered ideal.*
*††† The PCA on return series demonstrates one factor which explains 90,23%, 91,58%, 89,77% of the variability in each case. For 1 week there is another factor which explains an additional 1,9%, for 2 weeks there is only one factor, while for 4 weeks there are two extra factors which contribute 4,44% on the explained variability. Thus it is considered that only one common factor exists in each case, i.e. momentum.*

*1* The 10th and 11 factor have small correlations (between 0.2 and 0.5) with the 24-weeks and 4-weeks look back period respectively with regard to some variables*
*2* The 10th component is largely attributed to the 1 week look-back period of each variable*
*3* No significant allocation to variables for the 4th, 6th and 7th factor*
*4*No significant allocation to variables for the 5th and 6th factor*
*5* The 10th and 11 factor have small correlations (between 0.2 and 0.5) with the 4-weeks and 24-weeks look back period respectively with regard to some variables*
*6* The 9th factor is more related with the 4 weeks look back period of some variables. The 11th factor is highly correlated with the 4 week look back period of Asset Utilization Top.*
*7* The numbers withinin the brackets and after "md", (i.e momentum definition), correspond to the definitions of the VR ratio series which pas the last set of criteria (t-test and normality)*