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Joshy Jacob†, Pradeep K.P.‡ and Jayanth R.Varma§

November 23, 2022

Abstract

We study the characteristics of Quality factor (QMJ) in India, which is the second largest emerging market. Dimensions of quality factor are impacted by the weaker enforcement of corporate governance norms in emerging markets. Diversion of revenues by promoters would result in poor profitability, while tunneling of profits would result in lower payout and lower growth. Therefore, investors are likely to attach greater significance to the quality dimensions in stock pricing. Consistent with this hypothesis, the Quality factor is even more important for asset pricing in India than in developed markets. The QMJ factor earns a four factor alpha of 0.92% per month, significantly outperforming the other widely employed factors, market, size, value and momentum factors. A long-only Quality factor earns an alpha of 0.69% per month. The alpha of quality factors is highly significant, judged by the thresholds recommended by Harvey, Liu, and Zhu (2016). The key drivers of the alpha are profitability and payout, which are both consistent with the tunnelling hypothesis. Besides the alpha, the low portfolio churn, lower risk, shorter drawdowns, and viability of long-only strategies restricted to large capitalization stocks suggest that portfolios tilted towards high-quality stocks are highly attractive to institutional and retail investors.

Keywords: Quality factor, Asset Pricing, India

JEL classification: G11, G12, G4,

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1. Introduction

Investors and practitioners have favoured high-quality stocks for a very long time, at least since Graham, Dodd, Cottle, et al. (1934). The academic literature has also shown that stocks with high-quality characteristics earn higher returns. Novy-Marx (2013) show that firms with higher profitability, generate greater returns. Titman, Wei, and Xie (2004) demonstrate that firms that have excessive capital investments earn lower returns, particularly those with higher free cash flows. Both Black (1972) and Frazzini and Pedersen (2014) find that the relatively low-beta stocks (safe stocks) outperform their high-beta counterparts. Fama and French (2015) include two of these quality factors, profitability and investment, in their five-factor model. By contrast, Asness, Frazzini, and Pedersen (2019) combines several measures of firm-level quality into a single quality factor and create a 'Quality Minus Junk' (QMJ) factor that is long high-quality stocks and short low-quality stocks. They show that the QMJ factor earns positive alpha in 24 developed markets against Fama and French (1993) three-factor model as also the Fama and French (2015) five-factor model. This is all the more impressive because Fama and French (2015) five-factor model has two factors, RMW (a proxy for the return difference between high and low profitability stocks), and CMA (captures the return wedge between firms with high and low capital investment levels), that can be regarded as proxies for quality.

Moreover, in a study of the explanatory role of 14 well-known risk factors for stock returns by Harvey and Liu (2021), QMJ emerged as next only to the market factor when evaluated in terms of value-weighted pricing errors. In recent years, there has been a lot of interest among investors and portfolio managers in combining the quality factor (QMJ) with the value factor (HML in the Fama and French (1993) model) to obtain Quality at a Reasonable Price ($QARP$).

In this paper, we study the performance of the quality factor for firms listed in the Indian market. It is one of the largest emerging markets in the world, with a market capitalization of nearly $3 trillion, with only China ahead of it. There is reason to believe that optimizing portfolios to maximize exposure to quality dimensions is more important in an emerging market than in a developed market. First, at least till recently, the enforcement of both securities law and corporate law was weaker in emerging markets. Second, family-owned business groups are very important in many emerging markets, and these pose particular governance problems that could make quality more relevant from an investment perspective. These features, in combination, have allowed more wriggle room for the controlling shareholders in emerging markets to divert capital into self-serving projects at the cost of outside shareholders. These features strongly drive the portfolio construction under QMJ, through its dimensions, $profitability$, $growth$, $safety$, and *payout*. For instance, due to the presence of group-affiliated firms, emerging markets are known to face greater tunnelling of resources (Bertrand, Mehta, & Mullainathan, 2002; Claessens & Yurtoglu, 2013). Tunnelling of revenues results in lower profits and the tunnelling of profits lead to lower payout and diminished growth for the firms.

We find that the quality factor earns high returns in India both in its long-short form (long quality and short junk) and in its long-only form (long quality). A long-only portfolio that invests in the top-decile of quality stocks earns an alpha of 0.69% per month. The QMJ factor earns a Carhart (1997) four-factor alpha of 0.91%. The four-factor alpha estimated for QMJ factor in India is nearly 50% higher than that observed by Asness et al. (2019) for the US market.

In addition to the remarkable alpha the quality factor earns, it has at least two other favourable features, given the challenges faced in practical asset allocation. The biggest problem with factor investing from a practical point of view is that while it has attractive long-term performance, its medium-term performance can be dismal, with extended periods of poor performance. We, therefore, evaluate the quality portfolio in terms of its periods of poor performance, commonly called *drawdowns*, and find that quality fares significantly better than other factors. With a maximum drawdown period of about 18 months, quality recovers noticeably faster from a drawdown than the other factors. It has a significantly lower average drawdown and worst drawdown than momentum, the second-best performing factor.

Another big concern in factor investing is that it can cause excessive portfolio churn, and much of the alpha may be eaten away by transaction costs. Here also, the quality factor turns out to be quite attractive. The quality factor rankings of stocks are sticky, requiring only infrequent portfolio revisions. This result is intuitive because the variables employed to compute the quality score are primarily based on company fundamentals rather than on market prices, while all the Fama and French (1993) factors are based on market prices that tend to be quite volatile.

The combination of remarkable long-only performance, shorter drawdowns, and the need for less frequent portfolio revisions make the quality factor very attractive from an asset allocation perspective. Moreover, these characteristics make quality factors accessible even to retail investors.

2. Methodology and data

2.1. Estimation of quality factor

The estimation of quality factor return primarily involves the construction of stock portfolios that are maximally exposed to quality stocks within a selected universe. The portfolio construction closely follows the approach of Asness et al. (2019). Under the approach, typically a long position is maintained on stocks that rank high on the quality score, and a short position is taken in stocks that rank low on the quality score.

The quality score of a stock is computed by taking an average of the ranking of the stock on four financial parameters that are at the core of Gordon's dividend discount model (Gordon, 1962). These dimensions are profitability, growth, safety, and payout. Profitability and growth capture the operating performance of a firm. Safety, broadly measured as the inverse of the risk of a firm, captures the risk to the operating performance of a firm. The level of re-investment required to deliver the assumed future growth of the firm is reflected in the inverse of the level of payout. The overall quality rank of a stock within a sample is arrived at by taking a simple average of the standardized rank of the stock on each of the four dimensions as discussed below.

Within each of the dimensions, profitability, growth, safety, and payout, the rank score of a stock is obtained by taking a simple average of the standardized rank score of the stock across multiple proxies that are taken to capture dimension. For instance, the score for profitability is computed by taking a simple average of the standardized rank scores across, gross profit over assets ($gpoa$), return on equity (roe), return on assets (roa), cash flow over assets ($cfoa$), gross margin ($gmar$) and accruals (acc). Accordingly, the standardized score of stock on profitability is given below

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

A definition of each of the variables included in the estimation o the z-score for each dimension is given in Table 1.

The score for growth is computed by taking a simple average of the standardized scores across the growth of gross profit over assets, return on equity, return on assets, cash flow over assets and gross margin, as given below.

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

The Δ in the equation represents five year change in each of the variables.

The score of the safety of a stock is defined by taking a simple average of the standardized scores across low beta (bab), low leverage (lev), low bankruptcy risk (Ohlson (1980) $O - Score$ and Altman (1968) $Z - Score$)[1], and low roe volatility ($evol$), as defined below.

$$Safety = average(z_{bab} + z_{lev} + z_{o} + z_{z} + z_{evol}) \quad (3)$$

The score of payout is computed as the simple average of the standardized scores across net equity issuance ($eiss$), net debt issuance ($diss$), and total net payout over profits ($npop$).

[1] Using accounting data of the firms the likely failure due to bankruptcy is measured by Altman (1968) and Ohlson (1980)

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

Finally, the Quality score is obtained by the simple average of the four above measures as follows:

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

The overall quality score is estimated as a simple average of the *profitability*, *growth*, *safety* and *payout*. Based on the overall quality score, *quality* (*junk*) stocks are defined as those ranked into the top decile (bottom decile) by their quality score. Closely following the approach of Asness et al. (2019) the long-short quality factor (QMJ, hereafter) is estimated as,

$$QMJ = \frac{1}{2}\,(small\ quality + big\ quality) - \frac{1}{2}\,(small\ junk + big\ junk) \tag{6}$$

where *small quality*, represents the value weighted monthly return of a portfolio of small stocks classified as quality stocks based on the overall quality score. The other constituents of the QMJ factor, *big quality*, *small junk*, and *big junk* are defined analogously. Big stocks are those which are ranked in the top decile by their market capitalisation at the end of the month. All the remaining stocks are counted as small stocks.

Furthermore, we also define a long-only quality factor (LQ, hereafter) to capture the average of the returns of *small quality* and *big quality* portfolios, as below.

$$LQ = \frac{1}{2}\,(small\ quality + big\ quality) \tag{7}$$

2.2. Characteristics of the Indian stocks

The stock data employed in the study covers a 26-year period from April 1995 to March 2021. The sample firms are selected based on their market capitalisation each month. Particularly, we draw a monthly sample of firms that represent the top 1,000 firms by market capitalization in our main analysis of the quality factor. Supplementary results are provided for stock samples constituting top-500 and top-250 firms. Stock returns and firm-level financial data for the analysis are drawn from the CMIE Prowess database.

The summary statistics of the key variables that determine the different dimensions of the quality score of a stock are given in Table 2 for the sample of 1,000 firms employed in the baseline analysis. For each of the variables, the table provides values corresponding to the mean, median, 25th-percentile, the 75th-percentile and standard deviation. The summary statistics are obtained after winsorizing the values at 1% and 99% on an annual basis. The median firm has a market capitalization of INR 3.34 billion. The median firm in the sample is profitable when judged based on the profitability indicators for most of the sub-periods. For instance, the median firm earns a positive gross profit margin ($GMAR$), return on assets (ROA), return on equity (ROE) and cash flow return on assets ($CFOA$). The median firm has a CAPM beta of 0.9. The summary statistics of the variables for various five-year sub-periods are given in Table A1 in the Appendix.

The returns on market, size, value and momentum factors are estimated following the approach of Agarwalla, Jacob, and Varma (2014) for the relevant stock sample. The risk-free returns are taken from the data library maintained by Agarwalla et al. (2014).[2]

3. Findings and discussion

3.1. Performance of long-short quality factor portfolios

We examine the performance of portfolios created based on the quality factor with their monthly returns. Table 3 provides a comparison of the performance of the quality portfolios with those created based on size, value and momentum factors. Panel A gives a comparison of the performance of the long-short quality portfolios, as defined in Equation 6 (QMJ). Panel B provides the monthly return characteristics for the long-only portfolios as defined in Equation 7 (LQ). The factor return data for market, size, value and momentum factors are generated for the sample of 1000 firms following the methodology of Agarwalla et al. (2014).

[2] The data can be downloaded from https://faculty.iima.ac.in/~iffm/Indian-Fama-French-Momentum/

We find that among the different factors, QMJ has the highest average monthly returns. For instance, while the average returns on the market factor is 1.33%, the same for the QMJ factor is 1.69%. Both value and size factors earn significantly lower returns, with the value factor earning marginally negative returns. Only the momentum factor earns returns closest to the quality factor (1.62%). The quality factor returns also show lower volatility (6.71%) than the next best performer, the momentum factor (7.16%). Figure 2 shows the growth of INR 100 notional invested in long-short portfolios of the different factors over a 26-year period from April 1995 to March 2021. The figure shows that while the investment in QMJ factor portfolio would grow to INR 9,345, it only grew to INR 6,988 when invested in the momentum factor, and even lower for the other factors.

As indicated by the return of the LQ portfolio (as in Panel B), the performance of the quality factor is resilient to the exclusion of the short-leg of the portfolio. In fact, LQ outperforms long only versions of the other factors to a marginally higher degree than QMJ outperforms the long-short versions of those factors. For instance, the mean returns increases to 2.12%, an increase of 53 basis points, as compared to the long-short portfolio. Comparison based on the median shows a similar outperformance of the quality factor suggesting that its performance is not driven by a few months with extremely favourable returns.

A comparison of the Sharpe ratio along with the drawdown characteristics of the factor portfolios is provided in Table 4. As indicated by the Sharpe ratio, the quality factor has the most favourable return characteristics. While the QMJ portfolio has a lower Sharpe ratio (0.25) than that of the momentum factor (0.38), it is significantly higher for the LQ portfolios. Figure 1a and Figure 1b compare the compounded annual growth rate (CAGR), the annual standard deviation of returns, Sharpe ratios and the worst drawdown for the different factors.

Evidently, portfolios constructed out of the quality factor have favourable drawdown characteristics. The average drawdown and the worst drawdown are the lowest for both the QMJ and LQ quality portfolios. For instance, the average drawdown for the QMJ

(LQ) quality factor is only 9.76% (7.99%) as compared to 12.13% (14.52%) for the momentum factor. Comparison based on the drawdown period also suggests that the quality factor portfolios recover faster to relative to those based on other factors. For instance, while the maximum drawdown period for a long-short factor based on momentum is 600 weeks (as given in Panel A), the corresponding figure for the quality factor is only about 78.57 weeks. The drawdown chart of the different factors is given in Figure A4 and the same for different quality quartiles is given Figure 4. The average returns, Sharpe ratios, and drawdown characteristics indicate that the risk-reward ratio in stock investing can be improved significantly through portfolios constructed based on the quality characteristics of stocks.

3.2. Quality factor alpha in India

Given the outperformance of the long-only and the long-short quality factors, we examine the alpha generated by the quality portfolios after accounting for the potential explanatory role of the other widely employed factors, market, size, value and momentum. We carry this out for each decile of stocks created by sorting them on their overall quality score as defined in Equation 5. Essentially, it involves calendar-time portfolio regressions of the monthly excess returns of the decile portfolios, on the returns of the other factors. The excess returns and the estimated alphas of the different quality portfolios are given in Table 5. In the table D1 represents the lowest decile by quality score and D10 is the highest decile by quality score.

The monthly excess returns of the decile portfolios show an increasing trend with the quality rank of the portfolios. For instance, while the monthly value weighted excess return is 0.17% for the lowest quality decile, the corresponding figure for the highest decile (D10) is about 1.73%. The higher ranked quality deciles also show significant positive CAPM, three-factor and four-factor alphas. The results indicate that the quality factor earns excess returns even after accounting for the possible exposure to the other factors. For instance, the D10 portfolio earns a monthly four-factor alpha of about 0.69%. While the long-short portfolio involving extreme deciles (D10 - D1) earns significant positive three-factor alpha of 1.47% and four-factor alpha of 0.98%. The CAPM beta estimates of the quality deciles show that quality stocks tend to have lower betas, as could be expected. The significant alpha earned by the quality sorted portfolios suggests that investors can significantly improve the risk-return trade-off by optimizing stock portfolios based on their quality dimensions.

The exposure of the stock deciles sorted on the quality score to the individual factors, market, size, value and momentum as reflected in the calendar time regression estimates are given Table 6. The 'High-Low' portfolio is created by taking a long position in stocks that are ranked in the top decile (D10) by their quality score and shorting stocks in the bottom decile (D1). The coefficients suggest that the quality factor has a negative exposure to the size factor, indicating that stocks that rank higher on quality are larger stocks. Similarly, it has a negative coefficient with the value factor. On the other hand, stocks that rank high on the quality dimension tend to be momentum stocks.

3.3. Which components of quality drive the alpha?

We examine the alpha of the quality factor, as defined in Equation 6 (QMJ), in Table 7. The first column gives the four-factor alpha of the quality factor. Columns (2) - (4) provide the alpha of analogous portfolios created by taking one of the quality dimensions, profitability, growth, safety and payout. We find that the QMJ factor generates a monthly four-factor alpha of 0.917% over the entire period. The alpha is economically significant given the market risk premium in India. The results also indicate that the QMJ factor has a positive exposure to the momentum factor, but has a negative exposure to both value and size. The coefficient of the market factor suggests that the quality factor delivers higher returns during relatively poor market conditions.[3] Among the quality dimensions employed in the construction of the factor, it is profitability and payout that appear to deliver significant alphas. It is somewhat surprising that higher growth does not in itself contributes positive alpha. It could be driven by characteristics of emerging market firms such as tunnelling of profits and over investment in group firms.

[3]The correlations across the factors are given in Figure 5

It is also possible that emerging markets, characterised by higher growth rates, attract greater investment into growth firms, leading to their overpricing. While we do not find significant contribution of certain dimensions of quality to the portfolio outperformance, the findings for the QMJ factor suggests that the long-short quality factor generates economically significant alpha in the Indian market.

3.4. Price premium and quality score of stocks

Following the approach of Asness et al. (2019), we examine the pricing of quality among the stock universe in India. Effectively, we investigate whether stocks that score high on quality dimensions command a price premium relative to their lower quality counterparts. The estimations involve panel regressions of the yearly $log(M/B)$ ratio of stocks on its standardised quality score and other control variables. The control variables employed are market capitalization, past one-year returns, firm age, and a dummy variable to capture the dividend payment status of the firm (variable definitions are given in Table 1).

In the estimations, we employ both firm fixed effects and year fixed effects. The firm fixed effect could capture the impact of any unobserved time-invariant firm level factors that affect the pricing of stocks. The year fixed effects account for any likely variation in the pricing level of stocks over the years. The results of the estimations, carried out for various sub-periods covered by our data, are given in Table 8.

Largely, we find that quality stocks hold a premium in the Indian market through the various sub-periods considered in our study. After controlling the various firm-level factors that influence the market-to-book premium of stock, we find that the quality score has a significant impact on the price premium of stocks. For instance, during the entire sample period (results in the rightmost column in the table), a one standard deviation increase in the quality score results in a 23.6% increase in the market-to-book premium of stocks. The sign and significance of the premium attracted by the quality score of stocks are consistent throughout the various sub-periods.

3.5. Persistence of quality factor rankings

As trading cost is an important friction that lowers the effective alpha generation potential of empirical factors, we examine the persistence of the quality score of stocks in our sample. A high degree of persistence of the quality score of the stocks over time on would indicate that any potential alpha can be exploited without frequent portfolio churn and attendant trading costs. We investigate the persistence by computing the value-weighted quality score of stocks ranked into a certain decile (decile 1 to decile 10) at a particular time point, over future horizons varying from 12 months ($t+12$) to 120 ($t+120$) months. The estimates are given in Table 9. The pattern shows a high degree of persistence of the quality rank of stocks. Although we observe a decline in the quality rank of the top decile stocks over a long period, stocks ranked in the top decile of quality in a month would largely retain their high rank on quality score even over a one-year period. For instance, the decile 10 stocks have a value weighted quality score of 1.41 at time t, which though declines to 1.02 by time $t + 12$, is still higher than the time t level of decile 9 stocks. In a similar manner, stocks that are ranked in the lowest quality decile remain in the same group for a year. Furthermore, we compare the average annual churn rates between long-short factor portfolios based on momentum and quality. While the average annual churn rate for momentum is about 249% the corresponding figure for quality factor is only about 87%.[4] The pattern suggests that optimizing stock portfolios to maximize exposure to quality factor does not require re-constitution of the portfolio allocation at frequent intervals.

4. Quality factor: Restricted to large cap stocks

It is well-known that smaller cap stocks inflate the magnitude of most anomalies because of the greater cross-sectional standard deviations of returns and many anomaly variables among these stocks (Hou, Xue, & Zhang, 2020). Moreover, higher transaction costs make

[4] The annual churn rate for momentum factor is computed as the sum of the percentage of stocks that are dropped from the portfolio compared to the number of stocks in the portfolio at the beginning of the month. For the quality factor, the annual churn is simply the percentage of dropped stocks compared to the number of stocks in the portfolio at the beginning of the year.

it difficult to exploit these anomalies in smaller cap stocks. We, therefore, evaluate the quality factor within the universe o of large cap stocks. Specifically, we assess the alpha of QMJ and LQ factors within the universe of top-500 and top-250 stocks[5] Compared to the median market capitalization of INR 35.32 billion of the baseline sample of 1,000 stocks, the median is INR 115.91 billion and INR 337.22 billion for the sample of top-500 and top-250 stocks, respectively. The characteristics of the quality portfolios (QMJ) and their alphas for the top-500 and top-250 firms are given in Table A2 and Table A4.

The performance of both the long-short (QMJ) and long-only (LQ) portfolios based on top-500 stocks shows more or less the same return characteristics as that of quality factor portfolios created out of the baseline sample. The four-factor alpha of QMJ and LQ is significant and marginally higher than that of the baseline sample. The alpha of the QMJ factor created out of top-250 stocks also shows significant outperformance, albeit with marginally lower alpha than that of the baseline sample. Significant four-factor alpha earned by quality factor portfolios within firms with greater market capitalization suggests that quality factor has a high investment capacity so as to be suitable for institutional asset allocation.

5. Conclusion

We examine the performance of the quality factor and its components with stock data from India, a leading emerging market. Investigating the quality factor assumes significance in emerging markets, given the dominant role of group firms and a patchy history of corporate governance. While the overall regulatory norms and corporate governance standards have significantly evolved in India, enforcement of regulations remains an area of concern. Our estimations suggest that both long-short (QMJ) and long-only (LQ) portfolios constructed with maximum exposure to quality factor generate economically and statistically significant monthly alphas. Over the 26 years period, the long-short quality factor generates an annualized four-factor alpha of more than 10%, which is nearly

[5]There are popular equity indices that correspond to the top-500 stocks by market capitalisation in India. The top-250 stocks largely constitute the universe of stocks for the large and mid-cap mutual funds in India.

twice that estimated for the US market. Portfolios sorted with the quality score also have attractive drawdown features with significantly lower worst drawdown and drawdown periods compared to value, momentum, and market factors. Furthermore, the persistent nature of stock-level quality scores lowers the need for frequent portfolio revisions. The risk-return characteristics of the quality sorted portfolios, and their performance within the large cap universe, make them a valuable factor in asset allocation decisions.

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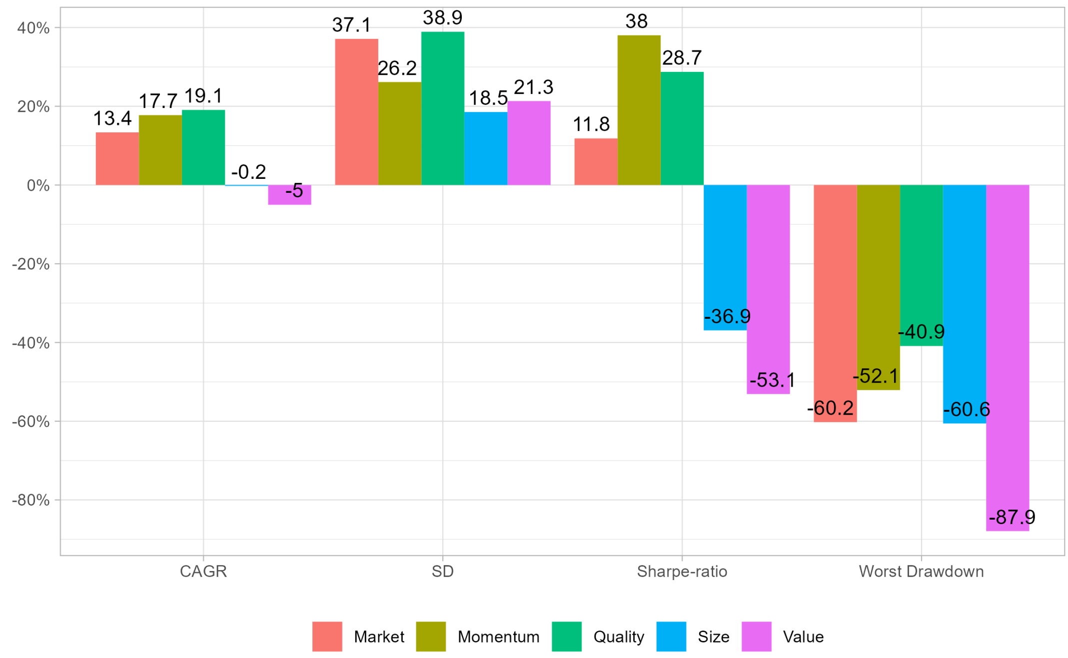
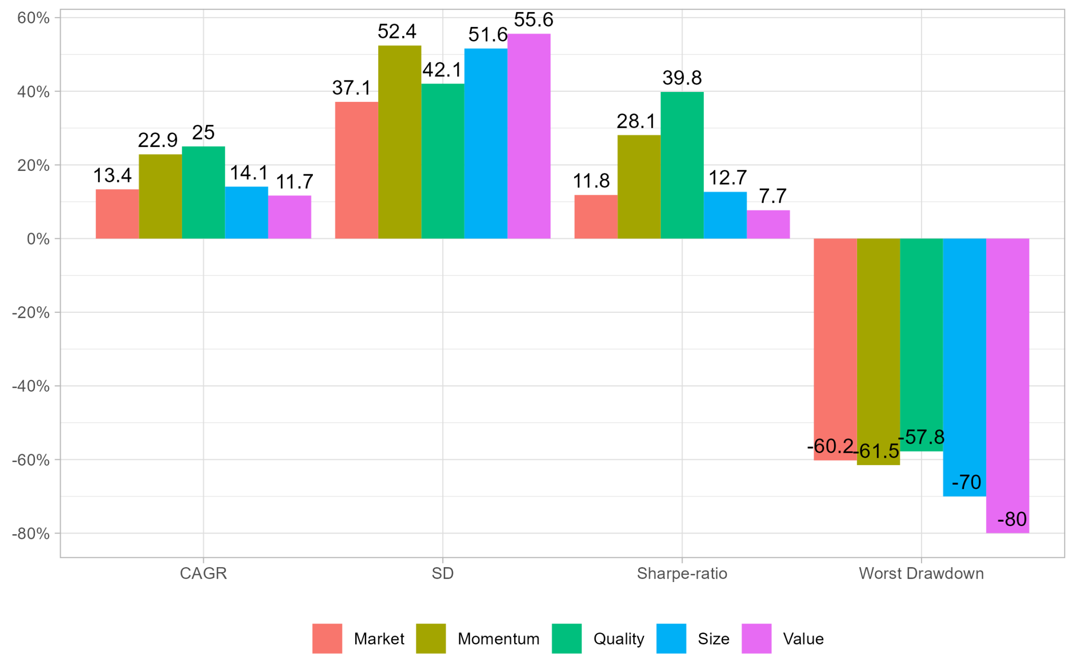
Figure 1: Comparison of different factor portfolios

(a) Panel A: Long-short factors

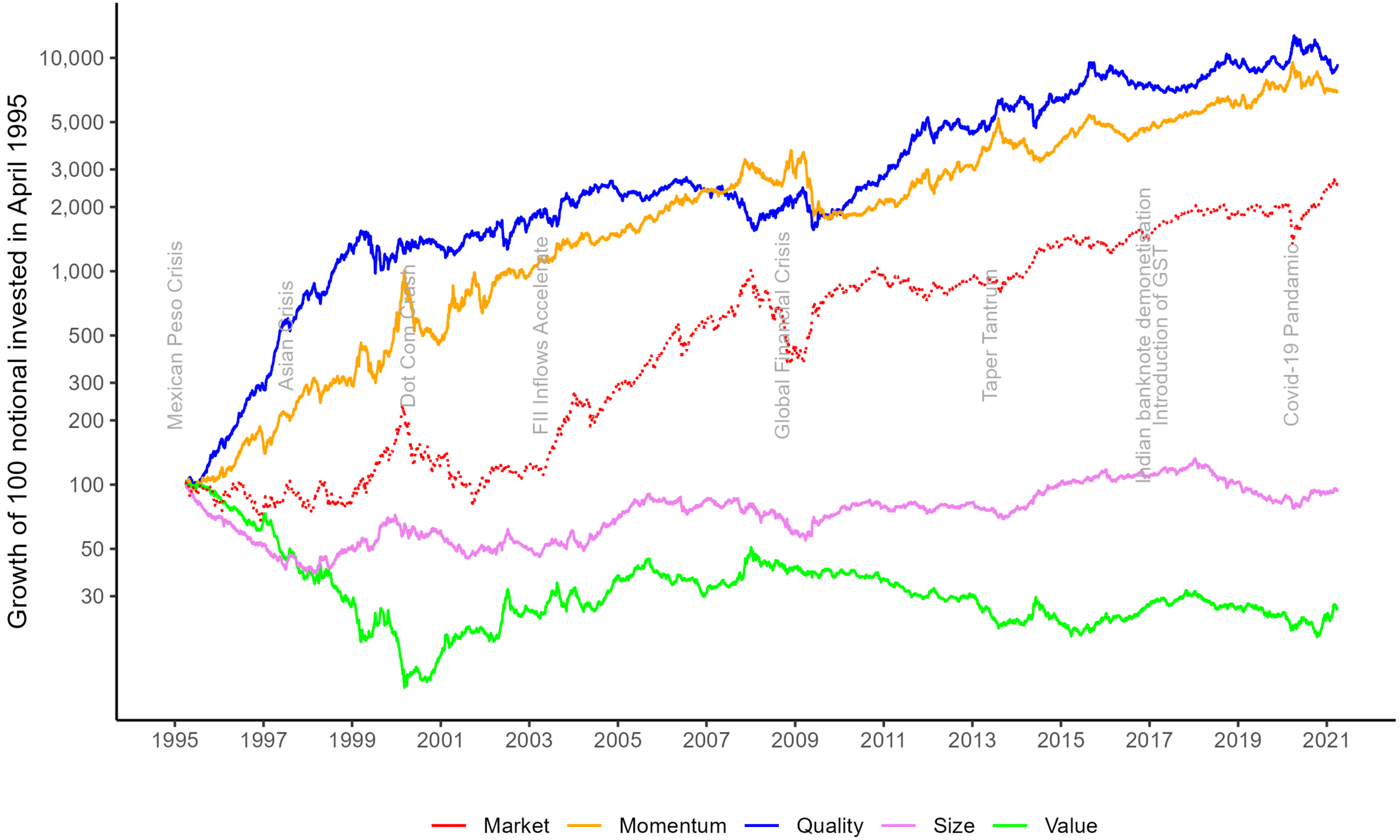


(b) Panel B: Long-only factors



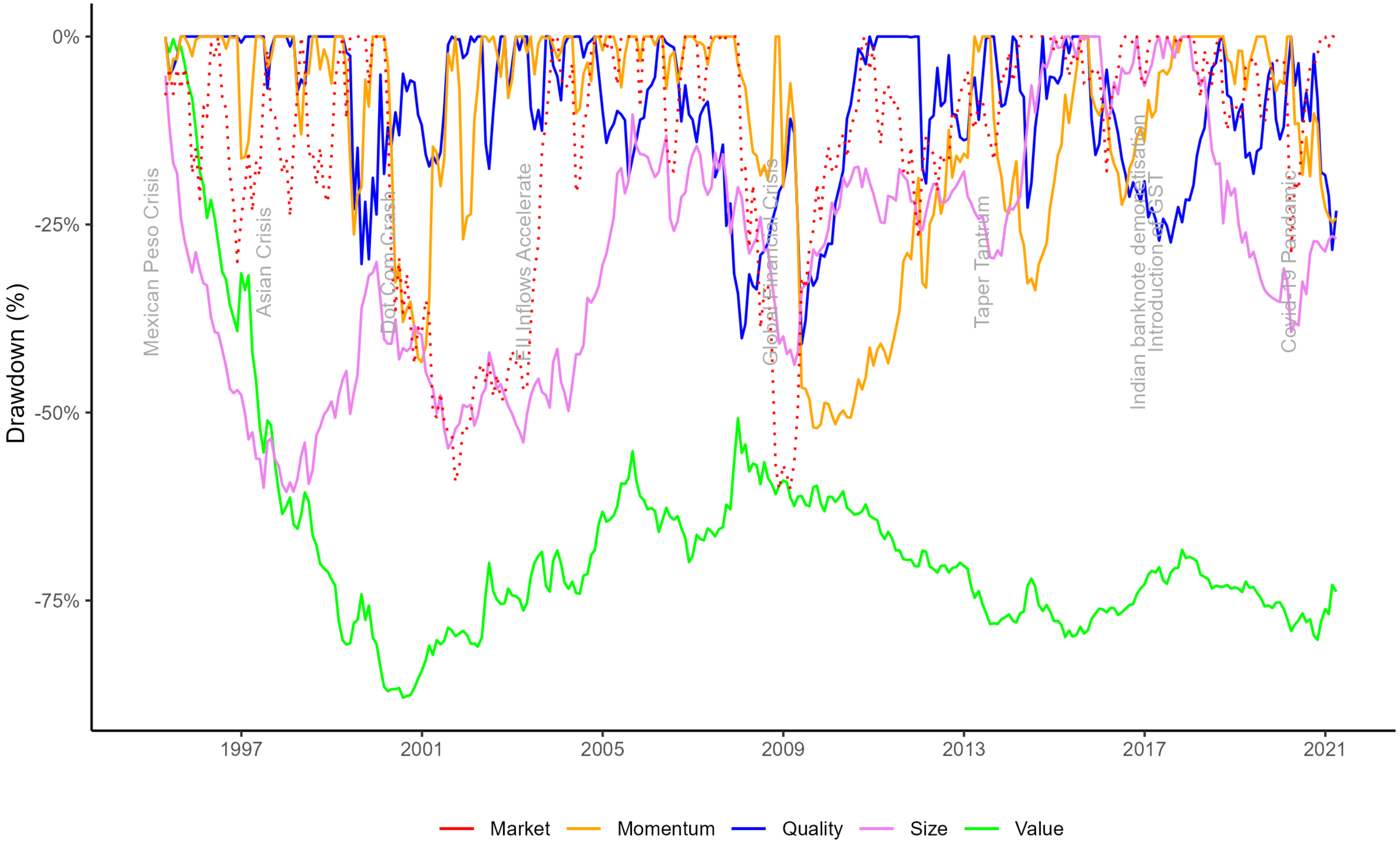
The figure shows the statistics of the long-short (Panel A) and long-only (Panel B) portfolios representing different factors, market, value, size, quality and momentum for the period from April 1995 to March 2021. The long-short and long-only portfolios are constructed as per Equation 6 and Equation 7. The other factors are constructed following the approach of Agarwalla et al. (2014).

Figure 2: Growth of 100 notional investment over time - a comparison of factors



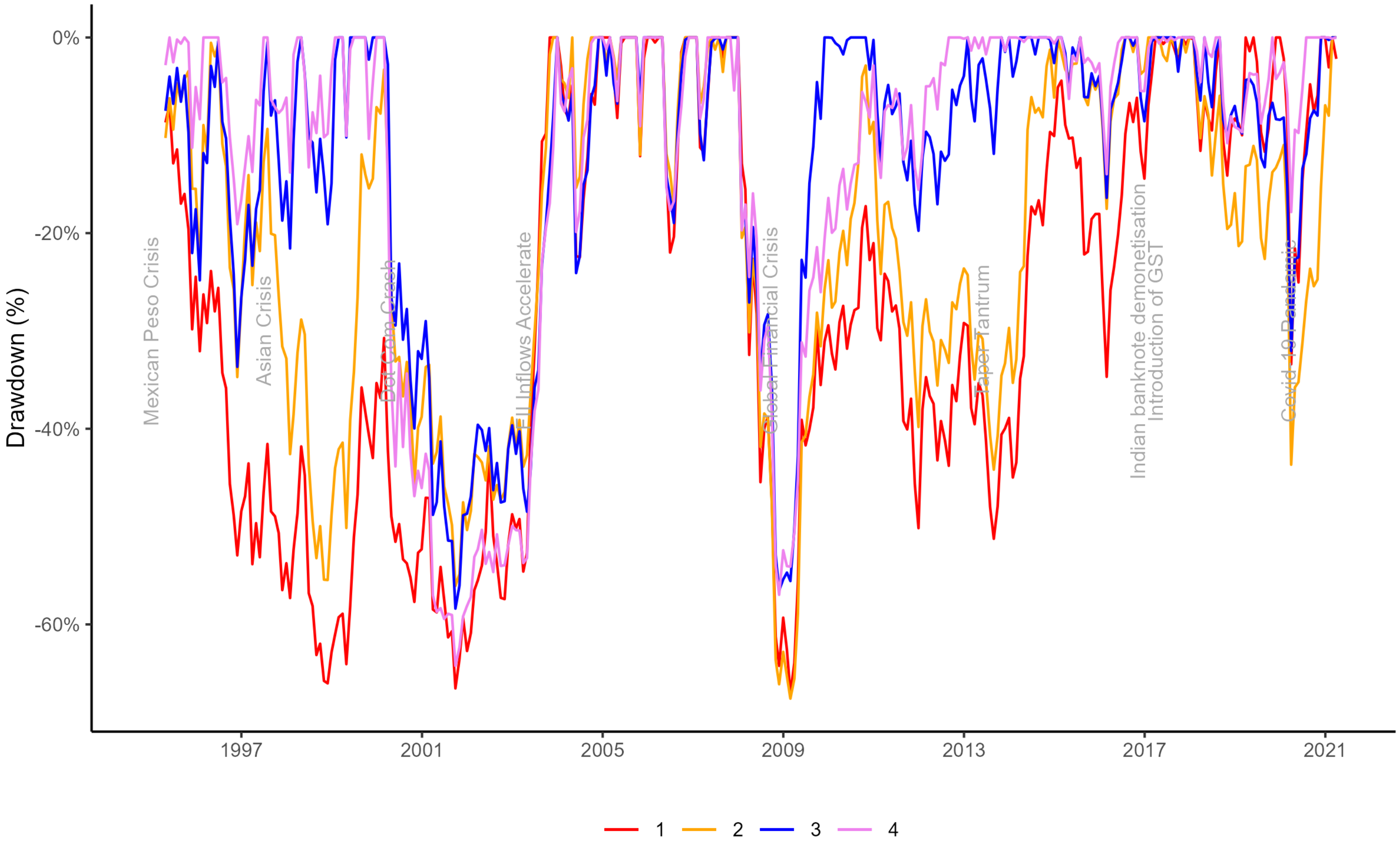
The figure shows the growth of the 100 notional invested in long-short portfolios representing different factors, market, value, size, quality and momentum for the period from April 1995 to March 2021.

Figure 3: Comparison of the drawdown of different factors



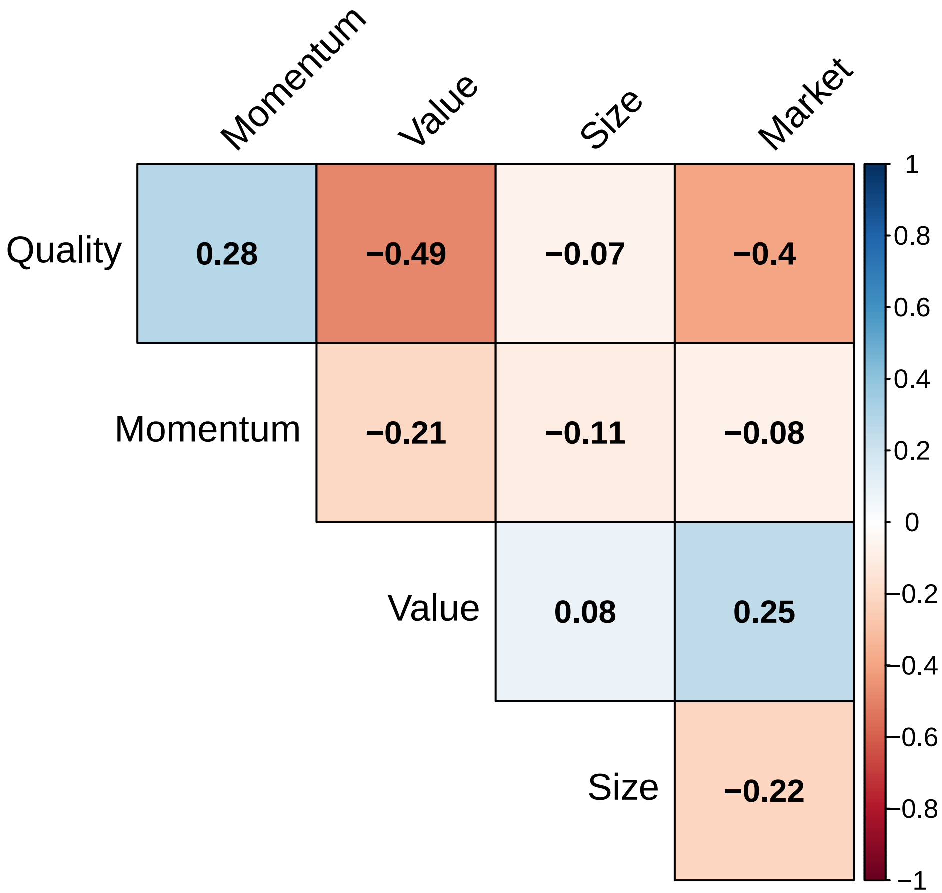
The figure shows the drawdowns of the different factors, market, value, size, quality and momentum for the period from April 1995 to March 2021.

Figure 4: Comparison of the drawdowns of quality factor quartiles



The figure shows the drawdowns of the four quartile portfolios based on quality factor for the period from April 1995 until March 2021.

Figure 5: Correlations of the market, size, value, momentum, and quality factors



The figure shows the correlation matrix of the returns of different long-short factors for the period from April 1995 until March 2021.

Table 1: Variable definitions

Variable	Definition
Gross Profit Over Asset ($GPOA$)	(Revenue ($RVET$) - Cost of Goods Sold ($COGS$)) / Total Assets (TA) $RVET$ is the 'Sales', $COGS$ is the 'Cost of goods sold' and TA is 'Total assets'.
Return on Equity (ROE)	Net income (IB) / Book-equity (BE) IB is 'Profit after tax' and BE is the 'Net worth'
Return on Assets (ROA)	IB/TA
Capex ($CAPX$)	Change in 'Gross fixed assets'
Working Capital (WC)	'Net Working Capital' less 'Cash balance'
Cash Flow Over Assets ($CFOA$)	(net income (NB) + depreciation (DP) - changes in working capital (Δ WC) - capital expenditures ($CAPX$)) / TA NB is 'Profit after tax', DP is 'Depreciation / Amortisation (net of transfer from revaluation reserves)' and Δ WC is change in Working Capital
Gross Margin ($GMAR$)	($REVT$ - $COGS$)/ 'Sales'
Accruals (ACC)	- (Δ WC - DP)/TA
Five-Year Growth in Residual Gross Profit Over Asset (Δ $gpoa$)	$[(gp_t - r_f \times ta_{t-1}) - (gp_{t-5} - r_f \times ta_{t-6})]/ta_{t-5}$ gp is ($REVT$ - $COGS$) per share, r_f is risk-free rate, ta is 'Total assets' per share
Five-Year Growth in Residual Return on Equity (Δroe)	$[(ib_t - r_f \times be_{t-1}) - (ib_{t-5} - r_f \times be_{t-6})]/be_{t-5}$ ib is 'Profit after tax' per share and be is 'Net worth' per share

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Table 1 – continued from previous page

Variable	Description
Five-Year Growth in	
Residual Return Over Assets (Δroa)	$[(ib_t - r_f \times ta_{t-1}) - (ib_{t-5} - r_f \times ta_{t-6})]/ta_{t-5}$
Five-Year Growth in	
Residual Cash Flow Over Assets ($\Delta cfoa$)	$[(cf_t - r_f \times ta_{t-1}) - (cf_{t-5} - r_f \times ta_{t-6})]/ta_{t-5}$ cf is Cash Flow Over Assets ($CFOA$) per share
Five-Year Growth in	
Gross Margin ($\Delta gmar$)	$(gp_t - gp_{t-5})/sale_{t-5}$ $sale$ is 'Sales' per share.
Low Beta (BAB)	- β Betas are estimated as in Frazzini and Pedersen (2014)
Low Leverage (lev)	- (Long-term Debt ($DLTT$) + Short-term Debt (DLC) + Preferred Stock ($PSTK$)/ TA) $DLTT$ is 'Long-term Borrowings', DLC is 'Short-term Borrowings' and $PSTK$ is 'Paid up preference capital'
Ohlson's O-Score (o)	-$(1.32 - 0.407 \times log(ADJASSET/CPI) + 6.03 \times TLTA - 1.43 \times WCTA + 0.076 \times CLCA - 1.72 \times OENEG - 2.37 \times NITA - 1.83 \times FUTL + 0.285 \times INTWO - 0.521 \times CHIN)$ Adjusted Total Assets ($ADJASSET$) is 'Total Assets' + 0.1 ×(Market capitalisation−BE) CPI is the Consumer Price Index $TLTA$ is $(DLTT + DLC)/ADJASSET$

Continued on next page

Table 1 – continued from previous page

Variable	Description
	$CLCA$ is 'Current liabilities & provisions' (LCT)/'Current assets' (ACT) $OENEG$ is a dummy equal to 1 if Total Liabilities (LT='Non-current liabilities'+'Current portion of long term borrowings') exceed 'Total Assets' $1(LT > AT)$ $NITA$ is IB/TA $FUTL$ is 'PBIT'$/LT$ $INTWO$ is a dummy equal to 1 if MAX($IB_t, IB_{t-1} < 0$) $CHIN$ is $(IB_t - IB_{t-1})/(\|IB\|_t + \|IB_t - 1\|)$
Altman's Z-Score (z)	$(1.2 \times WC + 1.4 \times RE + 3.3 \times EBIT + 0.6 \times ME + Sales)/TA$ RE is 'Reserves and funds', $EBIT$ is 'PBIT' and ME is market capitisation.
$EVOL$	Standard deviation of ROE over past 5-years
$EISS$	$log(SHROUT\_ADJ_t/SHROUT\_ADJ_{t-1})$ $SHROUT\_ADJ_t$ is split-adjusted shares outstanding
$DISS$	-log($TOTD_t/TOTD_{t-1}$) $TOTD$ is $DLTT + DLC + PSTK$
$NPOP$	Total net payout over last 5-years / total profit in last 5-years Total net payout is the sum of past 5-years IB-ΔBE Total profit in the past 5-years is the sum of $(RETV - COGS)$

The variable names in single quotes used in the table represent the corresponding names in the Prowess database.

Table 2: Summary statistics of the key variables

Parameter	Variables	Mean	25^{th}	Median	75^{th}	SD
Mcap in billion INR		41.52	0.92	3.34	15.447	161.71
Profitability	GMAR	-2.66	20.76	29.2	39.29	552.86
	GPOA	29.12	12.5	25.33	40.89	23.62
	ROE	15.46	5.11	13.47	23.7	24.69
	ROA	6.6	1.63	5.08	10.21	8.46
	CFOA	3.94	-2.88	3.59	11.09	16.66
	Acc	2.94	-2.01	2.56	7.9	11.17
Growth	$\Delta gmar$	20.84	-10.52	5.34	26.76	101.79
	$\Delta gpoa$	9.21	-7.18	2.4	18.96	32.08
	Δroe	9.48	-9.59	1.85	18.44	43.19
	Δroa	-104.84	-68.39	-20.67	-5.92	310.66
	$\Delta cfoa$	2.49	-8.58	1.71	13.95	28.83
Safety	$-$beta	-0.94	-1.07	-0.9	-0.77	0.24
	altman.Z.score	2.47	1.51	2.19	3.13	1.52
	O	11.03	3.96	5.27	7.62	40.48
	LEV	-25.71	-40.18	-24.16	-7.04	20.22
	EVOL	18.34	4.67	8.7	17.16	42.88
Payout	EISS	-6.22	-0.06	0	0	18.96
	DISS	-6.67	-28.38	-5.59	14.52	66.05
	NPOP	-12.2	-7.95	2.47	9.29	200.99

The table shows the summary statistics of z-scores of the key variables used in the construction of quality scores as defined in Table 1. The variables are estimated annually. The sample of stocks is the top 1,000 firms by market capitalisation every year. Market capitalisation figures are in INR billion. The z-scores are winzorised at 1% and 99% levels to estimate the summary statistics.

Table 3: Comparison of QMJ and LQ factor returns - top 1,000 firms by market capitalisation

Factors	Mean	Median	$25^{th}percentile$	$75^{th}percentile$	Volatility
Panel A: Long-short factor portfolios					
Quality	1.69	1.74	-2.11	5.59	6.71
Momentum	1.62	1.38	-2.04	4.79	7.16
Value	-0.25	-0.59	-3.48	2.54	5.97
Size	0.07	0	-2.51	2.64	4.33
Market	1.33	1.56	-2.74	6.07	7.45
Panel B: Long-only factor portfolios					
Quality	2.12	2.51	-1.49	6.12	7.03
Momentum	2.05	2.25	-2.08	6.92	8.02
Value	1.50	0.83	-4.93	7.23	10.88
Size	1.53	1.7	-3.55	6.98	9.25
Market	1.33	1.56	-2.74	6.07	7.45

The table gives the statistics of monthly returns for the market, value, size, momentum and quality factors in India. Each of the figures represents the corresponding percentage values of the factors. Panel A represents the long-short (zero investment) portfolio returns, whereas Panel B shows the long-only portfolio returns.

Table 4: Performance characteristics of QMJ and LQ factor returns - top 1,000 firms by market capitalisation

Factor	Sharpe ratio	Avg. Drawdown	Worst Drawdown	Avg Drawdown period	Max drawdown period
Panel A: Long-short portfolio					
Quality	0.29	-9.76	-40.9	33.57	78.57
Momentum	0.38	-12.13	-52.09	31.71	600.00
Value	-0.53	-66.96	-87.92	44.57	1078.29
Size	-0.37	-28.70	-60.57	42.57	1213
Market	0.12	-14.00	-60.23	35.14	100.00
Panel B: Long-only portfolio					
Quality	0.40	-7.99	-57.78	27.86	56.86
Momentum	0.28	-14.52	-61.51	32.14	643.71
Value	0.08	-32.46	-79.98	38.14	1017.71
Size	0.13	-24.11	-70.02	36.43	630.71
Market	0.12	-14.00	-60.23	35.14	100.00

The table provides the performance of the long-short factor portfolios constructed based on the quality and other factors. The Avg. drawdown represents the average percentage drawdown. The average drawdown period (Avg. drawdown period) and the maximum drawdown period are given in weeks (Max drawdown period).

Table 5: Alpha and other characteristics of quality sorted portfolios

	D1 (Low)	D2	D3	D4	D5	D6	D7	D8	D9	D10 (High)	High-Low
Excess return	0.170	0.805	0.491	0.316	0.479	0.660	0.895	0.908	0.606	1.734	1.565
CAPM-alpha	−0.679**	−0.098	−0.341	−0.502**	−0.291	−0.073	0.139	0.263	−0.087	1.087***	1.765***
	(0.319)	(0.280)	(0.248)	(0.233)	(0.220)	(0.205)	(0.208)	(0.238)	(0.222)	(0.236)	(0.459)
3-factor alpha	−0.483*	−0.006	−0.209	−0.408*	−0.227	−0.051	0.105	0.256	−0.108	0.989***	1.472***
	(0.251)	(0.266)	(0.222)	(0.218)	(0.208)	(0.204)	(0.207)	(0.239)	(0.221)	(0.223)	(0.370)
4-factor alpha	−0.289	0.209	−0.008	−0.219	0.042	0.106	0.105	0.049	−0.105	0.694***	0.983***
	(0.254)	(0.270)	(0.224)	(0.221)	(0.205)	(0.207)	(0.214)	(0.242)	(0.229)	(0.219)	(0.364)
Beta	1.114***	1.187***	1.093***	1.076***	1.012***	0.964***	0.993***	0.847***	0.911***	0.851***	−0.264***
	(0.043)	(0.037)	(0.033)	(0.031)	(0.029)	(0.027)	(0.028)	(0.032)	(0.030)	(0.031)	(0.061)
Observations	312	312	312	312	312	312	312	312	312	312	312
Adjusted R^2	0.688	0.764	0.778	0.794	0.792	0.800	0.804	0.696	0.752	0.702	0.053

The table shows the excess return and alpha of different quality sorted portfolios. D1 (D10) represents the lowest (highest) decile of stocks ranked by quality score in a month. The high-low portfolio is a long-short portfolio formed by going long on the highest quality decile portfolio and shorting the lowest quality decile. Excess returns is the monthly returns in excess of the risk-free return. CAPM-alpha is the intercept of the regression of excess returns on market factor. Analogously, 3-factor alpha is the intercept of regression involving size, value and market factor. 4-factor alpha is the intercept in the regression where momentum is added as a fourth factor in addition to the 3-factors. *, **, and *** indicates the significance levels at the 10%, 5% and 1% levels.

Table 6: Quality sorted portfolios and four-factor alphas

	P1 (Low)	P10 (High)	High-Low	QMJ
Market	0.969***	0.918***	−0.051	−0.186***
	(0.034)	(0.030)	(0.049)	(0.039)
Size	0.342***	0.031	−0.311***	−0.173**
	(0.060)	(0.052)	(0.086)	(0.068)
Value	0.434***	−0.175***	−0.609***	−0.539***
	(0.046)	(0.039)	(0.065)	(0.052)
Momentum	−0.119***	0.182***	0.301***	0.135***
	(0.038)	(0.033)	(0.054)	(0.043)
Alpha	−0.289	0.694***	0.983***	0.917***
	(0.254)	(0.219)	(0.364)	(0.288)
Observations	312	312	312	312
Adjusted R^2	0.814	0.758	0.444	0.462

The table shows the regression estimates of the alpha of quality sorted portfolio with the four-factor. The dependent variable and the market are monthly excess returns. The portfolios are quality sorted within the universe of the top 1,000 firms by market capitalisation. D1 and D10 are the portfolios sorted by the lowest and highest decile by the quality scores within each month. High-Low is the long-short portfolio by going long on P10 and shorting the P1 portfolio. QMJ is long-short quality portfolio, as defined in Equation 6. *, **, and *** indicate the significance levels at the 10%, 5% and 1% levels.

Table 7: Four-factor alpha of QMJ and its dimensions

	Quality	Profitability	Growth	Safety	Payout
Value	−0.539***	−0.539***	−0.324***	−0.570***	0.075
	(0.052)	(0.051)	(0.048)	(0.045)	(0.054)
Momentum	0.135***	0.057	0.220***	0.120***	0.011
	(0.043)	(0.043)	(0.040)	(0.037)	(0.044)
Size	−0.173**	−0.187***	0.079	−0.117**	−0.060
	(0.068)	(0.068)	(0.063)	(0.059)	(0.071)
Market	−0.186***	−0.281***	0.063*	−0.172***	−0.319***
	(0.039)	(0.039)	(0.036)	(0.034)	(0.040)
Alpha	0.917***	1.375***	0.429	0.100	0.621**
	(0.288)	(0.288)	(0.267)	(0.250)	(0.299)
Observations	312	310	312	312	312
Adjusted R^2	0.462	0.484	0.258	0.527	0.170

The table shows the regression results of the QMJ and its dimension returns with four-factors. Table shows the long-short portfolio regression results. The value, momentum, market and size factor portfolio are constructed as per Agarwalla et al. (2014) within the sample of top 1,000 firms by market capitalisation each month.*, **, and *** indicate the significance levels at the 10%, 5% and 1% levels.

Table 8: The price of quality: cross-sectional regressions

	Sub-periods				
	1995/04-2000/04	2000/05-2008/09	2008/10-2016/11	2016/12-2021/03	1995/04-2021/03
Quality	0.155***	0.181***	0.152***	0.088***	0.236***
	(0.025)	(0.015)	(0.013)	(0.018)	(0.008)
Firm.size	0.732***	1.075***	1.243***	1.060***	1.037***
	(0.033)	(0.020)	(0.021)	(0.039)	(0.010)
return	−0.219***	−0.241***	−0.273***	−0.239***	−0.213***
	(0.010)	(0.006)	(0.005)	(0.007)	(0.004)
Firm.age	0.294*	0.185***	−0.164***	−0.535***	−0.149***
	(0.156)	(0.063)	(0.051)	(0.159)	(0.028)
Dividend.Dummy	−0.062***	−0.055***	−0.073***	−0.033**	−0.093***
	(0.024)	(0.016)	(0.013)	(0.016)	(0.009)
Firm FE	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes
Observations	2,542	7,906	7,933	3,985	22,366
Adjusted R^2	−0.063	0.268	0.325	0.068	0.343

The table shows the regression estimates of the price of quality on control variables. The dependent variable is the logarithmic of market-to-book ratio. The variables 'Quality' is the quality scores of each firm in the given year, the 'Firm size' is the logarithmic of market capitalisation, 'returns' is the one-year total return of the firm in the previous year and 'Dividend dummy' is equal to 1 if the firm issued any dividend in the previous year. *, **, and *** indicate the significance levels at the 10%, 5% and 1% levels.

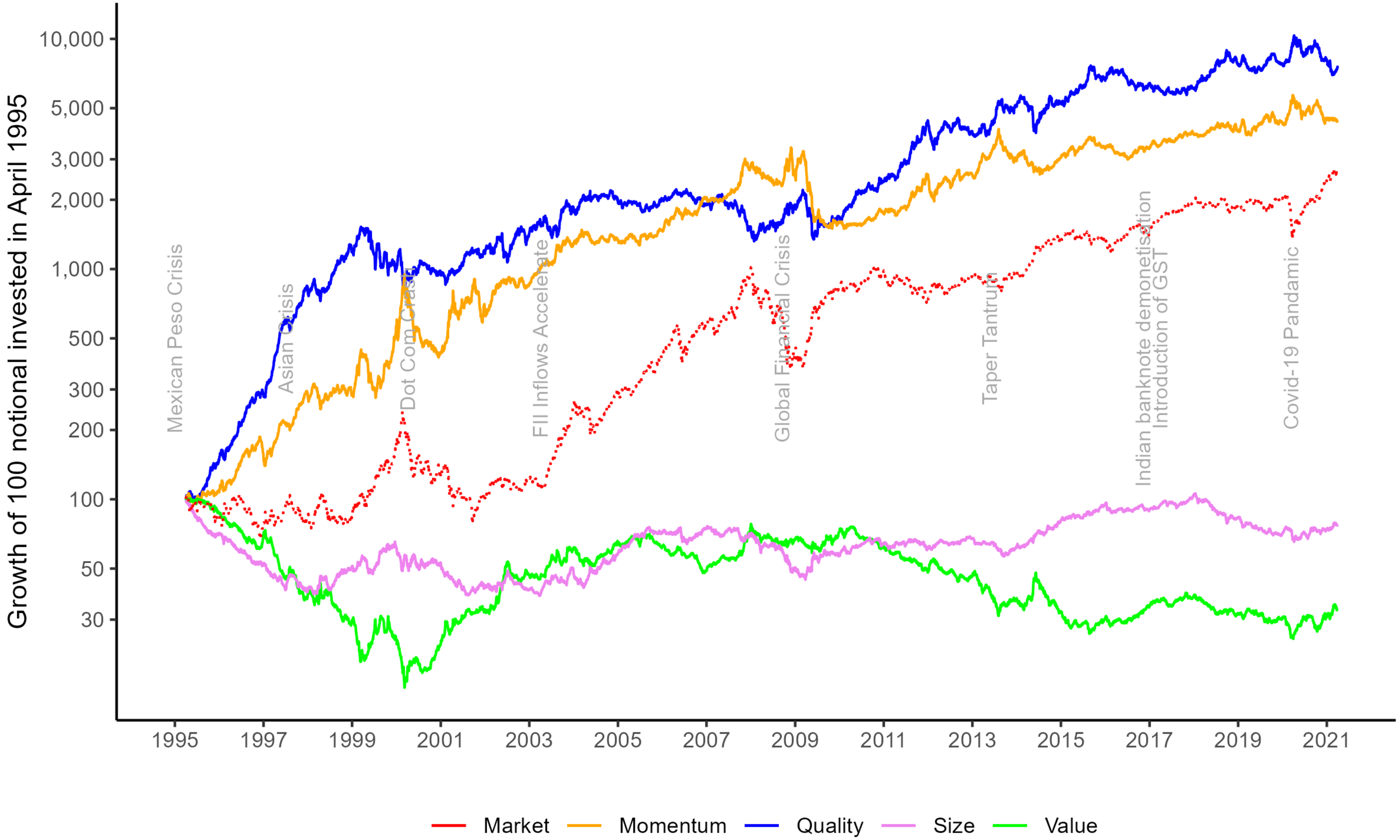
Table 9: Persistence of stock level quality scores

Factor	Period	1	2	3	4	5	6	7	8	9	10
Quality	t	-1.28	-0.82	-0.55	-0.31	-0.11	0.18	0.39	0.64	0.94	1.41
	t + 12 M	-0.85	-0.57	-0.38	-0.25	-0.1	0.09	0.27	0.45	0.63	1.02
	t + 36 M	-0.54	-0.41	-0.28	-0.15	-0.06	0.07	0.15	0.36	0.46	0.75
	t + 60 M	-0.33	-0.26	-0.15	-0.08	-0.04	0.05	0.15	0.28	0.35	0.59
	t + 120 M	-0.28	-0.17	-0.07	-0.04	-0.01	0.13	0.18	0.27	0.36	0.56
Profit	t + 120 M	0.01	0.14	0.19	0.29	0.4	0.46	0.56	0.64	0.8	0.94
Growth	t + 120 M	-0.18	-0.21	-0.22	-0.21	-0.12	-0.12	-0.08	-0.14	-0.01	-0.01
Safety	t + 120 M	-0.86	-0.48	-0.38	-0.29	-0.19	-0.11	0.09	0.27	0.54	0.74

The table shows the average value-weighted quality factor scores over a period of time. The scores are ranked into 10 deciles and the weighted average value is estimated annually. The t represents the time period and M represents the number of months from the time period t. The scores in each decile are estimated by considering the same stocks constituting each decile at time t, t + 12 months, t + 36 months, t + 60 months, t + 120 months over a period of 12, 36, 60 and 120 months.

Appendix

Figure A1: Growth of 100 notional investment in long-short factors - top-500 firms by market capitalisation

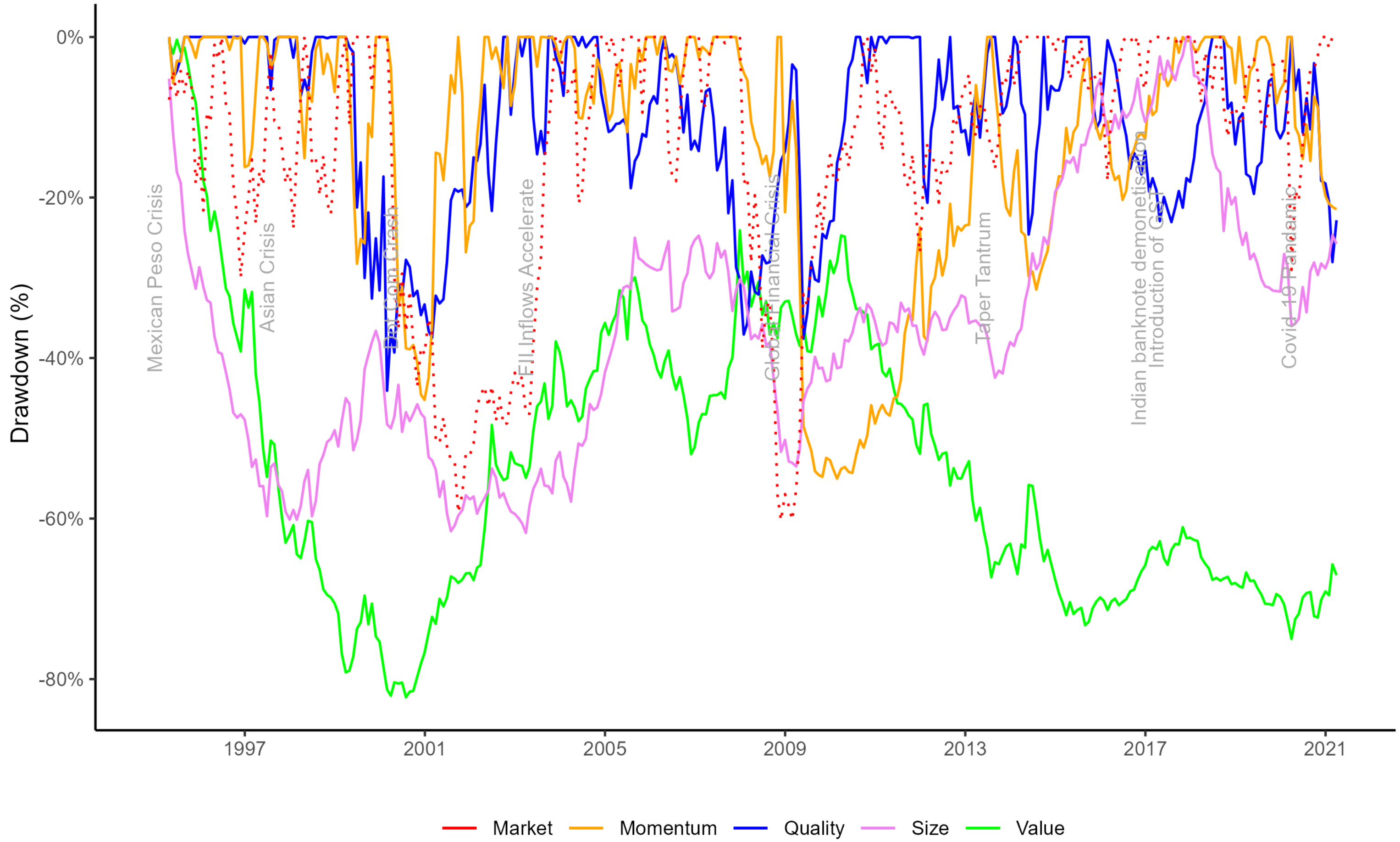


The figure shows the growth of 100 notional invested in long-short portfolios representing different factors, market, value, size, quality and momentum for the period from April 1995 to March 2021.

Figure A2: Growth of 100 notional investment in long-short factors - top-250 firms by market capitalisation

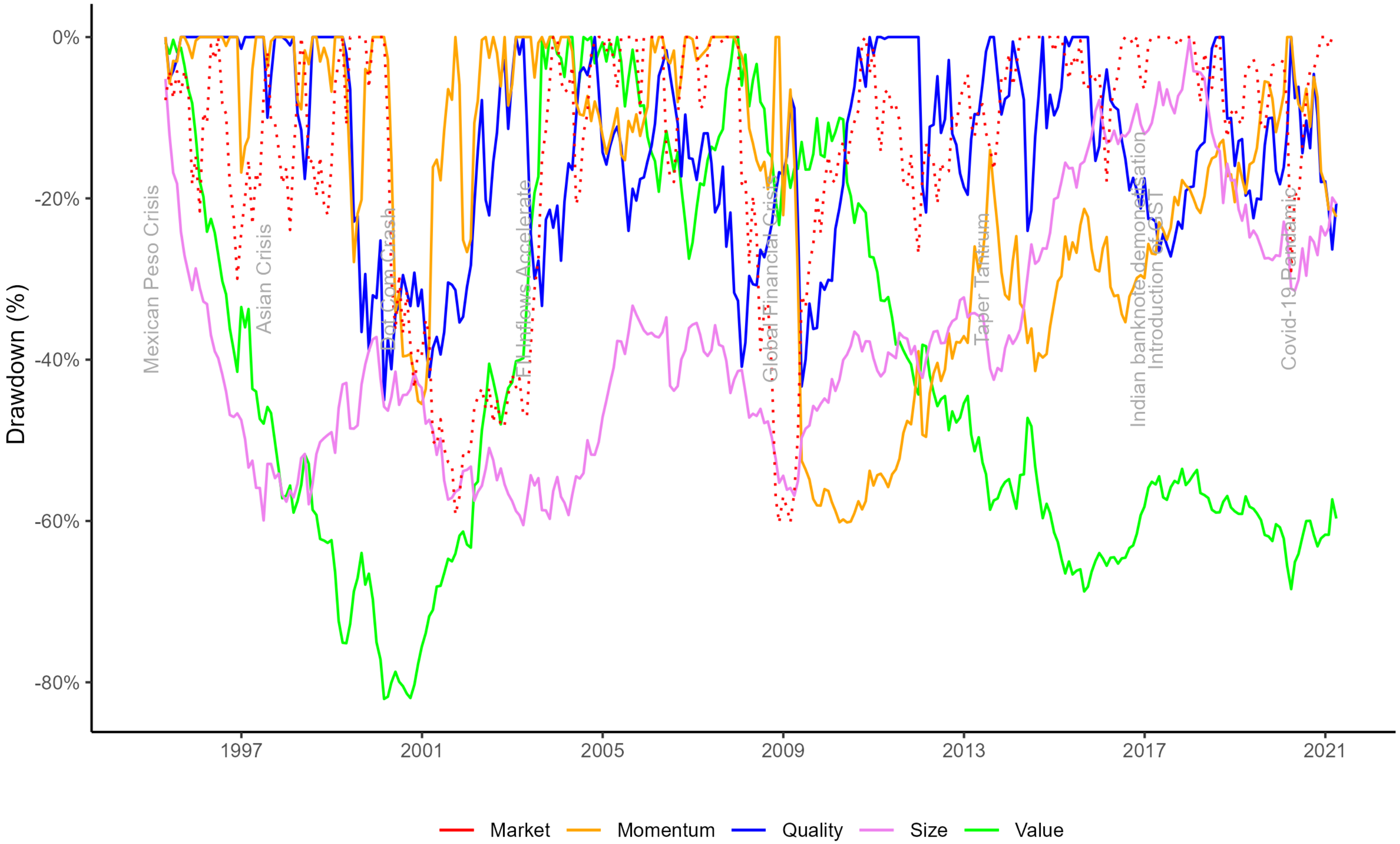
The figure shows the growth of 100 notional invested in long-short portfolios representing different factors, market, value, size, quality and momentum for the period from April 1995 to March 2021.

Figure A3: Comparison of the drawdown of long-short factors - top 500 firms by market capitalisation



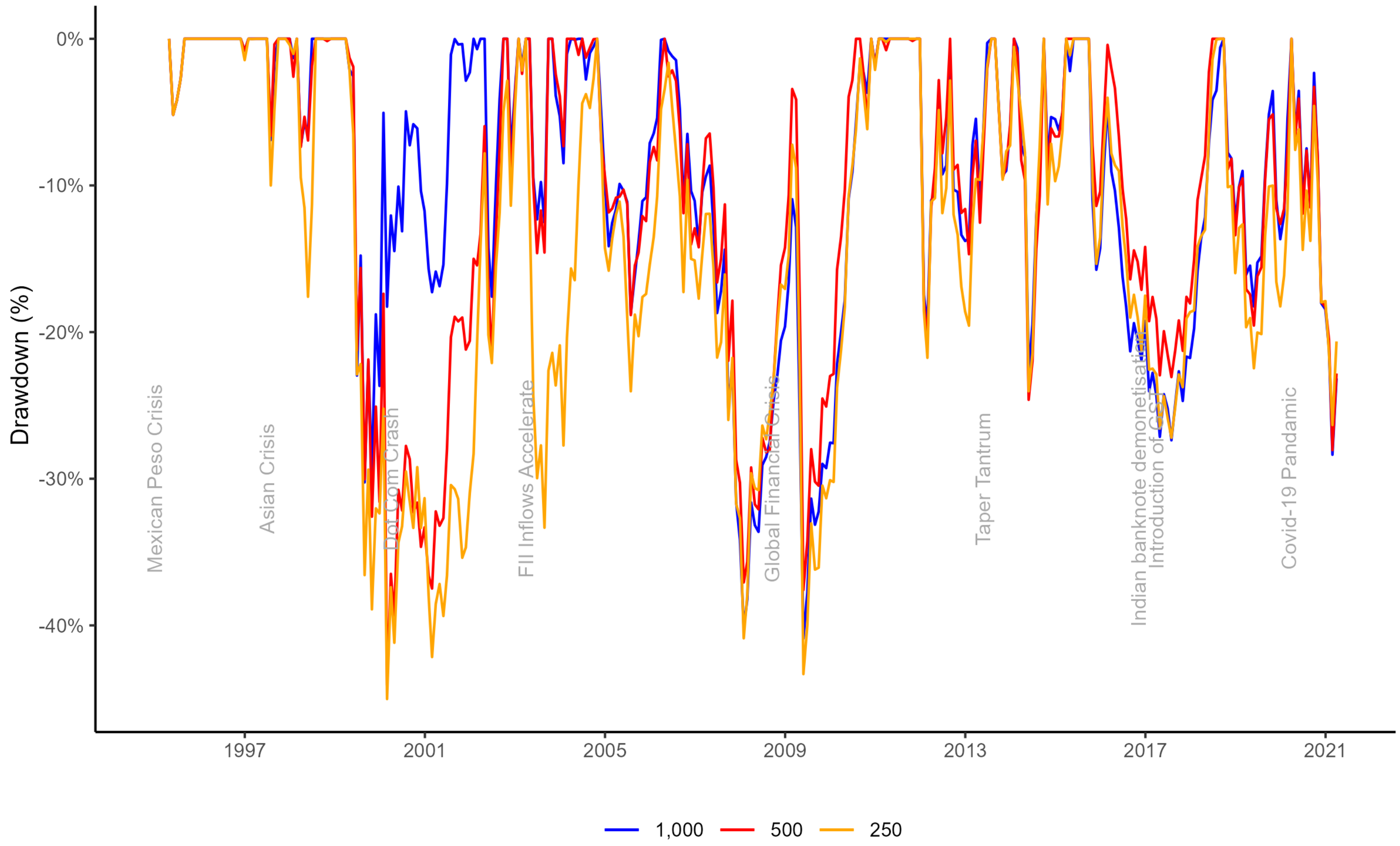
The figure shows the drawdowns of the portfolios representing long-short factors, market, value, size, quality and momentum for the period from April 1995 to March 2021.

Figure A4: Comparison of the drawdown of long-short factors - top 250 firms by market capitalisation



The figure shows the drawdowns of the portfolios representing long-short factors, market, value, size, quality and momentum for the period from April 1995 to March 2021.

Figure A5: Comparison of the drawdown of QMJ portfolio with the different sample of stocks

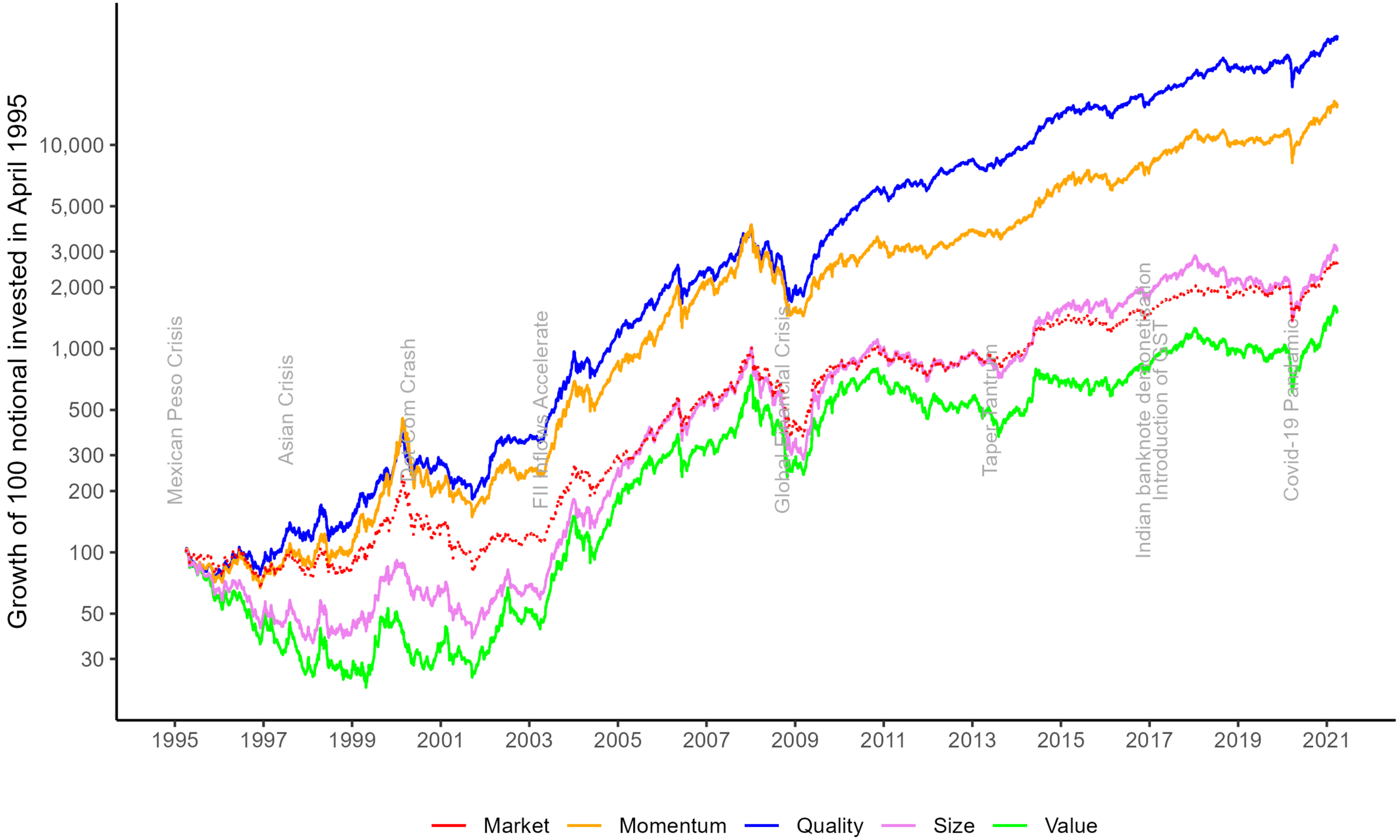


The figure shows the drawdowns of the portfolios representing QMJ factors with different samples of stocks. The legend 1,000, 500 and 250 indicates the number of the top firms by market capitalisation included in the sample every month. The drawdowns are for the period from April 1995 to March 2021.

Figure A6: Growth of 100 notional investment in long-only factors - top-1000 firms by market capitalisation

The figure shows the growth of 100 notional invested in long-only portfolios representing different factors, market, value, size, quality and momentum for the period from April 1995 to March 2021.

Figure A7: Growth of 100 notional investment in long-only factors - top-500 firms by market capitalisation



The figure shows the growth of 100 notional invested in long-only portfolios representing different factors, market, value, size, quality and momentum for the period from April 1995 to March 2021.

Figure A8: Growth of 100 notional investment in long-only factors - top-250 firms by market capitalisation

The figure shows the growth of 100 notional invested in long-only portfolios representing different factors, market, value, size, quality and momentum for the period from April 1995 to March 2021.

Table A1: Summary statistics of the key variables

Parameter	Variables	Mean	25^{th}	Median	75^{th}	SD
Panel A: Period 1995-2000						
Mcap		4.16	0.19	0.6	2.32	12.51
Profitability	GMAR	33.11	25.57	33.12	40.76	13.49
	GPOA	35.64	19.53	30.8	46.35	25.48
	ROE	12.68	4.4	12.84	22.98	22.25
	ROA	5.43	1.35	4.52	8.84	8.03
	CFOA	0.63	-5.61	2	8.82	16.22
	Acc	3.81	-1.34	3.81	9.18	10.47
Growth	$\Delta gmar$	26.11	-8.03	6.99	30.77	91.34
	$\Delta gpoa$	11.24	-8.35	4.17	24	33.15
	Δroe	5.47	-15.07	-1.37	16.51	44.98
	Δroa	-35.29	-34.56	-14.75	-5.02	75.17
	$\Delta cfoa$	1.16	-9.72	2.39	14.91	28.2
Safety	beta	-0.92	-1.03	-0.9	-0.8	0.19
	altman.Z.score	2.29	1.47	2.02	2.74	1.4
	O	5.68	3.44	4.41	5.56	7.48
	LEV	-34.79	-47.91	-35.62	-21.14	18.7
	EVOL	19.54	6.64	11.57	20.87	29.02
Payout	EISS	-7.24	0	0	0	18.9
	DISS	-7.54	-25.96	-7.84	9.58	44.98
	NPOP	-8.04	-12.4	-1.75	3.52	27.7
Panel B: Period 2001-2005						
Mcap		6.78	0.21	0.67	2.66	22.91
Profitability	GMAR	28.81	23.17	31.21	40.05	31.88
	GPOA	32.79	17.46	29.12	44.39	23.31
	ROE	14.34	4.49	12.6	23.37	25.42
	ROA	5.9	1.29	4.41	9.53	8.31
	CFOA	3.89	-2.73	3.63	10.91	15.3
	Acc	3.69	-1.56	3.35	8.52	10.36
Growth	$\Delta gmar$	23.7	-8.22	6.13	26.35	100.96
	$\Delta gpoa$	9.64	-6.12	4.33	20.21	29.19
	Δroe	5.04	-10.1	0.85	15.21	32.69
	Δroa	-28.07	-22.64	-9.31	-1.83	74.25
	$\Delta cfoa$	3.84	-7.06	3.08	15.33	24.38
Safety	beta	-0.87	-0.98	-0.83	-0.72	0.23
	altman.Z.score	2.17	1.45	2.01	2.75	1.16
	O	10.02	3.7	4.8	6.42	25.64

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Table A1 – continued from previous page

Parameter	Variables	Mean	25^{th}	Median	75^{th}	SD
	LEV	-29.16	-43.94	-28.89	-10.47	20.62
	EVOL	14.94	4.81	8.61	16.39	23.1
Payout	EISS	-5	0	0	0	16.9
	DISS	-1.37	-22.37	-1.47	15.57	59.33
	NPOP	-3.61	-2.44	4.62	10.32	45.35
Panel C: Period 2006-2010						
Mcap		25.96	0.99	2.81	12.15	90.51
Profitability	GMAR	23.64	21.07	29.51	39.84	67.33
	GPOA	31.49	13.8	27.71	44.82	24.86
	ROE	23.46	8.51	18.37	31.04	32.04
	ROA	8.48	2.62	6.56	12.51	9.43
	CFOA	3.45	-4.71	3.63	12.12	19.3
	Acc	2.92	-3.08	2.66	9.13	14.1
Growth	$\Delta gmar$	28.49	-13.38	7.52	34.33	100.68
	$\Delta gpoa$	13.49	-9.11	3.54	24.65	41.67
	Δroe	22.69	-5.8	7.66	32.56	60.11
	Δroa	-57.07	-44.23	-15.52	-3.14	146.93
	$\Delta cfoa$	0.87	-10.57	1	13.79	34.94
Safety	beta	-0.83	-0.93	-0.82	-0.72	0.16
	altman.Z.score	2.47	1.59	2.29	3.16	1.33
	O	17.66	3.88	5.1	7.09	80.65
	LEV	-27.47	-42.69	-26.74	-7.47	21.1
	EVOL	27.98	5.88	11.04	22.33	72.52
Payout	EISS	-9.14	-4.44	0	0	23.13
	DISS	-14.36	-40.16	-10.99	11.64	71.04
	NPOP	-10.31	-12.09	1.92	9.43	128.63
Panel D: Period 2011-2015						
Mcap		57.36	2.15	5.65	26.41	181.62
Profitability	GMAR	-0.56	18.74	26.51	37.53	229.58
	GPOA	25.29	8.64	21.55	36.85	22.29
	ROE	13.28	4.4	12.02	21.44	20.34
	ROA	6.11	1.38	4.45	9.43	8.06
	CFOA	4.28	-2.12	3.56	10.55	15.46
	Acc	3.01	-1.7	2.28	7.55	10.86
Growth	$\Delta gmar$	18.74	-12.68	5.63	26.54	85.57
	$\Delta gpoa$	8.49	-7.2	1.78	18.75	30.8
	Δroe	4.33	-12.86	-0.54	13.67	38.43
	Δroa	- 160.44	- 126.65	-42.83	-13.93	363.36

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Table A1 – continued from previous page

Parameter	Variables	Mean	25^{th}	Median	75^{th}	SD
	$\Delta cfoa$	2.55	-9.51	1.06	13.83	30.3
Safety	beta	-1.03	-1.19	-1.01	-0.85	0.26
	altman.Z.score	2.47	1.44	2.16	3.16	1.6
	O	9.82	4.28	5.79	8.38	16.66
	LEV	-22.46	-35.37	-20.38	-4.97	18.76
	EVOL	17.46	4.57	8.35	15.67	38.08
Payout	EISS	-5.48	-0.16	0	0	18.81
	DISS	-3.68	-26.58	-6.02	15.24	64.6
	NPOP	-15.06	-6.88	2.73	10.03	233.67
Panel E: Period 2016-2021						
Mcap		96.26	4.81	13.46	54.29	267.1
Profitability	GMAR	-83.56	18.17	26.24	37.78	1153.01
	GPOA	23.03	7.95	19.43	33.47	20.31
	ROE	12.47	4.37	12.02	20.28	18.72
	ROA	6.62	1.74	5.23	10.26	7.93
	CFOA	6.36	-0.77	4.61	12.12	15.97
	Acc	1.67	-2.22	1.59	5.82	8.95
Growth	$\Delta gmar$	9.09	-10.68	2.5	18.19	122.32
	$\Delta gpoa$	4.26	-5.91	0.75	11.46	21.91
	Δroe	7.46	-6.53	2.14	15.13	29.76
	Δroa	-198.65	-148.16	-43.31	-12.07	488.1
	$\Delta cfoa$	3.63	-6.69	1.56	12.12	23.96
Safety	beta	-1.01	-1.16	-0.97	-0.82	0.26
	altman.Z.score	2.85	1.64	2.53	3.66	1.85
	O	10.57	4.79	6.56	9.28	17.63
	LEV	-18.1	-28.51	-14.04	-2.01	17.82
	EVOL	11.68	3.17	5.76	11.12	21.19
Payout	EISS	-4.39	-0.06	0	0	15.52
	DISS	-5.86	-26.9	-2.65	20.4	79.89
	NPOP	-21.39	-4.6	3.38	12.42	330.94

The table shows statistics of key variables which are involved in constructing the quality score. Different panels in the table indicate different 5-year time periods for which the statistics are estimated. The variable values are estimated annually, at the end of each financial year. The definition of variables are given in Table 1.

Table A2: Summary statistics of quality portfolios returns

Factors	Mean	Median	$25^{th} percentile$	$75^{th} percentile$	Volatility
Top 500 firms by market capitalisation					
Panel A: Long-short factor portfolios					
Quality	1.65	1.65	-1.99	6.2	7.04
Momentum	1.47	0.92	-1.99	4.85	7.16
Value	-0.19	-0.46	-3.54	2.75	5.71
Size	0.00	0.06	-2.42	2.46	4.16
Market	1.32	1.61	-2.76	6.11	7.42
Panel B: Long-only factor portfolios					
Quality	2.14	2.46	-1.61	5.98	7.02
Momentum	1.95	2.22	-2.02	6.6	7.87
Value	1.37	1.24	-4.45	6.77	9.94
Size	1.49	1.91	-3.18	6.57	8.82
Market	1.32	1.61	-2.76	6.11	7.42
Top 250 firms by market capitalisation					
Panel C: Long-short factor portfolios					
Quality	1.41	1.78	-2.42	6.14	7.2
Momentum	1.49	0.91	-1.98	4.24	7.47
Value	-0.02	-0.29	-3.61	3.13	5.66
Size	0.01	0.1	-2.47	2.4	4.01
Market	1.31	1.48	-2.69	6.12	7.38
Panel D: Long-only factor portfolios					
Quality	2.00	2.45	-2.13	6.08	7.01
Momentum	2.01	2.04	-1.93	6.25	7.89
Value	1.42	1.21	-3.6	6.74	9.35
Size	1.49	1.8	-3.24	6.43	8.46
Market	1.31	1.48	-2.69	6.12	7.38

The table gives the monthly returns, mean, median, percentiles and volatility for the market, value, size, momentum and quality factors portfolio. Each of the figures represents the corresponding percentage values for long-short (Panel A and C) and long-only (Panel C and D) portfolios involving the factors. Panel A and B correspond to the universe of stocks with the top 500 firms by market capitalisation each month, similarly, Panel C and D correspond to the top 250 firms.

Table A3: Performance characteristics of the quality factor

Factor	Sharpe ratio	Avg. Drawdown	Worst Drawdown	Avg Drawdown period	Max drawdown period
		Top 500 firms by market capitalisation			
Panel A: Long-short portfolio					
Quality	0.26	-10.72	-44.08	33.29	134.86
Momentum	0.30	-13.19	-55.03	34.43	578.71
Value	-0.48	-53.41	-82.26	44.57	1078.29
Size	-0.42	-36.07	-61.79	44.29	939.29
Market	0.12	-13.9	-59.93	35.43	100.00
Panel B: Long-only portfolio					
Quality	0.42	-7.99	-56.58	27.14	56.86
Momentum	0.27	-15.32	-61.59	32.57	630.71
Value	0.07	-30.18	-76.41	39.29	1143.71
Size	0.13	-22.44	-68.99	35.86	630.71
Market	0.12	-13.9	-59.93	35.43	100.00
		Top 250 firms by market capitalisation			
Panel C: Long-short portfolio					
Quality	0.20	-13.89	-45.02	35.71	152.43
Momentum	0.25	-18.43	-60.18	35.71	565.29
Value	-0.30	-41.18	-82.06	43.29	1100.14
Size	-0.47	-37.31	-60.51	44.57	939.29
Market	0.12	-13.7	-59.45	35.29	117.71
Panel D: Long-only portfolio					
Quality	0.42	-8.01	-54.68	28.14	52.43
Momentum	0.25	-16.28	-61	33.29	643.71
Value	0.09	-28.25	-71.28	38.71	1143.71
Size	0.15	-19.24	-67.24	34.57	643.71
Market	0.12	-13.7	-59.45	35.29	117.71

The table provides the comparative performance of the long-short and long-only factor portfolios constructed based on the quality factor. The Avg. drawdown represents the average percentage drawdown. The average drawdown period (Avg. drawdown period) and the maximum drawdown period are given in weeks (Max drawdown period). Panel A and B correspond to the universe of stocks with the top 500 firms by market capitalisation each month, similarly, Panel C and D correspond to the top 250 firms.

Table A4: Quality factor and four-factor alphas across different stock groups

	QMJ			*LQ*		
	Top 1,000	Top 500	Top 250	Top 1,000	Top 500	Top 250
Value	−0.539***	−0.562***	−0.416***	−0.116***	−0.123***	0.001
	(0.052)	(0.059)	(0.063)	(0.031)	(0.034)	(0.038)
Momentum	0.135***	0.086*	0.115**	0.095***	0.094***	0.106***
	(0.043)	(0.048)	(0.049)	(0.025)	(0.027)	(0.029)
Size	−0.173**	−0.220***	−0.358***	0.313***	0.295***	0.343***
	(0.068)	(0.077)	(0.084)	(0.041)	(0.044)	(0.050)
Market	−0.186***	−0.226***	−0.285***	0.851***	0.850***	0.806***
	(0.039)	(0.043)	(0.046)	(0.023)	(0.025)	(0.027)
Alpha	0.917***	1.017***	0.875***	0.700***	0.765***	0.668***
	(0.288)	(0.315)	(0.337)	(0.171)	(0.180)	(0.201)
Observations	312	312	312	312	312	312
Adjusted R^2	0.462	0.412	0.355	0.830	0.809	0.760

The table shows the regression estimates of the alpha of *QMJ* and *LQ* portfolio with four factors. The dependent variable and the market are monthly excess returns. The top 1,000, 500 and 250 indicate samples of firms with top 1,000, 500, and 250 firms by market capitalisation respectively. *, **, and *** indicate the significance levels at the 10%, 5% and 1% levels.