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Reaping the Size and Value Effects: Controlling for Pure Quality

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Abstract

We investigate if small and low Market-to-Book firms have higher risk-adjusted returns when controlling for quality. We define quality characteristics as something investors should be willing to pay a higher price for, all else equal. The analysis is based on all common stocks in the Swedish stock market for year 1996-2014. We show that quality companies have higher Market-to-Book, and that larger firms earn a price premium when holding Quality constant. We introduce a new Pure Quality metric which is adjusted for a firm's Market-to-Book and Size, resulting in a metric that is predicting subsequent returns. A trading strategy that takes a long position in high pure quality, small and low Market-to-Book firms and that goes short low pure quality, large and high Market-to-Book firms generates economically large and statistically significant three-factor alphas at the 1% level. This finding is also robust to the QMJ factor. Furthermore, we argue that the price of quality characteristics indicate tendencies in valuation irrationality and predict the strategy return. Indeed, during the rise of the internet bubble year 1999 the price of profitability peaked and the strategy underperformed. However, after the burst of the bubble the price adjusted and the strategy more than recovered.

Keywords: Quality, Size effect, Value effect, Trading strategy, Asset pricing

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I. Introduction

The Size and Value effects have long been identified and their presence is clear. Small and low Market-to-Book firms outperform large and high Market-to-Book firms, underlying the famous Fama-French factors (Fama, French 1993). The underlying risk factors that they are approximating are however less clear. Are their behaviour related to the underlying quality of the stocks and is this priced rationally among small and low Market-to-Book firms?

In this paper, we define a Quality characteristic as something investors should be willing to pay a higher price for, all else equal. Quality characteristics are identified through company's fundamentals data where metrics provide guidance in assessing the level of quality. The Gordon Growth model[1] is used to approximate the relationship between the characteristics, being: Profitability, Growth, Safety and Payout. An ideal company in terms of quality is profitable and growing while also being safe and having a high payout ratio. Limiting our study to the Swedish Stock Market running from year 1990-2014, this paper identifies a strong relationship between Quality, Market-to-Book and Size. We find that larger firms earn a price premium when holding Quality constant. Furthermore, in accordance with previous research we find that high quality firms demand a price premium. Following up on recent work in this area that introduced a metric successfully capturing a firm's quality level (Asness, Frazzini & Pedersen 2014), this paper extends and answers the following questions:

A. Do small firms have higher risk-adjusted returns, holding Quality constant?
B. Do low Market-to-Book firms have higher risk-adjusted returns, holding Quality constant?

In order to test these hypotheses, we investigate how the Size and Value effects are related to a company's Quality. We show that trading on SMB and HML generates risk-adjusted abnormal returns by including a Quality dimension. While trading on small and low Market-to-Book companies might cause high risk factor loadings, we show that by controlling for Quality we avoid much of the risk associated with these anomalies and can thereby capture risk-adjusted returns. To reach these conclusions, we disentangle the three interrelated variables, namely Quality, Size and Market-to-Book in order to sort on each specific variable. We present a new $Pure\ Quality$ metric, adjusted for the Size and Market-to-Book effects on Quality, which

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[1] An investor's willingness to pay a higher price for the quality subcomponents will show up in a company's Market-to-Book metric. By dividing the Gordon Growth model with book value of equity we approximate the following relationship:

$$\frac{P}{B} = \frac{1}{B} \times \frac{dividend}{required\ return\ -\ growth} = \frac{\frac{profit}{B} \times \frac{dividend}{profit}}{required\ return\ -\ growth} = \frac{Profitability \times Payout\ ratio}{Safety\ -\ Growth}$$

predicts economically large and statistically significant returns. When adjusting, we avoid the noise of targeting high Market-to-Book and large firms when sorting on high quality firms.

Having isolated a variable capturing $Pure\ Quality$, we reintroduce the two dimensions of Size and Market-to-Book to trade on the Size (SMB) and Value (HML) effects. More specifically, we implement a trading strategy that goes long in high Pure Quality, small and low Market-to-Book firms and that goes short in low Pure Quality, large and high Market-to-Book firms. Additionally, in order to keep the transaction costs at a lower level and be applicable in practice the strategy is designed to be upheld with reasonably few stock positions, on average 12 positions (6 long and 6 short). We find that this strategy generates high monthly risk-adjusted excess returns, showing economically large and statistically significant three-factor alphas of 1.39% with a significance level of 1%. Further, we also find that the return is robust to the QMJ-factor (Asness, Frazzini & Pedersen 2014). These results are evidence in favour of the hypothesis that the Size and Value effects can be reaped by controlling for quality without taking on extra risk defined by SMB and HML.

We also find that the time-varying prices the investors are willing to pay for the Quality Characteristics are closely related to the trading strategy return. We retrieve the prices by regressing Market-to-Book on the quality measures and we interpret the coefficient from these regressions as the Price of those Quality Characteristics. Putting these price levels in month t in relation to the strategy performance between month t and $t+1$, we show that periods where the strategy performed worse are very much related to the price the market is paying for these quality characteristics. More specifically, the Price of Profitability is the main driver behind the return of our portfolio, where a higher price predicts negative subsequent returns. Moreover, we argue that the variation of Price of Profitability is a noisy approximation for investor valuation irrationality when put in relation to the market condition. Price of Profitability reaches its peak right before the burst of the internet bubble suggesting that the valuation of stocks lost its connection to the underlying quality received, i.e. investors paid too much for too little quality in a bull market. In comparison, the Price of Profitability reached equal levels *during* and *after* the Global Financial Crisis of 2007-2009, suggesting another phenomenon driving the increased price, namely an increase in demand for profitable companies during low market liquidity. Applying this way of thinking on the performance of the trading strategy; investors must price quality companies higher than its counterpart in order for the strategy to perform as intended. Indeed, during the period where the market valued quality least rationally (namely the rise during the internet bubble) our strategy performed the worse. However, it quickly more than regained its return as the bubble burst and prices adjusted to more accurate valuations in line with the companies' underlying quality levels. During the financial crisis, we argue that the valuation of profitability was rational as the need for profitability and self-financing should be more pronounced in bear markets, and accordingly we show that our strategy return performed very well during the same period - barely affected by the market condition.

While quality can be understood in a general way, the calculations behind it are far more tricky and essential in order to interpret the results in the correct way. The first step in constructing the $Pure\ Quality$ metric was to create the unadjusted quality metric, which is created from four subcomponents, all of which related to the Gordon Growth model. Using data on fundamentals and security prices from Compustat Global, Thomson Datastream and Serrano, we approximate all components in the Gordon Growth model being Profitability, Growth, Payout and Safety. To our help, previous research aids us in the selection of fruitful metrics related to return predictability. In terms of $Profitability$ characteristics, studies have shown that profitable firms (gross profit over assets) generates significantly higher returns than firms that are unprofitable (Novy-Marx 2013), firms having earnings consisting of large accruals tend to under-deliver, leading to significant security mispricing ((Sloan 1996) and (Richardson et al. 2005)). Literature covering $Growth$ characteristics shows that firms that are in a mature state accompanied with low growth under-perform (Mohanram 2005), also known as the Value effect (Fama, French 1993). For $Payout$ characteristics, share repurchases/issuance can be used to predict returns in the cross-section both in the U.S market as well as in international markets ((Pontiff, Woodgate 2008) and (David McLean, Pontiff & Watanabe 2009)). The related literature on $Safety$ characteristics show that firms in distress have a higher probability of default under-perform ((Altman 1968) and (Ohlson 1980)) and finally, returns are negatively correlated to leverage (Penman, Richardson & Tuna 2007).

While these papers have proven abnormal returns, Asness, Frazzini and Pedersen (2014) do so in a far more complete setting, where all four components mentioned above from the Gordon Growth model are being used simultaneously and where an overall $Quality$ score is established. A Quality-Minus-Junk (QMJ) factor that takes a long position in quality stocks and goes short in low-quality stocks earns significant risk-adjusted returns. While stocks in general might face crash risk, QMJ benefits from *flight to quality* during poor market conditions. In this paper, the same definition of Quality and its quality components Profitability, Growth, Safety and Payout will be used as a starting point in assessing firms' quality.

Having constructed the quality measure, we then adjust this measure to construct $Pure\ Quality$ by removing the quality-score attributable to the relationship of Size and Market-to-Book. By doing this, we can separately sort stocks on Pure Quality, Size and Market-to-Book without running into reversed causality. Novy-Marx (2013) argues that Quality firms associated with a higher Market-to-Book are often expensive. Indeed, we show that there is a strong relationship between Market-to-Book and Quality. We further extend this by adding a size dimension and show that large firms have higher Market-to-Book, when holding quality constant.

By sorting stocks based on the Pure Quality measure into quintile portfolios, we then proceed to investigate the Size and Value effects in order to test our hypothesis (A) and (B). While both the literature and the market are aware of these effects, the causes of these anomalies are still a topic of discussion. Vassalou and Xing (2004) argued that SMB (Size effect) and HML (Value effect) factors (Fama, French 1993) can largely be seen as a proxy for systematic default risk, while earlier research (Ohlson 1980) showed that bankruptcy risk was not rewarded with higher returns. Griffin and Lemmon (2002) also found that the Value effect was indeed not a proxy for a distress factor. Indifferent of the underlying cause, this paper contributes to the discussion by showing that the Size and Value effects become extra pronounced as long as the pure quality is controlled for, providing an opportunity to reap the fruit from the Size and Value effect without taking on more risk.

In summary, we extend beyond the literature by studying: (i) how the relationship between Size, Value and Market-to-Book are related to each other; (ii) how controlling for Quality affects known trading strategies as HML and SMB; and (iii) how investors can exploit the Size and Value anomalies using a reasonable amount of positions robust to transaction costs.

The rest of the paper is organized as follows. Section II presents the data sources and the original quality measure. Section III presents the methodology for the price of quality, constructing the Pure Quality metric and our portfolios. Section IV analyses the price of quality and the quality components. Section V introduces the Pure Quality measure. Section VI develops a trading strategy based on Pure Quality, Size and Market-to-Book. Section VII analyses the strategy performance over time and its relation to the Price of Quality Characteristics. Section VIII shortly discusses transaction costs. Section IX presents the concluding remarks. The appendix contains in-depth explanations of calculations and portfolios.

II. Data and Quality measures

In this section we describe our data sources and the construction of quality measures.

Data sources

Our sample is consisting of 374 publicly traded stocks in Sweden for January 1990 to December 2014. We report summary statistics in Table I. At the last trading day of every month, the average sample size of stocks is 127. All financial data is presented in SEK and the average firm size in our sample is 14.33 Billion SEK. All monthly returns are measured as excess return over the Swedish risk free rate approximated as the STIBOR 1 month and all daily returns are measured as excess return over the STIBOR T/N and we use the STIBOR 1 week, should the overnight be unavailable.

Fundamentals data are taken from merging three databases, where data items are chosen based on a priority list in the following order: (1) Compustat Global, (2) Thomson Datastream and (3) The Serrano Database. Should the first-choice database have missing data items, we proceed to our second choice and so on. Daily security prices are taken from Compustat Global, where the complete set of stocks available for the Swedish market during January 1990 to December 2014 is chosen. The number of stocks of 374 is the resulting surviving set of stocks with a successfully calculated quality score from the total outstanding number of common stocks, as identified by Compustat Global for Sweden during the sample period. Furthermore, should a company have multiple securities trading, the primary issue stock is used. Fundamentals data from year t is matched with security prices for year $t + 1$.[2] Should a company have more than one annual report for the same financial year, the most recent version will be used. Since some of the calculations require five years of data, the measures of quality and quality components are first available year 1996 stretching to the end of year 2014.

By focusing on one country we minimize the noise resulting from country differences, such as different regulations and accounting standards. Since we are heavily dependent on cross-sectional calculations, analysing one market will increase comparability of the quality metrics to be calculated. We would argue that the method soon to be presented in this paper is universal, but followed with a trade-off between noise and sample size when including multiple countries. In this paper, we want to minimize the noise and the Swedish market is chosen due to familiarity with the accounting standards and extra data availability coming from the Serrano Database.

Quality Measures

Based on the variables in the Gordon Growth model, we aim to identify companies that are profitable, safe, growing and have high payouts. Intuitively, Profitability and Safety are closely

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[2] This is a reasonable assumption considering the fact that we ignore quarterly reports, and can thus expect the market have more recent information than what our assumption results in.

related to the quality level of the company. On the other hand, regarding Growth and Payout, it is possible that a company face trade-offs between these variables. For example, high payouts do not necessarily translate into higher quality if a company's growth or profitability is reduced as a consequence. However, companies that manage to outperform peers in both Growth and Payout show high quality tendencies and should thus command a higher price. In summary, Profitability, Growth, Safety and Payout represent characteristics investors should be willing to pay a higher price for, holding all characteristics constant.

Following previous research on the subject (Asness, Frazzini & Pedersen 2014), we aim to capture each of these four quality characteristics by looking at several measures in each category. We use the average of multiple measures for every quality characteristic in order to limit the impact of potential extreme values. Utilising multiple measures of the components allows for a robust analysis and ensures that the explanatory power of quality on Market-to-Book, or the lack thereof, is not based on a specific measurement choice (Asness, Frazzini & Pedersen 2014).

The components are constructed as follows (with details in the appendix A1). For every measure at every last trading day of the month, a company's values of these measures are ranked and standardized against the whole sample, resulting in a cross-sectional z-score for every subcomponent. More specifically, let x be the measure of interest and r be the vector of ranks, $r_i = rank(x_i)$. The firm and time specific z-score is then given by $z(x) = z_x = (r - \mu_r)/\sigma_r$, where μ_r and σ_r are the cross-sectional mean and standard deviation of r.

In total, we measure the four quality characteristics Profitability, Growth, Safety and Payout and we form a general measure of Quality defined as the arithmetic average of these characteristics. The first component Profitability is defined as:

$$Profitability = z(z_{gpoa} + z_{roe} + z_{roa} + z_{cfoa} + z_{gmar} + z_{acc}) \quad (1)$$

Where the profitability is the average of the standardized subcomponents (mean of 0 and standard deviation of 1) being gross profit over assets (GPOA), return on equity (ROE), return on assets (ROA), cash flow over assets (CFOA), gross margin (GMAR) and the fractions of earnings composed of cash (ACC). We define Growth as the five-year growth in the above profitability measures:

$$Growth = z(z_{\Delta gpoa} + z_{\Delta roe} + z_{\Delta roa} + z_{\Delta cfoa} + z_{\Delta gmar} + z_{\Delta acc}) \quad (2)$$

More precisely, the five-year change in the numerator divided by the lagged denominator. We define the third measure of Safety as:

$$Safety = z(z_{bab} + z_{ivol} + z_{lev} + z_o + z_z + z_{evol}) \tag{3}$$

where safe companies have low beta (BAB), low idiosyncratic volatility (IVOL), low leverage (LEV), low bankruptcy risk (as approximated by Ohlson's O-score and Altman's Z-score) and low ROE volatility (EVOL). The final quality component is Payout and it is defined as:

$$Payout = z(z_{eiss} + z_{diss} + z_{npop}) \tag{4}$$

where the subcomponents are equity net issuance (EISS), debt net issuance (DISS) and total net payout over profits (NPOP). Finally, by averaging the company scores of Profitability, Growth, Safety and Payout - we arrive at the more general Quality measure:

$$Quality = z(Profitability + Growth + Safety + Payout) \tag{5}$$

III. Methodology

In this section we present the methodology for the Price of Quality calculations, the construction of the $Pure\ Quality$ metric and finally the portfolio definitions.

Price of Quality and Quality Components

The first step in the analysis is to verify that the metrics of Quality defined in Section II capture a firm's quality. Considering that a quality characteristic is something investors should be willing to pay a higher price for (all else equal), we test and analyse the value the market assign to these characteristics defined above. By running pooled cross-sectional regressions of a firm's standardized Market-to-Book on its Quality and also adding a Standardized Size variable:

$$MB_i = a + P_{Quality}Quality_i + P_{Size}Size_i + \varepsilon_i \tag{6}$$

where a positive and statistically significant sign of the coefficient on the independent variable would confirm our hypothesis that quality is priced in the market. In a similar manner, we perform both univariate and multivariate regressions by replacing Quality in equation (6) with the Quality characteristics of $Profitability$, $Growth$, $Safety$ and $Payout$. The coefficients $P_{Quality}$ (or any other coefficient on Quality characteristics) will throughout this paper be referred to as the price of that variable. Furthermore, by controlling for size being the z-score of market capitalisation, this will provide information of the close relationship between a firm's Size, Market-to-Book and its Quality levels.

Pure Quality

The baseline of this paper is to investigate the relationship between a firm's Market-to-Book, Size and Quality level. Since Quality, Size and Market-to-Book are much interrelated, the first goal is to isolate the Quality measure from its relationship with the other two. Accordingly, we proceed with introducing $Pure\ Quality$, a measure based on the Quality metric defined above, but adjusted for the impact of Size and Market-to-Book on the score. We start off with running cross-sectional regressions of Quality on the standardized Market-to-Book and Size at the end of every month during the sample period of January 1996 – December 2014. Time subscripts are removed but regressions and adjustments are performed monthly:

$$Quality_i = a + b_{MB}MB_i + b_{Size}Size_i + \varepsilon_i \qquad (7)$$

Here, we use the coefficients on Market-to-Book (MB) and Size to adjust each firm's Quality-score to calculate $Pure\ Quality$. More specifically, we define it as:

$$Pure\ Quality_i = Quality_i - \ b_{MB}MB_i - b_{Size}Size_i \qquad (8)$$

Portfolios

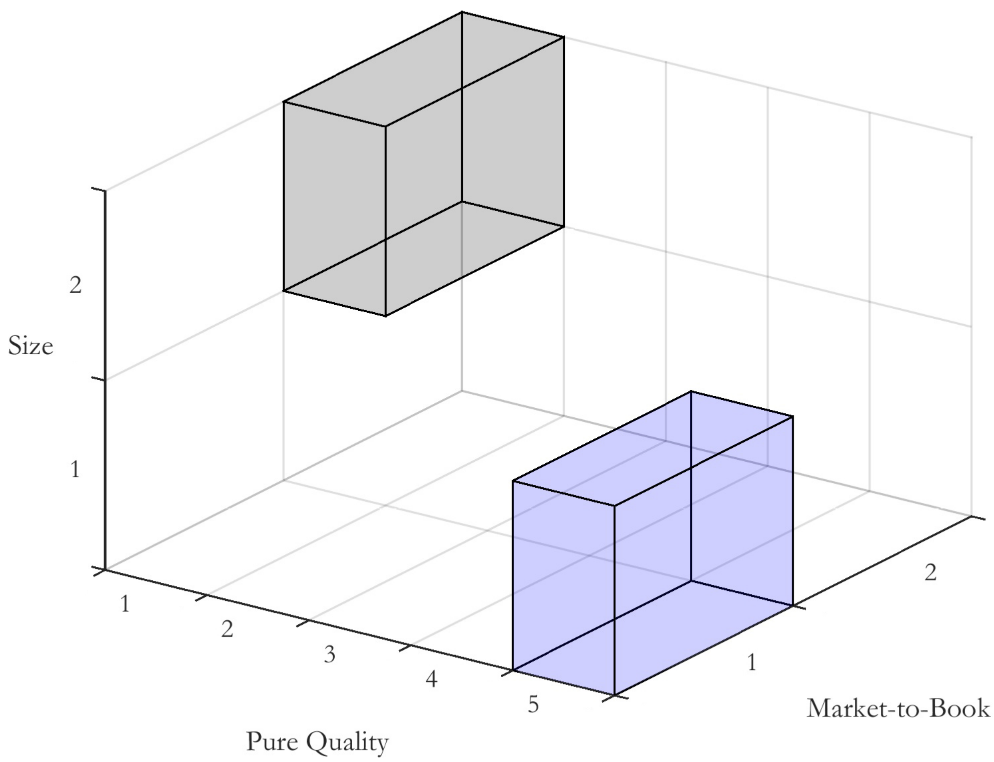
To conduct our analyses and answer the question whether small and low Market-to-Book firms generate risk-adjusted returns when you control for quality, we construct two sets of portfolios. The first set are five quintile portfolios sorted on $Pure\ Quality$. The second set of portfolios are sorted on $Pure\ Quality$, Size and Market-to-Book and are the ones underlying our Trading Strategy. All returns are measured in excess of STIBOR 1-month rate approximated as the Swedish risk-free rate. The first set of the five portfolios is constructed at last trading day of every month by sorting on $Pure\ Quality$ and splitting the outstanding sample of stocks with a

$Pure\ Quality$ score into quintiles. Considering our analysis is performed without consideration to Size, the portfolio returns are the equally-weighted return of the stocks in that sample.

Our trading strategy is constructed using three dimensions, being a firm's Market-to-Book, Size and $Pure\ Quality$. More specifically, at the end of every month we assign all stocks with a pure quality-score into quintiles. Internally, we then proceed with sorting on Market-to-Book and Size and splitting each quintile into four portfolios – in total generating a set of 20 portfolios (5x2x2). Our trading strategy is essentially trading on SMB and HML anomalies (Fama, French 1993), while controlling for the firms' $Pure\ Quality$. In detail, the strategy goes long in stocks being small, low Market-to-Book and high $Pure\ Quality$ and goes short in stocks that are large, high Market-to-Book and with low $Pure\ Quality$. Considering our analysis is performed without consideration to Size, the portfolio returns are the equally-weighted return of the stocks in that sample. Figure 1 plots the targeted portfolios:

Figure I
Targeted Portfolios for Trading Strategy

This figure plots two of the 20 identified portfolios generated by over three dimensions being Pure Quality, Size and Market-to-Book. The blue coloured (lower right) rectangular cuboid represents the portfolio being longed and the grey coloured (upper left) rectangular cuboid represents the portfolio being shorted.



The portfolios are refreshed and rebalanced at the last trading day of every month, running from 1996 to 2014. To evaluate our strategy's risk-adjusted performance, we consider alphas with respect to domestic factors for the market return (MKT), book-to-market (HML), size (SMB) and previous research on Quality returns (QMJ). In-depth calculations and definitions are provided in the Appendix.

IV. The price of Quality and its components

Going back to the original definition of a Quality characteristic, we define it as something investors should be willing to pay a higher price for, all else equal. To confirm this hypothesis, we run pooled cross-sectional regressions of firms' standardized Market-to-Book (MB) on the Quality characteristics (QC) Profitability, Payout, Growth and Safety. Furthermore, we include the z-score of market capitalisation (Size) to analyse the relationship between Size and Quality. More specifically:

$$MB_i = a + \overline{P_{QC}} \cdot \overline{QC_i} + P_{Size}Size_i + \varepsilon_i \tag{9}$$

Where $\overline{P_{QC}} = (P_{Profitability}, P_{Growth}, P_{Payout}, P_{Safety})$ is a vector of coefficients on the various Quality Characteristics and $\overline{QC_i}$ is a vector representing the Quality Characteristics. By the use of z-scores on all variables, we limit the effect of potential outliers and leave the regression coefficients with a simple and intuitive reading: if the independent variable moves one standard deviation, then the dependent variable moves by P standard deviations. Onwards, the resulting coefficient P will be referred to as the Price of the characteristic.

The coefficients of the regression are reported in Table II Panel A, where the regressions are adjusted for heteroskedasticity. Intuitively, a high score in Growth might cause a lower score in Payout, but an increase in Payout should however be positively priced, ceteris paribus. We can conclude that all coefficients are statistically significant and have large economic magnitudes in both a univariate and multivariate setting. Furthermore, all coefficients have the expected positive sign except for the Price of Payout where reversed causality might be the cause of the negative sign. That is, a highly plausible explanation to the negative sign could be that high Market-to-Book firms might favour new issuance of shares while low Market-to-Book firms might favour share repurchases. Further, it should be noted that research made on global level (Asness, Frazzini & Pedersen 2014) have found the unrealistic scenario where Price of Safety is taking on a negative value. Considering our results points to a significant and positive value of the Price of

Safety, we believe our results to be more economically compelling due to noise reduction stemming from our sample being limited to a single market (in contrast to a broader and global level) - avoiding potential country differences, such as accounting standards and tax differences.

Regarding the explanatory power of Quality characteristics on price, our results are in accordance with previous research (Asness, Frazzini & Pedersen 2014) with an R^2 of 3%, leaving the larger part of the Market-to-Book unexplained. While the metrics underlying our quality characteristics should reasonably play a more important role in determine a company's Market-to-Book, the method applied in this paper is giving each of the metrics the same and equal weight, which is an assumption highly unlikely to reflect the weight the market is assigning to these metrics. Determining the weight yielding the highest explanatory power is however beyond the scope and relevance of this paper. For simplicity and robustness over time, considering these weights most likely are time-varying - we chose to proceed with equal weightings.

After confirming the price of quality components and their signs, we proceed with the more general metric of Quality, being the average of Profitability, Growth, Safety and Payout and perform pooled cross-sectional regressions:

$$MB_i = a + P_{Quality} Quality_i + P_{Size} Size_i + \varepsilon_i \qquad (6)$$

The coefficients of the regression are reported in Table II Panel B, where the regressions are adjusted for heteroskedasticity. Interpreting the coefficient, one standard deviation increase in the Quality would result in a 0.36 standard deviation increase in Market-to-Book. Considering our Price of Quality is still highly significant with a t-score of 16.19 and economically large, we can confirm that this metric also captures the relationship between Market-to-Book and quality level.

Having confirmed all the components and their prices, we now turn to the Size variable and its effect on Market-to-Book. We extend the regression by controlling for size, being the z-score of the firm's market capitalization. Not only does the explanatory power increase upon including size; we can conclude that the Price of Quality remains robust and barley affected with a value of 0.35 and a t-score of 15.94. More interestingly, the size coefficient is further positive and highly significant with a value of 0.11 and a t-score of 11.57. The interpretation of this is that larger firms are more expensive when controlling for quality. This finding is interesting in many ways. One might ask why larger firms have higher Market-to-Book when holding quality constant, since the quality measure itself is reasonably exhaustive in capturing potential benefits a large firm could have, such as less liquidity risk than small firms (Acharya, Pedersen 2005). If this size premium is irrational, could this effect contribute to the Size effect (SMB) itself?

In summary, we have confirmed that Quality and Quality Characteristics are priced by the market and partly explain a firm's Market-to-Book. More interestingly, these results present a highly significant relationship between Market-to-Book, Size and Quality, where larger firms are more expensive when holding quality fixed.

V. Introducing Pure Quality

Going forward with our analysis, in section III we notice the relationship between Market-to-Book, Size and Quality. This intertwined relationship presents a problem: to target only Large and high Market-to-Book firms when sorting on Quality, going in the opposite direction of the Size and Value effect. Reminding us of the two main questions to be examined in this paper:

A. Do small firms have higher risk-adjusted returns, holding Quality constant?
B. Do low Market-to-Book firms have higher risk-adjusted returns, holding Quality constant?

We need to isolate Quality from Size and Market-to-Book in order to avoid the reversed causality. That is, avoiding targeting high quality and be accompanied with Large firms (A). Likewise, avoiding buying high quality firms and be accompanied with expensive firms with high Market-to-Book (B). We take the first step in this process by flipping equation (6) letting Quality be the dependent variable and controlling for both Market-to-Book and Size:

$$Quality_i = a + b_{MB} MB_i + b_{Size} Size_i + \varepsilon_i \tag{7}$$

Examining the coefficients from the regressions shown in Table III, all the coefficients have the expected positive sign and are highly significant both in univariate and multivariate regressions. The economic magnitude of the Market-to-Book and Size coefficients are however relativity low; one standard deviation increase in MB is followed with a 0.0330 standard deviation in Quality-score and one standard deviation increase in market capitalization results in 0.0041 standard deviations increase in the Quality-score. While these results both have a R^2 in class with regression (6), they still provide an area of improvement for the Quality-score.

To reconnect to the reason why we want to clean the quality score from its effect on Size and Market-to-Book, from a trading point of view, we argue that the decision to buy a stock should not be driven by the fact that a company already has a high Market-to-Book and thus a higher quality-score. Rather, the decision should be based on a Purified Quality score (i.e. the residual Quality-score not attributable to the Market-to-Book), as we cannot be certain that the market have priced quality in a rational way. Further, firms of high quality with respect to the metrics and that still have low Market-to-Book could be a way of identifying undervalued firms. In analogy, we argue that a firm's Size should not impede the decision to buy a stock when holding Quality fixed. This is because of our exhaustive metrics: price premiums only stemming from a firm's Size should be captured in the Quality-score itself. For example, larger firms experience less liquidity problems and this should translate directly into less leverage, less ROE volatility and so forth.

Incorporating these thoughts, we present an alternative metric aimed to identify companies with high Quality which is neither driven by Market-to-Book nor Size – i.e. without noise from their correlations. In other words, a $Pure\ Quality$ firm is not necessarily large and is no longer rewarded for having a high price that far exceeds the underlying book value. In terms of calculations, by using the cross-sectional coefficients on Market-to-Book (MB) and Size from regression (7), we subtract every company's share of Quality-score attributed to Market-to-Book and Size:

$$Pure\ Quality_i = Quality_i - b_{MB}MB_i - b_{Size}Size_i \tag{8}$$

Analysing the correlation matrix between $Pure\ Quality$, the Quality Components, Size and Market-to-Book reported in Table IV, our new narrowed down measure positively correlates with the underlying quality components while having zero correlation with Size and Market-to-Book. Furthermore, we can conclude that the variable yielding the highest correlation with $Pure\ Quality$ was Profitability with 0.770 and the lowest correlation was Safety with 0.484.

In the end, a desirable property of the $Pure\ Quality$ score is its return predictability. Therefore, Table V Panel A reports the coefficient from a pooled cross-sectional regression, where the dependent variable is subsequent monthly excess return and the independent variable is $Pure\ Quality$. Panel B reports the same regressions however based on Quality (Asness, Frazzini & Pedersen 2014). In both panels, we also control for Size and MB in a multivariate regression. While we fail to reject the equality in return predictability of the two metrics, analysing column (1) shows that $Pure\ Quality$ predicts economically large and statistically significant returns with a higher t-score and coefficients value than its predecessor. Furthermore, interesting to notice is that the two different measures almost converge in column (4), when Size and

Market-to-Book are included. These results are expected, as the $Pure\ Quality$ metric is directly adjusted for Size and Market-to-Book in order to isolate the Quality characteristics.

To check if the return pattern is consistent over the spectrum of Pure Quality scores, we sort all firms on $Pure\ Quality$ and divided them into quintiles (five portfolios). Table VI reports portfolio excess monthly returns and factor loadings on the Fama-French three-Factor model. Interestingly, there is a clear pattern in returns over the five different portfolios; the higher $Pure\ Quality$, the higher return.

Recognizing that higher returns not necessarily translate into higher risk-adjusted returns, we proceed to analyse the factor loadings on portfolios. Constructing a portfolio that goes long PQ5 (highest pure quality) and short PQ1 (lowest pure quality) indeed brings the highest return, shown in the column furthest to the right. More interestingly, the portfolios market beta is negative with a value of -0.3691 and highly significant - presenting a puzzle for the return-factor loadings relationship. Theory suggests that high loadings on the Fama-French factors would predict higher return due to risk compensation. Our strategy however has negative exposure, even suggesting a negative return for our portfolio. This is however not the case as it earns positive three-factor alphas of 0.84% with a t-score of 2.65. Moreover, factor loadings on SMB and HML are also negative even though not statistically significant.

We extend the analysis of the Pure Quality metric by asking the question: do high pure quality firms have higher returns, holding Size and Market-to-Book constant? By sorting the stocks on Size and Market-to-Book into four different portfolios, we then proceed internally to divide each of these portfolios in 5 different quality levels, where PQ5 is the highest pure quality. In total we generate 20 different portfolios, and Table VII reports the return dispersion. This table shows that the return predictability by $Pure\ Quality$ indeed is robust over the Size and Market-to-Book dimensions, where high quality companies on average generate higher returns than low quality companies. Looking at the Size and Value effects, which are positive on average, one can conclude that there is further dispersion over the quality dimension. In detail, while in this setting the value effect (Low MB – High MB) shows no uniform pattern, comparing the returns of the small and big portfolios shows that the Size effect is most pronounced for High Quality firms and that this effect is reversed within low Quality Firms. In total, this finding provides evidence that a firm's Size, Market-to-Book and Quality level are interrelated. To evaluate this pattern in more detail, we need to consider the risk-adjusted returns which the upcoming section will cover.

In summary, we have introduced a new measure successfully identifying firms associated with higher subsequent returns. Indeed, a simple portfolio going long high $Pure\ Quality$ firms and short low $Pure\ Quality$ firms not only has higher monthly excess returns, but also has economically large and significant three-factor alpha of 0.84% with a t-score of 2.65. We further show that the return predictability is robust over the Size and Market-to-Book dimensions, also indicating that the Size effect is most pronounced when controlling for quality. This provides evidence for the Quality dimension, and next we move on to further analyse the two remaining dimensions, being Size and Market-to-Book - and examine Pure Quality's relationship to the Size and Value effects.

VI. Trading on Size, Value and Quality effects

In section V we showed that a portfolio that goes long high $Pure\ Quality$ firms and goes short low $Pure\ Quality$ firms yielded high excess returns as well as significant three-factor alpha. The next step is to trade on Size and Value.

While the literature on the Size and Value effects is massive, the reasons behind these effects are still a topic of discussion and they are thus still classified as anomalies. Vassalou and Xing (2004) argued that SMB and HML factors (Fama, French 1993) can largely be seen as a proxy for systematic default risk, while earlier research (Ohlson 1980) showed that bankruptcy risk was not rewarded with higher returns. Griffin and Lemmon (2002) also found that the value effect was indeed not a proxy for a distress factor.

Considering that $Pure\ Quality$ directly takes default risk measures into consideration, such as Ohlson's O-score and Altman's Z-score etc., a trading strategy based on Size and Value while holding Quality constant gives insight into this discussion. Consider the case if the underlying risk factor explaining SMB and HML is actually systematic default risk and that the market uniformly give all small companies this risk premium, while in reality there are high quality companies among small companies whose higher Quality score mitigates the potential default risk assigned to them. Is it possible that the market uniformly punishes small and value firms in the belief that they have the same exposure, when in fact within these classifications the Quality levels differ?

To answer this question, we form a trading strategy aimed at identifying the stocks with highest $Pure\ Quality$ and then sort stocks into portfolios to capture the Size and Value effects. Stemming from the five Pure Quality-sorted portfolios from section III, we do this by adding two more dimensions to our pure quality portfolios, namely Market-to-Book and Size, creating

5x2x2 portfolios. The strategy to be implemented goes long in the portfolio with low Market-to-Book, Small and high Pure Quality firms (PQ5) and goes short in high Market-to-Book, Large and low Pure Quality (PQ1). Figure 1 provides a visualisation of this.

While this type of sorting most naturally give rise to return dispersion, they are also likely to be accompanied with risk factor loadings to mitigate the abnormal return. In other words, to test the hypothesis we need to analyse the risk-adjusted returns. Table VIII reports the coefficients from the regression of the Strategy's excess monthly return, controlling for the market return (MKT), book-to-market (HML), size (SMB) and previous research on Quality returns (QMJ). The holding period is one month and the strategy is rebalanced and refreshed in the end of every month.

We can conclude that the strategy performs very well when controlling for all factors, yielding monthly abnormal returns that are of the high economic magnitude of 1.27% and highly statistically significant at the 1% level with a t-score of 2.66. Analysing the factor loadings on the independent variables, the strategy has some interesting properties. Firstly, the strategy has a negative market beta. This is due to the fact that high $Pure\ Quality$ stocks in general have lower market exposure than its counterparty. Furthermore, the sorting on Size also resulted in a statistically significant positive exposure towards the SMB factor in accordance with our expectations. In contrast, sorting on Market-to-Book resulted in no statistically significant relationship to its global risk factor HML. Another interesting property of the trading strategy is the negative exposure towards QMJ-factor (Asness, Frazzini & Pedersen 2014), which is based on the original definition of quality. We argue that this is due to two reasons: Firstly, we have two different measures ($Pure\ Quality$ versus Quality), although the underlying subcomponents are alike. Secondly, while QMJ was intended to approximate for a yet unexplained risk factor, its portfolio return is value-weighted. In contrast, as we both specifically control for Size and Market-to-Book in order to identify the best trading decision based on pure quality, we see no reason to give a large company a higher weight in our strategy portfolio in comparison to a small company which is why we are using equally weighted returns. The QMJ factor could even mitigate its potential return, since trading purely on Quality would result in a portfolio loading up on large and high Market-to-Book firms, opposing the Size and Value effect.

To summarize the risk factor loadings and the returns: considering the abnormal returns are very large and statistically significant, it provides evidence in favour of our hypothesis that risk-adjusted returns can be achieved by trading on the Size and Value effects while controlling for $Pure\ Quality$. We argue that there are two reasons why we obtain these results. It could be that the firms we identify: (a) are mispriced due to the market uniformly assumes that all small and low Market-to-Book firms have the same exposure towards the risk factors underlying SMB and HML, when in fact the differences in quality between these firms mitigate/enhances the actual risk; or (b) have higher return in compensation for its exposure to the true risk factors underlying the Size and Value effect, just that the SMB and HML factors does not, but should, include the quality dimension.

In summary, by creating portfolios mainly sorted on Pure Quality and adding two dimensions of Size and Market-to-Book, a trading strategy can be formed with highly significant three-factor alphas with economically large magnitudes. The explanation to this could be either: (a) a mispricing by the market; or (b) flaws of the risk factors used as control.

VII. Performance of Strategy over time

It is also interesting to analyse the performance of the strategy over the time. Figure 2 plots the cumulative excess return of the trading strategy and the cumulative excess return of the market during the sample period 1996 - 2014. Examining the strategy return we can conclude that it performed very strongly during times with low market returns, specifically during the burst of the internet bubble (March 2000 – March 2001) and during the Global Financial Crisis (2007 - 2009). This goes hand in hand with the theory behind trading on quality, namely that quality companies should perform relatively better than junk companies - especially in times of financial distress. In contrast, one period where the strategy of buying pure quality firms and shorting "pure junk" firms showed poor performance was *during* the rise of the stock market, January 1999 to March 2000, leading up to the internet bubble, which was a period where the market performed exceptionally well. Could the lower performance of our strategy for this window be driven by irrational views on Quality?

To explore this, we need to go back to the definition: A Quality characteristic is something investors should be willing to pay a higher price for, all else equal. One building block to trade on quality is that the market is rational in valuing the quality characteristics that we classified in Section II, namely Profitability, Growth, Safety and Payout. Could it be that the market acted irrationally, perhaps buying more junk companies while giving less focus to the true quality companies during the rise of the internet bubble?

A pattern like this during the rise of the stock market in 1999 would indeed drive a lower return for our strategy. Our hypothesis is that investors paid too much for low Quality firms, raising the average price level of the underlying quality characteristics to heights unreasonable for the period of time. This would lead to higher returns for junk companies than for quality companies, and additionally push the prices of quality characteristics up.

In section IV we showed that each of the quality characteristics was statistically significant and reasonably priced by the market, by regressing each of the characteristics on a company's Market-to-Book. We now proceed in a similar manner but relaxing the assumption of a constant price, letting it instead vary from month to month. By performing multivariate cross-sectional regressions at the end of every month during our sample period, the coefficients provide us with prices of quality for that specific month. More specifically, we regress:

$$MB_{i,t} = a_t + \overline{P_{QC,t}} \cdot \overline{QC_{\imath,t}} + \varepsilon_{i,t} \tag{10}$$

Where $\overline{P_{QC,t}} = (P_{Profitability,t}, P_{Growth,t}, P_{Payout,t}, P_{Safety,t})$ is a vector of coefficients on the various Quality Characteristics and $\overline{QC_{\imath,t}}$ is a vector representing the Quality Characteristics. Time subscripts refer to months. The coefficients of these are plotted in Figure 3. While the prices might be hard to interpret, what is interesting is their return predictability. Accordingly, to examine these prices and their connections to subsequent strategy returns, we regress the excess strategy return between t and $t+1$ on the prices of quality characteristics in t:

$$Strategy\ Return_{t+1} = \alpha + \overline{b_{QC}} \cdot \overline{P_{QCt}} + \varepsilon \tag{11}$$

Where $\overline{P_{QC,t}} = (P_{Profitability,t}, P_{Growth,t}, P_{Payout,t}, P_{Safety,t})$ is a vector of coefficients on the various Quality Characteristics generated from equation (10) and $\overline{b_{QCt}}$ is a vector of coefficients on the independent variables. Table IX reports the coefficients $\overline{b_{QCt}}$.

Analysing the coefficients, the price of profitability has throughout the sample period been a predictor of subsequent strategy return. One standard deviation increase of the price of profitability has resulted in -3.26% subsequent excess returns. In accordance with the hypothesis, the price of these quality characteristics can predict the effectiveness of trading on Quality, where a price that is too high causes lower return. Digging deeper into the price of profitability, we plot its monthly cross-sectional price over the sample period in Figure IV. Interestingly, there are two periods where Profitability as such has been valued higher than previous years: *before* the collapse of the internet bubble (where our strategy perform worse) and during the Global Financial Crisis (where our strategy performed well). One might ask why these periods call for a higher price of profitability?

Our suggestion and explanation to both the pattern of the price of profitability and our strategy performing relatively worse during the internet bubble rally has to do with rationality. We argue that the climb in the last months of 1999 was driven by irrationality, pushing valuations too high in relation to the underlying quality. This goes hand in hand with junk stocks having higher return than quality stocks, causing negative returns for the strategy during this climb. Moreover, the next period where profitability was valued high was during and after the financial crisis, indicating something different. One must remember that valuation of quality characteristics is settled by supply and demand of the market. The reason why we see a high valuation of profitability during periods with distressed markets can simply be driven by an investor appetite for profitable companies and thus not necessarily represent investor irrationality. Consider for example that capital and liquidity is limited during the financial crisis, then a company with high profitability and a high degree of self-financing can easily be preferred over its counterpart. Following this argumentation, it should be no surprise to confirm that our strategy performed very well during the crisis - as the market is not *irrationally* putting a too high price of quality characteristics during these periods. In essence, we argue that the prices of quality characteristics must be considered in relation to current market condition: high prices in bull markets might indicate irrational valuations (climb of the internet bubble) and high prices in bear markets could be seen as rational (post and during the financial crisis).

Having covered when the strategy underperformed, we now investigate the performance after a time with high prices of quality characteristics in a bear market. Looking back at the burst of the internet bubble, there was a turbulent reversal effect as stock prices adjusted. Indeed, quickly after the burst of the internet bubble our strategy generated an extremely positive return, reaping the benefits from holding $Pure\ Quality$ companies and shorting "pure junk" companies as the market revaluated the stocks from the period of mispricing.

In summary, periods where the strategy was performing worse than the market can be explained by the cross-sectional pricing of quality characteristics, where the price of profitability significantly predicts subsequent returns of the trading strategy. The pattern of the price of profitability further provides us with information on tendencies for market irrationality, being dependant on the economic climate at the point of measurement: high prices in bull market might signal tendencies for market irrationally and high prices in bear markets might be driven by demand by investors seeking quality companies.

VIII. Transaction costs

Recent research suggests that many of the self-financed trading strategies that goes long and short in different portfolios in fact can be hard to trade on in practice. This is due to the transaction costs in the form of bid-ask spread and shorting fees, mitigating the abnormal returns. Itamar Dreschler and Qingyi (Freda) Song Dreschler (2014) have shown that the firms identified for shorting in 8 well know asset pricing anomalies have substantially larger shorting fees than the average in the sample. Accordingly, including transaction costs can partly reduce the abnormal return.

Taking this into account, we analyse the number of position needed to implement our trading strategy. One pillar that differentiates us from many other strategies is that our goal is not to identify a risk factor. In contrast, we explore if trading on Size (SMB) and Value (HML) can generate risk-adjusted returns when controlling for Quality, i.e. we are in search for a trading strategy. This allows us to relax the portfolio compositions, dividing the portfolios into smaller and smaller pieces – enables us trade on the stocks with the strongest characteristics. The numbers of positions required for the trading strategy, that we showed to prove risk-adjusted excess returns, were on average 12 (6 long and 6 short). This small amount of positions will limit the effect of bid-ask spreads and shorting fees. Further, the portfolio is only rebalanced once every month. Finally and most importantly, the economic magnitude of the alphas generated when controlling for the FF3 and QMJ are 1.27% per month. It is plausible that transaction costs to some extent may reduce this, it is however highly unlikely to eradicate all the abnormal return. For these reasons, we argue that the strategy is robust to transaction costs and deemed inviting to apply in practice.

IX. Conclusion

In this paper we investigate if small and low Market-to-Book firms have higher risk-adjusted returns when controlling for quality. We identify a strong relationship between Market-to-Book, Size and Quality. Stemming from this finding, we introduce a new $Pure\ Quality$ metric which is adjusted for a firm's Market-to-Book and Size, resulting in a metric that is predicting subsequent returns and that is statistically significant.

By sorting stocks into portfolios based on Pure Quality, we show that a simple portfolio that goes long high Pure Quality stocks and short low Pure Quality stocks generates large and statistically significant three-factor alphas. Having successfully identified a quality metric, we then introduce two dimensions of Size and Market-to-Book. A trading strategy is developed that takes a long position in high pure quality, small and low Market-to-Book firms and that goes short low pure quality, large and high Market-to-Book firms generates economically large and statistically significant alphas of 1.27% at the 1% level, controlling for the three Fama-French factors and QMJ. Even though sorting on known anomalies represented by the SMB and HML risk factors, including $Pure\ Quality$ seems to enhance return more than the mitigation from loading up on these risk factors. The explanation for this is either: (a) a mispricing by the market; or (b) flaws of the risk factors used as control. Furthermore, notable characteristics of the trading strategy include a negative market beta, low exposure to SMB and non-significant relationship to HML. Moreover, the required amount of positions is on average 12 stocks with rebalancing occurring once every month, making it robust to transaction cost.

Periods where the Strategy performed worse in comparison to the market can be explained by tendencies for market irrationality, as the strategy performed the worst during the rise of internet bubble from January 1999 to March 2000. Indeed, we show that an increase in the price of profitability predicts negative subsequent strategy return and that the market put a historically high price on Profitability during this period. During and throughout the collapse of the internet bubble the strategy performed very well, riding on a period of reversal from earlier optimistic valuations - strongly beating the market.

To conclude, we have proposed a trading strategy applicable in practice for investors looking to trade on quality. Furthermore, our results contribute to the discussion of the Size and Value effects, showing that their effects can be reaped and lead to risk-adjusted returns when also including a $Pure\ Quality$ dimension. Future research should confirm this hypothesis on a global level and also investigate the time-variation of price of quality characteristics more in-depth.

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Table I
Summary Statistics

This table reports summary statistics for the sample data running from January 1996 to December 2014. It includes all available common stock for the Swedish market identified by Compustat Global for which a valid Quality-score could be calculated. Sector classification is based on GICS codes (Bhojraj, Lee & Oler 2003). Total number of stocks refers to the number of unique stocks being in the sample at some point in time. Average number of stocks is the average number of stocks available at the end of every month throughout the sample period. Firm Size refers to the average market capitalisation within that sector. Weight in total portfolio is simply the value-weighted percentage of market capitalisation during the sample period. Start year refers to the date when the first stock within that sector was observed and End year is the last year.

Sector	Total number of stocks	Average number of stocks	Firm size (Billion-SEK)	Weight in total portfolio	Start year	End year
Consumer Discretionary	57	15	13.88	12%	1997	2014
Consumer Staples	14	5	17.15	5%	1997	2014
Energy	11	5	14.27	4%	2001	2014
Financials	38	12	13.66	9%	1996	2014
Health Care	36	11	13.36	8%	1997	2014
Industrials	100	40	15.14	34%	1996	2014
Information Technology	82	23	13.46	17%	1997	2014
Materials	24	9	15.11	8%	1996	2014
Telecommunication Services	8	3	11.24	2%	2001	2014
Utilities	4	2	9.80	1%	1996	2014
Total	374	127	14.33	100%	1996	2014

Table II
The Price of Quality and Quality characteristics

This table reports the coefficients from a pooled cross-sectional regression running from January 1996 to December 2014 with monthly data points. It includes all available common stock for the Swedish market identified by Compustat Global for which a valid Quality-score could be calculated. The dependent variable is the z-score of Market-to-Book at the end of every month. Panel A reports the coefficients on the Quality characteristics and the z-score of Market Capitalisation (Size). Panel B reports the coefficient on Quality and the z-score of Market Capitalisation (Size). Robust T-scores are displayed below in parenthesis and 5% statistical significance is indicated in bold.

Panel A: The Price of Quality Characteristics

	(1)	(2)	(3)	(4)	(5)	(6)
Profitability	**0.21**				**0.11**	**0.05**
	(14.74)				(5.09)	(2.69)
Growth		**0.25**			**0.15**	**0.16**
		(22.08)			(8.35)	(9.47)
Payout			**-0.13**		**-0.14**	**-0.16**
			(-8.86)		(-10.79)	(-12.47)
Safety				**0.31**	**0.27**	**0.35**
				(23.80)	(20.91)	(24.05)
Size						**0.14**
						(15.14)
Constant	**-0.03**	0.01	**0.01**	**0.01**	**0.03**	**0.04**
	(-4.67)	(1.10)	(1.98)	(1.98)	(4.43)	(5.65)
Observations	26,524	26,524	26,524	26,524	26,524	26,524
R-squared	0.01	0.02	0.01	0.01	0.03	0.05

Panel B: The Price of Quality

	(1)	(2)
Quality	**0.36**	**0.35**
	(16.19)	(15.94)
Size		**0.11**
		(11.57)
Constant	-0.01	-0.01
	(-1.88)	(-1.83)
Observations	26,524	26,524
R-squared	0.01	0.02

Table III
Quality on Market-to-Book and Size

This table reports the coefficients from a pooled cross-sectional regression running from January 1996 to December 2014 with monthly data points. It includes all available common stock for the Swedish market identified by Compustat Global for which a valid Quality-score could be calculated. The dependent variable is Quality-score in the end of every month and the independent variables are the z-score of Market-to-Book score and the z-score of Market Capitalisation (Size). Robust T-scores are displayed below in parenthesis and 5% statistical significance is indicated in bold.

	(1)	(2)	(3)
Market-to-Book	**0.0335**		**0.0330**
	(12.6211)		(12.3339)
Size		**0.0078**	**0.0041**
		(5.7078)	(2.9603)
Constant	**0.0322**	**0.0322**	**0.0322**
	(17.3950)	(17.2955)	(17.3962)
Observations	26,532	26,532	26,532
R-squared	0.0121	0.0007	0.0122

Table IV
Pure Quality correlation matrix

This table reports the correlation matrix for Pure Quality and the variables underlying its calculation at every month running from January 1996 to December 2014. It includes all available common stock for the Swedish market identified by Compustat Global for which a valid Quality-score could be calculated. Pure Quality is Quality adjusted for the quality attributable to Market-to-Book and the Size of the firm. Size is the z-score of the Market Capitalisation. Thorough calculations for Profitability, Growth, Safety and Payout can be found in the appendix.

	Pure Quality	Profitability	Growth	Safety	Payout	Market-to-Book	Size
Pure Quality	1						
Profitability	0.770	1					
Growth	0.660	0.576	1				
Safety	0.484	0.166	0.181	1			
Payout	0.485	0.157	-0.146	0.084	1		
Market-to-Book	0.000	0.103	0.141	0.119	-0.072	1	
Size	0.000	0.110	-0.019	-0.183	0.103	0.113	1

Table V
Return predictability of Pure Quality

This table reports the coefficients from a pooled cross-sectional regression running from January 1996 to December 2014 with monthly data points. It includes all available common stock for the Swedish market identified by Compustat Global for which a valid Quality-score could be calculated. The dependent variable is a firm's subsequent monthly excess return between month t and t+1. The risk free-rate is the STIBOR 1-Month. Panel A reports the coefficient on the independent variable Pure Quality at month t, also controlling for the z-score of Market-to-Book (MB) and the z-score of Market Capitalisation (Size). Panel B reports the same metrics but based on Quality (Asness, Frazzini & Pedersen 2014), also controlling for the z-score of Market-to-Book (MB) and the z-score of Market Capitalisation (Size). T-scores are displayed below in parenthesis and 5% statistical significance is indicated in bold.

Panel A: Return predictability by Pure Quality

	(1)	(2)	(3)	(4)
Pure Quality	**0.01241**	**0.01241**	**0.01241**	**0.01241**
	(3.57537)	(3.57506)	(3.57521)	(3.57496)
MB		-0.00165		-0.00158
		(-1.65752)		(-1.57909)
Size			-0.00075	-0.00057
			(-1.10351)	(-0.83141)
Constant	**0.00215**	**0.00215**	**0.00215**	**0.00215**
	(2.28024)	(2.28064)	(2.28079)	(2.28087)
Observations	26,170	26,170	26,170	26,170
R-squared	0.00065	0.00078	0.00068	0.00079

Panel B: Return predictability by Quality

	(1)	(2)	(3)	(4)
Quality	**0.01176**	**0.01252**	**0.01183**	**0.01254**
	(3.47932)	(3.65282)	(3.50546)	(3.66407)
MB		**-0.00207**		**-0.00200**
		(-2.05393)		(-1.96743)
Size			-0.00084	-0.00062
			(-1.24442)	(-0.90674)
Constant	**0.00217**	**0.00214**	**0.00217**	**0.00214**
	(2.30633)	(2.27926)	(2.30570)	(2.27926)
Observations	26,170	26,170	26,170	26,170
R-squared	0.00061	0.00081	0.00064	0.00082

Table VI
Pure Quality sorted Portfolios

This table reports the coefficients from a time-series regression with data points at the end of every month running from January 1996 to December 2014. It includes all available common stock for the Swedish market identified by Compustat Global for which a valid Quality-score could be calculated. The dependent variable is the monthly excess returns for the portfolio sorted on Pure Quality, where PQ5 refers to the highest Pure Quality-quintile. The risk free-rate is the STIBOR 1-Month. Portfolio returns are equally weighted. The independent variables are the monthly returns from the market portfolio (MKT) and size (SMB) and book-to-market (HML). Robust t-scores are displayed below in parenthesis and 5% statistical significance is indicated in bold.

	PQ1	PQ2	PQ3	PQ4	PQ5	PQ5-PQ1
Excess Return	-0.00171	0.00216	0.00431	0.00429	0.00432	.0060256
MKT	**1.0443**	**0.8797**	**0.8549**	**0.8366**	**0.6751**	**-0.3691**
	(16.3371)	(18.6910)	(19.6437)	(15.0880)	(12.8781)	(-5.8528)
SMB	**0.5701**	**0.4620**	**0.4325**	**0.4698**	**0.5133**	-0.0568
	(6.3374)	(7.6927)	(5.9060)	(6.7219)	(6.6222)	(-0.7959)
HML	**0.1569**	**0.2286**	0.0996	0.0334	0.0381	-0.1188
	(2.2446)	(3.6426)	(1.8583)	(0.5345)	(0.6596)	(-1.6614)
Constant	**-0.0086**	-0.0042	-0.0011	-0.0007	-0.0002	**0.0084**
	(-3.0984)	(-1.8101)	(-0.5500)	(-0.3548)	(-0.1053)	(2.6453)
Observations	219	219	219	219	219	219
R-squared	0.7057	0.7225	0.7595	0.7328	0.6422	0.2090

Table VII
Return dispersion holding Size and Market-to-Book constant

This table reports the subsequent average monthly excess returns running from 1996 to 2014 with monthly data points. The risk free-rate is the STIBOR 1-Month. It includes all available common stock for the Swedish market identified by Compustat Global for which a valid Quality-score could be calculated. The breakpoint for both Size, being market capitalisation, and Market-to-Book (MB) sorting is the median – generating 4 portfolios. These portfolios are then sorted into Pure Quality quintiles in total generating 20 portfolios. Here is Small – Big defined as the average return of the small companies minus the big companies and Low - High is the low Market-to-Book companies minus high Market-to-Book companies.

	PQ1	PQ2	PQ3	PQ4	PQ5	PQ5-PQ1
Small, low MB	-0.79%	0.52%	0.71%	0.83%	0.49%	1.28%
Small, high MB	-0.23%	-0.37%	0.48%	0.14%	0.89%	1.12%
Big, low MB	-0.01%	0.41%	0.52%	0.53%	0.20%	0.21%
Big, high MB	-0.45%	0.06%	0.33%	0.37%	0.44%	0.89%
Small – Big	-0.28%	-0.16%	0.17%	0.04%	0.37%	0.65%
Low - High	-0.06%	0.62%	0.21%	0.43%	-0.32%	-0.26%

Table VIII
Trading Strategy Return

This table reports the coefficients from a time-series regression with data points at the end of every month running from January 1996 to December 2014. It includes all available common stock for the Swedish market identified by Compustat Global for which a valid Quality-score could be calculated. In the end of each month, we sort the stocks into 5 quintiles based on Pure Quality. We then add two dimensions, being the z-score of Market-to-Book (MB) and the z-score of market capitalisation (Size). In total generating 20 portfolios (5x2x2), we form a strategy that goes long in the highest quintile of Pure Quality, with the lowest Size and the lowest MB and that goes short in the lowest quintile of Pure Quality, with the highest Size and the highest MB. The strategy return is equally weighted. The dependent variable is the monthly excess returns generated from this trading strategy. The risk free-rate is the STIBOR 1-Month. The independent variables are the monthly returns from the market portfolio (MKT) and size (SMB), book-to-market (HML) and Quality-minus- Junk (QMJ) (Asness, Frazzini & Pedersen 2014). Robust t-scores are displayed below in parenthesis and 5% statistical significance is indicated in bold.

	(1)	(2)	(3)
MKT	**-0.5460**	**-0.4959**	**-0.4770**
	(-5.2086)	(-4.5890)	(-5.0190)
SMB		**0.2494**	**0.2813**
		(2.0763)	(2.3599)
HML		-0.0235	-0.0555
		(-0.2335)	(-0.5445)
QMJ			**-0.2955**
			(-2.5805)
Constant	**0.0148**	**0.0139**	**0.0127**
	(3.0507)	(2.7982)	(2.6638)
Observations	219	219	219
R-squared	0.1965	0.2109	0.2559

Table IX
Return predictability by the Prices of Quality Characteristics

This table reports the coefficients from a time-series regression with data points at the end of every month running from January 1996 to December 2014. The dependent variable is the monthly excess returns generated from our trading strategy. The risk free-rate is the STIBOR 1-Month. The strategy is constructed accordingly: Starting with all available common stock for the Swedish market identified by Compustat Global for which a valid Quality-score could be calculated. In the end of each month, we sort the stocks into 5 quintiles based on Pure Quality. We then add two dimensions, being the z-score of Market-to-Book (MB) and the z-score of market capitalisation (Size). In total generating 20 portfolios (5x2x2), we form a strategy that goes long in the highest quintile of Pure Quality, with the lowest Size and the lowest MB and that goes short in the lowest quintile of Pure Quality, with the highest Size and the highest MB. The strategy return is equally weighted. The independent variables are the Prices of Quality Characteristics, being the coefficients from a cross-sectional regression of the z-score of Market-to-Book on the Quality Characteristics made in the end of every month running the same time period as the dependent variable. Robust t-scores are displayed below in parenthesis and 5% statistical significance is indicated in bold.

	(1)
Price of Profitability	**-0.0326**
	(-2.0113)
Price of Growth	-0.0052
	(-0.2366)
Price of Payout	0.0298
	(1.1433)
Price of Safety	-0.0152
	(-0.6851)
Constant	**0.0249**
	(2.2362)
Observations	219
R-squared	0.0347

Figure I
Targeted Portfolios for Trading Strategy

This figure plots two of the 20 identified portfolios generated by over three dimensions being Pure Quality, Size and Market-to-Book. The blue coloured (lower right) rectangular cuboid represents the portfolio being longed and the grey coloured (upper left) rectangular cuboid represents the portfolio being shorted.

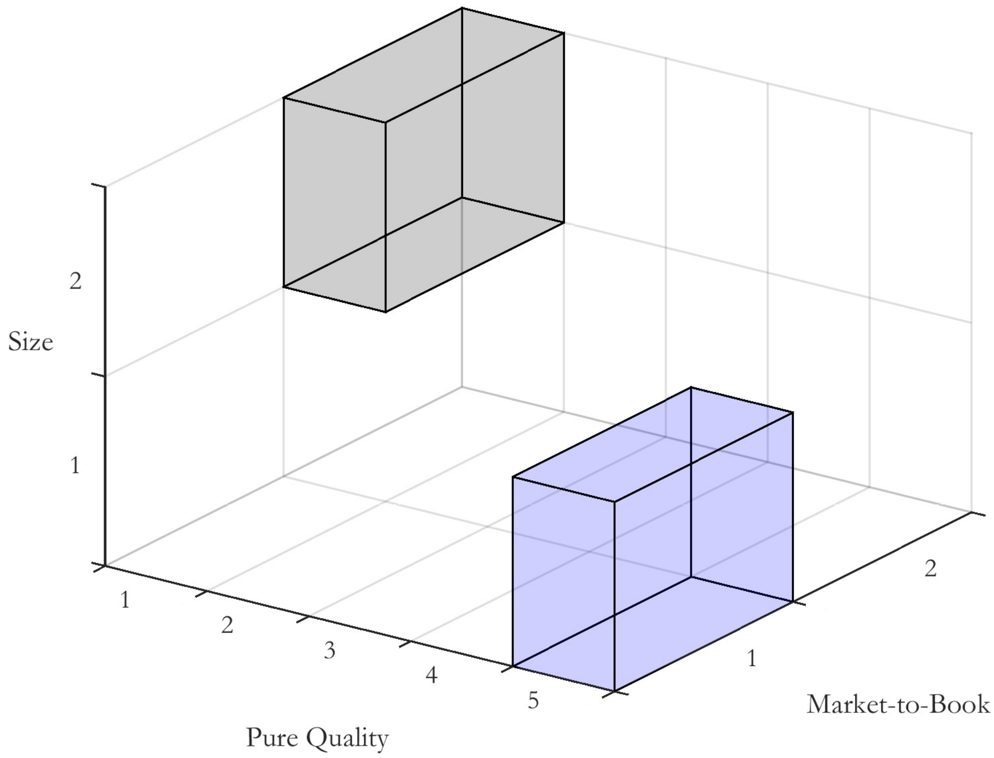


Figure II
Strategy performance over time

This figure plots the cumulative monthly excess return from of the trading strategy and cumulative monthly excess return for the market from 1996 to 2014. The risk free-rate is the STIBOR 1-Month. The strategy is constructed accordingly: Starting with all available common stock for the Swedish market identified by Compustat Global for which a valid Quality-score could be calculated. In the end of each month, we sort the stocks into 5 quintiles based on Pure Quality. We then add two dimensions, being the z-score of Market-to-Book (MB) and the z-score of market capitalisation (Size). In total generating 20 portfolios (5x2x2), we form a strategy that goes long in the highest quintile of Pure Quality, with the lowest Size and the lowest MB and that goes short in the lowest quintile of Pure Quality, with the highest Size and the highest MB. The strategy return is equally weighted and the Market return is value-weighted by the lagged market capitalisation. Both portfolios are refreshed and rebalanced in the end of every month. The cumulative strategy return is exceeding the market excess return in the beginning of year 2001 and onwards.

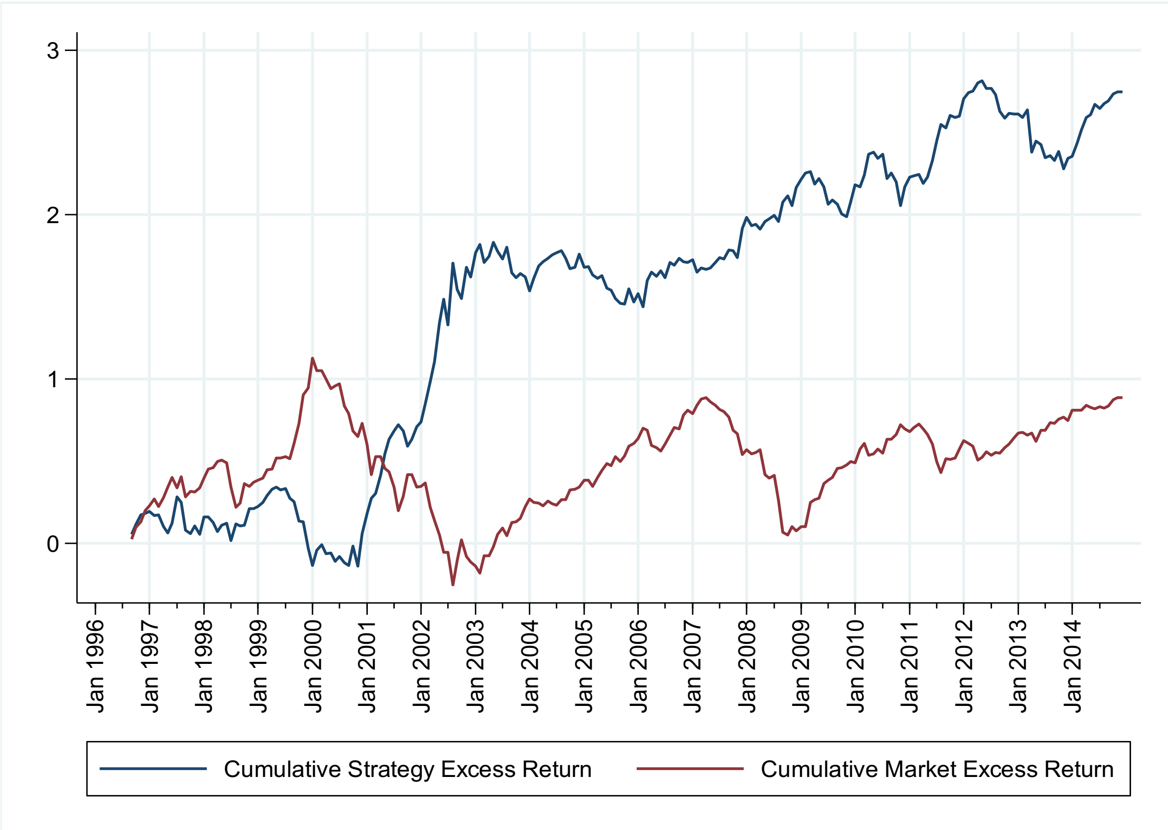


Figure III
Price of Quality Components over Time

This figure plots the monthly Prices of the Quality Characteristics Profitability, Growth, Payout and Safety, being the coefficients from cross-sectional regressions of the z-score of Market-to-Book on the Quality Characteristics made at the end of every month, running from 1997 to 2014.

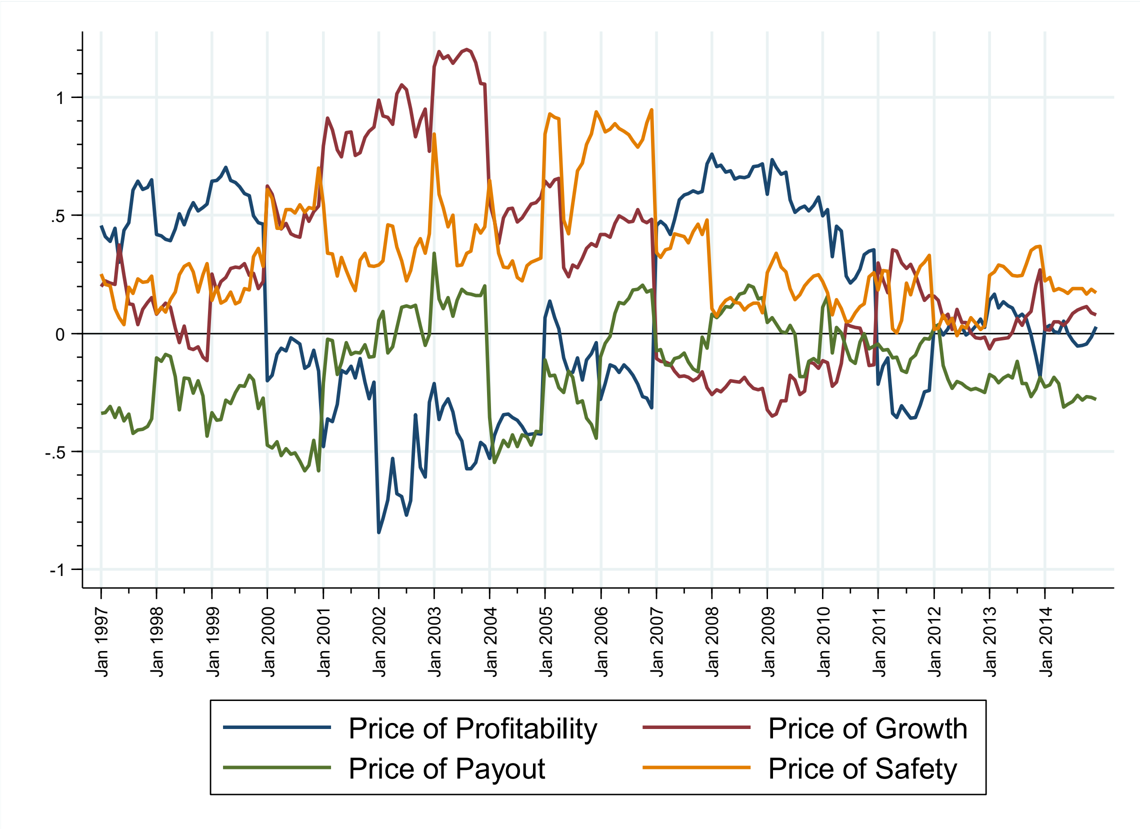
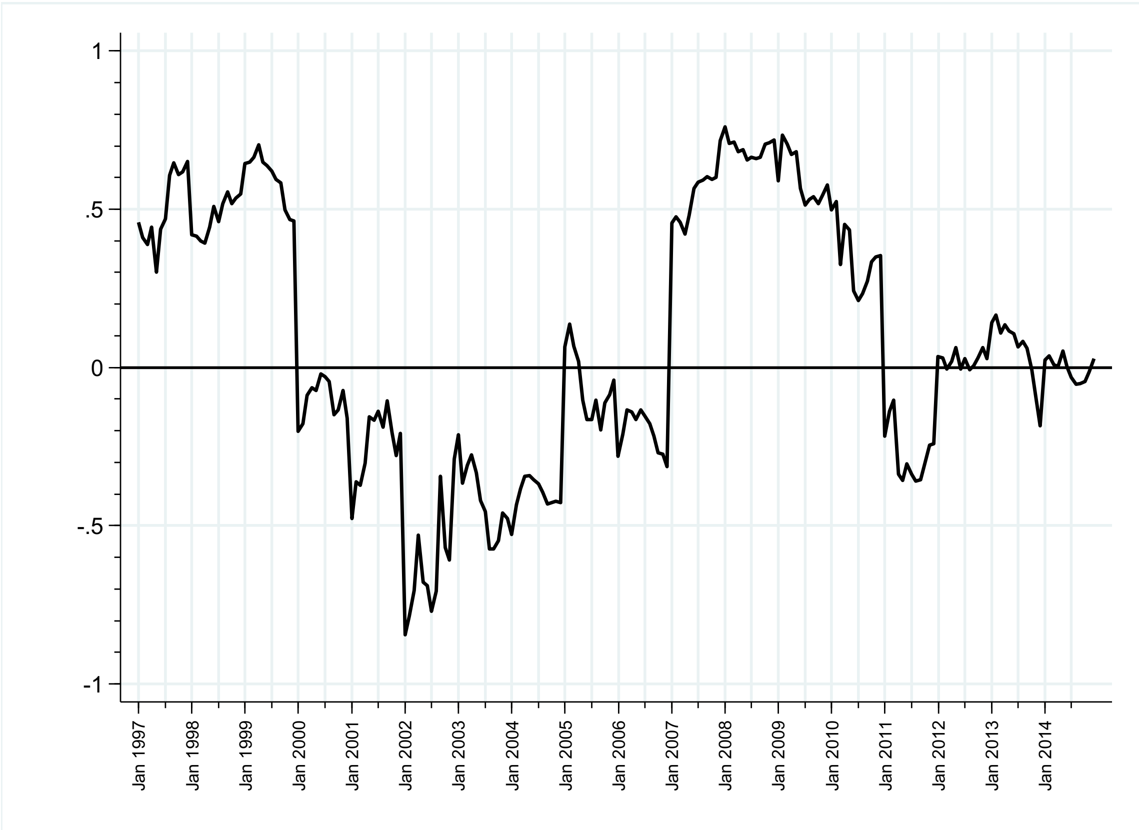


Figure IV
Focus: Price of Profitability over Time

This figure plots the monthly Price of the Profitability, being the coefficients from cross-sectional regressions of the z-score of Market-to-Book on Profitability made at the end of every month, running from 1997 to 2014.



APPENDIX

A1: Variable Definitions

In this section we report the calculations of the Quality score and its quality components. The definitions of the variables are based on recent work (Asness, Frazzini & Pedersen 2014). Security prices are provided by Compustat Global and the data required for the fundamentals are gathered from three databases, set up to follow a priority list; should data points for the first-choice database be unavailable, we proceed to the next choice in the following order: (1) Compustat Global, (2) Thomson Datastream and (3) The Serrano Database. Data availability starts from 1990 and stretches to 2014. Variable names are named arbitrarily and data items refer to annual items where the time subscript t also refers to annual items.

Profitability

The profitability score is calculated as the arithmetic average of the z-scores of gross profit over assets (GPOA), return on equity (ROE), Cash flow over assets (CFOA), Return on Assets (ROA), gross margin (GMAR) and low accruals (ACC):

$$Profitability = z(z_{gpoa} + z_{roe} + z_{roa} + z_{cfoa} + z_{gmar} + z_{acc})$$

$GPOA$ is equal to revenue minus cost of goods sold divided by total opening assets $(REV - COGS)/AT$. ROE is net income divided by opening book value of equity (NI/BE). $CFOA$ is net income plus depreciation minus change in working capital and capital expenditures divided by total opening assets $(NI + DP - \Delta WC - CAPEX)/AT$. ROA is net income divided by total opening assets (NI/AT). $GMAR$ is revenue minus cost of goods sold divided by revenue $(REV - COGS)/REV$. ACC is depreciation minus change in working capital divided by total opening assets $(DP - \Delta WC)/AT$. When defining Working Capital we follow the definition of Compustat it is defined as the difference between total current assets minus total current liabilities. Book equity is defined as shareholders' equity minus preferred stock. The shareholders' equity is treated as the stockholders' equity in first choice but if the stockholders' equity is not recognised it is then calculated as the sum of common equity and preferred stocks. The last in line approximation of stockholders' equity is total assets minus total liabilities and minority interests. Once stockholders equity is measured and treated as the shareholder's equity, we subtract the preferred stock and end up with book equity.

Growth

The Growth score is calculated as the arithmetic average of the z-scores of the five-year growth of the variables defined under Profitability. $\Delta GPOA$ is five-year growth in gross profit over assets $(GP_t - GP_{t-5})/AT_{t-5}$, where $GP = REV - COGS$, five-year growth in return on equity is $(NI_t - NI_{t-5})/BE_{t-5}$, five-year growth in cash flow over assets is $(FCF_t - FCF_{t-5})/AT_{t-5}$, where $FCF = NI + PD - \Delta WC - CAPEX$), five year growth in return on asset is $(NI_t - NI_{t-5})/AT_{t-5}$, five-year growth in gross margin is $(GP_t - GP_{t-5})/REV_{t-5}$ and five-year growth in (low) accruals is $(MWCPD_t - MWCPD_{t-5})/AT_{t-5}$, where $MWCPD$ is $DP - \Delta WC$:

$$Growth = z(z_{\Delta gpoa} + z_{\Delta roe} + z_{\Delta roa} + z_{\Delta cfoa} + z_{\Delta gmar} + z_{\Delta acc})$$

Safety

The safety score is calculated as the arithmetic average of the variables Low beta (BAB), low idiosyncratic volatility (IVOL), low leverage (LEV), low earnings volatility (EVOL), low bankruptcy risk as approximated with Altman's Z-score (Z) and Ohlson's O-score (O):

$$Safety = z(z_{bab} + z_{ivol} + z_{lev} + z_o + z_z + z_{evol})$$

BAB is calculated following (Frazzini, Pedersen 2014)), where Betas are calculated from using different time periods for standard deviations and correlations; in detail, a one-year rolling daily standard deviation and a five-year three-day correlation is used. This method of measuring correlation has been proven useful ((Frazzini, Pedersen 2014) and (Asness, Frazzini & Pedersen 2014)) since we limit the effect of nonsynchronous trading. The longer time horizon of five-year is also due to correlations are more stable over time in comparison to volatility. $IVOL$ is the idiosyncratic volatility of a stock, which is equal to the one-year rolling standard deviation of daily beta-adjusted excess return. LEV is minus total debt (the sum of total debt, minority interests and preferred stocks) divided by total assets $LEV = -(DT + MI + PSTK)/AT$. Ohlson's O-score is calculated as:

$$O = -(-1.32 - 0.407 * log(ADJASSET/CPI) + 6.03 * DT/ADJASSET - 1.43 * WC/ADJASSET + 0.076 * (CL/CA) - 1.72 * OENEG - 2.37 * NI/AT - 1.83 * EBT/LT + 0.285 * INTWO - 0.521 * (CHIN)$$

Here we define $ADJASSET$ as adjusted total assets and calculate this by adding 10% of the difference between market equity and book equity to the total assets $AT + 0.10 * (ME - BE)$. CPI is the consumer price index, DT is total debt, CL is current liabilities and CA is current assets, EBT is earnings before taxes, LT is total liabilities. $OENEG$ is a dummy that is equal to one if total liabilities is larger than total assets, $INTWO$ is a dummy that is equal to one if net income is negative for this fiscal year and the previous fiscal year, $CHIN$ is changes in net income defined as $(NI_t - NI_{t-1})/(|NI_t| + |NI_{t-1}|)$ and Altman's Z-score is calculated as:

$$Z = (1.2 * WC + 1.4 * RE + 3.3 * EBIT + 0.6 * MktCap + REV)/AT$$

where WC is working capital, RE is retained earnings, $EBIT$ is earning before interest and taxes, $MktCap$ is market capitalization, REV is revenue and AT is total assets. The last metric for safety is $EVOL$ and it is equal to the standard deviation of ROE over the last 5 year.

Payout

The Payout score is calculated as the arithmetic average of the z-scores of net equity issuance (EISS), net debt issuance (DISS) and total net payout over profits (NPOP):

$$Payout = z(z_{eiss} + z_{diss} + z_{npop})$$

$EISS$ is the minus one-year percentage change in split-adjusted number of shares $- log\ (ADJ\_CSHOC_t/ADJ\_CSHOC_{t-1})$. $DISS$ is minus one-year percentage change in total debt $-log(DISS_t - DISS_{t-1})$, where $DISS$ is the sum of total debt, minority interests and preferred stocks. $NPOP$ is the sum of net income minus change in equity over the last 5 years divided by total gross profit $(REV - COGS)$ over the last 5 years.

Market-to-Book

The Market-to-Book is calculated as the current market capitalization divided by the book value of equity. We require stocks to have a positive value of book equity in accordance with previous research (Asness, Frazzini & Pedersen 2014)

Quality

The measure combining the quality components is Quality, and it is calculated as the arithmetic average of the individual z-scores of the quality components Profitability, Growth, Safety and Payout:

$$Quality = z(Profitability + Growth + Safety + Payout)$$

A2: Factor Returns

In this section we present the calculations behind the construction of the Market (MKT), Size (SMB), Book-to-Market (HML) and Quality-Minus-Junk (QMJ). The market factor (MKT) is the valued weighted return on all available outstanding stocks identified by Compustat Global for the Swedish market during the period January 1990 - Dec 2014. The return is monthly and is reported in excess of the monthly risk free rate as approximated by STIBOR 1 month. The size (SMB) and Book-to-Market (HML) factors are constructed using 6 portfolios formed on Size (market capitalization) and Book-to-Market (most recent book equity divided by the market capitalization). More specifically, at the end of each month, based on size, we split the outstanding stocks into two separate portfolios where the break point for the larger is the 80th percentile. In each size portfolio, we then sort on Book-to-Market and split each of the two size portfolios into three, totally generating 6 portfolios. Each portfolio is value-weighted. The SMB is the average return of the three smaller portfolios minus the average of the three larger portfolios:

$$SMB = \frac{1}{3}\,(Small\ value + Small\ neutral + Small\ growth)$$
$$-\frac{1}{3}\,(Big\ value + Big\ neutral + Big\ growth)$$

The value factor is the average return of the two value portfolios minus the two growth portfolios:

$$HML = \frac{1}{2}\,(Small\ value + Big\ value) - \frac{1}{2}(Small\ growth + Big\ growth)$$

The final factor is the Quality-Minus-Junk factor (QMJ) and it is constructed from the intersection of 6 portfolios sorted on Size and Quality. At the end of every month, we split the outstanding stocks into two separate portfolios where the break point for the larger is the 80th percentile. In each size portfolio, we then sort on Quality and split each of the two size portfolios into three, totally generating 6 portfolios. Each portfolio is value-weighted The QMJ factor return is the average of the two Quality portfolios minus the average return of the two junk-portfolios:

$$QMJ = \frac{1}{2}(Small\ Quality + Big\ Quality) - \frac{1}{2}(Small\ Junk + Big\ Junk)$$