VALUE INVESTING WITHIN THE UNIVERSE OF S&P500 EQUITIES

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ABSTRACT: *By employing financial data screening we show that profitable value investment strategy can be built within the S&P 500 stock universe. We use simple ranking of stocks based on four screens that we identify as good joint candidates to influence stock returns – book-to-market ratio, return on equity, market capitalization and risk of bankruptcy. As expected, our four-variable portfolio consistently beats the market, which points to the conclussion that – using the standard risk models - investors inefficiently price stocks in the world's most developed capital market. We compare performance of our investment strategy with market performance, and also adjust for risk used in both current conventional asset pricing models – CAPM and Fama & French three-factor model. When comparing performance of our four-variable portfolio strategy to separate single-variable strategies, we find that other strategies record even higher returns. However, returns of such strategies exhibit lower significance levels, and are more volatile than the four-variable investment strategy.*

Keywords: *asset pricing, value investing, investment strategy*

JEL Classification: G12, G11

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INTRODUCTION AND MOTIVATION

Already in the middle of the eighties Rosenberg et al. (1985) reported superior value strategy performance on the largest 1,400 stock in the Compustat database between January 1973 and September 1984 and argued that the world's most developed capital market is inefficiently priced. Authors have created a monthly hedge portfolio based upon data available at the prior month's close. The hedge portfolio was created in a way to have equal long and short positions, with high book-to-market stocks being on the long side and low book-to-market stocks being on the short side. During the 12-year period of their study this portfolio had an average monthly return of 0.36 percent. The portfolio was positive 38 out of the 54 studied months.

After the breakthrough article of Fama & French (1992), return between portfolio of value companies (proxied by highest book-to-market ratio) and the one of portfolio of growth

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companies (proxied by the lowest book-to-market ratio) started even to be considered by the proponents of the market efficiency hypothesis as a risk factor. Value stocks were thus considered by many scholars to be inherently riskier. Fama & French (1992) examined the data in the period July 1963 - December 1990. They created one hundred equally weighted portfolios and showed that the difference in the average monthly returns for the highest book-to-market decile and the lowest book-to-market decile is 0.99 percent. They documented that book-to-market effect exists even when controlling for size as well as vice versa. In each size class, the average returns generally increase as the book-to-market increases and the effect is stronger for the smaller stocks. The high minus low book-to-market portfolio difference is over one percent for smaller size classes, 0.25 percent for the largest size class.

Lakonishok et al. (1994) conducted an interesting study of value and growth stocks in 1994. They evaluated the performance of several value strategies based on several measures, i.e. book-to-market, cash-flow-to-price, earnings-to-price, and growth of sales as well as multi-dimensional measures of value. In their paper growth of sales is used as a measure of value which unlike most measures of value is not a function of the price. They used five years of accounting data, formed equally weighted portfolios and reported the buy and hold returns for five years. The first decile of portfolio based on growth of sales returned 19.5 percent per annum over the five year holding period compared to 12.7 percent of the tenth decile. That gave them an annual difference of 6.8 percentage points. The cash flow to price presented the biggest difference in return between first and last decile of about 11 percentage points per annum. Authors argue that in contrary to Fama & French (1992) value is not a risk factor itself (i.e. they argue value strategies are not fundamentally riskier) as superior returns are a result of suboptimal behaviour of market participants. This view was also shared by some other authors. Namely, at the beginning of the nineties Klarman (1991) believed that the reason for their low price is that they are unheralded or just ignored. According to the author, some securities are very much out of favour in depressed financial markets and can thus be purchased at significant discount relative to other, more in-favour stocks. As with any value investment, the greater the undervaluation, the greater the margin of safety to investors. If we buy at considerable discounts from underlying value, we provide margin of safety for imprecision, bad luck, or analytical error, while avoiding sizable losses. Also Rafael La Porta, Josef Lakonishok, Andrei Schleifer, and Robert Vishny (La Porta et al. 1997) examined the hypothesis that the superior return to the so-called value stocks is the result of expectation errors made by investors. They studied stock price reactions around earnings announcements for value and growth stocks listed on the NYSE, AMEX and NASDAQ over the period of 5 years after portfolio formation. The examined period ranges from 1971 to 1993. The announcement suggested that a significant portion of the return difference between value and growth stocks is attributable to earnings surprises that were systematically more positive for value stocks. Authors note that evidence suggests that behavioural factors play an important role.

This has also been proven outside the United States. Chan et al. (1991) demonstrated the performance of high book-to-market stocks in the Japanese market. Their paper examines returns on Japanese stocks based on four variables: earnings yield, size, book-to-market ratio, and cash flow yield. They have based their research on the data ranging from 1971 to 1988 and their sample includes manufacturing and non-manufacturing companies from Tokyo Stock Exchange as well as delisted stocks. Their findings show a significant relation between the fundamental factors and expected returns. Among four considered factors, the book-to-market ratio was one with the most significant positive impact on expected return. They have found out that firms with large positive book-to-market ratios earn a premium of 1.10% over firms with low, positive book-to-market ratios. Among the examined variables, the book-to-market ratio consistently has the largest coefficient and the highest t-statistic.

More recent study performed by Chui et al. (2013) examines the market using CRSP and DataStream international database. The data range is from February 1980 to June 2003, and includes 40 capital markets. Among other things the authors have evaluated the returns of high and low book-to-market portfolios. Portfolios were sorted into three groups from bottom 30 percentages to top 30 percentages. The average monthly book-to-market effect for the low, medium and high group, were the following: 0.53%, 0.43% and 0.09%. The difference in the book-to-market effect between the low and the high groups is 0.43% per month with a t-statistic of 1.87. They further argue that value premium is significantly higher in countries where investors have higher degree of risk aversion. There is thus substantial evidence that value stocks proxied by low book-to-market ratio outperform and we are interested in designing a simple strategy that is capable of beating the market.

Lakonishok et al. (1994) reported that strategies built with two value measures outperform those using only one variable. They have formed nine groups of stocks and sorted them independently into bottom 30 percent, middle 40 percent and top 30 percent for two measures of value. The high cash flow-to-price and low growth of sales portfolio earned 22.1 percent per annum for five years following the formation period compared to 20.1 percent of the high cash flow to price and 19.5 percent of the low growth of sales decile. The improvements above one-dimensional strategy are similar for other portfolios. They have also restricted the analysis to only large capitalization stocks and found similar return differences between the value and growth stocks, suggesting that value strategies are useful for large stocks as well as small stocks.

One of the most intuitive measures that should perhaps be used in combination with book-to-market is return on equity (ROE). Some authors explicitly show the importance of taking the ROE in consideration when purchasing high book-to-market securities. Based on Value Line database, Wilcox (1984) reported strong relation between price-to-book ratio and the return on equity. Damodaran (2002) also argues that book-to-price ratio is strongly influenced by ROE and shows a connection through stock valuation. Namely, price of the stock P is equal to expected dividends per share divided by the equity return spread (i.e., required rate of return and the company's growth rate):

$$P=\frac{DPS*(1+g)}{k-g} \qquad (1)$$

If we substitute the DPS with earning per share EPS times the pay-out ratio, and further if we know that ROE equals earnings per share EPS divided by book value of equity BV, one can write the value of equity as follows:

$$P=\frac{BV*ROE*(1+g)*Payout\ ratio}{k-g} \qquad (2)$$

Rewriting equation (2) leads us to the following equation explaining the price-to-book ratio (i.e. the inverse of the book-to-price ratio):

$$\frac{P}{B}=\frac{ROE*(1+g)*Payout\ ratio}{k-g} \qquad (3)$$

We can see that the main factors influencing price-to-book ratio are: *first*, return on equity *ROE*, *second*, pay-out ratio, *third*, growth rate, and *fourth*, required rate of return (i.e. risk). Second, third and fourth factor together determine price earnings ratio (*P/E*)[3], and that is why it is no surprise that Sutton (2004) defines price-to-book ratio as a multiple of *ROE* and *P/E* ratio:

$$\frac{P}{B}=\frac{Earnings\ per\ share}{Book\ value\ per\ share\ (end\ period)} X \frac{Current\ market\ price\ per\ share}{Earnings\ per\ share} \qquad (5)$$

A lower return on equity affects the price-to-book ratio directly as well as indirectly through lowering the expected growth and pay-out. Damodaran (2002) argues that the price-to-book ratio of a firm is supposed to be determined by the differential between the return on equity and its cost of equity, and further that if the return on equity exceeds the cost of equity the stock price has a tendency to exceed the book value of equity.

ROE is thus a very good measure to use in justifying price of the stock. However, investors should distinguish between good firms and good investments. Unsophisticated investors may equate a good company with good investment irrespective of the price and put too much emphasis on company's performance (La Porta et al., 1997). Stock of a well performing firm (in terms of ROE), which is selling at extremely high price-to-book multiples, is poised to underperform. Unsophisticated investors may even perceive such stock to be less risky, even though the opposite in the case (La Porta et al., 1997). High ROE in itself does not imply that the stock is a good investment. Bodie et al. (2011) argue that firms with low ROEs can be even better investments if their prices are low enough. The same line of argument is used by Damodaran (2002) in his famous corporate valuation book stating that investors should carefully screen mismatches between of price

3 Again, substitute the DPS with earning per share EPS times the payout ratio in equation (1), and devide both sides by EPS to get a P/E ratio.

book ratios and returns on equity. If we assume that firms within a sector have similar costs of equity and growth opportunities, then ROE is the only variable to play the role in determining undervalued and overvalued stocks. The higher the ROE, the higher the justifiable price to book ratio. Investors should therefore prefer stocks with higher ROE for the same level of price-to-book ratio. Examples of recent empirical research combining price-to-book ratio and ROE are Wilcox & Philips (2005) and Hou et al. (2015). This argumentation is the reason we decided to include ROE together with book-to-price ratio in our tests, and that we expect that strategy using a combination of both measures will improve profitability of our investment strategy.

Building our investment strategy further, we look for further candidates to be included into our investment strategy. In their pioneering work, Fama & French (1992) reported that value premium decreases with company size. The performance difference between high minus low book-to-market portfolio is four-times bigger for smallest companies compared to largest ones. In the paper they argue that size should also be considered as a risk premium, in addition to market risk from the CAPM model and value premium described above. Small companies as such are the preferred strategy for some authors. Banz (1981) examined the empirical relation between the return and the total market value of NYSE common stocks. All common stocks quoted on the NYSE for at least five years between 1926 and 1975 were included in the sample. He found out that the smaller firms have had higher risk-adjusted returns on average than large firms. He went further and determined that the size effect is not linear. The main effect occurs for very small firms while there is little difference in return between average sized and large firms. The author based the empirical tests on a generalized asset pricing model which allows the expected return of a common stock to be a function of risk β and an additional factor, the market value of the equity. In the beginning of the eighties, Basu (1983) also reported size effect. He had examined the sample of companies traded on the NYSE between December 1962 and March 1980. He examined whether the high return associated with stocks that have high earning yields is related to the high return attributed to stocks with small market capitalizations. Conclusion was that small NYSE firms had substantially higher returns than large NYSE firms. Recently, Fama & French (2012) examined international stock returns and accounting data in the period November 1989 to March 2011, obtained from Bloomberg DataStream and Worldscope. Authors confirm presence of the standard size effect. Namely, small extreme value portfolios have higher average returns than the big extreme value portfolios. Based on the stated evidence above, we are including size as an important measure to screen outperforming stocks.

Based on the evidence that multiple-variable screens can improve the strategy, we build our strategy on all three above described drivers of stock performance; *first*, value indicator - proxied by high book-to-market, *second*, return on equity - as a justifier of level of stock pricing, and *third*, size of the company.

All this being argued, one should also bear in mind literature addressing issue of potential underperformance of some stocks with high book-to-ratio values. Namely, Piotroski (2000) establishes that within his database only 44 percent of high book-to-price companies earned positive returns two years after the portfolio formation. He concluded that universe of high book-to-market stocks also includes companies that exhibit low pricing for a reason. Within this universe, one might find stocks with falling profitability, increasing leverage or/and falling operational efficiency. He argues in his famous paper that researchers should screen out companies that are simply not performing well. This is the reason we have resorted to a financial distress measure being very famous in financial literature – Altman (1968) Z-Score. Altman (1968) uses five financial ratios (working capital, retained earnings, earnings before interest and taxes, sales, and market value of liabilities, every item compared to total assets) to rank companies in terms of bankruptcy risk. High Z-Score means low risk of bankruptcy, and low Z-Score just the opposite – high risk of bankruptcy. The accuracy of the model, reported by many authors (Lie, 2012; Altman, 2000; Gutzeit, 2011;) is high and ranges between 80 and 95 percent, even for non-US companies (Lugovskaya, 2010; Wang, 2010). Based on the evidence of Altman's model success and argumentation of Piotroski regarding the fact that some companies have high book-to-market ratio for a reason (as they are financially distress or approaching such state) we also use Altman Z-Score within our main model.

In this paper we contribute by providing evidence of market inefficiency in the world's most developed capital market, using standard risk measures. Our strategy based on careful selection of variables documented in the literature to contribute to excess stock performance, beats the market. Apart from comparing strategy results with general market index, we also adjust for the two most conventional asset pricing models risk factors, i.e. CAPM and Fama & French three-factor model. Even after controlling for risk, our strategy yields positive excess returns.

In the next chapter we provide description of the data we use and the method, and in the chapter that follows presents results from our tests. The last chapter concludes and lays down orientation for future work.

DATA AND METHOD

We use S&P 500 universe of stocks for our analysis. S&P Dow Jones U.S. indices are designed to reflect the U.S. equity market. The S&P 500 focuses on the largest-capitalization stocks in the market, however since it includes a significant portion of the total value of the market, it is also widely considered to represent the market. The index includes 500 leading companies and captures approximately 80% of available market capitalization (S&P Dow Jones Indices, 2014). We have obtained data for the period 2000 - 2013 from the Bloomberg terminal. We used individual stock price data, dividend data and total return index data with weekly frequency. We have built strategies with holding period of one year, always for periods May-to-May.

The book-to-market ratio is calculated as an accounting book value of equity provided by each company at year end divided by the company stocks' current closing market price. Market capitalization is calculated as closing market price of common equity at the date of portfolio rebalancing multiplied by the number of common stocks issued. Altman's

Z-Score is calculated only for industrial corporations; financial corporations were ignored and deleted from the database. The return on equity is calculated as a five-year average return on equity, considered to be normalized so that annual cyclical swings could not influence the analysis.

Investment strategy design:
We always arbitrarily select 20 companies to construct our strategies. Companies are selected based on the four metrics, namely the five-year average reported return on equity (ROE), book-to-market ratio (BtM), Altman's Z-score (AZS) and market capitalization (MCap). Every stock receives ranking score in each separate metric (i.e. stock with the highest ROE reading gets score 1, the second highest score 2, etc.; also stock with the highest book-to-market reading gets score 1, the second highest score 2, etc.). Each metric is equally weighted meaning that 20 stocks with the lowest joint score qualify to form the portfolio. Each of the 20 companies represents an equal stake (1/20). The portfolio is rebalanced every year in May.

In addition to the main investment strategy - we label this strategy as 4VP standing for Four Variables Portfolio - we also created partial strategy only including BtM & ROE joint screening – i.e. every year 20 companies were selected based on the BtM ratio and average five-year ROE screens. The 20 companies with the lowest sum of rankings were included in portfolio each year.

We also check what is performance of the four building blocks of our strategy. We measure performance of:

- BtM portfolio – i.e. in every year 20 companies that were included in S&P 500 with the highest rank according to the BtM metric were included in the portfolio;
- ROE portfolio – i.e. in every year 20 companies that were included in S&P 500 with the highest five-year average ROE metric were included in the portfolio;
- MCap portfolio – i.e. every year 20 of the smallest companies by market capitalization measure that were part of the S&P 500 index were included in the portfolio.
- AZS portfolio – i.e. in every year 20 companies that were included in S&P 500 with the highest rank of Altman's Z-Score (i.e. the most distant from bankruptcy) were included in the portfolio.

Return calculation:
We measured returns as total returns, taking account also of received dividends on all included stocks within the strategy. We thus added dividends D_t received during the past year to the each company's stock price at the end of the year P_{t+1}, and divided the sum by the price of a stock at the portfolio construction date P_t. We assumed no dividend reinvesting up to the end of formation year. Dividends are thus assumed to be held as cash until the date of portfolio rebalancing. While rebalancing these dividends would be used as receipts to buy new stock, based on the same screening criteria.

Individual stock returns were then weighted with their relative size in the portfolio. Since the portfolio consisted of 20 corporations and each was assigned equal weight, the returns were multiplied with 1/20 and summed up. The result of this calculation is the portfolio yearly return. After calculating these, the cumulative return and compound annual rate of return were calculated for all portfolios in order to facilitate comparison across different strategies.

We have used three standard risk-adjustment techniques for comparing our strategies returns' in the literature. Each individual portfolio performance was then compared against the used benchmark return. *First*, we used market return. We calculated total S&P 500 return (i.e. return including dividend, using the same formula as presented above) over the same period as we calculated returns for our strategies.

Second, we have used CAPM model of Sharpe (1964), Lintner (1965) and Mossin (1966) to take account of systematic risk of our portfolio selected stocks. Betas were calculated as raw betas for a two-year period and calculated against the S&P 500 index. They are stated as a volatility measure of the percentage price change of the security given a one percent change in the representative market index. The beta values were determined by comparing the price movements of the security and the representative market index for the weekly data over past two years. The risk free rates were estimated using the one year U.S. Treasury bill yield to maturity on the date of portfolio rebalancing. We thus use risk free rate over the same period as our strategy. Market returns were calculated as S&P500 return over the observed period and treated in the same way as portfolio returns in other calculations.

Third, we have used additional two Fama & French (1992) factors to additionally test for value and size factors of our return. We have retrieved Fama & French annual benchmark factors from Kenneth R. French Data Library. Data was used in performing a regression analysis of excess returns against the small market capitalization companies' excess returns, large book-to-market corporations' excess returns and market over the risk free rate excess returns. According to the website, the Fama & French factors are constructed using the 6 value weighted portfolios. Small minus big is the average return on three small portfolios minus the average return on three big portfolios.

RESULTS

As outlined in the Table AI.1, Panel A, portfolio based on four variables has grown with a compounded annual growth rate of 9.01% over the observed period, resulting in a cumulative return of 206.86%. The standard deviation of observed returns amounted to 0.265, with a Sharpe ratio of 0.248. As shown in the Panel C, when compared to a market returns, as a first benchmark, selected portfolio has generated excess returns in eight out of 13 observed periods, beating S&P500 index in terms of compound annual return (hereafter: CAR) by 6.5 percentage points. The difference was proven to be significant at a five percent level. If we further observe the Table AI.2, Panel D, taking into account CAPM risk, our portfolio has generated an alpha in terms of CAR of 6.63 percentage points, significant at five percent level. Further, comparing portfolio returns to Fama &

French adjusted performance (see Panel C of Table AI.3), selected portfolio has again produced alpha in terms of CAR of 2.23 percentage points, significant at ten percent level. As indicated in the Panel B of Table AI.2, portfolio betas have ranged between 0.75 in 2001 and 1.26 in both 2003 and 2010. Maximum portfolio drawdowns, shown in a Table AII.1, have amounted to -51%, a 12.8 percentage points more compared to a maximum index return drawdown.

Observing the Table AI.1, Panel A, BtM&ROE portfolio has grown with a compounded annual growth rate of 9.34% over the observed period, resulting in cumulative return of 219.28%. The standard deviation of observed returns amounted to 0.251, with a Sharpe ratio of 0.276. As shown in the Panel C, when compared to a market returns, as a first benchmark, selected portfolio has generated excess returns in nine out of 13 observed periods, beating S&P500 in terms of CAR by 6.83 percentage points. The difference has proven to be significant at ten percent level. If we further observe the Table AI.2, Panel D, taking into account CAPM captured risk, our portfolio has generated an alpha in CAR of 5.87 percentage points. Further, comparing portfolio returns to Fama & French adjusted performance (see Panel C of Table AI.3), selected portfolio has again produced alpha in terms of CAR amounting to 3.98 percentage points. As indicated in the Panel B of Table AI.2, portfolio betas have ranged between 0.66 in 2001 and 1.45 in 2008. Maximum portfolio drawdowns, shown in a Table AII.1, have amounted to -69.8%, a 31.6 percentage points more compared to a maximum index return drawdown.

Table AI.1, Panel A, shows that BtM portfolio has grown with a compounded annual growth rate of 11.21% over the observed period, resulting in cumulative return of 297.85%. The standard deviation of observed returns amounted to 0.308, with a Sharpe ratio of 0.285. As shown in the Panel C, when compared to a market returns, as a first benchmark, selected portfolio has generated excess returns in ten out of 13 observed periods, beating S&P500 in terms of CAR by 8.7 percentage points. The difference has proven to be significant at ten percent level. If we further observe the Table AI.2, Panel D, taking into account CAPM captured risk, our portfolio has generated alpha in terms of CAR of 8.02 percentage points, significant at ten percent level. Further, comparing portfolio returns to Fama & French adjusted performance (see Panel C of Table AI.3), selected portfolio has again produced alpha in terms of CAR amounting to 4.97 percentage points. As indicated in the Panel B of Table AI.2, portfolio betas have ranged between 0.58 in 2001 and 1.61 in 2003. Maximum portfolio drawdowns, shown in a Table AII.1, have amounted to -31.1%, a 7.1 percentage points less compared to a maximum index return drawdown.

Observing the ROE portfolio, Table AI.1, Panel A, shows that the portfolio has grown with CAR of 7.96% over the observed period, resulting in cumulative return of 170.65%. The standard deviation of observed returns amounted to 0.203, with a Sharpe ratio of 0.273. As shown in the Panel C, when compared to a market returns, as a first benchmark, selected portfolio has generated excess returns in eight out of 13 observed periods, beating S&P500 in terms of CAR by 5.45 percentage points. If we further observe the Table AI.2, Panel D, taking into account CAPM captured risk, our portfolio has generated an alpha in terms of CAR of 4.79 percentage points. Further, comparing portfolio returns to Fama & French adjusted performance (see Panel C of Table AI.3), selected portfolio has again produced alpha in terms of CAR amounting to 4.11 percentage points. As indicated in the Panel B of Table AI.2, portfolio betas have ranged between 0.66 in 2002 and 1.06 in 2008. Maximum portfolio drawdowns, shown in a Table AII.1, have amounted to -20%, a 18.2 percentage points less compared to a maximum index return drawdown.

As seen in the Table AI.1, Panel A, portfolio based on size has grown with a compounded annual growth rate of 14.46% over the observed period, resulting in cumulative return of 497.05%. The standard deviation of observed returns amounted to 0.399, with a Sharpe ratio of 0.302. As shown in a Panel C, when compared to a market returns, as a first benchmark, selected portfolio has generated excess returns in eight out of 13 observed periods, beating S&P500 in terms of CAR by 11.95 percentage points. The difference has proven to be significant at a ten percent level. If we further observe the Table AI.2, Panel D, taking into account CAPM captured risk, our portfolio has generated an alpha in terms of CAR of 10.23 percentage points, significant at a ten percent level. Further, comparing portfolio returns to Fama & French adjusted performance (see Panel C of Table AI.3), selected portfolio has again produced alpha in terms of CAR amounting to 9.09 percentage points. As indicated in the Panel B of Table AI.2, portfolio betas have ranged between 0.60 in 2001 and 1.45 in 2003. Maximum portfolio drawdowns, shown in a Table AII.1, have amounted to -32.8%, a 5.4 percentage points less compared to a maximum index return drawdown.

Observing Altman portfolio, looking at the Table AI.1, Panel A, portfolio has grown with a compounded annual growth rate of -5.81% over the observed period, resulting in cumulative return of -54.10%. The standard deviation of observed returns amounted to 0.235, with a Sharpe ratio of -0.35. As shown in a Panel C, when compared to a market returns, as a first benchmark, selected portfolio has generated excess returns in four out of 13 observed periods, beating S&P500 in terms of CAR returns by -8.32 percentage points. If we further observe the Table AI.2, Panel D, taking into account CAPM captured risk, our portfolio has generated an alpha in terms of CAR of -4.82 percentage points. Further, comparing portfolio returns to Fama & French adjusted performance (see Panel C of Table AI.3), selected portfolio has again produced alpha in terms of CAR amounting to -9.23 percentage points. As indicated in the Panel B of Table AI.2, portfolio betas have ranged between 1.04 in 2009 and 2.08 in 2002. Maximum portfolio drawdowns, shown in a Table AII.1, have amounted to -40.9%, a 2.7 percentage points more compared to a maximum index return drawdown.

Comparing portfolio drawdowns one can observe that ROE portfolio, proven not to be superior to other investigated strategies, has turned out to be a leading portfolio in this aspect as seen from the table AII.1. On the other hand, BtM&ROE portfolio, proven to be a strong in other aspects, has lagged behind on this criteria, having the largest observed drawdown of near 70 percent, more than 30 percent higher compared to the benchmark index.

CONCLUSION

Since the middle of the eighties value stocks proxied by high book-to-market stock have been found to be outperforming the market, which led authors to question validity of efficient market hypothesis. In the beginning of the nineties Fama & French (1992) even postulated return difference between high and low book-to-market stock as a risk premium, for which CAPM model should be improved. Authors started to justify book-to-market ratio by return on equity and argued that better-performing business should be worth relatively more that worse-performing counterparts. Further, quest for better performance also offered insight into performance of strategies built around multiple screens. This is why, we developed a strategy that is based on book-to-market screen, return on equity and also size. The latter was also found to have superior impact on stock performance. As some high book-to-market stocks are priced relatively low for the fact they exhibit (near) financial distress, we include also Altman Z-Score reading in order to filter out companies that have higher probability of becoming bankrupt.

Our results are in line with our expectations. Our four-variable investment strategy was superior to all the tested partial strategies in terms of significance. While interestingly, individual factors such as size, value and ROE have again proven to be important determinants of excess returns (i.e. some have shown even higher returns compared to the four-variable investment strategy), they exhibited much higher volatility and lower significance levels. With 9.01% compound annual return our four-variable strategy significantly (at level below 5%) outperformed market by 6.5 percentage points, which is more than 2.5-time the compound annual market return. The strategy has also beaten both conventional risk models, i.e. CAPM by 6.63 percentage points (at significance level below 5%) and Fama-French three-factor model by 2.23 percentage points at significance level below 10%), delivering returns significantly above the calculated benchmarks.

This paper represents an important building block for further exploration of possibilities of how to improve value investment strategy design. We are interested at extending the data to longer period and into the international markets, and perhaps also forming long-short investment strategies in order to also show the difference in returns towards stocks with worst rankings by the chosen metrics. It would also make a lot of sense to simulate daily returns from different portfolio construction dates, and test for optimal holding period. Also improved ranking system of stock attributes based on regression analysis has great potential to improve the strategy even further.

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Appendix I: Performance

Table AI.1: Raw strategy returns and performance measures compared to benchmark market portfolio (in %, except STD and SR/IR)

In Panel A raw strategy annual returns are presented, their cumulative 2001-2013 returns (CR), compound annual return (CAR), annual standard deviations, and Sharpe ratios (SR). In Panel B annual average risk free rates and annual S&P500 index returns are presented. Panel C reports annual strategy excess returns above S&P500 returns, i.e. alphas of every investment strategy. Instead of SR, information ratio (IR) is reported in the last column.

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	CR	CAR	STD	SR/IR
Panel A: Strategy performance																	
4VP	24.28	11.48	-3.72	36.24	3.21	22.22	4.12	-18.17	-40.13	47.38	16.91	-3.41	57.67	206.86	9.01	0.265	0.248
BtM&ROE	12.89	13.69	-16.55	35.22	12.99	20.94	-0.06	12.74	-40.86	53.62	20.22	-8.39	43.12	219.28	9.34	0.251	0.276
BtM	14.32	6.02	-31.06	70.67	4.61	26.23	19.32	0.74	-28.83	65.16	22.19	-10.75	37.11	297.85	11.21	0.308	0.285
ROE	13.71	-2.28	-16.71	28.49	-2.61	2.63	18.93	-2.56	-17.91	40.08	9.15	4.64	49.59	170.65	7.96	0.203	0.273
MCAP	8.96	10.08	-31.07	72.64	-2.91	70.30	22.83	-10.07	-25.25	89.06	6.63	-8.52	61.15	497.05	14.46	0.399	0.302
AZS	-40.84	-20.98	-15.25	26.55	-10.53	6.33	0.72	-9.89	-30.26	47.30	15.53	-0.69	-10.02	-54.10	-5.81	0.235	-0.350
Panel B: Market performance																	
Risk free rate	6.24	3.91	2.33	1.21	1.60	3.34	4.97	4.89	1.94	0.49	0.43	0.22	0.19	36.53	2.42	0.020	0.000
S&P500	-12.74	-13.03	-14.12	24.07	5.85	14.41	16.02	-3.28	-36.07	39.91	15.50	5.53	15.16	37.97	2.51	0.199	0.005
Panel C: Alphas above market																	
4VP	37.02	24.51	10.40	12.17	-2.64	7.81	-11.90	-14.89	-4.06	7.47	1.41	-8.95	42.52	168.89	6.50**	0.179	0.228
BtM&ROE	25.63	26.72	-2.43	11.14	7.13	6.52	-16.08	16.02	-4.79	13.71	4.72	-13.93	27.96	181.31	6.83*	0.145	0.305
BtM	27.06	19.05	-16.94	46.60	-1.25	11.82	3.30	4.03	7.24	25.25	6.69	-16.29	21.96	259.88	8.7*	0.176	0.356
ROE	26.45	10.75	-2.59	4.42	-8.46	-11.79	2.91	0.72	18.16	0.17	-6.35	-0.89	34.43	132.68	5.45	0.137	0.221
MCAP	21.70	23.10	-16.95	48.57	-8.76	55.88	6.81	-6.79	10.82	49.15	-8.86	-14.06	45.99	459.08	11.95*	0.267	0.356
AZS	-28.10	-7.95	-1.13	2.48	-16.39	-8.08	-15.31	-6.61	5.81	7.39	0.03	-6.23	-25.18	-92.07	-8.32	0.111	-0.969

Notes: BtM – book-to-market strategy, MCAP – market cap strategy, ROE – return on equity strategy, BtM&ROE – combined book-to-market and return on equity strategy, AZS – Altma Z-score strategy, 4VP – four variables portfolio strategy; In Panel C, one-sided t-tests are calculated for alphas above the market, measured as CARs – compound annual returns. Significance levels are stated as follows: *** at 1% level; ** at 5% level; * at 10% level.

Table AI.2: Raw strategy returns and CAPM-adjusted performance measures (in %, except betas, STD and SR/IR)

In Panel A raw strategy annual returns are presented, their cumulative 2001-2013 returns (CR), compound annual return (CAR), annual standard deviations, and Sharpe ratios (SR). In Panel B strategy CAPM model betas are presented. Panel C reports annual returns of each strategy when corrected for market (CAPM) risk. Panel D reports annual strategy excess returns above CAPM risk-adjusted returns. In column CAR significance of excess returns is reported. Instead of SR, information ratio (IR) is reported in the last column.

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	CR	CAR	STD	SR
Panel A: Strategy performance																	
4VP	24.28	11.48	-3.72	36.24	3.21	22.22	4.12	-18.17	-40.13	47.38	16.91	-3.41	57.67	206.86	9.01	0.265	0.248
BtM&ROE	12.89	13.69	-16.55	35.22	12.99	20.94	-0.06	12.74	-40.86	53.62	20.22	-8.39	43.12	219.28	9.34	0.251	0.276
BtM	14.32	6.02	-31.06	70.67	4.61	26.23	19.32	0.74	-28.83	65.16	22.19	-10.75	37.11	297.85	11.21	0.308	0.285
ROE	13.71	-2.28	-16.71	28.49	-2.61	2.63	18.93	-2.56	-17.91	40.08	9.15	4.64	49.59	170.65	7.96	0.203	0.273
MCAP	8.96	10.08	-31.07	72.64	-2.91	70.30	22.83	-10.07	-25.25	89.06	6.63	-8.52	61.15	497.05	14.46	0.399	0.302
AZS	-40.84	-20.98	-15.25	26.55	-10.53	6.33	0.72	-9.89	-30.26	47.30	15.53	-0.69	-10.02	-54.10	-5.81	0.235	-0.350
Panel B: Betas																	
4VP	0.75	1.20	1.26	1.07	1.07	1.16	1.24	1.25	1.13	1.26	0.90	1.03	1.09				
BtM&ROE	0.66	0.83	1.01	1.02	0.78	1.22	1.38	1.45	1.20	1.41	0.99	1.12	1.25				
BtM	0.58	0.93	1.61	1.28	0.99	1.29	0.98	1.16	1.13	1.27	1.02	1.03	1.42				
ROE	0.68	0.66	0.61	0.77	0.81	0.81	1.01	1.06	0.87	0.86	0.67	0.82	0.81				
MCAP	0.60	0.97	1.45	1.18	1.52	1.39	1.19	1.15	1.12	1.33	1.43	1.25	1.33				
AZS	1.56	2.08	1.59	1.21	1.46	1.38	1.25	1.36	1.04	0.91	0.91	1.12	1.05				
Panel C: CAPM-adj. perform.																	
4VP	-8.02	-16.34	-18.46	25.59	6.13	16.20	18.72	-5.33	-40.98	50.05	14.06	5.70	16.46	35.80	2.38	0.231	-0.002
BtM&ROE	-6.37	-10.10	-14.32	24.58	4.93	16.86	20.24	-6.92	-43.86	56.26	15.42	6.15	18.97	57.67	3.56	0.240	0.047
BtM	-4.81	-11.90	-24.09	30.45	5.81	17.64	15.85	-4.57	-41.17	50.54	15.79	5.69	21.42	50.40	3.19	0.239	0.032
ROE	-6.67	-7.35	-7.71	18.92	5.05	12.27	16.14	-3.81	-31.26	34.45	10.51	4.55	12.30	49.95	3.17	0.162	0.046
MCAP	-5.15	-12.52	-21.49	28.21	8.06	18.72	18.13	-4.49	-40.82	53.05	21.91	6.86	20.09	71.31	4.23	0.241	0.075
AZS	-23.43	-31.30	-23.85	28.89	7.82	18.68	18.74	-6.26	-37.68	36.43	14.17	6.18	15.84	0.87	0.06	0.240	-0.098
Panel D: Alphas above CAPM																	
4VP	32.30	27.82	14.74	10.65	-2.92	6.02	-14.60	-12.84	0.85	-2.67	2.85	-9.11	41.22	171.06	6.63**	0.175	0.378
BtM&ROE	19.26	23.79	-2.23	10.63	8.06	4.08	-20.30	19.66	3.00	-2.64	4.80	-14.54	24.15	161.61	5.78	0.139	0.417
BtM	19.13	17.92	-6.97	40.23	-1.20	8.59	3.47	5.32	12.34	14.62	6.40	-16.45	15.70	247.45	8.02*	0.139	0.579
ROE	20.39	5.07	-9.00	9.57	-7.66	-9.65	2.79	1.25	13.34	5.63	-1.36	0.09	37.29	120.70	4.79	0.130	0.369
MCAP	14.11	22.60	-9.59	44.43	-10.97	51.57	4.71	-5.58	15.56	36.01	-15.27	-15.38	41.06	425.74	10.23*	0.241	0.424
AZS	-17.41	10.32	8.60	-2.33	-18.36	-12.34	-18.03	-3.64	7.42	10.86	1.35	-6.87	-25.86	-54.97	-4.82	0.125	-0.470

Notes: BtM – book-to-market strategy, MCAP – market cap strategy, ROE – return on equity strategy, BtM&ROE – combined book-to-market and return on equity strategy, AZS – Altman Z-score strategy, 4VP – four variables portfolio strategy; In Panel D, one-sided t-tests are calculated for alphas above the CAPM, measured as CARs – compound annual returns. Significance levels are stated as follows: *** at 1% level; ** at 5% level; * at 10% level.

Table AI.3: Raw strategy returns and Fama & French-adjusted performance measures (in %, except STD and SR/IR)

In Panel A raw strategy annual returns are presented, their cumulative 2001-2013 returns (CR), compound annual return (CAR), annual standard deviations, and Sharpe ratios (SR). In Panel B reports annual returns of each strategy when corrected for risk according to Fama & French three-factor model. Panel C reports annual strategy excess returns above Fama & French risk-adjusted returns. In column CAR significance of excess returns is reported. Instead of SR, information ratio (IR) is reported in the last column.

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	CR	CAR	STD	SR/IR
Panel A: Strategy performance																	
4VP	24.28	11.48	-3.72	36.24	3.21	22.22	4.12	-18.17	-40.13	47.38	16.91	-3.41	57.67	206.86	9.01	0.265	0.248
BtM&ROE	12.89	13.69	-16.55	35.22	12.99	20.94	-0.06	12.74	-40.86	53.62	20.22	-8.39	43.12	219.28	9.34	0.251	0.276
BtM	14.32	6.02	-31.06	70.67	4.61	26.23	19.32	0.74	-28.83	65.16	22.19	-10.75	37.11	297.85	11.21	0.308	0.285
ROE	13.71	-2.28	-16.71	28.49	-2.61	2.63	18.93	-2.56	-17.91	40.08	9.15	4.64	49.59	170.65	7.96	0.203	0.273
MCAP	8.96	10.08	-31.07	72.64	-2.91	70.30	22.83	-10.07	-25.25	89.06	6.63	-8.52	61.15	497.05	14.46	0.399	0.302
AZS	-40.84	-20.98	-15.25	26.55	-10.53	6.33	0.72	-9.89	-30.26	47.30	15.53	-0.69	-10.02	-54.10	-5.81	0.235	-0.350
Panel B: FF-adj. performance																	
4VP	19.22	8.19	-15.02	30.46	22.51	11.62	26.94	-15.40	-40.96	43.14	14.04	-5.40	22.60	134.71	6.78	0.230	0.190
BtM&ROE	2.68	1.11	-18.55	36.16	18.68	8.92	21.89	-5.53	-40.75	39.93	18.52	-2.63	20.22	97.13	5.36	0.220	0.133
BtM	-2.51	6.88	-21.93	51.21	22.85	8.75	24.40	-7.54	-48.62	51.43	26.06	-4.05	23.48	119.64	6.24	0.279	0.137
ROE	7.56	-5.97	-15.81	20.84	14.46	9.22	19.50	-3.16	-33.63	28.37	10.95	-0.99	17.26	63.37	3.85	0.170	0.084
MCAP	5.37	3.10	-25.97	50.19	26.96	11.80	30.21	-12.73	-58.26	57.71	25.28	-4.77	29.04	97.46	5.37	0.315	0.094
AZS	-23.43	-1.97	-17.49	42.97	9.89	2.61	9.93	10.70	-29.26	29.17	23.92	1.07	11.28	54.74	3.42	0.205	0.049
Panel C: Alphas above FF																	
4VP	5.06	3.29	11.30	5.78	-19.30	10.61	-22.82	-2.77	0.83	4.24	2.87	1.98	35.08	72.15	2.23%*	0.141	0.159
BtM&ROE	10.20	12.59	2.01	-0.94	-5.69	12.02	-21.95	18.27	-0.11	13.69	1.70	-5.76	22.90	122.15	3.98	0.120	0.330
BtM	16.84	-0.86	-9.13	19.46	-18.24	17.48	-5.08	8.28	19.79	13.73	-3.88	-6.70	13.64	178.21	4.97	0.128	0.387
ROE	6.15	3.69	-0.90	7.65	-17.07	-6.59	-0.56	0.60	15.71	11.71	-1.80	5.63	32.34	107.28	4.11	0.118	0.349
MCAP	3.58	6.97	-5.11	22.45	-29.87	58.49	-7.37	2.65	33.01	31.36	-18.65	-3.76	32.11	399.59	9.09	0.245	0.371
AZS	-17.41	-19.01	2.24	-16.41	-20.42	3.72	-9.22	-20.59	-1.00	18.13	-8.39	-1.77	-21.31	-108.84	-9.23	0.122	-0.758

Notes: BtM – book-to-market strategy, MCAP – market cap strategy, ROE – return on equity strategy, BtM&ROE – combined book-to-market and return on equity strategy, AZS – Altman Z-score strategy, 4VP – four variables portfolio strategy; In Panel C, one-sided t-tests are calculated for alphas above the Fama-French three factor model returns, measured as CARs – compound annual returns. Significance levels are stated as follows: *** at 1% level ; ** at 5% level; * at 10% level.

Appendix II: Drawdown

Table AII.1: Maximal strategy drawdowns (DD) measured as percentage between the peak and the subsequent trough

	Max DD	Difference to S&P500 DD
4VP	-51	-12.8
BtM&ROE	-69.8	-31.6
BtM	-31.1	7.1
ROE	-20	18.2
MCAP	-32.8	5.4
AZS	-40.9	-2.7

Notes: BtM – book-to-market strategy, MCAP – market cap strategy, ROE – return on equity strategy, BtM&ROE – combined book-to-market and return on equity strategy, AZS – Altman Z-score strategy, 4VP – four variables portfolio strategy.