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Cohesiveness of value and quality anomalies*

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Abstract

The study examines the combination of the quality factor put forth by Asness *et al.,* (2017) and the value factor (BE/ME ratio) established by Fama and French (1992). The same is measured by constituting 'quality at reasonable price' (QARP) portfolio which refers to distinguishing inexpensive high-quality firms and expensive junk firms. The dynamics of combining quality and value can be observed from the high excess returns of 25 double-sorted value-quality portfolios. Further, QARP factor yields significant high returns and Sharpe ratio as compared to that of quality and value factor portfolios. Moreover, QARP factor alphas and the corresponding t-statistics increase in magnitude after controlling for additional risk factors.

Keywords: quality at reasonable price, quality, value, QARP, QMJ, HML, fundamental value investing.

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1 Introduction

"While some might mistakenly consider value investing a mechanical tool for identifying bargains, it is actually a comprehensive investment philosophy…"

- Seth A. Klarman, Security Analysis (2009)

The 'father of value investing' Benjamin Graham alongwith David Dodd published the first version of Security Analysis in 1934, laying the foundation for the principles of value investing. To put it succinctly, they propagated investment in securities available at bargain to its intrinsic value. The above quote aptly points out the general fallacy of few in understanding value investing. Value investing is as much about bargain purchase as it is about analysing the fundamentals. Both, Graham and Dodd (1934) advocated a thorough analysis of a firm's financial construct as well as its business prospects to determine the intrinsic value[1]. An investment decision is then made if the market price is lower than the derived intrinsic value. This very process came to be known as bottom-up analysis or fundamental/qualitative investing.

A similar investment philosophy in quantitative investing framework was established by Fama and French (1992) in their seminal paper 'The Cross-section of Expected Firm Returns'. Quantitative investing differs from traditional fundamental investing in the context of analysing data. Statistical tools are applied to identify return predicting factors, in other words risk/ behavioural characteristics which influence firm returns. Fama and French (1992) identified book-equity to market-equity (BE/ME) ratio as one such factor to measure the value effect. Value effect in the quantitative setting refers to firms with high BE/ME ratio (value/inexpensive) firms yielding better returns than low BE/ME ratio (growth/expensive) firms. While the robustness of the value effect is unquestioned, there is an obvious difference in the definition of

[1] Initially, Graham and Dodd prescribed firm screens (criteria) to shortlist value firms. However, in practice fundamental investors apply valuation techniques such as dividend discount model, free cash flow model or residual income model.

value investing in the fundamental and quantitative setting. As discussed above, the former considers both firm fundamentals and cheapness while the later focuses only on cheapness.

Quantitative investing, however, does not completely disregard fundamental or accounting construct. Quality effect entails investing in firms based on favourable accounting ratios. To name a few, high gross profitability (Novy-Marx, 2013), high asset turnover ratios and operating cash flows (Piotroski ,2000), low accruals (Sloan, 1996) were identified as quality factors to ascertain high quality companies. More recently, Asness, Frazzini, and Pedersen (2017) suggested that high quality stocks (defined as safe, profitable, growing, and well managed) outperform low quality stocks. However, the existence of value and quality as separate factor highlights the misunderstanding of quantitative setting in assessing value investing.

This study gains motivation from the above inadequacy of quantitative setting in approaching value investing. Moreover, a simple derivation of the Ohlson (1995) residual income valuation (RIV) model affirms that the intrinsic value of the firm is positively influenced by its profitability and growth. Additionally, combining RIV model with Shiller *et al.*, (1984) noise trader model illustrates the divergence of price from value.

$$\frac{p_t}{b_t} = \left[\frac{roe_{t+1} - g}{\rho - g + \emptyset}\right] + \emptyset\left[\frac{\frac{Y_{t+1}}{b_t}}{\rho - g + \emptyset}\right] \tag{1}$$

Together, RIV and noise trader model emphasize the consideration of both the quality aspect and bargain purchase.

Therefore, the study seeks to provide a novel perspective to value investing by analysing the efficacy of Graham and Dodd (1934) concept of value investing in quantitative setting. Specifically, the study tests whether quantitative factors representing quality and value can be combined to improve the existing quality and value measures.

Accordingly, the study combines the quality factor put forth by Asness *et al.,* (2017) and the value factor (BE/ME ratio) introduced by Fama and French (1992). The same is measured by constituting 'quality at reasonable price' (QARP) portfolio which refer to distinguishing inexpensive high-quality firms and expensive junk firms.

To begin with, the study observes the returns of pure quality, pure value and QARP decile portfolios. The dynamics of combining quality and value can be seen in the superior risk-adjusted returns of QARP decile portfolios. The annualised Sharpe ratio of long-short QARP portfolios (0.49) are almost twice that of pure quality (0.29) and pure value (0.24) portfolios.

A primary evidence for Graham and Dodd (1934) concept of value investing can be observed in the intermediate QARP decile portfolios which have better mean quality score than the top-decile portfolio. However, a low value score for intermediate portfolios results in sub-optimal returns. Further, low quality scores for value firms and high value scores for quality firms indicates the possible diversification benefit of combing quality and value factor into QARP factor.

The study also observes the returns of 25 double-sorted value-quality portfolios to understand the possible scale of return differential in QARP portfolios. The long-short quality portfolios within each value quintile yield monthly excess returns in the range of 0.54% to 0.71% with t-statistics in the range of 2.68 to 3.20. Similarly, long-short value portfolios within each quality quintile yield monthly excess returns in the range of 0.34% to 0.61% with t-statistics in the range of 2 to 3.99. The results exhibit that under any combination of quality and value, excess returns of long-short portfolios are economically and statistically significant.

Interestingly, combining quality and value works only with high value-quality and low value-quality portfolios. A long-short strategy of investing in highest quality-value quintile and selling lowest quality-value quintile could yield a monthly excess return of 1.26%. These results provide a direct evidence for combining high-quality value firms and/or low-quality growth firms.

The study further discusses the results of QARP factor portfolios. Consistent with Graham and Dodd (1934), QARP factor premium represents the difference in the average return of high percentile (70^{th} percentile and above) and low percentile (below 30^{th} percentile) portfolios within each size portfolio. In line with prior findings, QARP factor yields significant high average monthly return [0.47% (3.80)] as compared to that of quality factor [0.28% (3.40)] and value factor [0.36% (2.76)][2]. Further, combining quality and value yields high annualised Sharpe ratio to the tune of 0.49.

Additionally, QARP returns are robust to change in quality. Specifically, to account for a more stable growth measure, the five-year simple growth rate is modified to four-year compounded growth rate for each of the profit ratios considered. The subsequent results are robust to change in parameters of quality aspect (i.e. growth).

Moreover, abnormal returns for QARP portfolios after controlling for standard risk factors are economically and statistically significant. The high alpha of QARP portfolio can be attributed to the significant negative loading on standard risk factors such as market and momentum. Also, it indicates limited risk-based explanation for it.

The above analysis exhibits that combining two robust measures: quality and value yield significant risk-adjusted returns. The QARP factor distinguishes inexpensive quality firms from expensive junk firms.

The existing literature around the combination of quality and value factor is inadequate. A recent study by Cong *et al.,* (2018) finds the price of value (derived by residual income approach using accounting data and analyst forecasts) factor to subsume the explanatory power of BE/ME ratio and other quality measures. Another study by Li and Mohanram (2018), provides returns of portfolios formed based on quality factors such as F-Score and G-score, and value factor such as Value to price (V/P) and price-earnings to growth (PEG). This study's choice of financial statement information to measure the quality aspect avoids the expectation bias that can influence the results of Cong *et al's*., (2018) study. Although, the price of value factor is forward looking, use of

[2] Figure in parenthesis () represent t-statistic of reported alphas.

analyst forecasts exposes the results to mispricing errors prevalent in analyst forecasts[3]. Also, the study's choice of quality measure is observed to be effective for the entire cross-section of firms unlike the F-score or G-score which is observed to be effective in value and growth firms, respectively. Thus, this study is the first which provides a detailed analysis of the QARP factor, incorporating empirical quality and value factors, on a long sample of US firms.

The rest of the dissertation is organised in the following manner, Section 2 provides theoretical motivation for Graham and Dodd (1934) approach to value investing. Section 3 provides a review of related empirical literature and identifies the research gap. The data sources and methodology adopted to construct QARP score and factor portfolio is described in Section 4. Section 5 discusses the returns of quality, value and QARP decile portfolios along with reviewing the descriptive characteristics of each of the decile portfolios. Section 6 provides the differential returns of 25 double-sorted value-quality portfolios. Section 7 describes and discusses the returns of QARP factor portfolio. Section 8 summarises the results discussed in the study. Further additional results are provided in the Appendix.

[3] Refer discussion in section 3.2

2 Theoretical Motivation

This section provides further intuition into the fundamental value investing approach by exploring valuation theories and noise trader model. To begin with, reference is made to the most often taught valuation framework: residual income valuation (RIV)[4] model, to explain the quality dimension of value investing. This model is then extrapolated to include Shiller, Fischer and Friedman (1984) noise trader model to account for deviation of intrinsic value from prices. This forms the basis for assessing the bargain price of firms.

The general notations adopted are:

p_t = price of security

v_t = intrinsic value of equity

e_t = total earnings (including dividends)

d_t = dividend

b_t = book value

r = discounting factor or expected rate of return

Y_t = total value of shares (per share basis) demanded by ordinary investors

Q_t = total value of shares (as against total shares outstanding) demanded by smart money investors

ρ = expected real rate of return resulting in no demand by smart money investors

$\emptyset$ = risk premium resulting in smart money investors to hold shares

t= time subscript

[4] Refer Ohlson (1995) and Feltham and Ohlson (1995)

The generalized model construct developed by Ohlson (2000,2001) forms the basis of RIV model[5].

$$v_t = b_t + \sum_{t=0}^{\infty} \frac{[b_{t+1} + d_{t+1} - (1+r)b_t]}{(1+r)^{t+1}}$$

(2)

Further, under the assumption of clean surplus accounting relation (CSAR)[6], the RIV model is given by:

$$v_t = b_t + \sum_{t=0}^{\infty} \frac{(e_{t+1} - r * b_t)}{(1+r)^{t+1}}$$

(3)

where

$$z_{t+1} = b_{t+1} + d_{t+1} - (1+r)b_t$$

(4)

The RIV model signifies the influence of the current book value of the firm and the sum of the present value of all future residual income on the intrinsic value. Residual income (z_{t+1}) is the excess of accounting earnings over charge for capital employed. Hence, for the intrinsic value to increase, there should be a change in book value. This very change in book value is reflected through expected future firm earnings (e_{t+1}) being greater than the expected earnings ($r * b_t$).

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[5] RIV is the culmination of present value of expected dividend discount model and zero-sum series. Refer Appendix B for details

[6] The RIM model follows clean surplus relation (CSAR) assumption. CSAR accounting refers to $b_{t+1} - b_t = e_{t+1} - d_{t+1}$ where all changes in the balance sheet value of shareholders' equity, other than transactions with owners, are included in earnings.

Further, the above stipulates z_t to be greater than zero[7] i.e. for residual income to be positive. The intuition for higher expected future earnings is better understood by introducing a growth term. Accordingly, in line with Ohlson (2009), a growth term $(\gamma = 1 + g)$ is introduced[8], signifying the geometric increase in residual income. Therefore, a simple derivation[9] of equation (2) with growth term (γ) results in the following:

$$v_t = b_t * \frac{(roe_{t+1} - g)}{r - g} \tag{5}$$

where $roe_{t+1} = return\ on\ equity$ and $\gamma = 1 + g$

The above equation provides a more straightforward intuition for influence of earnings and growth on value. Ceteris paribus, value would increase if $roe_{t+1} > r$[10], signifying the importance of earnings or profitability[11] in influencing the intrinsic value of a company. Further, with $roe_{t+1} > r$, intrinsic value would also increase if the roe_{t+1} grows relative to its prior. Thus, two of the most conventional measures of performance, profitability and growth are imperative for higher intrinsic value of firms. Consequently, firms with high profitability and growth would lead to better value creation relative to firms with sub-optimal profits and growth. The contention of high profit and growth to ascertain quality companies is not alien. Early evidence of it can be found in the stock screens of Graham and Dodd (1934)[12].

The above further motivates our intuition to define quality dynamics. From the above, it can be deduced that high price to book firms exhibit high profitability,

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[7] A situation where z_t= 0 would result in $p_t = b_t$. While z_t< 0 points to a scenario where expected earnings performance is always lower than expected standard.

[8] The growth term γ is defined as $z_{t+1} = \gamma z_t$. The key assumptions being $1 \leq \gamma < (1 + r)$ and $z_{t+1} > 0$. Both the conditions are imperative as $z_{t+1} > 0$ and $\gamma < 1$ would avoid $p_t = b_t$. Also, $\gamma < (1 + r)$ is required for present values to converge due to zero-sum series assumption.

[9] Please refer to Appendix B for derivation

[10] $roe_{t+1} = r$ will lead to $p_t = b_t$. Further, $roe_{t+1} < r$ will yield a lower market to book price thereby resulting in no value creation.

[11] Return on equity $\left(\frac{e_{t+1}}{b_t}\right)$ is a function of expected future earnings and current book value. Accordingly, higher return on equity requires higher earnings.

[12] Refer to criteria 9 and 10 of Appendix A

growth and low systematic risk. This forms a base for the study to analyse the fundamental value investing approach.

The discussion above primarily concentrates on the quality dimension of fundamental value investing. The study delves further into the second dimension of Graham and Dodd (1934) value investing i.e. cheapness.

In an ideal world, the economic earnings concept leads to prices being equal to value $(p_t = v_t)$. However, under practical scenario the said concept seldom holds. Previous studies on efficient market hypothesis point out the fact that prices do not entirely reflect either prior price-volume or financial statement information[13]. One such study by Shiller *et al*., (1984) illustrates the divergence of prices from its correct value due to the 'noise trader' effect. In it they describe the influence of two kinds of investors: smart-money and ordinary/noise traders, on prices. Smart-money investors consider fundamental information while noise traders trade on inadequate or no information at all. The demand by these noise traders (at time t), expressed as the total value of share (per share basis) is denoted as Y_t. Further, the total demand by smart money investors (as a portion of total shares outstanding) is given by:

$$Q_t = \frac{(r - \rho)}{\emptyset}$$

(6)

A comparison of Y_t with equation (6) projects that smart-money investors trade on expected return which are optimally forecasted. On the contrary, the demand by noise trader although time-varying is arbitrary. Further, Shiller *et al*., (1984) noise trader model[14] is given by:

$$p_t = \sum_{k=0}^{\infty} \frac{E_t(d_{t+k}) + \emptyset E_t(Y_{t+k})}{(1 + \rho + \emptyset)^{k+1}}$$

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[13] Early evidence focused on the inability to observe perfect prices due to cost of collecting and analysing the information (Grossman and Stiglitz, 1980)). Several observations regarding calendar anomalies such as the 'January effect' (higher prices in the month of January) and 'Sell in may effect' challenged efficient market hypothesis, as such obvious patterns should not be persistent (Haugen and Lakonishok, 1988 and Bouman and Jacobsen, 2002). Fama and French (1992) exhibited superior return predictability of book values and market prices.

[14] E_t refers to expectation operator.

(7)

The above equation (7), exhibits that price is influenced by the discounted value[15] of future dividends and demand by noise traders. Considering equation (5) and equation (7) together, leads to the following equation[16]:

$$p_t = \frac{b_t \left[roe_{t+1} - g + \emptyset \left(\frac{Y_{t+1}}{b_t}\right)\right]}{\rho - g + \emptyset}$$

(8)

$$\frac{p_t}{b_t} = \left[\frac{roe_{t+1} - g}{\rho - g + \emptyset}\right] + \emptyset \left[\frac{\frac{Y_{t+1}}{b_t}}{\rho - g + \emptyset}\right]$$

(9)

The first term in equation (9) signifies the influence of profitability and growth on the price-to-book ratio. Consequently, the second term indicates the influence of demand by noise traders. A situation where $\emptyset = 0$, p_t would be equal to v_t (i.e. present value of residual income). However, as $\emptyset$ moves to infinity the arbitrary influence of noise traders increase resulting in deviation of p_t from v_t.

The above motivates this study to combine the quality and value factor. The price-to-book ratio of a firm is influenced by its profitability and growth. However, the interplay of different kinds of investors in the market deviates price from its true value. This could lead to a distorted price-book multiple ratio resulting in favourable/unfavourable investment opportunity. The above is in

[15] The discounting factor $\rho + \emptyset$ refers to the risk-free rate plus risk premium. The r which can be derived from the capital asset pricing model (CAPM) is on similar lines. The r_f refers to the risk-free rate and $\beta(r_m - r_f)$ refers to the market risk premium.
[16] Refer to Appendix B for derivation

line with Graham and Dodd (1984) concept of considering quality and cheapness together.

3 Literature review

This study encapsulates two major asset pricing factors: value and quality. While there have been several studies on the value factor, research on quality as a factor is still in preliminary stages. Further, an interesting paradox is the difference in understanding of these factors in quantitative and qualitative (fundamental) research setting. Accordingly, to comprehend the nuances of the above factors, the review of empirical literature is divided into a) Value investing – fundamental setting b) Value investing – quantitative setting c) Quality – an independent factor, and d) Quality at reasonable price – a unified setting.

3.1 Value – fundamental setting

Six decades before Fama and French (1992), Benjamin Graham and David Dodd published the earliest version of the bible of investing - *Security Analysis (1934)*. In it they advocated the traits of a value investor. It primarily stands on two pillars, 1) buying quality firms **and** 2) buying those at reasonable prices.

Graham and Dodd (1934) consider firms with sound fundamental or accounting construct as quality firms. They propagate thorough analysis of the prospective investment opportunity to derive the intrinsic value of the firm. Additionally, a margin of safety test is prescribed to ascertain whether the firm is available at a discount to its intrinsic value. The combined effect of financial statement analysis and margin of safety test therefore ensures investors' capital preservation and satisfactory returns.

The authors also propose firm screens to identify quality firms at cheap prices. It contains ten financial ratios or firm characteristics to measure quality and cheapness. The quality characteristics seek to identify firms with low leverage, high short-term liquidity, and consistent high earnings growth-rate. Further, the margin of safety test compares the fundamental value of the firm with its market price to assess the scale of bargain.

It is interesting to note that Graham and Dodd (1934) were well ahead of their time in identifying the two pillars of value investing. The noise trader hypothesis[17] is considered as one of the reasons for the divergence of price from its intrinsic value. This directly implicates the essence of margin of safety test to ascertain bargain purchase. Further, their quality measure directly challenges the semi-strong form of efficient market hypothesis[18], as it gives importance to analysing financial statement information. A study by Oppenheimer (1984) suggests that applying Graham and Dodd (1934) firm screen might result in excess return when compared to that of the market[19].

Thus, fundamental value investing refers to assessment of both quality and cheapness. An investment decision requires a strong accounting construct and relative discounted price to ensure principal protection and adequate returns.

$$\boldsymbol{Value = Quality + Cheapness} \tag{10}$$

In the paragraphs below, a comparative review of value investing in quantitative setting is discussed to understand the differences in the two approaches.

3.2 Value – quantitative setting

Quantitative investing is different from fundamental investing in the sense that it implements investment strategies based on known predictive factors. Asset pricing model is one such statistical method to identify factors (i.e. a characteristic) which would predict returns. The foundation for asset pricing

[17] Shiller, Fischer and Freidman (1984) described the 'noise trader' effect as the reason for divergence of prices from its correct value. Noise traders are those who trade with inadequate or no information at all. The prices of firms are affected due to the interaction of noise traders and smart money investors, as excess un-informed trade by noise traders causes drift in prices from its true value.

[18] The semi-strong form of market efficiency is known to exist if the market prices reflect all the price-volume as well as financial statement information.

[19] Additional studies have also been carried out on Warren Buffet's performance. Warren Buffet is a student of Benjamin Graham, and a strong follower of value investing (as prescribed by Graham and Dodd). Frazzini, Kabiller and Pedersen (2013) study the investment strategy of Warren Buffet (i.e. Berkshire Hathaway) and conclude that his stellar performance is attributed due to investing in high quality firms at cheap prices.

theories was laid by CAPM[20] which transforms Markowitz's portfolio optimization model into a predictive equation of return based on market risk. However, the ground-breaking research of Fama and French (1992) demonstrates that CAPM alone cannot predict returns. They particularly establish that the value factor is the most significant factor as it subsumes the predictive ability of other factors such as earnings – price ratio (E/P) and leverage.

Value investing in the quantitative setting refers to identifying firms which are priced relatively cheap in comparison to its fundamental value. It is measured by scaling a firm's fundamental value such as book equity, earnings, cashflow, etc. to its market price[21]. Such price multiple ratios are measurements for the value factor, and the cross-sectional return difference between high and low value factor firms are referred to as the value premium. Accordingly, value effect implies the superior performance of firms with high price multiple ratios versus that of firms with low price multiple ratios (Fama and French, 1992).

The first indication of the value effect in the US stock market was observed in the positive relation between future returns and book equity-to-market equity ratio (Stattman, 1980 and Rosenberg, Reid, and Lanstein, 1985)[22]. The value effect drew strong attention after the seminal paper of Fama and French (1992), as it provides a multidimensional explanation for risk-return trade-off in firm returns in the US markets. Simple firm characteristics such as market beta (β), size (ME), and book equity-to-market equity (BE/ME) ratio are considered as proxies for risk of firms. Consequently, the value factor came to be popularly known as high minus low (HML), representing buying high BE/ME ratio (value) firms and selling low BE/ME ratio (growth) firms. This directly challenges the semi-strong form of EMH, as both market equity and book equity are pervasively available for investors to trade on[23].

[20] The Capital Asset Pricing model
[21] In general context known as price multiple ratios
[22] Similar evidence is reported by Chan, Hamao, and Lakonishok (1991) in the Japanese markets.
[23] Various studies were also conducted to test the efficacy of other price multiples such as E/P (Basu, 1975,1977,1983; Jaffe et al., 1989, and Hou et al., 2011), cash flow-price (Chan et al., 1991 and Lakonishok et al., 1991), etc. However, it is the BE/ME which has notably received much attention due to its pervasiveness and persistence.

Evidence of the value effect is prevalent not only in the US market but also in international markets. Capaul *et al.* (1993) identified robust BE/ME premium in six developed countries other than the US. Additionally, parallel studies conducted by both Bauman *et al*. (1998) and Fama and French (1998, 2012) establish strong value effect in developed markets[24]. These studies also compare the efficacy of various price multiple ratios and find the value premium of BE/ME ratio to be the highest. The pervasiveness of the value effect is not just restricted to equities, it also extends to other asset classes. Recent studies have reported the robustness of value premium in asset classes such as bonds, currencies, commodity futures (Asness, Moskowitz, & Pedersen, 2013 and Li, 2017).

Various risk-based and behavioural explanations have emerged to explain the value effect. The seminal Fama and French (1992) paper[25], based on the close relation between leverage and BE/ME ratio, put forth the view that high BE/ME ratio (value) firms are expected to have lower growth prospect compared to lower BE/ME ratio (growth) firms. Therefore, value firms are expected to earn higher future returns due to its exposure to relative-financial distress. However, later studies conclude that the financial distress explanation is not conclusive as most distressed firms have lower BE/ME ratio, and hence premium for financial distress risk is not conclusive (Dichev, 1998; Griffin and Lemmon, 2002; Campbell *et al.,* 2008).

Another risk-based explanation refers to the "trapped asset" phenomenon. High BE/ME ratio (value) firms have higher assets deployed for revenue generation as compared to low BE/ME ratio (growth) firms. During economic downturn, it is difficult for value firms to expand their operations due to higher asset base. Thus, resulting in sub-optimal operating efficiency (Zhang, 2005). Further, during economic shocks, a value firm's fundamental responds in a negative manner (Petkova and Zhang, 2005) suggesting its inflexibility as compared to

[24] Evidence of significant value premium is also found in the emerging markets (Cakici et al., 2013, 2016).
[25] A similar study by Vassalou and Xing (2004) suggest that BE/ME is majorly attributed towards financial distress.

growth firms (Cooper, 2006; Li *et al.,* 2009; Gulen *et al.*, 2010; Novy-Marx, 2010).

Behavioural based explanations for value premium stem from over-optimistic or over-pessimistic expectations of growth. Previous studies suggest that firms with low BE/ME ratio are expected to grow at a faster rate than firms with high BE/ME ratio until a certain point, post which the growth rates settle to similar mean level (Fama and French, 1995). However, this slowing down of growth rate is not captured by market sentiments, and results in over-optimistic extrapolation of high growth rates for growth firms or conversely over-pessimistic extrapolation of weak growth rates for value firms (Chan *et al.*, 1993 and Penman, 1996). This leads to the mispricing hypothesis which states that such biased extrapolation leads to over/under pricing of firms resulting in divergence from intrinsic value (Piotroski and So, 2012; Hwang and Rubesam, 2013). Further, value premium results from the subsequent mispricing correction especially during bear market. It has been observed that the correction is more prominent for 'under-priced' value firms resulting in higher future returns for value firms compared to growth firms especially during bad times (Hwang and Rubesam, 2013).

A cursory comparison of the fundamental value investing concept and the quantitative value effect, points out the one-dimensional approach of quantitative value effect. As discussed above, value effect concentrates on assessing the cheapness of the firm while implicitly assuming that the book value of the firm signifies the true nature of the quality of the firm. However, it is not that quantitative setting ignores financial information. The concept of analysing financial statement information in quantitative setting is discussed in section 3.3 below.

3.3 Quality investing – an extension in quantitative setting

Unlike the value effect, there is no specific definition for the quality effect. If one were to summarise the various research findings, quality investing entails investing in high – quality companies with stable earnings, optimal leverage, high profitability, and consistent growth trend. Therefore, quality investing finds its roots in financial statement information to capture firm price information (Ball and Brown, 1968). It propagates identifying a single or a combination of fundamental ratios (as proxy for quality) which would predict the cross-section of firm returns (Ou and Penman, 1989)[26].

Amongst the various proxies of quality, profitability is one factor which has gained the most attention. It is generally observed that high quality firms exhibit high profitability. Profitability measures such as gross profitability, return on equity, return on assets, etc. depict the financial health of the company or how effectively a firm uses its resources (i.e. assets and debt). The most comprehensive study for the profitability measure is conducted by Piotroski (2000) and Mohanram (2005) by evaluating the F-score (9 fundamental ratios) and G-score (8 fundamental ratios), respectively. These scores are formed by computing the sum of binary ranking of firms based on their profit margins, asset turnover ratios, operating cash flows and other fundamental indicators. Sorting firms based on their F-score results in higher future returns due to investment in high quality firms within high BE/ME ratio firms. Conversely, the G-score provides similar results for low BE/ME ratio firms. Another ground-breaking study explores gross profit to asset ratio as a proxy for quality and observes that it yields significant cross-sectional returns (Novy-Marx, 2013).

It is not only the magnitude of earnings but also its persistence which attracts the focus of academics. Earnings comprises of both the cash flow (realised) and accrual component. It has been established that firms with high accruals are more likely to suffer earnings disappointment leading to lower future returns (Sloan, 1996 and Richardson *et al*., 2005). Earnings manipulation is another aspect which is considered to identify fundamental weakness. Intuitively, firms engaged in manipulating earnings earn lower future returns (Beneish, Lee, and Nichols, 2013).

[26] Lev and Thiagarajan (1993), Abarbanell and Bushee (1998) formed an investment strategy earning significant abnormal returns with 12 financial signals most likely used by analysts.

Other measures of quality relate to the safety aspect of firms which typically include leverage, volatility and beta. A high-quality firm is expected to have optimal leverage, low volatility and beta. It has been observed that firms with low volatility and beta earn higher future returns (Falkenstein, 2012; Ang *et al*., 2006; Black *et al*., 1972; Frazzini and Pedersen, 2014). Further, as pointed out in the case of value effect, leverage does not explain returns of financially distressed firms. On the contrary firms with lower leverage are observed to have higher future returns (Altman, 1968; Ohlson, 1980; Dichev, 1998; Campbell, Hilscher, and Szilagyi, 2008).

A recent study by Asness, Frazzini, and Pedersen (2017) affirms the above quality effect relating to profitability, safety and growth. In their study, high quality companies are expected to be 'safe, profitable, growing, and well managed'. This quality effect is measured by the 'quality minus junk' (QMJ) factor which implicates investing in high quality firms and selling low quality (junk) firms. Further, in line with previous research, this study establishes that the QMJ factor indeed yields significant premium in both the US and international market.

Asness *et al.,* (2017) also seek to explain the influence of quality factor on the current prices of security. They find that high quality firms in general are overpriced than junk firms but only to a limited extent. The restricted statistical explanation of quality on price suggests that the current prices of quality firms are higher only by a small margin, thereby resulting in existence of the quality effect. Further, quality effect is also largely unexplained by standard risk-based explanations since quality firms by nature entail minimal risk. Behavioral explanations refer to pessimistic analyst return expectations for high quality firms. The discussion for explanation of the quality effect is still in nascent stages, and no conclusive evidence has yet been reported.

The quality investing concept is much in line with that advocated by Graham and Dodd (1934). However, what is missing is the second dimension of evaluating the firm's cheapness. A high-quality firm which is appropriately priced would not ensure adequate returns.

3.4 Quality at reasonable price – a unified setting

The discussion above highlights the one-dimensional view of quantitative setting in addressing value investing. Unlike, the fundamental approach, quantitative investing evaluates quality characteristics and firm cheapness in isolation. Both the quality and value factor are effective in predicting significant stock returns. However, considering both separately does lead to certain disadvantages. The value effect (measured through the BE/ME ratio) assumes the book equity of the firm as a true reflection of the quality of the firm. This disregards a situation where a lower market price (and hence high BE/ME ratio) rightly incorporates the weak fundamentals not yet reflected in book equity. Further, it is not necessary for high quality companies to yield superior returns if they are adequately priced. A similar analogy can be observed from Piotroski and So (2012) where a behavioural explanation of the value effect is explained after controlling for firm quality characteristics (F-score).

Therefore, to align quantitative value investing with fundamental value investing concept, both the quality and value factor need to be considered in unison. The existing literature around the combination of quality and value factor is inadequate.

A recent study by Cong *et al.,* (2018) has found the price of value factor to subsume the explanatory power of the BE/ME ratio and other quality measures. The price of value factor is derived by employing residual income approach using accounting data and analyst forecasts to derive the intrinsic value. Although, the derived intrinsic value is forward looking, use of analyst forecasts exposes the results to mispricing errors prevalent in analyst forecasts. Another study by Li and Mohanram (2018), provides returns of portfolios formed based on quality factors such as F-Score and G-score, and value factor such as Value to price (V/P) and price-earnings to growth (PEG). They find that under any combination of quality and value measure the abnormal returns are almost twice that of returns based on single factor. Further, Asness *et al.,* (2017) provide only a glimpse of the combined 'quality at reasonable price' measure to improve the individual value and quality measure.

This study gains motivation from the above research gap or the inadequacy of quantitative setting in comprehending value investing. It contributes to the existing literature by exploring the combined effect of the quality and value factor. The same is measured by constituting a 'quality at reasonable price' (QARP) factor which refers to investing in under-priced high-quality firms and selling over-priced junk firms. Specifically, it focuses on providing an innovative perspective to value investing by analysing the efficacy of the fundamental concepts in quantitative setting. In accordance with the financial analysis concept elucidated by Graham and Dodd (1934), this study considers the comprehensive quality factors put forth by Asness *et al.,* (2017) to measure the fundamental characteristics of firms. Further, the pervasive BE/ME ratio is considered as the value factor for evaluating cheapness. Accordingly, it is the first study which provides a detailed analysis of the QARP factor, incorporating empirical quality and value factors, on a long sample of US firms.

Further, the study's choice of financial statement information to measure the quality aspect avoids the expectation bias that can influence the results of Cong *et al's*., (2018) study. Also, the study's choice of quality measure is observed to be effective for the entire cross-section of firms unlike the F-score or G-score which is observed to be effective in value and growth firms, respectively.

4 Data and Methodology

This section describes the data collection tools and portfolio construction methods adopted for analysing quality, value and quality at reasonable price (QARP) portfolios. The study is conducted on equity asset class in the United States (U.S) equity markets.

4.1 Data sources

The monthly price and annual accounting data for the U.S stock universe are collated from the Centre for Research on Security Prices[27] (CRSP) and Compustat North America Fundamentals Annual (COMPUSTAT) database, respectively. The U.S stock universe is filtered for considering only common firms identified by CRSP share code (SHRCD) 10 or 11. In line with the standard practice followed by Asness *et al.,* (2017) and Fama and French (1992), the return data from calendar year $July\ t$ to $June\ t+1$ is aligned with accounting data for the fiscal year ending anywhere in $year\ t-1$.

Therefore, the test dataset of the US equities consists of 24,384 firms for the period June 1957 to December 2017.

The monthly Fama-French three and five factor model factors as well as Jegadeesh and Titman (1993) momentum factor for the analysis period are retrieved from Kenneth French official website[28]. Similarly, Stambaugh and Yuan (2015) monthly mispricing factors are collected from the published data series[29]. Macro-economic data for the US has been retrieved from the Federal Reserve Bank of ST. LOUIS[30].

[27] The universe is filtered for firms listed on major firm exchanges such as NYSE, NYSE American and NASDAQ (CRSP EXCHCH = -2, -1, 1 ,2, 3)

[28] The listed empirical risk factor returns are collated from http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html

[29] The link for retrieving Stambaugh and Yuan (2015) mispricing factors is http://finance.wharton.upenn.edu/~stambaug/

[30] For further details refer Appendix C

4.2 Factor definitions

4.2.1 Value factor

As discussed before, various proxies exist for the value factor however empirical studies find the Fama and French (1992) introduced BE/ME ratio as a consistent measure. In their seminal paper, Fama and French (1992) use lagged values of both the book and market equity to calculate the BE/ME ratio. Asness and Frazzini (2011) discussed the use contemporaneous price information to improve the BE/ME ratio. They proposed that the use of recent price information results in a more robust value measure especially for monthly rebalancing windows. Accordingly, the standard BE/ME ratio is computed with lagged book values and recent market prices to examine value portfolios.

4.2.2 Quality factor

Obtaining a precise definition for quality is a challenge given the subjective nature of analysis. The empirical studies relating to quality investing provides a glimpse of the several factors considered for analysing the various quality aspects of firms.

In the fundamental context, one can refer to the firm screens prescribed by Graham and Dodd in their seminal work Security Analysis (1934)[31]. While the book advocates indept analysis of financial statements, they also provide a comprehensive criterion to assess value firms (refer Appendix A for complete list). The first five criterion assess the bargain price, and the next five relate to the quality aspect. In summary, the latter half of the criteria define quality firms as those with low leverage, high short-term solvency and consistent high profits.

Further insights can be gained from the theoretical motivation discussed in section 2. A simple derivation of the residual income valuation model depicts the influence of profitability, and growth on the intrinsic value of the firm.

[31] Stock screens are updated in the latest versions of the book. For comparison, this study discusses the original version.

Specifically, characteristics such as high profitability and growth positively influences the intrinsic value of a firm. On similar lines, Fama and French (2015) consider profitability and investment as return predictive factors to form the Fama-French five factor model. They propagated that firms with high profitability and low investment yield higher returns than their counterparts.

Asness *et al*., (2017) provide a meticulous understanding of the fundamental characteristics influencing firm value. They opine that the BE/ME ratio increases due to high persistent earnings, and lower risk in regard to the overall market. Therefore, profitability, growth and safety are considered as elements to evaluate the quality aspect of firms. The profitability element considers six profit ratios such as gross profit to assets, return on equity, accrual, cash flow over assets, etc. The five-year return of the profit ratios is considered to assess the sustainability of earnings. The standard measures of safety such as beta, leverage, bankruptcy risk and earnings volatility are considered for the safety element.

There are indeed several approaches to assess the true value or quality of a company. However, criteria's such as high and consistent profitability, adequate solvency, persistent earnings are undebated. The quality measure defined by Asness *et al.,* (2017) considers the comprehensiveness of most of the quality measures in empirical research. Accordingly, this study considers the quality measures of Asness *et al.*, (2017) to assess the quality aspect of firms.

4.2.2.1 Quality elements

Asness *et al.,* (2017) consider well-established financial ratios from empirical research to avoid data mining concerns in selecting the variables for each of the elements of quality.

- ***Profit:*** The rationale and evidence for high profitability as a proxy for assessing quality is abundant. The profit element considers the following accounting ratios: gross profit to asset ratio ($GPOA$), return on equity (ROE), return on asset (ROA), cash flow over assets ($CFOA$), gross profit margin ($GMAR$) and accrual to total assets (ACC). Novy-Marx (2013) substantiated the influence of GPOA in predicting superior stock returns. Further, Greenblatt (2006) vouches for the superiority of ROE to identify quality firms. Sloan's (1996) ACC based measure identifies companies with better realised earnings component or lower accruals. Additionally, both ACC and $CFOA$ measure the cash component or to put it in other words the recurring portion of earnings. $GPOA$, ROA, ROE, and $GMAR$ provide intuition for the performance of the firm in terms of the resources deployed by it. Overall, the above ratios assess the sustainable operating efficiency of a firm. Consequently, firms with high $GPOA$, ROA, ROE, $CFOA$, $GMAR$, and low ACC are considered as quality firms.

- ***Growth:*** For measuring the growth component, a five-year simple growth for each of the above profit ratios (except ACC) is considered. These growth ratios are computed by scaling the five-growth in numerator (i.e. profits) of $GPOA$, ROA, ROE, and $GMAR$ by the five-year lagged value of its denominator (i.e. resources deployed), respectively. A simple growth rate is considered to capture the earnings information of the latest year.
- ***Safety:*** The safety element considers low systematic risk firms measured through Frazzini and Pedersen (2014) 'betting against beta' (BAB) factor. Further, solvency of the firm is assessed by employing leverage ratio (LEV) and bankruptcy ratios such as Ohlson (1980) O-score (OS) and Altman (1986) Z-score (ZS). The volatility in quarterly ROE ($EVOL$) is also computed to account for variation in earnings performance. Accordingly, firms with low BAB, OS[32], $EVOL$ and high ZS[33] are considered as safe and quality firms.

The above profit, safety and growth elements evaluate characteristics such as lower leverage, and consistent high profits which are the essence of the quality dimension of Graham and Dodd (1934) value investing.

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[32] A large O-score specifically above 0.5 indicates high risk of bankruptcy. Hence, a lower O-score is favourable.

[33] Firms with Altman (1986) Z - score greater than 2.99 are considered as safe. Those with Z-scores less than 1.81 are considered as distressed firms or firms with high bankruptcy risk.

4.2.2.2 Quality score

To assess the overall quality of a firm the above quality elements are combined to form a single quality measure/score. The quality score $\left(z_{quality}\right)$ is obtained by averaging the z-scores of each of the three elements mentioned in section 4.2.2.1:

$$z_{quality} = avg\left(z_{profit} + z_{growt} + z_{safety}\right) \tag{11}$$

The z-score of profit $\left(z_{profit}\right)$, growth $\left(z_{growt}\right)$ and safety $\left(z_{safety}\right)$ elements are computed by averaging the z-scores of the of individual variables (refer section 4.2.2.1) included in each of the elements (refer Appendix C for details).

$$z_{profit} = avg\left(z_{gpoa} + z_{roe} + z_{roa} + z_{cfoa} + z_{gmar} + z_{acc}\right) \tag{12}$$

$$z_{gro} = avg\left(z_{\Delta gpoa} + z_{\Delta roe} + z_{\Delta roa} + z_{\Delta cfoa} + z_{\Delta gmar}\right) \tag{13}$$

$$z_{safety} = avg\,(z_{bab} + z_{lev} + z_{os} + z_{zs} + z_{evol}) \tag{14}$$

At the end of each month, the individual variables (x) are ranked (r_x) in the ascending order. Since the unit of measure for each variable is different, we compute the z-scores of ranks for each firm given by:

$$z - score\,(x_i) = \frac{r_{xi} - \bar{r}}{\sigma_r} \tag{15}$$

where $\bar{r}$ and σ_r are the cross-sectional mean and standard deviation of the ranks. Accordingly, firms with low total z-score refers to junk firms and those with high total z-score signifies quality firms. Furthermore, computing z-score serves the dual purpose of standardizing the unit of measure and containing outliers.

4.2.3 Quality at reasonable price (QARP) factor

The quality at reasonable price (QARP) factor considers both the quality and value factor. It refers to distinguishing inexpensive quality firms from expensive junk firms. Accordingly, the QARP factor combines the value factor (BE/ME ratio) defined in para 4.2.1 and the quality factor $(z_{quality})$ described in para 4.2.2.

Since, the unit of measure of the value (ratio) and quality factor (score) are different, the value factor (BE/ME ratio) is first standardized applying the method described in para 4.2.2.2.

At the end of each month, z-scores for the value factor are computed from the cross-sectional ranked BE/ME ratio $\left(r_{\frac{BE}{MEi}} \right)$.

$$z_{value} = \frac{r_{\frac{BE}{MEi}} - \bar{r}}{\sigma_r}$$

(16)

Subsequently, the QARP factor is the average of the standardized quality and value scores, given by

$$z_{QARP} = avg\left(z_{quality} + z_{value}\right)$$

(17)

As discussed above, a high-quality score $(z_{quality})$ indicates quality firms while a low-quality score indicates junk firms. Similarly, inexpensive stocks are denoted by high value score (z_{value}) and vice-versa[34]. Consequently, a high QARP score (z_{QARP}) denotes high quality inexpensive firm whereas a low QARP score denotes low quality expensive firm.

[34] In the general context, high BE/ME ratio firms are also referred to as value firms and low BE/ME ratio firms are referred to as growth firms.

4.3 Portfolio construction

The study focuses on testing the returns of quality and value factor portfolios in a unified setting. These combined portfolios are referred to as 'quality at reasonable price' $(QARP)$ portfolios which imply selecting inexpensive quality stocks. However, before delving into QARP factor portfolios the study analyses the characteristics of individual quality and value factor portfolios. Accordingly, the portfolio construction method for each of the quality, value and QARP factor portfolios are described below.

4.3.1 Quality minus junk (QMJ) portfolios

To begin with, the returns of quality factor portfolio referred to as 'quality minus junk' (QMJ) portfolio are examined. QMJ portfolio is a long-short portfolio investing in high quality stocks and selling low quality stocks. The standard dependent sort method propagated by Fama and French (1992,1993 and 1996) and Asness *et al.,* (2017) is applied for forming QMJ portfolio. At the end of each month, firms are sorted into two size portfolios based on median NYSE breakpoint[35]. These stocks are subsequently sorted into three percentile (30th, 70th and 100th percentile) portfolios[36] based on their total quality scores $\left(z_{quality}\right)$. Firms in the top percentile (70th percentile and above) are quality firms while firms below 30th percentile are junk firms. Accordingly, QMJ portfolio is long high-quality portfolio (top percentile) and short junk portfolio (bottom percentile) within both size portfolios. Value weighted portfolios are formed at the end of each month, and rebalanced monthly. Further, QMJ factor return is the difference between returns of two high-quality portfolios and two low-quality portfolios.

$$QMJ = \frac{1}{2}(small\ quality + big\ quality) - \frac{1}{2}(small\ junk + big\ junk) \tag{18}$$

[35] NYSE breakpoints are retrieved from Kenneth French website: http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/Data_Library/det_me_breakpoints.html

[36] Quality, value and quality at reasonable price portfolios are sorted into three percentile points (30th, 70th and 100th percentile) based on NYSE breakpoints for quality, BE/ME ratio and quality at reasonable price scores, respectively.

4.3.2 High minus low (HML) portfolios

Similar methodology, is adopted for forming value factor portfolio. This portfolio is referred to as 'high minus low' (HML) which entails investing in high BE/ME ratio (inexpensive) firms and selling low BE/ME ratio (expensive) firms. Accordingly, at the end of each month two size-sorted portfolios are further sub-divided into three value-sorted portfolios (30th, 70th and 100th percentile) based on median NYSE breakpoint and BE/ME ratio[36], respectively. The return of HML portfolio[37] signifies the difference in the average returns of small and big high BE/ME ratio portfolios (value/inexpensive firms) and the average returns of small and big low BE/ME ratio portfolios (growth/expensive firms).

$$HML = \frac{1}{2}(small\ value + big\ value) - \frac{1}{2}(small\ growth + big\ growth) \tag{19}$$

4.3.3 Quality at reasonable price (QARP) portfolios

Quality at reasonable price (QARP) portfolio adopts the fundamental concept of value investing, and accordingly, refers to considering both quality and value dimension of investing. As described above, the QARP factor indicates the quality as well as the cheapness of the firm. Accordingly, QARP factor return is computed by sorting stocks based on QARP factor (z_{QARP}). In line with the method described above, dependent sort is applied first sorting firms into two size-portfolios[38] and then into three QARP factor portfolios[36] (30th, 70th and 100th percentile). Firms in the top percentile (70th percentile and above) are inexpensive quality firms while firms below 30th percentile are expensive junk firms. Accordingly, QARP portfolio is long high-quality value portfolios (top percentile) and short junk growth portfolios (bottom percentile) within both size portfolios. QARP portfolio returns are value weighted and formed at the end of each month with monthly rebalance. Consequently, QARP factor return is the

[37] Value weighted portfolios are formed at the end of each month, and rebalanced monthly.
[38] Using median NYSE breakpoints

difference between the returns of two high-quality-value portfolios and two low-quality-growth portfolios.

$$QARP = \frac{1}{2}(small\ quality\ value + big\ quality\ value) - \frac{1}{2}(small\ junk\ growth + big\ junk\ growth) \quad (20)$$

5 Understanding QARP dimensions

This section analyses the characteristics of QARP decile portfolios alongwith providing insights on its dimensions: quality and value.

Table 1 presents results for quality, value, and QARP sorted decile portfolios for July 1957 - December 2017. Value-weighted decile[39] portfolios are formed at the end of each month based on the quality score, BE/ME ratio, and QARP quality and value score, respectively. Panel A refers to pure quality portfolios where the highest decile (P10) represents quality firms and the lowest decile (P1) represents junk firms. Similarly, results of pure value portfolios are presented in Panel B. Low BE/ME ratio (P1) indicates growth or expensive firms while high BE/ME ratio (P10) indicates value or cheap firms. Consequently, top decile (P10) portfolios in Panel C indicates high quality value firms, and lowest decile (P1) indicates low quality growth firms. Additionally, results of long-short portfolios which buys firms in top decile (P10) and sells firms in the bottom decile (P1) are also reported.

Further, Table 2 reports additional descriptive statistics and alphas for each of the quality, value, and QARP sorted decile portfolios. The reported alphas are estimated based on the time-series regression of monthly excess returns of portfolios on standard risk factors. Such standard risk factors represent CAPM 1-factor model [market premium ($MKT - RF$)], Fama-French 3 factor model [market premium ($MKT - RF$), size factor (SMB), and value factor (HML)], Carhart-4 factor model [market premium ($MKT - RF$), size factor (SMB), value factor (HML), and momentum factor (MOM)], Fama-French 5 factor model [market premium ($MKT - RF$), size factor (SMB), and value factor (HML), profitability factor (RMW) and investment factor (CMA)], Stambaugh mispricing factor model [market premium (MKT), size factor (SMB), and two mispricing factor ($MGMT, PERF$)] and q-factor model [market premium (MKT), size factor (r_{ME}), investment factor ($r_{\frac{I}{A}}$) and profitability factor (r_{ROE})]

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[39] Quality, value and quality at reasonable price portfolios are sorted into deciles based on the NYSE decile breakpoints for quality, BE/ME ratio and quality at reasonable price scores, respectively.

Both quality and value decile portfolios exhibit general monotonic increase in returns, affirming the consensus that high quality and value firms generate superior returns. Further, the results depicted in Panel A for pure quality portfolios are in line with those estimated by Asness *et al.*, (2017). A comparison of long-short portfolio returns in Panel A and B indicates that pure quality portfolios yield 0.05% higher monthly returns than pure value portfolios. Additionally, monthly returns of pure value long-short portfolios have no statistical significance.

Moreover, due to favourable volatility, long-short pure quality portfolio (Sharpe ratio: 0.29) yields higher risk adjusted return (annualised) than pure value portfolio (Sharpe ratio: 0.24). The substantial risk adjusted return of pure quality portfolio can be attributed to its lower exposure to standard risk factors. Indeed, the realised betas (from CAPM 1-factor model) represented in Table 2 (Panel A and B) of pure quality portfolios are lower than that of pure value portfolios. Further, the alphas of long-short pure quality portfolios are positive and highly significant for all standard risk factor models stated above. In fact, the alphas and the corresponding t-statistic increase in magnitude after controlling for additional risk factors. For instance, the CAPM alpha of 0.75% (t-statistic: 3.74) increases to 1.18% (t-statistic: 7.52), 1.00% (t-statistic: 6.35) and 0.83% (t-statistic: 6.88), respectively for Fama-French 3 factor model, Carhart – 4 factor model and Fama-French 5 factor model. On the contrary, pure value long-short portfolios exhibit significant positive alphas only in the case of Carhart – 4 factor model [0.33%(2.45)] and Stambaugh mispricing factor model [0.36%(1.96)][40].

Furthermore, pure value portfolios do exhibit size bias than pure quality portfolios. High quality portfolios in general are comprised of large capital firms whereas the opposite is true for high BE/ME ratio portfolios. This is further substantiated by the large deviation in the equally-weighted and value-weighted returns of pure value portfolio, with equally - weighted returns being both economically and statistically significant[41].

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[40] Figure in parenthesis () represent t-statistic of reported alphas.

[41] Although, QARP decile portfolios (Table 2 – Panel C) exhibit similar size characteristics as value portfolios, the results of size-sorted QARP portfolios have high statistical significance.

Interestingly, the mean value score[42] reported in Panel A for high quality portfolios indicate the expensiveness of high quality firms. This finding is in line with the hypothesis presented by Asness *et al.,* (2017), stating that high quality firms in general demand higher prices, and hence are expensive. Further, the mean quality score reported in Panel B for value sorted portfolios also indicate a similar picture. Low BE/ME ratio portfolios have higher quality score than high BE/ME ratio portfolios. To put it in other words, the predominance of low quality scores for value firms and high value scores for quality firms indicate that pure quality and pure value strategies invest in dissimilar firms. Thus, a combination of the two strategies provides a premise for exploiting diversification benefits[43].

The above observation does highlight the superiority of the quality factor over the value factor. However, QARP portfolio results in Panel C of both Table 1 and Table 2 provide insights for the importance of considering value factor as well.

A cursory look at the mean quality scores of QARP decile portfolios indicate better quality scores for intermediate decile portfolios than top-decile portfolios. However, a low value score for these intermediate portfolios results in sub-optimal returns.

In fact, Panel C provides a direct indication of the Graham and Dodd (1934) concept of value investing. Combining quality and value scores, enables sorting quality firms at a bargain price. Hence, the QARP effect entails in investing in high quality value firms and selling low quality growth stocks. Accordingly, long-short QARP portfolios yield monthly average returns of 0.69% with a t-statistic of 3.79. Further, combining quality and value factor results in substantially high risk-adjusted returns. The Sharpe ratio of long-short QARP portfolios (0.49) are almost twice that of pure quality (0.29) and pure value (0.24) portfolios.

Additionally, abnormal returns after controlling of all standard risk factors stated above for QARP portfolios [Table 2 (Panel C)] are positive and highly

[42] Value scores are computed by taking the z-score of the cross-sectional rank of BE/ME ratios of firms.
[43] More explanation in section 7

significant. The estimated alphas for Carhart-4 factor model is 0.96% (t-statistic: 8.42) and for Stambaugh mispricing factor is 0.82% (t-statistic: 4.84).

Overall, quality factor generates positive and statistically significant returns. Further, pure quality portfolios exhibit lower volatility and hence yield higher risk adjusted returns. However, ignoring the value (cheapness) dimension results in sub-optimal returns. Further, a simple analysis of the characteristics of pure quality and value portfolio points out the possible diversification benefit of combing quality and value factor into QARP factor.

The QARP factor follows the fundamental concept of value investing. Accordingly, QARP portfolios formed by combining quality and value scores propagates sorting quality firms at bargain price. This investment strategy results in long – only monthly average return of 1.11% (t-statistic: 4.96). Further, long-short portfolios yield average monthly returns of 0.69% (t-statistic: 3.79) with annualised Sharpe ratio of 0.49. On comparison, QARP portfolios provide much better risk – adjusted returns than pure quality and value portfolios.

6 Dynamics of combining quality and value factor

The study primarily gains motivation from the concept of value investing propagated by Graham and Dodd (1934). Further, the results discussed in section 5 above points to the efficacy of the fundamental concept of value investing in quantitative setting.

This section discusses the results of an in-dept analysis undertaken to comprehend the return dynamics of quality and value factor in unison. To test the combined quality and value factor, dependent sort is carried out, first sorting firms into quintiles based on the value score. Each value score quintile is further sorted into quintiles based on the quality score. Accordingly, returns of 25 (5x5) double sorted test portfolios are analysed.

Table 3 shows the results of the 25 double sorted test portfolios. Portfolios along the columns represent value quintiles, and those along the rows represent quality quintile portfolios. The lowest and highest decile is indicated by P1 (either low value or quality) and P5 (either high value or quality), respectively. Additionally, alphas are reported for long-short portfolio returns (P5-P1) as well. The alphas are estimated by regressing monthly long-short portfolio returns on Carhart – 4 factor model.

The average monthly returns represented in Table 3 is in line with the results discussed in para 5 above. Under any combination of quality and value, excess returns of portfolios are economically and statistically significant.

Long-short quality portfolios within each value quintile yield excess returns in the range of 0.54% to 0.71% with t-statistics in the range of 2.68 to 3.20. Similarly, long-short value portfolios within each quality quintile yield excess returns in the range of 0.34% to 0.61% with t-statistics in the range of 2 to 3.99.

Further, the results exhibit the possible scale of high excess returns that can be exploited by investing in high value-quality and low value-quality firms. Indeed, a long-short strategy of investing in highest quintile (P5-P5) and selling lowest quintile (P1-P1) of both quality and value portfolios could yield an excess return of 1.26%. It is pertinent to note that, combining quality and value works only with high value-quality and low value-quality portfolios. A reverse combination of high quality - low value and high value – low quality does not yield substantial excess return.

The results discussed above is consistent with the research objective of implementing the fundamental concept of value investing in quantitative setting. Combining two robust factors: quality and value leads to better returns. Moreover, such robust results can be exploited only through high- quality value firms and/or low-quality growth firms. The intuition for this combination of quality and value factor can again be gained from Graham and Dodd (1934). High quality firms represent stable firms with higher profitability and growth while high value firms indicate availability of firms at bargain prices. Accordingly, the above combination entails investing in quality firms at reasonable price.

7 Quality at reasonable price

This section discusses the results of quality at reasonable price (QARP) factor portfolio. Consistent with Graham and Dodd (1934), QARP factor considers quality and value in unison. Accordingly, QARP factor premium represents the difference in the average return of high percentile (70^{th} percentile and above) portfolios and low percentile (below 30^{th} percentile) portfolios within each size portfolios. Table 4 shows the performance of QARP factor returns. Reported alphas are estimated by regressing the monthly times-series factor returns on Fama-French 3 factor model ($FFM-3$), Carhart-4 factor model ($Carhart-4$), Fama-French 5 factor model ($FFM-5$), FFM-5 plus Jegadessh and Titaman (1993) momentum (MOM) factor ($FFM-6$), FFM-6 plus Frazzini and Pedersen (2014) 'betting against beta' (BAB) factor ($FFM-7$), Stambaugh mispricing factor model ($Stambaugh\, factors$) and q-factor model ($q-factor$). Further for comparison, results for 'quality minus junk' (QMJ) and 'high minus low' (HML) factors are depicted.

Consistent with prior findings, QARP factor yields significant high monthly returns [0.47% (3.80)] as compared to that of QMJ [0.28% (3.40)] and HML [0.36%(2.76)] factors[44]. Further, combining quality and value yields high annualised Sharpe ratios to the tune of 0.49.

The superiority of QARP factor can be deduced from the high significant alphas. Except, in case of FFM-5, abnormal returns of QARP factor are both economically and statistically significant. The alphas range from 0.19% to 0.59% with t-statistics in the range of 1.51 to 8.49.

In addition to the above, Figure 1 depicts the cumulative returns of QMJ, HML and QARP factors. The consistent growth in cumulative factor returns indicates the robustness of QARP factor across the test period.

Until now, the study has gained motivation for combining quality and value factors from the fundamental concept of value investing. However, in Section 5, the varying characteristics of quality and value decile portfolios indicate towards a probable diversification benefit. The mean quality and value scores

[44] Figure in parenthesis () represent t-statistic of reported returns.

in Table 1 (Panel A and B) indicate low quality scores for value firms and high value scores for quality firms emphasizing that pure quality and pure value strategies invest in dissimilar firm. Therefore, to understand the superior returns of QARP factor from quantitative standpoint, the correlation co-efficients of QMJ and HML factors are computed. Additionally, the elements of quality i.e. profit, growth and safety factors are also included for analysis. Specifically, the relationship between the returns of the sub-components of QARP portfolios are analysed.

Table 6 depicts the correlation matrix of the value weighted monthly returns of quality minus junk (QMJ), high minus low (HML), profit (PMJ), growth (GMJ) and safety (SMJ) factor portfolios. The returns of QMJ and HML factors are negatively correlated (-0.38) with each other. The negative correlation is strong as all the elements of quality have negative correlation, with GMJ factor returns having the highest negative correlation of 0.50. Empirical findings indicate superior returns for negative or uncorrelated factor combinations[45]. Accordingly, the above results provide additional explanation for considering QARP portfolios. Indeed, the high risk-adjusted returns of QARP portfolios can be attributed to the diversification benefit resulting from the negative correlation of quality and value portfolios.

[45] Asness et al., (2013) observe that combination two robust strategies value and momentum yield superior returns due to strong negative relation between value and momentum returns.

8 Robustness checks

As illustrated in section 4.2.2.1, the growth element of quality aspect is computed by taking a five-year simple growth for each of the profit elements. In this section, the results of the QARP portfolio constituted using alternate method for computing growth element (quality) is examined.

Specifically, to account for a more stable growth measure, the four-year compounded growth rate for each of the profit ratios is considered. The performance for each of the intermittent years is considered while computing the compounded growth rate whereas the same is ignored when calculating simple growth rate.

To compute the compounded growth rate (Δgr), each of the profit ratios (pr) from year t to year $t-3$ are multiplied and subsequently raised by one fourth to compute the compounded four-year returns. The same is given by:

$$\Delta gr = \left(\sqrt[1/4]{(1+pr_t) + (1+pr_{t-1}) + (1+pr_{t-2}) + (1+pr_{t-3})}\right) - 1 \quad (21)$$

Table 7 depicts the results of QMJ, HML and QARP portfolios formed based on the revised growth measure. The returns are in line with those depicted in Table 5. QARP factor yields significant high monthly returns as well as high annualised Sharpe ratios. Accordingly, QARP returns are robust to change in quality parameters such as growth.

9 Return attribution

This section discusses the source of abnormal returns of QARP factor portfolios. Table 6 depicts the results of monthly time-series regression of QARP factor returns on the standard risk factor returns. The standard risk factors consist of Fama-French five factor model (FFM-5) [market premium ($MKT - RF$), size factor (SMB), value factor (HML), profitability factor (RMW) and investment factor (CMA)] plus Jegadeesh and Titaman (1993) momentum (MOM) factor alongwith Frazzini and Pedersen (2014) 'betting against beta' (BAB) factor[46]. Additionally, for comparison the regression results for QMJ and HML are also included.

In line with the results discussed in the previous sections, QARP factor yields high statistically significant abnormal returns after controlling for FFM-5, MOM and BAB factors. The high alpha of QARP factor portfolio can be attributed to the significant negative loading on standard risk factors such as market and momentum. The negative loading on market can be attributed to consideration of low beta stocks as quality stocks. Further, due to combination of quality and value, the positive loading on HML reduces to 0.73 (t-statistic: 17.85) for QARP factor portfolio than 0.87 (t-statistic: 20.78) for HML factor. Also, the positive loading on RMW is reasonable as profitability forms a part of the quality element.

While QMJ factor has a slight positive loading of 0.05 (t-statistic: 2.20) towards momentum, QARP factor has a loading of -0.45 with t-statistic of -15.83. This indicates that like HML, QARP factor comprises of firms which have seen recent price reductions, and hence are probably available at bargain.

To summarise, the significant alpha of QARP factor portfolio signifies the superiority of the combined effect of quality and value factors. Further, it has

[46] Fama-French five factor model alongwith momentum factor returns are retrieved from Kenneth French website. http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html. Frazzini and Pedersen (2014) 'betting against beta' are collated from https://www.aqr.com/Insights/Datasets.

limited or negative exposure to standard risk factors. The above results also indicate that standard risk explanation for QARP factor portfolio is inadequate.

10 Conclusion

The seminal work of Fama and French (1992) introduces the concept of value investing in quantitative setting. It refers to investing in relatively inexpensive firms and selling expensive firms. However, a parallel concept in fundamental setting defines value investing as buying quality firms at bargain price. Originally propagated by Graham and Dodd (1934), it entails thorough analysis of accounting construct, and then verifying for relative cheapness. While investing in quality companies is not an unfamiliar concept in quantitative setting, it treats quality and bargain purchase as different investment strategies. This study gains motivation from the above inadequacy of quantitative setting in comprehending value investing.

The fundamental concept is also illustrated by understanding the Ohlson (1995) residual income valuation framework alongwith Shiller *et al*., (1984) noise trader model. The study observes that the intrinsic value of a firm is influenced by its profitability, and growth which forms the basis for considering the quality aspect. Further, the noise trader model explores the possibility of divergence of prices and intrinsic value due to influence of various market participants. Therefore, to analyse the efficacy of the fundamental concept of value investing in quantitative setting, the study combines the quality factors put forth by Asness *et al.,* (2017) and the Fama and French (1992) BE/ME ratio as the value factor. The same is measured by constituting a 'quality at reasonable price' (QARP) factor which refers to investing in under-priced high-quality firms and selling overpriced junk firms. Hence, the QARP effect entails investing in high quality value firms and selling low quality growth stocks.

As a part of primary analysis, the study observes the returns of pure quality, pure value and QARP decile portfolios. The results, in line with consensus, indicate general monotonic increase in returns for both pure quality and pure value decile portfolios. QARP long-short decile portfolios yield monthly average returns of 0.69% with a t-statistic of 3.79. Further, combining quality and value factor results in substantially high risk-adjusted returns. The Sharpe ratio of long-short QARP portfolios (0.49) are almost twice that of pure quality (0.29) and pure value (0.24) portfolios. On comparison, QARP decile portfolios provide much better risk – adjusted returns than pure quality and pure value portfolios.

The study also conducts an in-dept analysis into the combination of quality and value factor portfolios by forming 25 double-sorted value-quality portfolios. The results exhibit that under any combination of quality and value, excess returns of quality-value portfolios are economically and statistically significant. Moreover, the results show the possible scale of high excess returns that can be exploited by investing in high value-quality and low value-quality firms. Further, a reverse combination of high quality - low value and high value – low quality does not yield considerable excess return. These results provide a direct intuition for combining quality and value in the approach laid out by Graham and Dodd (1934).

Consequently, the study analysis the returns of QARP factor. Consistent with prior findings, QARP factor yields significant high average monthly returns [0.47% (3.80)] as compared to that of QMJ [0.28% (3.40)] and HML [0.36% (2.76)] factors[47]. Further, combining quality and value yields high Sharpe ratio to the tune of 0.49. The alphas of QARP factor are both economically and statistically significant, except in case of FFM-5. These alphas range from 0.19% to 0.59% with t-statistics in the range of 1.51 to 8.49. The superior abnormal returns of QARP portfolio can be attributed to its limited or negative exposure to standard risk factors. It also indicates that standard risk explanation for QARP factor portfolio is inadequate. Further, QARP returns are robust to change in parameters of quality aspect.

The above analysis exhibits that combining two robust measures: quality and value yield significant risk-adjusted returns. The QARP factor distinguishes inexpensive quality firms from expensive junk firms. High quality firms represent stable firms with higher profitability and growth while inexpensive firms indicate availability of it at bargain prices.

The superior returns of QARP portfolio unlocks a new dimension in the quantitative approach of value investing. Backed by a strong concept and motivation, the QARP effect does exhibit considerable potential for application

[47] Figure in parenthesis () represent t-statistic of reported returns.

in practical investment scenario. Further research on the QARP factor could involve exploring behavioral explanation for its superior returns or conducting similar tests on other international or emerging markets. It could also be interesting to consider QARP factor as an explanatory variable to explain the returns of value – oriented funds.

To conclude, QARP factor is indeed an improved alternative to traditional quality and value factor. It aligns well with the empirical fundamental value investing concept. The study documents high risk-adjusted return for QARP portfolios which are much superior than traditional quality and value factor portfolios. These returns are robust even after controlling for standard risk factors.

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Table 1: Quality, Value and QARP decile portfolios

The table below represents the results for quality, value and quality at reasonable price (QARP) sorted decile portfolios from July 1957 to December 2017. At the end of each month, firms are sorted into decile portfolios based on their quality score, BE/ME ratio and combined quality and value score, respectively. Panel A refers to pure quality portfolios where the highest decile (P10) represents quality firms whereas the lowest decile (P1) represents junk firms. Similarly, results of pure value portfolios are presented in Panel B. Low BE/ME ratio (P1) indicates growth or expensive firms while high BE/ME ratio (P10) indicates value or cheap firms. Consequently, top decile (P10) portfolios in Panel C indicates high quality value firms, and lowest decile (P1) indicates low quality growth firms. The last column represents results of long-short portfolios which entails buying firms in top decile (P10) and selling firms in the bottom decile (P1). Portfolios are rebalanced at the end of every month, and value weighted returns are computed. Portfolio returns for decile portfolios are reported in excess over risk-free rate. Returns in bold are statistically significant at 5 percent.

Panel A: Quality-portfolios	**P1**	**P2**	**P3**	**P4**	**P5**	**P6**	**P7**	**P8**	**P9**	**P10**	**P10-P11**
Summary statistics											
Mean quality score	- 0.86	- 0.52	- 0.31	- 0.15	- 0.02	0.11	0.25	0.40	0.59	0.94	-
Mean value score	0.05	0.09	0.04	- 0.04	- 0.18	- 0.30	- 0.39	- 0.63	- 0.88	- 1.25	-
Mean beta	1.22	1.27	1.19	1.03	0.97	0.97	1.01	1.07	1.07	0.81	-
Mean market capital (in millions)	329	617	953	1,221	1,425	1,561	1,822	1,811	2,196	4,305	-
No of companies	402	381	337	325	324	323	330	339	335	295	-
Value weighted portfolio											
Mean excess return	0.28%	**0.44%**	**0.61%**	**0.39%**	**0.53%**	**0.59%**	**0.60%**	**0.56%**	**0.57%**	**0.75%**	**0.47%**
Standard deviation	7.36%	5.72%	4.95%	4.79%	4.52%	4.38%	4.40%	4.47%	4.37%	4.80%	5.53%
Sharpe ratio annualised	0.13	0.26	0.43	0.28	0.41	0.46	0.47	0.43	0.46	0.54	0.29
t-stat	*1.03*	*2.05*	*3.31*	*2.17*	*3.16*	*3.60*	*3.69*	*3.36*	*3.54*	*4.20*	*2.28*

Panel B: Value-portfolios	**P1**	**P2**	**P3**	**P4**	**P5**	**P6**	**P7**	**P8**	**P9**	**P10**	**P10-P11**
Summary statistics											
Mean quality score	0.61	0.43	0.32	0.22	0.15	0.09	0.04	- 0.02	- 0.10	- 0.22	-
Mean value score	- 1.51	- 1.15	- 0.83	- 0.53	- 0.23	0.07	0.38	0.70	1.06	1.44	-

Mean beta	1.08	1.11	1.07	1.12	0.94	1.03	0.96	0.94	0.85	0.93	-
Mean market capital (in millions)	2,976	2,926	2,488	2,101	1,704	1,445	1,128	868	628	325	-
No of companies	431	320	292	283	283	285	301	334	384	476	-
Value weighted portfolio											
Mean excess return	**0.51%**	**0.51%**	**0.49%**	**0.54%**	**0.61%**	**0.66%**	**0.75%**	**0.90%**	**0.91%**	**0.93%**	0.42%
Standard deviation	5.11%	4.60%	4.54%	4.41%	4.34%	4.43%	4.49%	4.95%	5.72%	7.37%	6.11%
Sharpe ratio annualised	0.35	0.39	0.38	0.42	0.49	0.52	0.58	0.63	0.55	0.44	0.24
t-stat	*2.70*	*3.01*	*2.92*	*3.28*	*3.78*	*4.01*	*4.52*	*4.87*	*4.31*	*3.41*	*1.86*

Panel C: Quality at reasonable price-portfolios	**P1**	**P2**	**P3**	**P4**	**P5**	**P6**	**P7**	**P8**	**P9**	**P10**	**P10-P11**
Summary statistics											
Mean quality score	- 0.10	0.28	0.46	0.49	0.36	0.24	0.18	0.12	0.11	0.20	-
Mean value score	- 1.34	- 1.18	- 1.07	- 0.86	- 0.49	- 0.13	0.20	0.52	0.83	1.17	-
Mean beta	1.14	1.16	1.10	1.05	0.99	1.05	0.97	0.88	0.84	0.87	-
Mean market capital (in millions)	1,185	2,662	2,851	2,912	2,427	1,895	1,412	978	797	461	-
No of companies	499	308	275	266	271	278	295	325	372	497	-
Value weighted portfolio											
Mean excess return	0.41%	0.30%	**0.52%**	**0.57%**	**0.55%**	**0.73%**	**0.83%**	**0.77%**	**0.95%**	**1.11%**	**0.69%**
Standard deviation	5.81%	4.89%	4.59%	4.37%	4.33%	4.32%	4.61%	4.76%	5.12%	6.01%	4.92%
Sharpe ratio annualised	0.25	0.22	0.39	0.46	0.44	0.58	0.63	0.56	0.64	0.64	0.49

t-stat	*1.92*	*1.68*	*3.07*	*3.55*	*3.40*	*4.55*	*4.87*	*4.34*	*4.98*	*4.96*	*3.79*

Table 2: Quality, Value and QARP decile portfolios – Alphas

The table below depicts additional descriptive statistics and alphas for each of the quality, value, and QARP sorted decile portfolios from July 1957 to December 2017. At the end of each month, firms are sorted into decile portfolios based on their quality score, BE/ME ratio and combined quality and value score, respectively. Panel A refers to pure quality portfolios where the highest decile (P10) represents quality firms whereas the lowest decile (P1) represents junk firms. Similarly, results of pure value portfolios are presented in Panel B. Low BE/ME ratio (P1) indicates growth or expensive firms while high BE/ME ratio (P10) indicates value or cheap firms. Consequently, top decile (P10) portfolios in Panel C indicates high quality value firms, and lowest decile (P1) indicates low quality growth firms. The last column represents results of long-short portfolios which entails buying firms in top decile (P10) and selling firms in the bottom decile (P1). Portfolios are rebalanced at the end of every month, and value weighted returns are computed. The reported alphas are estimated based on the time-series regression of monthly excess returns of portfolios on standard risk factors. The explanatory variables include CAPM 1-factor model ($CAPM$), Fama-French 3 factor model ($FFM-3$), Carhart-4 factor model ($Carhart-4$), Fama-French 5 factor model ($FFM-5$), Stambaugh mispricing factor model ($Stambaugh\ factors$) and q-factor model ($q-factor$). Information ratio is computed by dividing the Carhart – 4 alphas by the standard deviation of estimated residuals from time-series regression of portfolio return on Carhart-4 factors. The reported information ratios are annualised. Returns in bold are statistically significant at 5 percent.

Panel A: Quality – portfolios	**P1**	**P2**	**P3**	**P4**	**P5**	**P6**	**P7**	**P8**	**P9**	**P10**	**P10-P11**
Summary statistics											
Realised beta - CAPM	1.44	1.22	1.07	1.02	0.97	0.95	0.96	0.99	0.96	0.97	- 0.46
Information ratio	- 0.66	- 0.63	- 0.23	- 0.60	- 0.19	- 0.00	0.18	- 0.02	0.16	0.68	0.86
Adjusted R-square	0.81	0.89	0.91	0.89	0.90	0.90	0.90	0.92	0.90	0.83	0.46
Alphas											
CAPM	**- 0.50%**	**- 0.23%**	0.03%	**- 0.17%**	0.00%	0.06%	0.08%	0.02%	0.05%	**0.22%**	**0.72%**
t-stat	*- 3.42*	*- 2.73*	*0.39*	*- 2.46*	*- 0.04*	*1.16*	*1.44*	*0.35*	*0.99*	*2.52*	*3.74*
FFM-3	**- 0.76%**	**- 0.40%**	**- 0.13%**	**- 0.33%**	**- 0.12%**	- 0.01%	0.03%	0.01%	0.09%	**0.41%**	**1.18%**
t-stat	*- 6.09*	*- 5.62*	*- 2.33*	*- 5.38*	*- 2.21*	*- 0.23*	*0.64*	*0.12*	*1.71*	*5.48*	*7.52*
Carhart-4	**- 0.61%**	**- 0.34%**	- 0.10%	**- 0.27%**	- 0.08%	0.00%	0.07%	- 0.01%	0.06%	**0.39%**	**1.00%**
t-stat	*- 4.87*	*- 4.65*	*- 1.71*	*- 4.47*	*- 1.42*	*- 0.02*	*1.34*	*- 0.15*	*1.20*	*5.00*	*6.35*
FFM-5	**- 0.48%**	**- 0.29%**	- 0.07%	**- 0.28%**	- 0.13%	- 0.07%	0.03%	- 0.09%	- 0.04%	**0.35%**	**0.83%**
t-stat	*- 4.63*	*- 4.03*	*- 1.16*	*- 4.32*	*- 2.20*	*- 1.23*	*0.43*	*- 1.79*	*- 0.81*	*6.09*	*6.88*

Stambaugh factors	**- 0.31%**	**- 0.17%**	- 0.01%	**- 0.23%**	- 0.01%	0.00%	0.10%	- 0.06%	- 0.04%	**0.24%**	**0.54%**
t-stat	*- 2.65*	*- 2.13*	*- 0.13*	*- 3.22*	*- 0.11*	*- 0.08*	*1.60*	*- 1.15*	*- 0.77*	*3.38*	*3.75*
q-factor	**- 0.35%**	**- 0.25%**	- 0.05%	**- 0.25%**	- 0.13%	- 0.09%	0.02%	**- 0.12%**	- 0.06%	**0.35%**	**0.31%**
t-stat	*- 3.05*	*- 3.06*	*- 0.77*	*- 3.25*	*- 1.83*	*- 1.37*	*0.35*	*- 2.24*	*- 1.02*	*4.92*	*2.15*

Panel B: Value – portfolios	**P1**	**P2**	**P3**	**P4**	**P5**	**P6**	**P7**	**P8**	**P9**	**P10**	**P10-P11**
Summary statistics											
Realised beta - CAPM	1.08	1.00	0.99	0.95	0.91	0.92	0.92	0.98	1.08	1.29	0.21
Information ratio	0.09	0.00	- 0.18	- 0.03	0.05	0.17	0.36	0.67	0.50	0.39	0.33
Adjusted R-square	0.92	0.91	0.89	0.88	0.87	0.88	0.89	0.89	0.87	0.80	0.67
Alphas											
CAPM	- 0.08%	- 0.04%	- 0.05%	0.02%	0.11%	**0.16%**	**0.25%**	**0.36%**	**0.32%**	**0.23%**	0.31%
t-stat	*- 1.00*	*- 0.64*	*- 0.81*	*0.28*	*1.64*	*2.14*	*3.22*	*3.75*	*2.63*	*1.27*	*1.36*
FFM-3	**0.16%**	0.04%	- 0.07%	- 0.05%	- 0.03%	- 0.02%	0.03%	0.08%	- 0.04%	- 0.20%	**- 0.36%**
t-stat	*2.86*	*0.81*	*- 1.20*	*- 0.85*	*- 0.50*	*- 0.41*	*0.44*	*1.04*	*- 0.42*	*- 1.30*	*- 2.09*
Carhart-4	0.04%	0.00%	- 0.08%	- 0.01%	0.02%	0.07%	**0.16%**	**0.32%**	**0.30%**	**0.37%**	**0.33%**
t-stat	*0.68*	*0.02*	*- 1.31*	*- 0.25*	*0.37*	*1.25*	*2.66*	*4.97*	*3.68*	*2.92*	*2.45*
FFM-5	**0.13%**	**- 0.09%**	**- 0.18%**	**- 0.16%**	**- 0.15%**	- 0.06%	0.00%	0.08%	0.00%	0.00%	**- 0.13%**
t-stat	*2.24*	*- 1.77*	*- 3.19*	*- 2.63*	*- 2.49*	*- 0.87*	*0.05*	*1.02*	*- 0.01*	*- 0.02*	*- 0.73*
Stambaugh factors	0.03%	**- 0.13%**	**- 0.14%**	- 0.08%	- 0.06%	0.09%	**0.19%**	**0.32%**	**0.25%**	**0.39%**	**0.36%**
t-stat	*0.45*	*- 2.22*	*- 2.20*	*- 1.22*	*- 0.78*	*1.13*	*2.47*	*3.64*	*2.38*	*2.35*	*1.96*

q-factor	0.00%	**- 0.19%**	**- 0.23%**	**- 0.15%**	- 0.11%	0.06%	0.10%	**0.25%**	**0.32%**	**0.55%**	0.16%
t-stat	*0.02*	*- 3.13*	*- 3.57*	*- 2.24*	*- 1.42*	*0.79*	*1.21*	*2.39*	*2.45*	*2.90*	*0.73*

Panel C: Quality at reasonable price – portfolios	**P1**	**P2**	**P3**	**P4**	**P5**	**P6**	**P7**	**P8**	**P9**	**P10**	**P10-P11**
Summary statistics											
Realised beta - CAPM	1.25	1.07	1.01	0.95	0.92	0.90	0.94	0.93	1.00	1.10	- 0.14
Information ratio	- 0.62	- 0.71	0.05	0.20	0.15	0.49	0.56	0.50	0.76	0.99	1.14
Adjusted R-square	0.92	0.92	0.93	0.89	0.86	0.86	0.88	0.86	0.88	0.85	0.64
Alphas											
CAPM	**- 0.27%**	**- 0.28%**	-0.03%	0.06%	0.04%	**0.24%**	**0.32%**	**0.26%**	**0.40%**	**0.50%**	**0.77%**
t-stat	*- 3.33*	*- 4.67*	*- 0.54*	*1.02*	*0.68*	*3.37*	*3.95*	*2.73*	*3.91*	*3.68*	*4.23*
FFM-3	- 0.13%	**- 0.18%**	0.08%	**0.11%**	0.00%	0.11%	0.10%	0.01%	0.11%	0.18%	**0.31%**
t-stat	*- 1.86*	*- 3.19*	*1.79*	*2.06*	*- 0.02*	*1.66*	*1.59*	*0.12*	*1.35*	*1.54*	*2.01*
Carhart-4	**- 0.30%**	**- 0.29%**	0.02%	0.08%	0.07%	**0.23%**	**0.26%**	**0.26%**	**0.39%**	**0.67%**	**0.96%**
t-stat	*- 4.59*	*- 5.26*	*0.35*	*1.45*	*1.13*	*3.65*	*4.11*	*3.70*	*5.61*	*7.31*	*8.42*
FFM-5	**- 0.16%**	**- 0.27%**	0.00%	0.04%	- 0.05%	0.04%	0.05%	0.01%	0.11%	**0.28%**	**0.44%**
t-stat	*- 2.15*	*- 4.73*	*0.07*	*0.63*	*- 0.74*	*0.63*	*0.74*	*0.13*	*1.20*	*2.19*	*2.63*
Stambaugh factors	**- 0.20%**	**- 0.28%**	- 0.04%	- 0.03%	0.01%	**0.16%**	**0.20%**	**0.26%**	**0.36%**	**0.62%**	**0.82%**
t-stat	*- 2.50*	*- 4.61*	*- 0.79*	*- 0.58*	*0.13*	*2.01*	*2.46*	*3.00*	*3.90*	*4.84*	*4.84*
q-factor	**- 0.38%**	**- 0.39%**	-0.09%	0.03%	0.01%	0.16%	**0.20%**	**0.23%**	**0.37%**	**0.72%**	**0.71%**
t-stat	*- 4.31*	*- 6.26*	*- 1.63*	*0.44*	*0.18*	*1.89*	*2.16*	*2.20*	*3.20*	*4.80*	*3.53*

Table 3: Quality and Value double sorted portfolios

The table below shows results for 25 double sorted portfolios from July 1957 to December 2017. Dependent sort is carried out, first sorting firms into quintiles based on value score. Each value score quintile is further sorted into quintiles-based on quality score. At the end of each month, firms are assigned to five quality-sorted portfolios based on their value scores. The lowest and highest decile is indicated by P1 (either low value or quality) and P5 (either high value or quality), respectively. The last column represents results of long-short portfolios which entails buying firms in top decile (P5) and selling firms in the bottom decile (P1). Portfolio returns for quintile portfolios are reported in excess over risk-free rate. The reported alphas are estimated based on the time-series regression of monthly excess returns of portfolios on Carhart-4 factor model ($Carhart - 4$). Returns in bold are statistically significant at 5 percent.

		Value						Carhart-4 P5-P1
		P1	**P2**	**P3**	**P4**	**P5**	**P5-P1**	**Alpha**
Quality	**P1**	0.07%	0.33%	**0.45%**	**0.41%**	**0.60%**	**0.53%**	**0.95%**
	t-stat	*0.24*	*1.43*	*2.14*	*2.15*	*3.43*	*2.80*	*5.71*
	P2	0.34%	0.36%	0.34%	**0.55%**	**0.72%**	**0.38%**	**0.76%**
	t-stat	*1.43*	*1.86*	*1.92*	*3.19*	*4.34*	*2.31*	*4.98*
	P3	**0.53%**	0.31%	**0.65%**	**0.78%**	**0.86%**	**0.34%**	**0.62%**
	t-stat	*2.35*	*1.78*	*3.90*	*4.60*	*4.97*	*2.29*	*4.29*
	P4	**0.53%**	**0.79%**	**0.81%**	**0.85%**	**1.14%**	**0.61%**	**0.89%**
	t-stat	*2.31*	*4.34*	*4.64*	*4.82*	*5.80*	*3.99*	*5.92*
	P5	**0.78%**	**0.91%**	**0.99%**	**1.03%**	**1.19%**	**0.41%**	**0.67%**
	t-stat	*2.82*	*3.85*	*4.60*	*4.33*	*4.73*	*2.00*	*3.31*
	P5-P1	**0.71%**	**0.58%**	**0.54%**	**0.62%**	**0.59%**		
	t-stat	*3.00*	*2.80*	*2.85*	*3.20*	*2.68*		
Carhart-4 P5-P1	**Alpha**	**0.77%**	**0.65%**	**0.64%**	**0.73%**	**0.49%**		
	t-stat	*4.16*	*4.28*	*4.76*	*5.06*	*2.74*		

Table 4: QMJ, HML and QARP factor returns

The table represents results for size-sorted quality (QMJ), value (HML) and quality at reasonable price (QARP) value weighted portfolios from July 1957 to December 2017. Conditional sorts are applied, first sorting firms into two size portfolios and then into three portfolios based on quality score, BE/ME ratio and combined quality and value score, respectively. The monthly median NYSE market equity is considered as the size breakpoint. Further, NYSE breakpoints are applied for quality score, BE/ME ratio and combined quality and value scores. At the end of each month, firms are assigned to two size-sorted portfolios based on their market equity. Factor returns represents the difference in the average monthly return of two high percentile portfolios and two low percentile portfolios within each size portfolios. Alphas from regressing the monthly QMJ, HML and QARP portfolio returns on monthly seminal factor returns are also reported. The explanatory variables include Fama-French 3 factor model $(FFM-3)$, Carhart-4 factor model $(Carhart-4)$, Fama-French 5 factor model $(FFM-5)$, FFM-5 plus Jegadessh and Titaman (1993) momentum (MOM) factor $(FFM-6)$, FFM-6 plus BAB factor $(FFM-7)$, Stambaugh mispricing factor model $(Stambaugh\ factors)$ and q-factor model $(q-factor)$. The Newey-West approach is applied to adjust t-statistics for autocorrelation and heteroskedasticity. Returns statistically significant at 5% are highlighted in bold.

	QMJ	HML	QARP
Value weighted portfolio			
Mean return	**0.28%**	**0.36%**	**0.47%**
t-stat	*3.40*	*2.76*	*3.80*
Standard deviation	2.19%	3.53%	3.33%
Sharpe ratio annualised	0.44	0.35	0.49
Max drawdown	37%	48%	48%
Alphas			
FFM-3	**0.57%**	-0.05%	**0.19%**
t-stat	*8.00*	*-0.62*	*2.12*
Carhart-4	**0.50%**	**0.36%**	**0.58%**
t-stat	*7.07*	*5.36*	*8.49*
FFM-5	**0.37%**	0.00%	0.19%
t-stat	*6.35*	*0.03*	*1.51*
FFM-6 (FFM-5+MOM)	**0.33%**	**0.33%**	**0.51%**
t-stat	*5.96*	*4.81*	*6.78*
FFM-7 (FFM-6+BAB)	**0.33%**	**0.34%**	**0.50%**
t-stat	*5.68*	*4.60*	*6.32*
Stambaugh factors	**0.26%**	**0.35%**	**0.50%**
t-stat	*3.63*	*3.86*	*5.11*
q-factor	**0.33%**	**0.38%**	**0.59%**
t-stat	*4.28*	*1.96*	*2.98*

*Fama-French five – factor and Stambaugh mispricing factor returns are available from July 1963, accordingly regression results for FFM-5, and Stambaugh factors are from the period July 1963-December 2017 (December 2016 for Stambaugh).

q-factor model return is available for January 1967; hence results are presented from January 1967-December 2016.

Figure 1: QMJ, HML, and QARP cumulative returns

The figure shows the cumulative returns for size-sorted quality (QMJ), value (HML) and quality at reasonable price (QARP) value weighted portfolios from July 1957 to December 2017. Conditional sorts are applied, first sorting firms into two size portfolios and then into three portfolios based on quality score, BE/ME ratio and combined quality and value score, respectively. The monthly median NYSE market equity is considered as the size breakpoint. Further, NYSE breakpoints are applied for quality score, BE/ME ratio and combined quality and value scores. At the end of each month, firms are assigned to two size-sorted portfolios based on their market equity. Factor returns represents the difference in the average monthly return of two high percentile portfolios and two low percentile portfolios within each size portfolios.

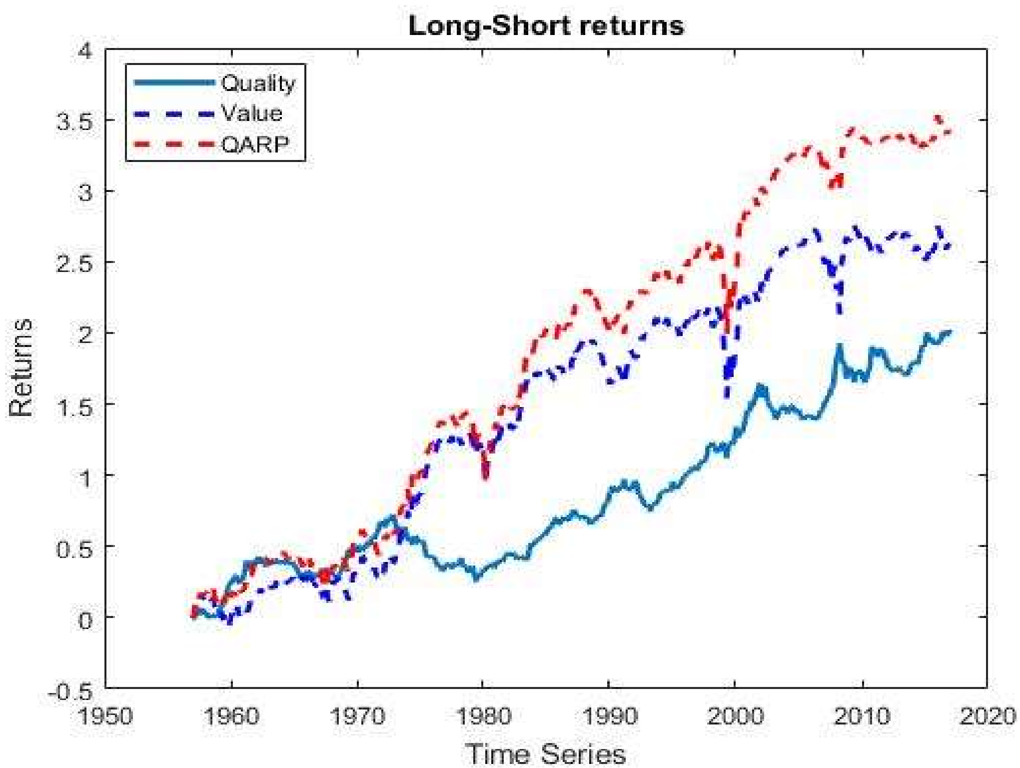

Table 5: Quality and Value correlation matrix

The table below represents the correlation matrix of the value weighted monthly returns of quality minus junk (QMJ), high minus low (HML), profit (PMJ), growth (GMJ) and safety (SMJ). QMJ portfolios are formed based on conditional sorts, first sorting firms into two size portfolios and then into three quality portfolios with monthly rebalance. Further, NYSE breakpoints are applied for quality score, BE/ME ratio, profit scores, growth score and safety score. The monthly median NYSE market equity is considered as the size breakpoint. At the end of each month, firms are assigned to two size-sorted portfolios based on their market equity. A long position is taken in firms in the top percentile and a short position in the firms in the bottom percentile within both size portfolios. Similar approach is applied to form HML, PMJ, GMJ and SMJ portfolios.

	Value	Quality	Profit	Growth	Safety
Value	1.00				
Quality	- 0.38	1.00			
Profit	- 0.34	0.85	1.00		
Growth	- 0.50	0.52	0.51	1.00	
Safety	- 0.26	0.76	0.50	0.08	1.00

Table 6: QMJ, HML and QARP: FFM-7 factor adjusted return

The table below depicts regression results for quality minus junk (QMJ), high minus low (HML), quality at reasonable price (QARP) value weighted portfolios from July 1963 to December 2017. Conditional sorts are applied, first sorting firms into two size portfolios and then into three portfolios based on quality score, BE/ME ratio and combined quality and value score, respectively. The monthly median NYSE market equity is considered as the size breakpoint. Further, NYSE breakpoints are applied for quality score, BE/ME ratio and combined quality and value scores. At the end of each month, firms are assigned to two size-sorted portfolios based on their market equity. Factor returns represents the difference in the average monthly return of two high percentile portfolios and two low percentile portfolios within each size portfolios. The explanatory variable consists of monthly time-series returns of Fama-French 5 factor model [market premium ($MKT-RF$), size factor (SMB), and value factor (HML), profitability factor (RMW) and investment factor (CMA)] plus Jegadeesh and Titaman (1993) momentum (MOM) factor alongwith Frazzini and Pedersen (2014) 'betting against beta' (BAB) factor. The Newey-West approach is applied to adjust t-statistics for autocorrelation and heteroskedasticity. Returns statistically significant at 5% are highlighted in bold.

	QMJ	HML	QARP
Alpha	**0.33%**	**0.34%**	**0.50%**
t-stat	*5.68*	*4.60*	*6.32*
MKT-RF	**- 0.17**	0.03	**- 0.09**
t-stat	*- 10.16*	*1.43*	*- 3.87*
SMB	**- 0.14**	0.01	- 0.03
t-stat	*- 6.20*	*0.26*	*- 1.00*
HML	**- 0.28**	**0.87**	**0.73**
t-stat	*- 8.36*	*20.78*	*17.85*
RMW	**0.49**	0.01	**0.11**
t-stat	*12.33*	*0.14*	*2.23*
CMA	- 0.08	0.04	0.01
t-stat	*- 1.84*	*0.61*	*0.08*
UMD	**0.05**	**- 0.45**	**- 0.45**
t-stat	*2.20*	*- 16.40*	*- 15.83*
BAB	0.01	0.00	0.03
t-stat	*0.31*	*- 0.19*	*1.10*
R-squared	70%	89%	85%
Adjusted R-squared	69%	89%	84%

*Fama-French five – factor and Stambaugh mispricing factor returns are available from July 1963, accordingly regression results for FFM-5, and Stambaugh factors are from the period July 1963-December 2017 (December 2016 for Stambaugh).

q-factor model return is available for January 1967; hence results are presented from January 1967-December 2016.

Table 7: Robustness tests: QMJ, HML and QARP factor returns

The table represents results for size-sorted quality (QMJ), value (HML) and quality at reasonable price (QARP) value weighted portfolios from July 1957 to December 2017. The QMJ and QARP portfolios results represent change in the method of computation of quality growth element. Conditional sorts are applied, first sorting firms into two size portfolios and then into three portfolios based on quality score, BE/ME ratio and combined quality and value score, respectively. The monthly median NYSE market equity is considered as the size breakpoint. Further, NYSE breakpoints are applied for quality score, BE/ME ratio and combined quality and value scores. At the end of each month, firms are assigned to two size-sorted portfolios based on their market equity. Factor returns represents the difference in the average monthly return of two high percentile portfolios and two low percentile portfolios within each size portfolios. Alphas from regressing the monthly QMJ, HML and QARP portfolio returns on monthly seminal factor returns are also reported. The explanatory variables include Fama-French 3 factor model ($FFM-3$), Carhart-4 factor model ($Carhart-4$), Fama-French 5 factor model ($FFM-5$), FFM-5 plus Jegadessh and Titaman (1993) momentum (MOM) factor ($FFM-6$), FFM-6 plus BAB factor ($FFM-7$), Stambaugh mispricing factor model ($Stambaugh\ factors$) and q-factor model ($q-factor$). The Newey-West approach is applied to adjust t-statistics for autocorrelation and heteroskedasticity. Returns statistically significant at 5% are highlighted in bold.

	QMJ	HML	QARP
Value weighted portfolio			
Mean return	**0.33%**	**0.36%**	**0.49%**
t-stat	*3.63*	*2.76*	*3.81*
Standard deviation	2.45%	3.53%	3.45%
Sharpe ratio annualised	0.47	0.35	0.49
Max drawdown	37%	48%	48%
Abnormal return - alphas			
FFM-3	**0.65%**	-0.05%	**0.21%**
t-stat	*7.75*	*-0.62*	*2.44*
Carhart-4	**0.57%**	**0.36%**	**0.61%**
t-stat	*7.06*	*5.36*	*8.59*
FFM-5	**0.42%**	0.00%	0.20%
t-stat	*5.98*	*0.03*	*1.62*
FFM-6 (FFM-5+MOM)	**0.38%**	**0.33%**	**0.53%**
t-stat	*5.54*	*4.81*	*6.96*
FFM-7 (FFM-6+BAB)	**0.37%**	**0.34%**	**0.52%**
t-stat	*5.23*	*4.60*	*6.60*
Stambaugh factors	**0.25%**	**0.35%**	**0.47%**
t-stat	*3.05*	*3.86*	*4.95*
q-factor	**0.38%**	**0.38%**	**0.60%**
t-stat	*4.33*	*1.96*	*3.08*

*Fama-French five – factor and Stambaugh mispricing factor returns are available from July 1963, accordingly regression results for FFM-5, and Stambaugh factors are from the period July 1963-December 2017 (December 2016 for Stambaugh).

q-factor model return is available for January 1967; hence results are presented from January 1967-December 2016.

Appendix A: Graham and Dodd (1934) prescribed firm screen

The original Graham and Dodd (1934) prescribed firm screen contained ten criteria to identify quality firms at bargain price. The list below has been retrieved from Damodaran (2012):

1. Earnings to price ratio that is twice the AAA bond yield
2. Price to earnings (PE) ratio of the firm must be less than 40% of the average PE for all firms over the previous five years.
3. Dividend Yield should be greater than two thirds of the AAA Corporate Bond Yield
4. Market Price of a firm should be less than two thirds of Tangible Book Value
5. Market Price of a firm should be less than two thirds of Net Current Asset Value (NCAV), where net current asset value is defined as liquid current assets including cash minus current liabilities
6. Debt-Equity Ratio should be less than one
7. Current Assets must be greater than twice that of Current Liabilities
8. Debt should be twice Net Current Assets
9. Historical growth in earnings per share (EPS) over last 10 years must be greater than 7%
10. No more than two years of declining earnings over the previous 10 years

Appendix B: Derivation of residual income model

1. General model construct

The standard dividend discount model is given by

$$p_t = \sum_{t=0}^{\infty} \frac{z_{t+1}}{(1+r)^{t+1}} \tag{1}$$

Combining equation (1) with the below zero-sum series[48]

$$0 = y_0 + \frac{[y_1 - (1+r)y_0]}{1+r} + \frac{[y_2 - (1+r)y_1]}{(1+r)^2} + \cdots \tag{2}$$

results in

$$p_t = y_t + \sum_{t=0}^{\infty} \frac{z_{t+1}}{(1+r)^{t+1}} \tag{3}$$

where

$$z_{t+1} \equiv y_t + d_t - (1+r)y_{t-1} \tag{4}$$

[48] In the above equations no economic significance is given to y-sequence and z-sequence. These equations are a generalised form to suit any sequence of y and z. The idea behind such generalised representation is to define intrinsic value of equity with an initial point (y_t) and the sum of a present value sequence dependent of variable (x_t). (Ohlson, 2009)

2. General model construct (with abnormal growth)

Further, to consider abnormal growth in z_t, a growth parameter γ is introduced which refers to the geometric increase in z_{t+1} $\left(\gamma = \frac{z_{t+1}}{z_1}\right)$. Therefore, the above standard equation transforms to

$$p_t = y_t + \frac{y_t + d_1 - (1+r)y_{t-1}}{1+r-\gamma} = y_t + \frac{\left(\frac{y_1 + d_1}{y_{t-1}} - \gamma\right)}{1+r-\gamma}$$

(5)

3. Residual income valuation (RIV) model

The RIV model follows the general model construction mentioned in equation (3) above. Substituting $y_t = b_t$ in equation (3) and (4) yields

$$p_t = b_t + \sum_{t=0}^{\infty} \frac{[b_{t+1} + d_{t+1} - (1+r)b_t]}{(1+r)^{t+1}}$$

(6)

Assuming clean surplus[49], the RIV model is given by

$$p_t = b_t + \sum_{t=0}^{\infty} \frac{(x_{t+1} - r * b_t)}{(1+r)^{t+1}}$$

(7)

[49] The RIM model follows clean surplus accounting (CSAR) assumption. CSAR accounting refers to $b_{t+1} - b_t = x_{t+1} - d_{t+1}$ where all changes in the balance sheet value of shareholders' equity, other than transactions with owners, are included in earnings.

Ohlson (2009) introduced the abnormal growth term (γ) signifying geometric increase (decrease) in residual income[50]. Consequently, the RIV[51] equation, in line with equation (5) transforms to

$$p_t = b_t + \frac{b_{t+1} + d_{t+1} - (1+r)b_t}{1+r-\gamma}$$

(8)

Taking b_t common results in

$$p_t = b_t\left[1 + \frac{\frac{b_{t+1} + d_{t+1}}{b_t} - (1+r)}{1+r-\gamma}\right]$$

(9)

Further, taking $1+r-\gamma$ as the common dividing factor, results in

$$p_t = b_t\left[\frac{1+r-\gamma+\left(\frac{b_{t+1} + d_{t+1}}{b_t}\right) - 1 - r}{1+r-\gamma}\right]$$

(10)

After cancelling common opposite sign terms,

$$p_t = b_t\left[\frac{\left(\frac{b_{t+1} + d_{t+1}}{b_t}\right) - \gamma}{1+r-\gamma}\right]$$

(11)

Additionally, assuming clean surplus

$$b_{t+1} + d_{t+1} = x_{t+1} + b_t$$

(12)

---

[50] Refer Appendix ** for details

[51] The general form of this equation has the additive book value (Penman, 2007), however Ohlson (2009) represented it as a multiplicative adjustment $p_t = b_t + \frac{(roe_{t+1} - (\gamma - 1))}{1+r-\gamma}$. This dissertation considers the standard multiplicative derivation.

Results in

$$p_t = b_t \left[\frac{\left(\frac{x_{t+1} + b_t}{b_t}\right) - \gamma}{1 + r - \gamma} \right]$$

(13)

$$p_t = b_t \left[\frac{\frac{x_{t+1}}{b_t} + \frac{b_t}{b_t} - \gamma}{1 + r - \gamma} \right]$$

(14)

$$p_t = b_t \left[\frac{roe_{t+1} + 1 - \gamma}{1 + r - \gamma} \right]$$

(15)

Putting $\gamma = 1 + g$

$$p_t = b_t \left[\frac{roe_{t+1} + 1 - (1 + g)}{1 + r - (1 + g)} \right]$$

(16)

$$p_t = b_t \left[\frac{roe_{t+1} - g}{r - g} \right]$$

(17)

4. Residual income valuation (RIV) model with Shiller *et al.*, (1984) noise trader model

Shiller *et al*., (1984) noise trader model is given by:

$$p_t = \sum_{k=0}^{\infty} \frac{E_t(d_{t+k}) + \emptyset E_t(Y_{t+k})}{(1+\rho+\emptyset)^{k+1}}$$

(18)

Combining equation (18) with equation (8) results in

$$p_t = b_t + \frac{b_{t+1} + d_{t+1} - (1+\rho+\emptyset)b_t + \emptyset Y_{t+1}}{1+\rho+\emptyset-\gamma}$$

(19)

Taking b_t common results in

$$p_t = b_t \left[1 + \frac{\frac{b_{t+1} + d_{t+1}}{b_t} - (1+\rho+\emptyset) + \emptyset \frac{Y_{t+1}}{b_t}}{1+\rho+\emptyset-\gamma} \right]$$

(20)

Further, taking $1+\rho+\emptyset-\gamma$ as the common dividing factor, results in

$$p_t = b_t \left[\frac{1+\rho+\emptyset-\gamma + \left(\frac{b_{t+1} + d_{t+1}}{b_t}\right) - 1 - \rho - \emptyset + \emptyset \frac{Y_{t+1}}{b_t}}{1+\rho+\emptyset-\gamma} \right]$$

(21)

After cancelling common opposite sign terms,

$$p_t = b_t \left[\frac{\left(\frac{b_{t+1} + d_{t+1}}{b_t}\right) - \gamma + \emptyset \left(\frac{Y_{t+1}}{b_t}\right)}{1+\rho+\emptyset-\gamma} \right]$$

(22)

Additionally, assuming clean surplus

$$b_{t+1} + d_{t+1} = e_{t+1} + b_t$$

(23)

Results in

$$p_t = b_t \left[\frac{\left(\frac{e_{t+1} + b_t}{b_t}\right) - \gamma + \emptyset\left(\frac{Y_{t+1}}{b_t}\right)}{1 + \rho + \emptyset - \gamma} \right]$$

(24)

$$p_t = b_t \left[\frac{\frac{x_{t+1}}{b_t} + \frac{b_t}{b_t} - \gamma + \emptyset\left(\frac{Y_{t+1}}{b_t}\right)}{1 + \rho + \emptyset - \gamma} \right]$$

(25)

$$p_t = b_t \left[\frac{roe_{t+1} + 1 - \gamma + \emptyset\left(\frac{Y_{t+1}}{b_t}\right)}{1 + \rho + \emptyset - \gamma} \right]$$

(26)

Putting $\gamma = 1 + g$

$$p_t = b_t \left[\frac{roe_{t+1} + 1 - (1 + g) + \emptyset\left(\frac{Y_{t+1}}{b_t}\right)}{1 + \rho + \emptyset - (1 + g)} \right]$$

(27)

$$p_t = b_t \left[\frac{roe_{t+1} - g + \emptyset\left(\frac{Y_{t+1}}{b_t}\right)}{\rho + \emptyset - g} \right]$$

(28)

Appendix C: Construction of quality score

This section describes the quality measures of Asness *et al.,* (2017). The total quality score is obtained by averaging the z-scores of each of the three elements of quality i.e. profit, growth and safety:

$$z_{quality} = avg\left(z_{profit} + z_{growt} + z_{safety}\right) \tag{1}$$

1. Profit

The profit component consists of gross profit to asset ratio ($GPOA$), return on equity (ROE), return on asset (ROA), cash flow over assets ($CFOA$), gross profit margin ($GMAR$) and accrual to total assets (ACC).

$GPOA$ is computed as the difference between revenue ($REVT$) and cost of goods sold ($COGS$) scaled by total assets (AT). ROE refers to net income before extraordinary items (IB) divided by book equity (BE). BE is calculated as the difference between shareholders equity (SEQ) and preferred firm value. In case of absence of SEQ values, the sum of common shareholders equity (CEQ) and preferred firm ($PSTK$) is considered. In case both above are unavailable, SEQ is substituted as difference between total assets (AT) and total liabilities (TL) plus redeemable minority interest ($MIBT$). Further, in case $PSTK$ is unavailable, the redeemable values ($PSTKL$ or $PSTKRV$, whichever is higher) is considered. ROA is defined as net income before extraordinary items (IB) divided by total assets (AT). In line with Fama and French (1998) and Daniel and Titman (2006), $CFOA$ refers to net income before extraordinary (IB) items plus depreciation (DP) minus sum of change in working capital[52] (ΔWC) and capital expenditure ($CAPX$), if available, scaled by total assets $[\frac{IB+DP-\Delta WC-CAPX}{AT}]$. Working capital is defined as current assets (ACT) minus current liabilities (LCT) excluding cash and cash equivalents (CHE), short -term

[52] Annual change.

debt (DLC) and income tax payable (TXP)[53]. GMAR is computed as the difference between revenue ($REVT$) and cost of goods sold ($COGS$) scaled by total sales ($SALE$). ACC is equal to sum of depreciation (DP) and changes in working capital (ΔWC) scaled by AT $\left[-\frac{(\Delta WC-DP)}{AT}\right]$.

Every month, the ratios (x) are ranked (r_x) in the ascending order, and z-scores of ranks for each firm is given by:

$$z-score\ (x_i) = \frac{r_{xi} - \bar{r}}{\sigma_r}$$

(2)

where $\bar{r}$ and σ_r are the cross-sectional mean and standard deviation of the ranks.

Subsequently, the z-score for profit element is derived by averaging the z-score of all the above variables:

$$z_{profit} = avg\left(z_{gpoa} + z_{roe} + z_{roa} + z_{cfoa} + z_{gmar} + z_{acc}\right)$$

(3)

2. Growth

Growth component consist of five-year simple growth of the above stated profit variables (except ACC). The growth ratios are computed as follows:

$$\Delta gpoa = \frac{GP_t - GP_{t-5}}{AT_{t-5}}$$

(4)

$$\Delta roe = \frac{IB_t - IB_{t-5}}{BE_{t-5}}$$

(5)

$$\Delta roa = \frac{IB_t - IB_{t-5}}{AT_{t-5}}$$

(6)

[53] For computing working capital, in order to consider sizeable observation cash and cash equivalents (CHE), short -term debt (DLC) and income tax payable (TXP) are considered if data is available.

$$\Delta cfoa = \frac{CF_t - CF_{t-5}}{AT_{t-5}}$$

(7)

$$\Delta gmar = \frac{GP_t - GP_{t-5}}{SALE_{t-5}}$$

(8)

where $GP = REVT - COGS$, $CF = IB + DP - \Delta WC - CAPX$ and $WC = ACT - LCT - CHE + DLC + TXP$[54].

After computing the z-score for each of the growth variables, the combined growth score is given by:

$$z_{growt} = avg\left(z_{\Delta gpoa} + z_{\Delta roe} + z_{\Delta roa} + z_{\Delta cfoa} + z_{\Delta gmar}\right)$$

(9)

3. **Safety**

The safety element consists of Frazzini and Pedersen (2014) 'betting against beta' (BAB) factor (multiplied by -1 as low beta are considered as quality stocks), leverage ratio (LEV), Ohlson (1980) O-score (OS), Altman (1986) Z-score (ZS), and volatility in quarterly ROE ($EVOL$)[55].

Consistent with Frazzini and Pedersen (2014) BAB ($\hat{\beta}_i^{ts}$) is computed as follows:

$$\hat{\beta}_i^{ts} = \hat{\rho}\frac{\widehat{\sigma_i}}{\widehat{\sigma_m}}$$

(10)

where $\widehat{\sigma_i}$ and $\widehat{\sigma_m}$ denotes standard deviation of security returns and market returns, respectively. Standard deviations are computed using one-year rolling window on daily logarithmic returns. Further, the correlation ($\hat{\rho}$) between security returns and market returns is computed based on five-year overlapping

[54] CHE, DLC and TXP only if available.
[55] EVOL is multiplied by -1 as low volatile earning stocks are considered as quality stocks.

three-day logarithmic returns. The three-day logarithmic returns are computed as follows:

$$r_{i,t}^{3d} = \sum_{k=0}^{2} \text{In}\left(1 + r_{t+k}^{i}\right)$$

(11)

LEV is computed as negative sum of long term debt $(DLTT)$, long term debt (DLC), minority interest $(MIBT)$ and $PSTK$, whichever is available, divided by TA.

Altman Z-score (ZS) is given by:

$$ZS = (1.2WC + 1.4RE + 3.3EBIT + 0.6ME + SALE)/AT)$$

(12)

where WC = working capital, RE= retained earnings, $EBIT$ = earnings before interest and taxes, ME=market equity[56]

Further, Ohlson O-score equation is given by

$$OS = -\left(-1.32 - 0.407 * \log\left(\frac{ADJASSET}{CPI}\right) + 6.03 * \left(\frac{DLC + DLTT}{ADJASSET}\right) - 1.43 * \left(\frac{ACT - LCT}{ADJASSET}\right) + 0.076 * \left(\frac{LCT}{ACT}\right) - 1.72 * OENEG - 2.37 * \left(\frac{IB}{AT}\right) - 1.83 * \left(\frac{PI}{LT}\right) + 0.285 * INTWO - 0.521 * CHIN\right)$$

(13)

where $ADJASSET$ refers to the excess of ten percent of difference between market equity[57] and book equity plus total assets $[TA + 0.1(ME - BE)]$. CPI refers to consumer price index[58]. PI indicates pre-tax income. OENEG is equal to one if total assets are less than total liabilities, zero otherwise. INTWO is again a dummy equal to the firm is making losses for cumulative two year

[56] Altman Z-score for year t+1 is assigned the market equity as on end of June t
[57] Ohlson O-score for year t+1 is assigned the market equity as on end of June t
[58] CPI is retrieved from Federal Reserve Economic Data website: https://fred.stlouisfed.org/series/CPALTT01USA661S

($MAX\{IB_t, IB_{t-1}\} < 0$). CHIN is defined as the change in annual IB scaled by absolute sum of the current and previous IB $\left[\frac{(IB_t - IB_{t-1})}{(|IB|_t + |IB|_{t-1})}\right]$.

$EVOL$ is the volatility in the previous 60 quarterly ROE. A minimum of 12 non-missing quarter information is necessary for computing $EVOL$. Further, in line with Hou, Xue, and Zhang (2015, RFS), quarterly ROEs is computed by scaling the quarterly income before extraordinary items (IBQ_q) by one-quarter lagged book-equity. Quarterly book equity is computed as the quarterly ($SEQQ$) plus deferred taxes and investment tax credit ($TXDITCQ$), if available, minus book value of preferred stock[59] ($PSTKQ$). Further, if $SEQQ$ is unavailable book equity is quarterly common equity plus $PSTKQ$. If both $SEQQ$ and $CEQQ$ is unavailable, quarterly book equity is quarterly total assets (ATQ) minus quarterly total liabilities (LTQ).

Further, while aligning quarterly $EVOL$ with monthly CRSP returns, the most recent public quarterly earnings announcement dates (RDQ) is considered. Quarterly $EVOL$ data is aligned with monthly CRSP only when the CRSP months is after RDQ. Specifically, for example, if the RDQ is June of year t, quarterly $EVOL$ would be considered for next CRSP month i.e. July year t [60]. Additionally, the end of fiscal quarter that matched with most recent RDQ should be within 6 months of the aligned CRSP month.

[59] The redemption value of quarterly preferred equity (PSTKRQ) is also considered, if available.

[60] Generally, quarterly information is considered for next three months CRSP months, however in cases where latest quarterly data is available, the same is considered.

Appendix D: Additional results and robustness checks

Table 8: Quality, Value and QARP decile portfolios (equally weighted)

The table below represents the results for quality, value and quality at reasonable price (QARP) sorted decile portfolios from July 1957 to December 2017. At the end of each month, firms are sorted into decile portfolios based on their quality score, BE/ME ratio and combined quality and value score, respectively. Panel A refers to pure quality portfolios where the highest decile (P10) represents quality firms whereas the lowest decile (P1) represents junk firms. Similarly, results of pure value portfolios are presented in Panel B. Low BE/ME ratio (P1) indicates growth or expensive firms while high BE/ME ratio (P10) indicates value or cheap firms. Consequently, top decile (P10) portfolios in Panel C indicates high quality value firms, and lowest decile (P1) indicates low quality growth firms. The last column represents results of long-short portfolios which entails buying firms in top decile (P10) and selling firms in the bottom decile (P1). Portfolios are rebalanced at the end of every month, and equally weighted returns are computed. Portfolio returns for decile portfolios are reported in excess over risk-free rate. Returns in bold are statistically significant at 5 percent.

Panel A: Quality-portfolios	**P1**	**P2**	**P3**	**P4**	**P5**	**P6**	**P7**	**P8**	**P9**	**P10**	**P10-P11**
Value weighted portfolio											
Mean excess return	0.54%	**0.90%**	**0.90%**	**0.89%**	**0.92%**	**0.94%**	**0.98%**	**0.94%**	**0.97%**	**1.06%**	**0.52%**
Standard deviation	8.35%	6.73%	5.98%	5.60%	5.28%	5.15%	5.12%	5.04%	4.97%	5.28%	5.31%
Sharpe ratio annualised	0.22	0.46	0.52	0.55	0.61	0.63	0.66	0.65	0.68	0.70	0.34
t-stat	*1.74*	*3.59*	*4.07*	*4.28*	*4.71*	*4.92*	*5.13*	*5.04*	*5.26*	*5.43*	*2.66*

Panel B: Value-portfolios	**P1**	**P2**	**P3**	**P4**	**P5**	**P6**	**P7**	**P8**	**P9**	**P10**	**P10-P11**
Value weighted portfolio											
Mean excess return	0.39%	**0.55%**	**0.59%**	**0.65%**	**0.63%**	**0.79%**	**0.92%**	**1.06%**	**1.17%**	**1.70%**	**1.31%**
Standard deviation	6.62%	5.79%	5.57%	5.28%	5.14%	5.08%	5.14%	5.31%	5.72%	7.67%	5.43%
Sharpe ratio annualised	0.20	0.33	0.37	0.43	0.43	0.54	0.62	0.69	0.71	0.77	0.84
t-stat	*1.59*	*2.57*	*2.85*	*3.33*	*3.31*	*4.19*	*4.83*	*5.38*	*5.52*	*5.98*	*6.50*

Panel C: Quality at reasonable price-portfolios	**P1**	**P2**	**P3**	**P4**	**P5**	**P6**	**P7**	**P8**	**P9**	**P10**	**P10-P11**
Value weighted portfolio											
Mean excess return	0.18%	**0.50%**	**0.71%**	**0.66%**	**0.73%**	**0.88%**	**0.98%**	**1.13%**	**1.29%**	**1.65%**	**1.48%**
Standard deviation	7.11%	5.85%	5.40%	5.18%	5.11%	5.22%	5.39%	5.61%	5.86%	6.14%	4.25%
Sharpe ratio annualised	0.09	0.30	0.45	0.44	0.49	0.58	0.63	0.70	0.76	0.93	1.20
t-stat	*0.66*	*2.32*	*3.54*	*3.45*	*3.84*	*4.54*	*4.91*	*5.43*	*5.94*	*7.25*	*9.36*

Table 9: Quality and Value double sorted portfolios (independent sort)

The table below shows results for 25 double sorted portfolios from July 1957 to December 2017. Independent sort is applied, separately sorting firms into five quintiles based on value score and five quintiles based on quality score. Accordingly, 25 portfolios are formed at the intersection of value and quality score quintiles. The lowest and highest decile is indicated by P1 (either low value or quality) and P5 (either high value or quality), respectively. The last column represents results of long-short portfolios which entails buying firms in top decile (P5) and selling firms in the bottom decile (P1). Portfolios are formed at the end of each month, and rebalanced monthly. Portfolio returns for quintile portfolios are reported in excess over risk-free rate. The reported alphas are estimated based on the time-series regression of monthly excess returns of portfolios on Carhart-4 factor model ($Carhart - 4$). Returns in bold are statistically significant at 5 percent.

		Value						**Carhart-4 P5-P1 Alpha**
		P1	**P2**	**P3**	**P4**	**P5**	**P5-P1**	
Quality	**P1**	0.10%	0.28%	0.37%	**0.59%**	**0.73%**	**0.63%**	**0.66%**
	t-stat	0.37	1.17	1.69	2.67	2.67	2.84	3.85
	P2	0.34%	0.37%	0.32%	**0.75%**	**0.98%**	**0.63%**	**0.81%**
	t-stat	1.46	1.90	1.79	3.99	4.02	2.90	4.96
	P3	**0.51%**	0.34%	**0.62%**	**0.81%**	**1.00%**	**0.49%**	**0.56%**
	t-stat	2.34	1.89	3.77	4.60	4.63	2.64	4.00
	P4	**0.40%**	**0.52%**	**0.72%**	**0.81%**	**1.04%**	**0.64%**	**0.71%**
	t-stat	2.06	3.04	4.22	4.63	4.47	3.20	4.89
	P5	**0.58%**	**0.68%**	**0.81%**	**1.18%**	**1.06%**	**0.48%**	**0.47%**
	t-stat	3.35	4.16	4.81	6.01	4.36	2.35	2.93
	P5-P1	**0.48%**	**0.40%**	**0.44%**	**0.59%**	0.33%		
	t-stat	2.75	2.60	3.15	4.19	1.73		
Carhart-4 P5-P1	**Alpha**	**0.83%**	**0.68%**	**0.67%**	**0.80%**	**0.65%**		
	t-stat	5.52	4.80	4.99	5.68	3.48		

Table 10: PMJ, GMJ and SMJ factor returns

The table represents results for size-sorted profit (PMJ), growth (GMJ) and safety (SMJ) value weighted portfolios from July 1957 to December 2017. Conditional sorts are applied, first sorting firms into two size portfolios and then into three portfolios based on profit, growth and safety score, respectively. The monthly median NYSE market equity is considered as the size breakpoint. Further, NYSE breakpoints are applied for quality score, BE/ME ratio and combined quality and value scores. At the end of each month, firms are assigned to two size-sorted portfolios based on their market equity. Factor returns represents the difference in the average monthly return of two high percentile portfolios and two low percentile portfolios within each size portfolios. Alphas from regressing the monthly PMJ, GMJ and SMJ portfolio returns on monthly seminal factor returns are also reported. The explanatory variables include Fama-French 3 factor model ($FFM-3$), Carhart-4 factor model ($Carhart-4$), Fama-French 5 factor model ($FFM-5$), FFM-5 plus Jegadessh and Titaman (1993) momentum (MOM) factor ($FFM-6$), FFM-6 plus BAB factor ($FFM-7$), Stambaugh mispricing factor model ($Stambaugh\ factors$) and q-factor model ($q-factor$). The Newey-West approach is applied to adjust t-statistics for autocorrelation and heteroskedasticity. Returns statistically significant at 5% are highlighted in bold.

	PMJ	GMJ	SMJ
Value weighted portfolio			
Mean return	**0.21%**	0.01%	**0.39%**
t-stat	*2.99*	*0.07*	*4.00*
Standard deviation	1.89%	1.87%	2.65%
Sharpe ratio annualised	38.49%	0.96%	51.45%
Max drawdown	24%	46%	47%
Alphas			
FFM-3	**0.42%**	**0.15%**	**0.72%**
t-stat	*5.96*	*2.54*	*8.45*
Carhart-4	**0.39%**	**0.17%**	**0.58%**
t-stat	*5.41*	*2.76*	*7.17*
FFM-5	**0.23%**	**0.11%**	**0.60%**
t-stat	*5.00*	*2.59*	*6.18*
FFM-6 (FFM-5+MOM)	**0.22%**	**0.13%**	**0.49%**
t-stat	*4.67*	*3.00*	*5.63*
FFM-7 (FFM-6+BAB)	**0.24%**	**0.14%**	**0.46%**
t-stat	*4.81*	*3.08*	*5.15*
Stambaugh factors	**0.17%**	**0.16%**	**0.32%**
t-stat	*2.46*	*2.36*	*3.32*
q-factor	**0.21%**	0.11%	**0.51%**
t-stat	*2.66*	*1.65*	*5.25*

*Fama-French five – factor and Stambaugh mispricing factor returns are available from July 1963, accordingly regression results for FFM-5, and Stambaugh factors are from the period July 1963-December 2017 (December 2016 for Stambaugh).

q-factor model return is available for January 1967; hence results are presented from January 1967-December 2016.

Table 11: PMJ, GMJ and SMJ: FFM-7 factor adjusted return

The table below depicts regression results for profit (PMJ), growth (GMJ) and safety (SMJ) value weighted portfolios from July 1963 to December 2017. Conditional sorts are applied, first sorting firms into two size portfolios and then into three portfolios based on profit, growth and safety score, respectively. The monthly median NYSE market equity is considered as the size breakpoint. Further, NYSE breakpoints are applied for quality score, BE/ME ratio and combined quality and value scores. At the end of each month, firms are assigned to two size-sorted portfolios based on their market equity. Factor returns represents the difference in the average monthly return of two high percentile portfolios and two low percentile portfolios within each size portfolios. The explanatory variable consists of monthly time-series returns of Fama-French 5 factor model [market premium ($MKT - RF$), size factor (SMB), and value factor (HML), profitability factor (RMW) and investment factor (CMA)] plus Jegadeesh and Titaman (1993) momentum (MOM) factor alongwith Frazzini and Pedersen (2014) 'betting against beta' (BAB) factor. The Newey-West approach is applied to adjust t-statistics for autocorrelation and heteroskedasticity. Returns statistically significant at 5% are highlighted in bold.

	PMJ	GMJ	SMJ
Alpha	**0.24%**	**0.14%**	**0.46%**
t-stat	*4.81*	*3.08*	*5.15*
MKT-RF	**-0.08**	**0.01**	**-0.33**
t-stat	*-5.89*	*0.80*	*-12.35*
SMB	**-0.06**	0.02	**-0.21**
t-stat	*-3.02*	*1.00*	*-4.92*
HML	**-0.30**	**-0.23**	**-0.21**
t-stat	*-12.09*	*-7.47*	*-3.79*
RMW	0.63	**0.33**	0.05
t-stat	*22.31*	*9.65*	*0.56*
CMA	**0.12**	-0.42	0.01
t-stat	*3.08*	*-8.72*	*0.10*
UMD	**0.01**	**-0.02**	**0.13**
t-stat	*0.76*	*-1.25*	*2.87*
BAB	-0.05	-0.02	**0.09**
t-stat	*-2.36*	*-0.85*	*2.00*
R-squared	72%	69%	55%
Adjusted R-squared	72%	69%	54%

*Fama-French five – factor and Stambaugh mispricing factor returns are available from July 1963, accordingly regression results for FFM-5, and Stambaugh factors are from the period July 1963-December 2017 (December 2016 for Stambaugh).

q-factor model return is available for January 1967; hence results are presented from January 1967-December 2016.

Table 12: FFM-3 factor adjusted return

The table below depicts regression results for quality minus junk (QMJ), high minus low (HML), quality at reasonable price (QARP), profit (PMJ), growth (GMJ) and safety (SMJ) value weighted portfolios from July 1963 to December 2017. Conditional sorts are applied, first sorting firms into two size portfolios and then into three portfolios based on quality score, BE/ME ratio, combined quality and value score, profit, growth and safety score, respectively. The monthly median NYSE market equity is considered as the size breakpoint. Further, NYSE breakpoints are applied for quality score, BE/ME ratio, combined quality and value score, profit, growth and safety scores. At the end of each month, firms are assigned to two size-sorted portfolios based on their market equity. Factor returns represents the difference in the average monthly return of two high percentile portfolios and two low percentile portfolios within each size portfolios. The explanatory variable consists of monthly time-series returns of Fama-French 3 factor model [market premium ($MKT - RF$), size factor (SMB), and value factor (HML)] The Newey-West approach is applied to adjust t-statistics for autocorrelation and heteroskedasticity. Returns statistically significant at 5% are highlighted in bold.

	QMJ	**HML**	**QARP**	**PMJ**	**GMJ**	**SMJ**
Alpha	**0.57%**	**-0.05%**	**0.19%**	**0.42%**	**0.15%**	**0.72%**
t-stat	*8.00*	*-0.62*	*2.12*	*5.96*	*2.54*	*8.45*
MKT-RF	**-0.21**	**0.10**	-0.02	**-0.12**	0.04	-0.37
t-stat	*-8.35*	*2.52*	*-0.66*	*-4.99*	*1.85*	*-12.10*
SMB	**-0.28**	0.00	-0.06	**-0.23**	-0.07	-0.21
t-stat	*-8.82*	*0.06*	*-0.73*	*-4.74*	*-1.71*	*-3.44*
HML	**-0.37**	**1.04**	**0.88**	**-0.28**	**-0.44**	**-0.25**
t-stat	*-8.88*	*14.46*	*12.71*	*-5.60*	*-12.40*	*-4.83*
R-squared	46%	61%	56%	33%	42%	47%
Adjusted R-squared	46%	61%	55%	33%	42%	46%

Table 13: Carhart-4 factor adjusted return

The table below depicts regression results for quality minus junk (QMJ), high minus low (HML), quality at reasonable price (QARP), profit (PMJ), growth (GMJ) and safety (SMJ) value weighted portfolios from July 1963 to December 2017. Conditional sorts are applied, first sorting firms into two size portfolios and then into three portfolios based on quality score, BE/ME ratio, combined quality and value score, profit, growth and safety score, respectively. The monthly median NYSE market equity is considered as the size breakpoint. Further, NYSE breakpoints are applied for quality score, BE/ME ratio, combined quality and value score, profit, growth and safety scores. At the end of each month, firms are assigned to two size-sorted portfolios based on their market equity. Factor returns represents the difference in the average monthly return of two high percentile portfolios and two low percentile portfolios within each size portfolios. The explanatory variable consists of monthly time-series returns of Carhart - 4 factor model [market premium ($MKT - RF$), size factor (SMB), value factor (HML) and momentum (MOM)] The Newey-West approach is applied to adjust t-statistics for autocorrelation and heteroskedasticity. Returns statistically significant at 5% are highlighted in bold.

	QMJ	**HML**	**QARP**	**PMJ**	**GMJ**	**SMJ**
Alpha	**0.50%**	**0.36%**	**0.58%**	**0.39%**	**0.17%**	**0.58%**
t-stat	*7.07*	*5.36*	*8.49*	*5.41*	*2.76*	*7.17*
MKT-RF	**-0.19**	0.01	**-0.11**	**-0.12**	0.04	-0.34
t-stat	*-8.42*	*0.47*	*-5.17*	*-5.09*	*1.82*	*-12.74*
SMB	**-0.28**	0.01	-0.06	**-0.23**	-0.07	-0.21
t-stat	*-7.45*	*0.15*	*-1.54*	*-4.49*	*-1.80*	*-4.28*
HML	**-0.34**	**0.87**	**0.72**	**-0.27**	**-0.44**	**-0.19**
t-stat	*-8.02*	*26.29*	*20.84*	*-5.43*	*-12.54*	*-4.37*
UMD	**0.08**	**-0.45**	**-0.43**	**0.04**	-0.02	**0.16**
t-stat	*2.95*	*-15.12*	*-14.01*	*1.27*	*-0.90*	*3.73*
R-squared	48%	86%	81%	33%	43%	52%
Adjusted R-squared	47%	86%	81%	33%	42%	52%

Table 14: FFM-5 factor adjusted return

The table below depicts regression results for quality minus junk (QMJ), high minus low (HML), quality at reasonable price (QARP), profit (PMJ), growth (GMJ) and safety (SMJ) value weighted portfolios from July 1963 to December 2017. Conditional sorts are applied, first sorting firms into two size portfolios and then into three portfolios based on quality score, BE/ME ratio, combined quality and value score, profit, growth and safety score, respectively. The monthly median NYSE market equity is considered as the size breakpoint. Further, NYSE breakpoints are applied for quality score, BE/ME ratio, combined quality and value score, profit, growth and safety scores. At the end of each month, firms are assigned to two size-sorted portfolios based on their market equity. Factor returns represents the difference in the average monthly return of two high percentile portfolios and two low percentile portfolios within each size portfolios. The explanatory variable consists of monthly time-series returns of Fama-French 5 factor model [market premium ($MKT - RF$), size factor (SMB), and value factor (HML), profitability factor (RMW) and investment factor (CMA)]. The Newey-West approach is applied to adjust t-statistics for autocorrelation and heteroskedasticity. Returns statistically significant at 5% are highlighted in bold.

	QMJ	HML	QARP	PMJ	GMJ	SMJ
Alpha	**0.37%**	0.00%	**0.19%**	**0.23%**	**0.11%**	**0.60%**
t-stat	*6.35*	*0.03*	*1.51*	*5.00*	*2.59*	*6.18*
MKT-RF	**-0.18**	0.09	-0.03	-0.08	0.01	**-0.34**
t-stat	*-10.56*	*2.10*	*-0.61*	*-6.49*	*0.92*	*-10.62*
SMB	**-0.14**	-0.02	-0.05	**-0.07**	0.02	**-0.19**
t-stat	*-6.13*	*-0.36*	*-0.93*	*-3.35*	*0.82*	*-3.93*
HML	**-0.31**	**1.11**	**0.97**	**-0.31**	**-0.22**	**-0.27**
t-stat	*-8.28*	*10.49*	*10.40*	*-12.68*	*-7.74*	*-3.32*
RMW	**0.51**	-0.10	0.01	0.61	**0.32**	**0.13**
t-stat	*12.13*	*-0.76*	*0.12*	*22.49*	*9.39*	*1.27*
CMA	-0.05	-0.13	-0.15	**0.10**	**-0.43**	**0.10**
t-stat	*-1.10*	*-0.79*	*-0.92*	*2.45*	*-9.32*	*1.21*
R-squared	69%	63%	57%	72%	69%	49%
Adjusted R-squared	69%	63%	57%	72%	69%	48%

*Fama-French five – factor and Stambaugh mispricing factor returns are available from July 1963, accordingly regression results for FFM-5, and Stambaugh factors are from the period July 1963-December 2017 (December 2016 for Stambaugh).

q-factor model return is available for January 1967; hence results are presented from January 1967-December 2016.

Table 15: FFM-6 factor adjusted return

The table below depicts regression results for quality minus junk (QMJ), high minus low (HML), quality at reasonable price (QARP), profit (PMJ), growth (GMJ) and safety (SMJ) value weighted portfolios from July 1963 to December 2017. Conditional sorts are applied, first sorting firms into two size portfolios and then into three portfolios based on quality score, BE/ME ratio, combined quality and value score, profit, growth and safety score, respectively. The monthly median NYSE market equity is considered as the size breakpoint. Further, NYSE breakpoints are applied for quality score, BE/ME ratio, combined quality and value score, profit, growth and safety scores. At the end of each month, firms are assigned to two size-sorted portfolios based on their market equity. Factor returns represents the difference in the average monthly return of two high percentile portfolios and two low percentile portfolios within each size portfolios. The explanatory variable consists of monthly time-series returns of Fama-French 6 factor model [market premium ($MKT - RF$), size factor (SMB), and value factor (HML), profitability factor (RMW) and investment factor (CMA)] plus Jegadeesh and Titaman (1993) momentum (MOM). The Newey-West approach is applied to adjust t-statistics for autocorrelation and heteroskedasticity. Returns statistically significant at 5% are highlighted in bold.

	QMJ	**HML**	**QARP**	**PMJ**	**GMJ**	**SMJ**
Alpha	**0.33%**	**0.33%**	**0.51%**	**0.22%**	**0.13%**	**0.49%**
t-stat	*5.96*	*4.81*	*6.78*	*4.67*	*3.00*	*5.63*
MKT-RF	**-0.17**	0.03	**-0.08**	**-0.08**	0.01	**-0.32**
t-stat	*-9.97*	*1.41*	*-3.73*	*-6.21*	*0.70*	*-11.42*
SMB	**-0.14**	0.01	-0.03	**-0.07**	0.02	**-0.20**
t-stat	*-6.62*	*0.25*	*-0.90*	*-3.31*	*0.93*	*-4.81*
HML	**-0.28**	**0.87**	**0.74**	**-0.31**	**-0.24**	**-0.19**
t-stat	*-9.05*	*19.99*	*17.89*	*-12.84*	*-7.92*	*-3.39*
RMW	**0.50**	0.01	**0.12**	**0.60**	**0.33**	**0.09**
t-stat	*13.33*	*0.09*	*2.37*	*22.16*	*9.13*	*1.10*
CMA	-0.07	**0.04**	0.02	**0.10**	-0.42	0.04
t-stat	*-1.64*	*0.60*	*0.24*	*2.51*	*-9.03*	*0.63*
UMD	**0.05**	**-0.46**	**-0.45**	**0.00**	**-0.03**	**0.15**
t-stat	*2.52*	*-15.99*	*-14.92*	*0.27*	*-1.47*	*3.37*
R-squared	70%	89%	85%	72%	69%	54%
Adjusted R-squared	69%	89%	84%	72%	69%	53%

*Fama-French five – factor and Stambaugh mispricing factor returns are available from July 1963, accordingly regression results for FFM-5, and Stambaugh factors are from the period July 1963-December 2017 (December 2016 for Stambaugh).

q-factor model return is available for January 1967; hence results are presented from January 1967-December 2016.

Table 16: Mispricing factor adjusted return

The table below depicts regression results for quality minus junk (QMJ), high minus low (HML), quality at reasonable price (QARP), profit (PMJ), growth (GMJ) and safety (SMJ) value weighted portfolios from July 1963 to December 2017. Conditional sorts are applied, first sorting firms into two size portfolios and then into three portfolios based on quality score, BE/ME ratio, combined quality and value score, profit, growth and safety score, respectively. The monthly median NYSE market equity is considered as the size breakpoint. Further, NYSE breakpoints are applied for quality score, BE/ME ratio, combined quality and value score, profit, growth and safety scores. At the end of each month, firms are assigned to two size-sorted portfolios based on their market equity. Factor returns represents the difference in the average monthly return of two high percentile portfolios and two low percentile portfolios within each size portfolios. The explanatory variable consists of monthly time-series returns of Stambaugh mispricing factor model [market premium (MKT), size factor (SMB), and two mispricing factors ($MGMT, PERF$)]. The Newey-West approach is applied to adjust t-statistics for autocorrelation and heteroskedasticity. Returns statistically significant at 5% are highlighted in bold.

	QMJ	**HML**	**QARP**	**PMJ**	**GMJ**	**SMJ**
Alpha	**0.26%**	**0.35%**	**0.50%**	**0.17%**	**0.16%**	**0.32%**
t-stat	*3.63*	*3.86*	*5.11*	*2.46*	*2.36*	*3.32*
MKT-RF	-0.13	0.02	-0.08	**-0.06**	0.01	**-0.25**
t-stat	*-5.62*	*0.68*	*-2.64*	*-2.92*	*0.33*	*-8.32*
SMB	-0.24	0.10	0.04	**-0.18**	**-0.10**	**-0.18**
t-stat	*-6.69*	*1.07*	*0.40*	*-3.83*	*-0.39*	*-3.17*
MGMT	**-0.10**	**0.67**	**0.61**	-0.05	**-13.40**	**0.07**
t-stat	*-2.62*	*8.81*	*9.09*	*-1.50*	*8.64*	*0.83*
PERF	**0.31**	**-0.60**	**-0.51**	**0.30**	**0.15**	**0.28**
t-stat	*11.88*	*-11.00*	*-11.43*	*11.31*	*6.19*	*5.61*
R-squared	54%	65%	60%	48%	43%	55%
Adjusted R-squared	54%	65%	59%	48%	42%	54%

*Fama-French five – factor and Stambaugh mispricing factor returns are available from July 1963, accordingly regression results for FFM-5, and Stambaugh factors are from the period July 1963-December 2017 (December 2016 for Stambaugh).

q-factor model return is available for January 1967; hence results are presented from January 1967-December 2016.

Table 17: q-factor adjusted return

The table below depicts regression results for quality minus junk (QMJ), high minus low (HML), quality at reasonable price (QARP), profit (PMJ), growth (GMJ) and safety (SMJ) value weighted portfolios from July 1963 to December 2017. Conditional sorts are applied, first sorting firms into two size portfolios and then into three portfolios based on quality score, BE/ME ratio, combined quality and value score, profit, growth and safety score, respectively. The monthly median NYSE market equity is considered as the size breakpoint. Further, NYSE breakpoints are applied for quality score, BE/ME ratio, combined quality and value score, profit, growth and safety scores. At the end of each month, firms are assigned to two size-sorted portfolios based on their market equity. Factor returns represents the difference in the average monthly return of two high percentile portfolios and two low percentile portfolios within each size portfolios. The explanatory variable consists of monthly time-series returns of q-factor model [market premium (MKT), size factor (r_{ME}), investment factor ($r_{\frac{I}{A}}$) and profitability factor (r_{ROE})]. The Newey-West approach is applied to adjust t-statistics for autocorrelation and heteroskedasticity. Returns statistically significant at 5% are highlighted in bold.

	QMJ	HML	QARP	PMJ	GMJ	SMJ
Alpha	**0.33%**	0.38%	**0.59%**	**0.21%**	**0.11%**	**0.51%**
t-stat	*4.28*	*1.96*	*2.98*	*2.66*	*1.65*	*5.25*
MKT-RF	**-0.19**	0.04	-0.08	**-0.10**	0.02	**-0.35**
t-stat	*-8.99*	*0.58*	*-1.52*	*-4.85*	*1.17*	*-10.28*
ME	**-0.16**	-0.11	-0.15	**-0.12**	-0.04	-0.14
t-stat	*-6.53*	*-0.82*	*-1.16*	*-4.00*	*-1.37*	*-1.84*
IA	**-0.36**	**0.97**	**0.78**	**-0.21**	**-0.66**	**-0.21**
t-stat	*-8.20*	*6.10*	*5.24*	*-4.65*	*-15.69*	*-2.40*
ROE	**0.43**	**-0.63**	**-0.53**	**0.40**	**0.25**	**0.28**
t-stat	*13.32*	*-5.01*	*-4.29*	*9.97*	*6.23*	*4.09*
R-squared	60%	39%	35%	48%	55%	52%
Adjusted R-squared	60%	39%	34%	47%	54%	52%

*Fama-French five – factor and Stambaugh mispricing factor returns are available from July 1963, accordingly regression results for FFM-5, and Stambaugh factors are from the period July 1963-December 2017 (December 2016 for Stambaugh).

q-factor model return is available for January 1967; hence results are presented from January 1967-December 2016.

Table 18: Sub-period factor returns

The table below shows the sub-period results for quality minus junk (QMJ), high minus low (HML), and quality at reasonable price (QARP) value weighted portfolios. The sub-periods include 30 June 1957-31 December 1988, 1 January 1989-31 December 2005, and 1 January 2006 – 31 December 2017, respectively. Conditional sorts are applied, first sorting firms into two size portfolios and then into three portfolios based on quality score, BE/ME ratio, and combined quality and value score, respectively for each sub-period. The monthly median NYSE market equity is considered as the size breakpoint. Further, NYSE breakpoints are applied for quality score, BE/ME ratio, and combined quality and value score. At the end of each month, firms are assigned to two size-sorted portfolios based on their market equity. Factor returns represents the difference in the average monthly return of two high percentile portfolios and two low percentile portfolios within each size portfolios. Alphas from regressing the monthly QMJ, HML and QARP portfolio returns on monthly seminal factor returns are also reported for each sub-period. The explanatory variable consists of monthly time-series returns of Carhart-4 factor model [market premium ($MKT - RF$), size factor (SMB), value factor (HML), and momentum factor (MOM)]. Panel A, Panel B and Panel C depicts are results for QMJ, HML and QARP portfolios, respectively. The Newey-West approach is applied to adjust t-statistics for autocorrelation and heteroskedasticity. Returns statistically significant at 5% are highlighted in bold.

	30.06.1957-31.12.1988	**01.01.1989-31.12.2005**	**01.01.2006-31.12.2017**
Panel A: QMJ portfolio			
Mean return	0.19%	**0.37%**	0.37%
t-stat	*1.84*	*2.38*	*1.70*
Standard deviation	1.97%	2.23%	2.63%
Sharpe ratio annualised	0.33	0.58	0.49
Alpha	**0.52%**	**0.57%**	**0.60%**
t-stat	*6.74*	*3.74*	*3.82*
Adjusted R-squared	0.48	0.43	0.65
Panel B: HML portfolio			
Mean return	**0.52%**	0.32%	0.01%
t-stat	*3.41*	*1.11*	*0.02*
Standard deviation	2.97%	4.10%	3.98%
Sharpe ratio annualised	0.61	0.27	0.00
Alpha	**0.39%**	**0.51%**	-0.01%
t-stat	*4.60*	*4.19*	*- 0.10*
Adjusted R-squared	0.82	0.88	0.93
Panel C: QARP portfolio			
Mean return	**0.61%**	0.46%	0.12%
t-stat	*3.93*	*1.65*	*0.47*
Standard deviation	3.02%	4.00%	3.07%
Sharpe ratio annualised	0.70	0.40	0.13
Alpha	**0.60%**	**0.75%**	**0.20%**
t-stat	*6.95*	*5.30*	*2.16*
Adjusted R-squared	0.78	0.78	0.85

Figure 2: ICs and moving average IC line

The figure depicts the times series information co-efficients (IC) and the moving average IC line of quality at reasonable price (QARP) factor. At the end of each month spearman rank correlation is computed between the QARP factor returns and lagged QARP factor. To compute QARP portfolio returns, conditional sorts are applied, first sorting firms into two size portfolios and then into three portfolios based combined quality and value score (QARP factor). The monthly median NYSE market equity is considered as the size breakpoint. Further, NYSE breakpoints are applied for combined quality and value score. At the end of each month, firms are assigned to two size-sorted portfolios based on their market equity. Factor returns represents the difference in the average monthly return of two high percentile portfolios and two low percentile portfolios within each size portfolios.