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NSP: PERFORMANCE ENHANCEMENT THROUGH THE IMPROVEMENT OF INVESTMENT DECISIONS

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ABSTRACT

This paper aims to improve the stock-picking process within the NSP in order to enhance the overall performance of the portfolio. For that purpose, four investment models based on value, growth, and quality metrics were compared for the 2002-2015 window. Results showed that the inclusion of a quality component in simple value and growth models improves results. Besides, all models delivered a statistically significant abnormal excess return after controlling for factors included in three different asset pricing models such as the CAPM, the Fama and French five-factor model, and the Carhart four-factor model with a quality factor added to it.

Keywords: Stock-Picking; Performance; Investment Models; Abnormal Excess Return

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1. INTRODUCTION

The NSP project is a twelve-month program run by an annually rotating group of fifteen students whose purpose is to manage a long-only portfolio of 310,000 USD, as of inception date, composed of US equities and bonds for a sponsor bank. The participants are required to decide on the most suitable investment strategy to apply, do macroeconomic research, pick stocks, and analyze securities in order to make sound decisions. Individually, each student is assigned to a specific function on a rotating basis. Regarding available positions within the group of selected students, there are portfolio, risk, and investor relations managers, a trader, macro analysts, and stock pickers. Each student assigned to one of those functions intervenes and briefly gives an overview of his area, based on his role throughout the week, during weekly investment committees (ICs) in order for the portfolio to be closely monitored and often updated for enhanced performance. The participants main objective is thus to maximize the NSP's risk-adjusted return for the portfolio's low-to-medium risk profile investors given a set of restrictions, namely risk and asset allocation. In terms of risk, an annual target volatility is set at 7.00%, and as for allocation, students are required to approximately maintain a 40/60 structure, which corresponds to the benchmark structure, unless decided otherwise. Positions can be taken in stocks, ETFs, and derivatives, such as futures contracts.

Prior to the portfolio's performance description, bear in mind that the period considered for the analysis ranges from 13/11/2014, which is the NSP's inception date, to 25/05/2016. In terms of summary statistics, the portfolio presented an info Sharpe of 0.26 as of 25/05/2016, resulting from an annualized return of 2.16% and an annualized volatility of 8.43%. Additionally, the weekly returns series displayed a maximum and minimum of 3.01% and -2.92% respectively, and a maximum drawdown of 5.35%. The information ratio (IR), which not only indicates the ability of the portfolio manager to generate excess returns above the

benchmark[1] but also measures the consistency of the NSP's outperformance in relation to the latter, was -0.17 (Appendix 1). This negative result is driven by a greater annualized return of the benchmark, 2.57%, in comparison to the return of the portfolio, 2.16% (the performance of the benchmark's constituents is showed in Appendix 2). However, the NSP was outperforming the benchmark from its inception to the end of 2015 until the relationship clearly inverted in the beginning of 2016 (Appendix 3), which can be mainly attributed to a progressively decreasing outperformance of the NSP's bond component versus the benchmark's bond component (Appendix 4). The NAV started at 310,000 USD and increased to 319,528 USD for the last date considered (Appendix 5).

Concerning asset allocation, there is a clear distinction between the equity/bond weights from 13/11/2014 to 01/07/2015 and from 29/07/2015 to 25/05/2016. In the former period, a risk-parity weighting scheme was evident while in the latter period, this scheme was abandoned, except for 24/02/2016, and a structure of 40/60 (equity/bond) was maintained (Appendix 6). The equity and bond components of the portfolio presented a cumulative return of 0.37% and 2.93% respectively as of 25/05/2016 (Appendix 7, and Appendix 8 as a complement).

Finally, the scope of the current analysis was narrowed to stocks only as this study solely focuses on stock selection improvements. Therefore, the remaining instruments that also constitute the portfolio will not be covered. Hence, in terms of stock-picking performance, and only considering picks from 25/11/2015 to 25/05/2016 in this section as the stock-picking analysis was just focused on the past year, seventeen out of thirty-three picks had a positive return while the remaining presented a negative return during their holding period. Analyzing the relative performance of the choices made against the benchmark (SPDR S&P 500 ETF Trust), sixteen stocks outperformed the benchmark while the remaining seventeen underperformed it. The total weighted return of the stock picks was 2.09% against 2.44% for

[1] The benchmark considered for the NSP is 40% S&P 500 Index + 60% Barclays US Aggregate Total Return Value Unhedged USD Index.

the benchmark, which represents a total underperformance of 0.35%. The best and worst relative returns came from the Michael Kors stock, with an outperformance of 31.55% in respect to the benchmark, and the Delta Airlines stock, which underperformed by 18.82% (Appendix 9).

In order to enhance the future performance of the NSP, which is the main objective of this thesis, a set of criteria based on financial statement analysis will be taken from the literature with the intent of obtaining quantitative information that can be used to successfully pick stocks. Stock-picking models will then be created based on those metrics taken from the literature. Afterward, scorecards will be built for ranking motives and portfolios, which will fully rotate on a yearly basis, will be formed[2]. Furthermore, in order to assure the generation of a truly meaningful alpha, some factors from well-known asset pricing models will be considered in the analysis for control purposes. Note that the portfolios' performance will be compared with the benchmark[3]'s one in backtests of thirteen years (2002-2015), hence concluding on the quality of the research. Also, and as a complement, the NSP's constitution (equity/bond) will be reproduced and a final backtest for the past year, as the stock-picking analysis was focused on the past year only, will be conducted so a direct comparison with the performance of the students portfolio's stock-picking part can be made. However, only the model that displayed the best results between 2002 and 2015 will be eligible for direct comparison. Consequently, the equity part of the portfolio will be constituted of stocks selected through this best performing model. For a correct appreciation of the work delivered, it is important to take into account that this project is focused on equity and its sole motivation is to analyze relevant stock-picking criteria in the interest of earning abnormal returns above the benchmark considered.

[2] One portfolio per model was considered.
[3] The benchmark for the portfolio of stocks is the S&P 500 Index.

2. LITERATURE REVIEW

According to the Efficient Market Hypothesis (EMH), it is impossible for investors to obtain abnormal returns when trading actively in the market. In this context, no market intervenient could profit even if new information was disclosed. However, in spite of developed markets appearing to be highly efficient (Fama, 1998, Horowitz, Loughran, and Savin, 2000), many anomalies have been observed and studied in the financial markets. Also, some trading strategies have proved to outperform the market, as it is the case for the CAN SLIM investment strategy proposed by William J. O'Neil (2009) and which results have shown to be positive in relative terms (Schadler and Cotton, 2008, Lutey, Crum, and Rayome, 2013). This strategy consists of seven stock selection criteria that can be easily understandable but that may also be difficult to implement in practice by typical investors. Thus, instead of having to consider the seven metrics altogether, which consist of a complementarity between fundamental analysis and technical analysis, Lutey et al. (2013) considered a simplified strategy with only three factors to analyze stocks: the five-year average of annual earnings per share growth must be greater than 20.00%, the current quarterly earnings per share growth must be greater than 25.00%, and the stock price must be greater than 10$; note that their simplified strategy outperformed the S&P 500 index between 2001 and 2012. However, additional factors such as the return on equity and industry leadership, which are explored in O'Neil's work (2009), could be added to the simplified version of the CAN SLIM strategy due to their straightforward implementation to evaluate stocks. The rules state that investors should invest in companies presenting a return on equity of at least 17.00% and that outperformed most of their peers over the past fifty-two weeks. Nonetheless, simulations in the US market between 1967 and 2013 showed that quality measurements such as the return on equity, gross margins, gross

profitability, and book leverage appear to be statistically not significant[4] in terms of premium carriage. Contrary to this, variables like book-to-price, earnings-to-price, cash flow-to-price, and dividend-to-price are statistically significant and thus seem to carry the aforementioned premium (Hsu and Kalesnik, 2014, from Research Affiliates).

Departing from the previously exposed growth investing strategy, is it core to presently introduce value investing. For that matter, it seems imperative to invoke the founder of value investing, Benjamin Graham, who deeply believed that investors should carefully analyze fundamentals and be rational instead of letting themselves be led by emotions. Thus, his primary aim was to detect bargain stocks, defined as having a lower market value in comparison to their intrinsic value, and take advantage of the mispricing by setting simple stock screening criteria both suitable for defensive and so-called enterprising investors. Graham suggested protective investors to invest in highly capitalized and financially strong companies presenting historically stable earnings. Also, and besides considering the fact that earnings must have displayed growth in the past, it is important to examine the dividend record of the company as well as controlling its price-to-earnings and price-to-assets ratios that need to be moderate. Concerning enterprising investors that are more prone to risk, he advises very similar but looser criteria. Henry Oppenheimer (1984) testing of Graham's stock selection criteria suggested that the screening method used by the investor was able to generate excess returns even after risk and size adjustments. Even though excess returns declined after the criteria publication in 1976, they still persisted.

Although Benjamin Graham was a pioneer in his time, his stock selection criteria are too strict to be applied nowadays. Indeed, and as mentioned by the value investor Joel Greenblatt, Graham designed its stock-picking strategy during a period in which many stocks

[4] At the 5.00% significance level. Source: https://www.researchaffiliates.com/en_us/publications/articles/223_finding_smart_beta_in_the_factor_zoo.html

were underpriced. As a result, if it was to be applied without variants today, almost no stock would be selected. Greenblatt designed a formula that works well for both large and small companies and which results have been tested in the period of 1988-2004. It was shown that the formula gives investors an indication of the stocks' behavior in the future through the use of two indicators: the earnings yield and the return on capital, which purpose is to find above average companies that are being sold at below average prices. Moreover, Joel Greenblatt stressed that this particular strategy of screening stocks is intended to work for the long-run (5, 10 or even 20 years is ideal), based on the idea that prices will end up adjusting correctly. This "magic formula" as he puts it, delivered superior returns with much lower risk than the market averages but also presented negative results for some consecutive periods. Nonetheless, Gray and Carlisle (2013) showed that the return on capital part of the "magic formula" actually lowers the compound annual growth rate, increases the downside volatility, and lowers the risk-adjusted performance calculated based on the Sharpe and Sortino ratios.

As a complement to Graham and Greenblatt's views regarding prime factors to consider when screening stocks, it is key to introduce now the perspective of a highly successful and acknowledged value investor. Warren Buffett, a follower of Graham's investment philosophy, has been confronting the validity of market efficiency by consistently generating abnormal returns in a relatively stable way. For doing so, he focuses on choosing safe stocks, which display a low beta as well as low volatility; cheap stocks, value stocks with low price-to-book ratios, and high-quality stocks that are profitable, stable, exhibiting growth, and with high payout ratios. Therefore, Buffett's performance can be considerably explained by exposures to value, low-risk, and quality factors[5]. Considering these three factors, studies have suggested that value stocks outperform on average growth stocks (Stattman, 1980, Rosenberg, Reid, and

[5] Concluded from the loadings' signs observed in the following regression (for Berkshire Hathaway):
$R_t - R_t^f = \alpha + \beta_1 MKT_t + \beta_2 SMB_t + \beta_3 HML_t + \beta_4 UMD_t + \beta_5 BAB_t + \beta_6 QMJ_t + \varepsilon_t$

Lanstein, 1985, Fama and French, 1992), high-quality stocks outperform on average junk stocks (Asness, Frazzini, and Pedersen, 2013), and low beta stocks outperform on average high beta stocks (Frazzini and Pedersen, 2013). Concerning quality metrics, it was evidenced that high profitability stocks outperform peers with low profitability (Novy-Marx, 2013), companies with low leverage show high abnormal returns (Penman, Richardson, and Tuna, 2007, George and Hwang, 2010), and firms with high credit risk tend to underperform firms with low credit risk (Altman, 1968, Ohlson, 1980, Campbell, Hilscher, and Szilagyi, 2008). Also, enterprises displaying growth outperform the ones presenting poor growth perspectives (Mohanram, 2005), and stocks disclosing low accruals tend to outperform high accrual stocks (Sloan, 1996, Richardson, Sloan, Soliman, and Tuna, 2005). Furthermore, with the primary purpose of understanding the source of Buffett's alpha, Martin and Puthenpurackal (2008) came to the conclusion that factors such as the market, size, and value (Fama and French, 1993), but also momentum (Jegadeesh and Titman, 1993, Asness, 1994, Carhart, 1997), cannot explain the abnormal return generated by the Chairman, President, and CEO of Berkshire Hathaway[6]. Fama and French (2014) extended their original three-factor model to include two new important variables for asset pricing such as profitability and companies' investment patterns. According to Asness, Frazzini, and Pedersen (2013), accounting for both the quality and risk factors when attempting to identify the sources of the strategy's returns explains a great part of Buffett's alpha. Furthermore, and finishing off, Robert Hagstrom (2005) highlighted the following Buffett's four essential financial tenets: the return on equity, preferred measurement when compared to the earnings per share; the "owners' earnings", which corresponds to the actual dollar value collected by the owners[7]; the profit margin, and the relationship between retained

[6] Note that these four factors compose the Carhart four-factor model (extension of the F&F three-factor model).
[7] This term was used by Warren Buffett himself in a 1986 letter to shareholders. Owners' earnings can be interpreted as free cash flow with a subtle difference; the former considers maintenance capex, which allows the company to "fully maintain the business long-term competitive position", while the latter considers all capex without making any particular distinction. Source: http://www.berkshirehathaway.com/letters/1986.html

earnings and market value generation, as per each dollar of retained earnings the company needs to generate at least one dollar of market value.

In concordance with the ideas expressed by now about the outperformance of value investing, Chan, Hamao, and Lakonishok (1991) showed that high cash flow-to-price ratios predict higher returns (both in US and Japan). Additionally, there is evidence that stocks with high earnings-to-price ratios also earn higher returns (Basu, 1977, Jaffe, Keim, and Westerfield, 1989, Chan, Hamao, and Lakonishok, 1991, Fama and French, 1992). Lakonishok, Shleifer, and Vishny (1994) confirmed the common findings in the literature that companies presenting high earnings-to-price, book-to-market, and cash flow-to-price ratios outperform. The major takeout of their paper is that value stocks have outperformed growth stocks from April 1968 to April 1990, which can be mostly explained by an exuberant extrapolation of unsustainable past growth rate into the future by market participants.

With the purpose of concluding this discussion focused on value investing, a reference to Joseph Piotroski is crucial. As previously exposed in the literature review, prior research showed that high book-to-market companies generally outperformed their low book-to-market peers. However, Piotroski (2000) showed that in such a traditional segregation, and within the sample considered, about a mere 57.00% of the high book-to-market stocks actually outperformed. He then went further and separated high book-to-market enterprises into two categories: strong value companies and weak value companies. For the purpose, he developed an aggregate fundamental measure, the F_SCORE, which englobes nine binary financial performance signals measured through profitability, operating efficiency, leverage, liquidity, and source of funds. Considering the latter, Loughran and Ritter (2005) reported that companies issuing new shares underperform afterward in comparison to firms that do not opt for such funding. In addition, and as an interesting fact to refer, it seems that the use of a composite measure of fundamentals to pick stocks leads to a better performance than considering

individual metrics alone. Indeed, there is a stronger positive correlation between the individual value stocks' market-adjusted return and the overall F_SCORE than between the stock's market-adjusted return and each individual constituents of the composite measure. Also, and as expected, high-quality firms appear to generate stronger returns. Joseph Piotroski aimed, based on this approach, to shift the distribution of realized returns to the right by identifying poor deals and excluding them from the portfolio formation. However, even if this approach seems to be implementable for all types of businesses, benefits of acting upon the analysis of financial statements tend to vanish for big capitalization stocks as they are highly covered by analysts and widely known by investors. There is evidence that the market tends to progressively incorporate historical public information into prices, especially in the case of small companies displaying low volume and not much followed by analysts. Lastly, the strategy of going long expected winners selected with the F_SCORE and shorting expected losers generated sizeable returns between 1976 and 1996. Notwithstanding, Woodley, Jones, and Reburn (2011) indicated that the selection of stocks based on the F_SCORE displayed a reversed conclusion in the twelve years following the period considered by Piotroski. This means that high F_SCORE value stocks seemed to produce lower market-adjusted returns than low F_SCORE value stocks from 1997 to 2008. Gray and Carlisle (2013) proposed a slightly modified version of the F_SCORE, which they qualified as FS_SCORE, that outperformed the former measure by a small but economically meaningful amount.

3. DATA AND METHODOLOGY

This work is aimed to find an intuitive combination of variables in order to improve stock-picking. For that purpose, a comparative analysis of stock selection methods was made for increased robustness of conclusions. This analysis is thus grounded on a comparison of results between stock-picking based on plain value and growth models, and on value and growth models complemented with a quality component. In order to build scorecards based on the approaches exposed above, and find top performers, metrics from the literature were considered. Bear in mind that a combination of value and quality is highly significant as it allows to avoid the "value trap" [8]. Naturally, some stocks may look like a bargain to investors but can be, however, fairly priced due to their overall fundamental weakness. Following the ranking process based on the scorecards analysis, the aforementioned stock-picking models originated four distinct equally weighted portfolios constituted of twenty top stocks each. Afterward, backtests for the portfolios were conducted for thirteen years, from 2002 to 2015, in order to consider both bear and bull market phases. Then, a portfolio with a similar structure as the NSP (40.00% equity/ 60.00% bond) was reproduced, and a final backtest was conducted for the past year, as the stock-picking analysis was focused on the past year only, allowing thus for a direct comparison with the students portfolio's performance. In order to get to the 40.00% of equity, the best performing stock-picking model for the 2002-2015 window was considered and a weight of 2.00% was attributed to each one of the twenty stocks selected. Note that for alignment purposes with the main objective of this paper, the performance analysis was exclusively focused on stock-picking when doing the direct comparison. As for transaction costs, 0.05% (5 BPS) were included in the investment models, which corresponds to the approximate costs supported by the NSP. This percentage does not include brokerage fees and

[8] Asness, Frazzini, and Pedersen (2013) introduced the QARP (Quality At a Reasonable Price) concept based on the idea of combining value with quality. Piotroski (2000) also followed this approach in his study.

is only influenced by the bid-ask spread; as the securities traded are liquid (stocks within the S&P 500), the bid-ask tends to be lower than five basis points approximately. Note that the portfolios of stocks were compared with the S&P 500 Index for relative performance analysis. Besides, full portfolio turnovers were considered each year in order to account for the correct yearly constitution of the S&P 500 Index when comparing stocks for selection purposes. Thus, financial data was considered at each December 31st to compute the metrics used to select stocks at each January 1st. Additionally, and to avoid look-ahead bias as companies release their financial statements at different dates, daily returns started to be computed approximately six months after the stock selection date, on each last Thursday of June, with the portfolios being always formed the day before.

Equation 1. Computation of Daily Returns

$$R_t = \frac{P_t + \text{Dividend}}{P_{t-1}}$$

If for some reason a stock selected on the first day of January stopped being traded during the six-month lag, for delisting or M&A activity for instance, the twenty-first best stock would then be included in the list of stocks eligible for investment at the beginning of the year in order to ensure the selection of precisely twenty stocks. This process goes on if more than one stock stops being traded. Also, if a stock stopped being traded while included in the portfolio, no other stock was acquired for substitution purposes during that year. Whenever the latter event happened, and for simplification, the calculation of transaction costs was made as if the stock remained in the portfolio until the end of the year. Thereby, all transaction costs were computed at the same time.

All financial information and ratios were taken from Bloomberg if not stated otherwise and concerning free cash flow, consider unlevered free cash flow (UFCF) whenever the metric is referred.

For assessing quality, a variant to the original Piotroski F_SCORE was suggested, the FS_SCORE, which showed to perform slightly better and in an economically meaningful amount. Table 1 displays the metrics considered in this FS_SCORE while Table 2 shows the binary signal system of this model.

Table 1. Constituents of the FS_SCORE

Current Profitability	
ROA	$\left(\frac{\text{Net income before extraordinary items}}{\text{Most recent total assets}}\right)_t$
FCFTA	$\left(\frac{\text{Free cash flow}}{\text{Most recent total assets}}\right)_t$
ACCRUAL	$\left(\frac{\text{Net income before extraordinary items} - \text{Cash flow from operations}}{\text{Beginning of the year total assets}}\right)_t$
Stability	
ΔLEVER	$\left(\frac{\text{Total long term debt}}{\text{Average total assets}}\right)_t - \left(\frac{\text{Total long term debt)}}{\text{Average total assets}}\right)_{t-1}$
ΔLIQUID	$\left(\frac{\text{Current assets}}{\text{Current liabilities}}\right)_t - \left(\frac{\text{Current assets}}{\text{Current liabilities}}\right)_{t-1}$
NEQISS	$(\text{Equity repurchases} - \text{Equity issuance})_t$
Recent Operational Improvements	
ΔROA	$ROA_t - ROA_{t-1}$
ΔFCFTA	$FCFTA_t - FCFTA_{t-1}$
ΔMARGIN	$\left(\frac{\text{Gross margin}}{\text{Total sales}}\right)_t - \left(\frac{\text{Gross margin}}{\text{Total sales}}\right)_{t-1}$
ΔTURN	$\left(\frac{\text{Total sales}}{\text{Beginning of the year total assets}}\right)_t - \left(\frac{\text{Total sales}}{\text{Beginning of the year total assets}}\right)_{t-1}$

Table 2. Binary Signal System from the Constituents of the FS_SCORE

If $ROA > 0$, FS_ROA $= 1$; 0 otherwise
If $FCFTA > 0$, FS_FCFTA $= 1$; 0 otherwise
If $CFO > ROA$, FS_ACCRUAL $= 1$; 0 otherwise

If $\Delta LEVER < 0$, FS_ΔLEVER $= 1$; 0 otherwise
If $\Delta LIQUID > 0$, FS_ΔLIQUID $= 1$; 0 otherwise
If $NEQISS > 0$, FS_NEQISS $= 1$; 0 otherwise

If $\Delta ROA > 0$, FS_ΔROA $= 1$; 0 otherwise
If $\Delta FCFTA > 0$, FS_ΔFCFTA $= 1$; 0 otherwise
If $\Delta MARGIN > 0$, FS_ΔMARGIN $= 1$; 0 otherwise
If $\Delta TURN > 0$, FS_ΔTURN $= 1$; 0 otherwise

As shown in Table 1, this quality measure is built upon observation of a firm's current profitability, stability, and recent operational improvements. First of all, the best quality firms

in terms of profitability must be able to efficiently generate internal funds. Higher return on assets, higher free cash flow generation over assets, and low accruals are all variables associated with good profitability. Also, an increase in the company's leverage, a liquidity shrinkage, and the use of external financing through the issuance of equity are seen as negative signs when it comes to financial health. In addition, a positive change in operational efficiency metrics such as the return on assets, free cash flow-to-assets, gross margin ratio, and asset turnover is considered to be a good characteristic. Table 2 shows that the variables considered receive the value of one whenever the quality rule stipulated is respected, and zero otherwise. The FS_SCORE is nothing but the sum of the ten binary variables specified (Equation 2). Firms displaying the highest FS_SCORE were top-ranked.

Equation 2. Constitution of the FS_SCORE

FS_SCORE = FS_ROA + FS_FCFTA + FS_ACCRUAL + FS_ΔLEVER + FS_ΔLIQUID + FS_NEQISS + FS_ΔROA + FS_ΔFCFTA + FS_ΔMARGIN + FS_ΔTURN

Also, two measurements involving free cash flow generation to the yet presented FS_SCORE model were added to get a broader picture of a company's quality. These two measurements are the cash return on invested capital (CROIC) and the free cash flow-to-sales[9]. The former indicates how much cash a company can generate based on each dollar invested in operations, while the latter indicates how much cash is generated by each dollar of revenue. A free cash flow generation metric is relevant to use in comparison to earnings for assessing quality as it is not only tougher to manipulate but it also accounts for the actual cash that is available for distribution among the company's security holders. Besides that, even if the return on equity presents the drawback of not taking into consideration differences in capital structures

[9] Source: https://demo.oldschoolvalue.com/osvapp.php#/rating

across firms, it was still included for its widespread use in the industry. The companies presenting the highest ratios were top-ranked.

Furthermore, commonly used value metrics as the price-to-book, price-earnings, price-to-free cash flow, enterprise value-to-free cash flow, and enterprise value-to-EBITDA ratios were considered to rank stocks. These ratios were utilized to assess the value of stocks in relation to their fundamentals and, in concordance with the literature, low-ratio stocks were top-ranked. Note that the enterprise value multiples are important inclusions to make in the analysis, jointly with the other equity multiples, as they allow for a much more accurate comparison of companies with different capital structures. Also, in the enterprise value-to-EBITDA ratio, EBITDA was preferred in relation to EBIT since depreciation is an accrual rather than a cash expense and therefore, it represents nothing but a difference in accounting policy, having no impact on the variation of a company's economic value. Moreover, both the EBITDA and EBIT exclude tax effects, which is important to allow for a better comparison between companies as those effects may vary widely from firm to firm.

Finally, growth metrics were also considered during the ranking process of stocks. Past performance, linked to growth in this part, was determined through the analysis of the compound annual growth rate (CAGR) in sales, earnings per share, and free cash flow. These variables were considered as they represent key elements for a company's success and are widely used in practice. The five-year compound annual growth rate, which indicates the yearly growth rate of the measurement considered if it would have grown in steady state in a five-year period, was used in order to assess smoothed historical variations. Stocks displaying higher growth were top-ranked.

Table 3. Quality, Value, and Growth Metrics Considered to Rank Stocks

Quality Metrics	Value Metrics	Growth Metrics
FS_SCORE	P/B	5Y CAGR of Sales
FCF/ Invested Capital (CROIC)	P/E	5Y CAGR of EPS
FCF/ Sales	P/FCF	5Y CAGR of FCF
ROE	EV/FCF	
	EV/EBITDA	

Following the definition of the quality, value, and growth metrics considered to rank stocks (all summarized in Table 3 above), the construction of the final ranks for the plain value and growth models is explained in Table 4 (FVR and FGR). Note that the final quality rank, also displayed below, was used to build the value plus quality and growth plus quality ranks as shown in Table 5.

Table 4. Methodology Used to Calculate the Final Ranks

Final Quality Rank (FQR)

$$\frac{\sum \text{Ranks Attributed Per Quality Indicator to Stock i}}{\text{Number of Quality Indicators Used}}$$

Final Value Rank (FVR)

$$\frac{\sum \text{Ranks Attributed Per Value Indicator to Stock i}}{\text{Number of Value Indicators Used}}$$

Final Growth Rank (FGR)

$$\frac{\sum \text{Ranks Attributed Per Growth Indicator to Stock i}}{\text{Number of Growth Indicators Used}}$$

*These ranks are on a per stock basis.

Table 5. Construction of the Value + Quality and Growth + Quality Ranks

$$\textbf{Value + Quality Rank} = \frac{1}{2} \times \text{FVR} + \frac{1}{2} \times \text{FQR}$$

$$\textbf{Growth + Quality Rank} = \frac{1}{2} \times \text{FGR} + \frac{1}{2} \times \text{FQR}$$

The results of a stock-picking based on simple value and growth models were then compared with the results of a stock-picking based on value plus quality and growth plus quality models, as previously referred, in order to assess which stock selection approach classifies better.

At last, it was assessed if the daily excess returns of the four portfolios built were significantly abnormal after controlling for common factors included in widely known asset pricing models. Hence, for that matter, the CAPM, the Fama-French five-factor model, and the Carhart four-factor model with a quality minus junk factor added to it were used respectively:

CAPM: $r_{it} = \alpha_{it} + \beta_{it}\text{EXMARKET}_t + \varepsilon_{it}$

FF5FM: $r_{it} = \alpha_{it} + \beta 1_{it}\text{EXMARKET}_t + \beta 2_{it}\text{SMB}_t + \beta 3_{it}\text{HML}_t + \beta 4_{it}\text{RMW}_t + \beta 5_{it}\text{CMA}_t + \varepsilon_{it}$

CQ5FM: $r_{it} = \alpha_{it} + \beta 1_{it}\text{EXMARKET}_t + \beta 2_{it}\text{SMB}_t + \beta 3_{it}\text{HML}_t + \beta 4_{it}\text{WML}_t + \beta 5_{it}\text{QMJ}_t + \varepsilon_{it}$

Where r_{it} corresponds to the excess return of the portfolio after adjusting for the risk free rate, EXMARKET is the excess return of the market portfolio (includes SPX firms), and SMB, HML, RMW, WML, CMA, and QMJ are returns on zero-investment, factor-mimicking portfolios for size, book-to-market, profitability, momentum, investment patterns, and quality respectively. The factors included in the FF5FM model and the momentum factor (WML) were both taken from the data set available in Kenneth French data library[10]. The QMJ factor was taken from AQR's website[11]. Regarding the risk-free rate, it is a daily rate that compounds to the 1-month T-Bill over the number of trading days included in a month. Bear in mind that a 5.00% significance level was considered for the regressions outputs interpretation.

[10] Source: http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html#Research
[11] Source: https://www.aqr.com/library/data-sets/quality-minus-junk-factors-daily

4. RESULTS

This section discusses the performance of the four portfolios built during the 2002-2015 period and concludes on the abnormality of their excess returns. A direct comparison between the best performing model and the NSP, with regard to stock-picking, was also included in this part. Table 6 below presents the descriptive statistics of the value portfolio.

Table 6. Descriptive Statistics of the Value Portfolio

Risk and Return Profile of the Portfolio	
Average Annualized Arithmetic Return	18,63%
Average Annualized Volatility	30,98%
Info Sharpe	0,6012
Information Ratio	0,6481
Maximum Drawdown	102,87%
Higher Moments	
Skewness	0,16
Kurtosis	10,95
Distribution of Returns	
Daily Maximum	18,09%
Q3	0,84%
Median	0,12%
Q1	-0,66%
Daily Minimum	-13,20%
Percentage of Positive Days	
% of positive days	54,19%
Total Return and Growth Rate of the Portfolio Value	
Total Return in 13 Years	510,74%
CAGR 13 Years	14,93%

The value portfolio, which is only composed of the cheapest-in-relation-to-fundamentals stocks picked from the S&P 500 Index universe, presented an info Sharpe of 0.60 and an information ratio (IR) of 0.65. Appendix 10 displays the comparison of the cumulative return between the portfolio and the benchmark. For information concerning the percentage of positive months, monthly info Sharpes, and annual returns consult Appendix 11. Besides, in thirteen years of daily returns, 54.19% of those days displayed positive returns, which is a good indication for whoever may want to use the model. Furthermore, the total return of the strategy equaled 510.74% and the compound annual growth rate reached 14.93%, which indicates that a constant growth rate of 14.93% would be earned per year with this investment strategy for the period considered. For illustration purposes, if 100,000 USD were invested at inception

(26/06/2002), the outcome would be 610,742 USD as of 25/06/2015 (Appendix 12). The drawback, however, resides on the 102.87% maximum drawdown of the model; it should be however noticed that the backtest includes a considerable bearish period, the global financial crisis of 2007-2008. Appendix 13 shows the evolution of the portfolio drawdowns for the period of thirteen years considered. Regarding higher moments, the riskiness of the strategy is also indicated by a high excess kurtosis in relation to the normal distribution of 10.95. This kind of distribution of returns presents fat tails, which leads to an increase in the likelihood of both negative and positive extreme returns occurring, therefore increasing risk. Furthermore, the distribution of returns is slightly positively skewed, which is a characteristic that is liked by investors as the returns' average is pulled rightwards.

The second model constructed was a simple growth model; the descriptive statistics are showed in Table 7 below.

Table 7. Descriptive Statistics of the Growth Portfolio

Risk and Return Profile of the Portfolio	
Average Annualized Arithmetic Return	17,23%
Average Annualized Volatility	28,14%
Info Sharpe	0,6122
Information Ratio	0,6979
Maximum Drawdown	83,97%
Higher Moments	
Skewness	0,01
Kurtosis	9,82
Distribution of Returns	
Daily Maximum	18,79%
Q3	0,93%
Median	0,12%
Q1	-0,72%
Daily Minimum	-14,15%
Percentage of Positive Days	
% of positive days	53,97%
Total Return and Growth Rate of the Portfolio Value	
Total Return in 13 Years	467,26%
CAGR 13 Years	14,28%

With an info Sharpe of 0.61, an information ratio of 0.70, and a maximum drawdown of 83.97%, the simple growth model yielded better results than the simple value model in terms of risk-adjusted return, relative performance against the benchmark, and maximum loss

percentage for the 2002-2015 period. Appendix 14 shows the comparison of the portfolio's cumulative return against the benchmark and Appendix 15 presents the drawdowns for this portfolio composed of growth stocks. For information concerning the percentage of positive months, monthly info Sharpes, and information about annual returns consult Appendix 16. However, the percentage of positive days decreased slightly in an almost insignificant amount to 53.97%, while the total return in thirteen years and the CAGR also decreased to 467.26% and 14.28% respectively. If the same 100,000 USD were invested at inception (26/06/2002), 567,258 USD would be available to the investor as of 25/06/2015 (Appendix 17). As for higher moments, this model has an almost perfectly symmetrical distribution of returns and its excess kurtosis is lower than the excess kurtosis of the value portfolio (9.82 vs 10.95). Thus, the probability of extreme outcomes occurring is diminished, which indicates lower risk.

Concerning the third model considered, Table 8 presents descriptive statistics of the value plus quality portfolio.

Table 8. Descriptive Statistics of the Value + Quality Portfolio

Risk and Return Profile of the Portfolio	
Average Annualized Arithmetic Return	16,08%
Average Annualized Volatility	25,78%
Info Sharpe	0,6235
Information Ratio	0,7738
Maximum Drawdown	62,71%
Higher Moments	
Skewness	0,21
Kurtosis	12,52
Distribution of Returns	
Daily Maximum	15,85%
Q3	0,75%
Median	0,10%
Q1	-0,59%
Daily Minimum	-12,23%
Percentage of Positive Days	
% of positive days	54,86%
Total Return and Growth Rate of the Portfolio Value	
Total Return in 13 Years	430,69%
CAGR 13 Years	13,70%

The value plus quality portfolio should be directly compared with the simple value portfolio to assess the relevance of including quality metrics in the model. Concerning risk and return, the info Sharpe, information ratio, and maximum drawdown for this portfolio are 0.62, 0.77, and 62.71% respectively. Therefore, the risk-return profile of this portfolio has considerably improved in relation to the simple value model and the maximum drawdown of this model has substantially decreased from 102.87% to 62.71%. Note that a comparison of the cumulative return between the portfolio and the benchmark is made on Appendix 18. For information concerning the percentage of positive months, monthly info Sharpes, and information about annual returns consult Appendix 19. Appendix 20 presents the portfolio's drawdowns. The excess kurtosis is, however, higher in this case, 12.52, which increases the likelihood of extreme outcomes occurring, and the skew is positive at 0.21. Therefore, the value plus quality model appears to be much safer than the simple value one. Regarding the percentage of positive days, the result is slightly better for this model (54.86%). The thirteen years total return equaled 430.69%, with a CAGR of 13.70%, which is significantly lower in comparison to the simple value model. For 100,000 USD invested at inception (26/06/2002), 530,693 USD would be available to the investor as of 25/06/2015 (Appendix 21). Notwithstanding, this model is still considered better than the simple value model as it has a better risk adjusted return, much lower drawdown, and higher information ratio.

Finally, the performance of the growth plus quality model was assessed and directly compared with the simple growth model. The descriptive statistics of this last model considered are showed in Table 9.

Table 9. Descriptive Statistics of the Growth + Quality Portfolio

Risk and Return Profile of the Portfolio	
Average Annualized Arithmetic Return	16,41%
Average Annualized Volatility	24,06%
Info Sharpe	0,6820
Information Ratio	0,9472
Maximum Drawdown	80,30%
Higher Moments	
Skewness	0,06
Kurtosis	11,71
Distribution of Returns	
Daily Maximum	16,48%
Q3	0,80%
Median	0,10%
Q1	-0,61%
Daily Minimum	-12,73%
Percentage of Positive Days	
% of positive days	54,28%
Total Return and Growth Rate of the Portfolio Value	
Total Return in 13 Years	486,02%
CAGR 13 Years	14,57%

The growth plus quality model presents better results when compared to the simple growth model. The portfolio has an info Sharpe, information ratio, and maximum drawdown of 0.68, 0.95, and 80.30% respectively. Appendix 22 compares the cumulative return of the portfolio against the benchmark and Appendix 23 exhibits the drawdowns of this portfolio. For information concerning the percentage of positive months, monthly info Sharpes, and information about annual returns consult Appendix 24. The portfolio's total return for this period was 486.02% and the CAGR equaled 14.57%. Therefore, if 100,000 USD were invested at inception (26/06/2002), 586,017 USD would be available for the investor as of 25/06/2015 (Appendix 25). The percentage of positive months increased to 54.28%, from 53.97% for the simple growth model. Finally, concerning higher moments for the distribution of returns, skewness increased slightly, which is positive, and kurtosis also increased from 9.82, for the simple growth model, to 11.71, for the growth plus quality model, increasing thus risk.

After the comparison of results for the four investment models considered, a ranking from the best to worst model can be made. This ranking is showed in Table 10 below; the

criteria used to rank the models are the info Sharpe and information ratio. Appendix 26 shows a summary plot of the four models cumulative return against the benchmark.

Table 10. Ranking of Models based on their Info Sharpe and Information Ratio

Rank	Model	Info Sharpe	Information Ratio
1	Growth + Quality	0,6820	0,9472
2	Value + Quality	0,6235	0,7738
3	Growth	0,6122	0,6979
4	Value	0,6012	0,6481

Based on the models' results discussed throughout this section and on the ranking displayed in Table 10, one should notice that including a quality component to simple value and growth models essentially improves the risk-adjusted return, the relative performance against the benchmark, and the maximum drawdown of these portfolios.

Besides, after having obtained the descriptive statistics of the four models built, the excess returns of these were checked for abnormality through regression analysis. The three asset pricing models used for this purpose, as explained in the data and methodology section, pointed to the abnormality of the four portfolios' daily excess returns at the 5.00% significance level (per investment model). Therefore, besides beating the benchmark for almost thirteen years, it was statistically showed that the excess returns generated by the four investment models considered seem to be abnormal. Appendix 27 exhibits the regressions results for the simple value portfolio. Appendix 28, 29, and 30 present the regressions outputs for the simple growth, value plus quality, and growth plus quality portfolios respectively.

Note that the previously exposed stock-picking models' risk level was not controlled in this analysis. The objective of this study was to build portfolios that can consistently beat the benchmark and prove the relevance of the returns generated. Therefore, whoever applies the models studied must adapt them to their risk tolerance profile by setting a target volatility level as done by the NSP team for instance.

Finally, the direct comparison between the best performing model and the Nova Students Portfolio for the past year, in terms if stock-picking, showed an underperformance of the former portfolio in relation to the latter. The growth plus quality model yielded a -0.71% weighted[12] return of picks versus 2.09% for the NSP. Beyond that, the weighted difference between the returns of the picks and the returns of the SPDR S&P 500 Trust ETF, between 18/11/2015 and 25/05/2016, was -1.80% for the growth plus quality model and -0.35% for the NSP. Appendix 31 shows the stocks picked by the growth plus quality model and their performance against the SPDR S&P 500 Trust ETF (35.00% of the growth plus quality model stock picks were positive and above the benchmark against 51.52% for the NSP. Cf. Appendix 9 and 31).

The NSP invests a heavy amount of its equity share in the SPDR S&P 500 Trust ETF and gives low weight to stocks (around 1.00% each) when investment is made on these instruments. Also, the number of picks made within the NSP reached thirty-three for the period considered. In the growth plus quality portfolio case, and for the same time frame, only twenty stocks were picked, which allowed for lower diversification. Besides, each stock started with a weight of 2.00% in the portfolio and thus, the growth plus quality portfolio's returns were impacted, both positively and negatively, more heavily than the NSP's returns. Ultimately, and for the NSP case, stocks picked within the 18/11/2015 and 25/05/2016 window had different holding periods. Actions were then taken to prevent poorly performing stocks from further depressing the portfolio's returns, which did not happen with the growth plus quality portfolio as investment was made on twenty stocks in the beginning of the period and no other action was taken until 25/05/2016, the last date considered. Therefore, the NSP participants might have capitalized on better opportunities by adopting an active trading style of stocks for the past year. The growth plus quality model fails to do so.

[12] Weighted by their percentage share in the portfolio for the last date considered in this particular analysis, 25/05/2016.

5. SUMMARY AND CONCLUSION

A comparative method was proposed in this paper with the intent of robustly finding good models that can be applied in practice with some adaptations to diminish risk. Four investment models composed of value, growth, and a combination of value plus quality and growth plus quality metrics were considered, and thirteen-year backtests were conducted to assess the impact of both bullish and bearish market phases on the portfolios' performance. Furthermore, the abnormality of the excess returns generated was verified through regression analysis.

This study showed that the inclusion of a quality component in simple value and simple growth stock-picking models improves results. Indeed, the exclusion of value and growth stocks with poor quality from consideration increases the info Sharpe, the information ratio, and decreases the maximum drawdown of simple value and growth portfolios. Besides, and for the sample considered, growth outperformed value. Thus, as the consideration of quality improved the portfolios' performance while picking stocks, and since growth outperformed value between 2002 and 2015, it comes clear that the best performing model was the growth plus quality one, followed by the value plus quality, growth, and finally, value models. Furthermore, all models generated significant abnormal daily excess returns at the 5.00% significance level after controlling for factors included in the CAPM, the Fama-French five-factor model, and the Carhart four-factor model with a quality minus junk factor added to it.

Therefore, the future NSP team should be certain, independently of considering value or growth metrics to select stocks, that the companies analyzed are financially strong. Instead of building independent scorecards that consider value and growth metrics separately, which is an actual assignment that is given to the students, the participants should build scorecards that actually mix quality with value and quality with growth. Mixing quality with momentum should be another idea, since momentum is also used for stock-picking purposes within the NSP.

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