

# Survey of Quality Investing

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## 1. INTRODUCTION

Factor investing has experienced a resurgence in popularity under the moniker “smart beta.” Several traditional factors, such as value, size, momentum, and low beta, are well defined and have been heavily researched in academia as return anomalies for many decades. These factors have also been exploited by practitioners as quantitative strategies for enhancing returns. Today, these factors each define a distinct smart beta category (think of style boxes for smart beta strategies) and are the foundational building blocks for the now-ubiquitous multi-factor products.

The recently popularized quality factor, however, appears to stand-alone in many regards. Like the four previously named factors, quality investing has been widely practiced as an investment strategy by portfolio managers. MSCI, FTSE Russell, S&P, EDHEC, and Deutsche Bank, among others, have created quality factor indices for licensing and have generally included quality as a part of their multi-factor offerings. But, unlike the conventional factors, quality as a source of return has attracted limited academic attention and has been focused on only some facets of what practitioners categorize as quality. In a way, quality is a product waiting for academic validation, and the early results appear to be more inconclusive than its massive popularity might warrant.<sup>1</sup>

In a routine product conversation with investors, the quality factor is pitched by providers as an independent source of return and as providing diversification due to its supposedly low correlation with the value factor. What remains uncomfortable for researchers, however, is that the quality factor is constructed very differently than other factors. Factors, such as value or low beta, are created from a particular stock characteristic (or a set of highly related stock characteristics) to capture a risk premium associated with an undiversifiable economic risk or to capture an anomalous return associated with a persistent investor behavioral bias. For example, the value factor is generally constructed from stocks that have high book-to-price, high earnings-to-price, high dividend-to-price, or some combination of these valuation measures. Regardless of the chosen definition for factor construction, the resulting portfolio looks and feels like a value portfolio in that it owns low valuation stocks.

In contrast, quality factor portfolios, as constructed by the different providers, have been entirely multi-signal in nature. Providers tag a stock as high quality if it scores high on some combination of the

following attributes: earnings growth, earnings-growth stability, low return-volatility, high profitability, high return on assets (ROA), low debt ratio, and low accounting accruals. We begin our study by examining definitions of quality implemented in different product offerings. We show that quality, as executed by practitioners, is a collection of heterogeneous signals having little correlation with each other. Quality, as currently defined, would seem to be a catch-all bucket for those portfolios that blend many otherwise-independent return factors.

These stock screens appear to favor heterogeneous groups of stocks and produce portfolios with low correlation to one another. The stocks appear to be selected for their diversity, and the multiple signals used in constructing the quality portfolios do not appear to be proxies for a single specific risk exposure or behavioral anomaly. Thus, a quality portfolio can seem more like a quantitative strategy based on multiple signals than a factor in the heritage of the arbitrage pricing theory (APT) framework. This unique feature plays an important role in how we analyze quality products versus how we examine other more conventional factors.

Because quality is being defined as it is—a collection of heterogeneous signals—a spectrum of possible portfolio outcomes exists. In the most positive case, the resulting quality portfolio has impressive out-of-sample performance if each of the signals or characteristics included in the construction of the portfolio represents a unique source of premium, whether risk based or behavioral based. In this case the resulting quality portfolio would be a multi-factor portfolio offering a diversified basket of excess returns.

In the worst case, the multi-signal portfolio will have indistinguishable from zero out-of-sample performance despite its impressive back-tested  $t$ -stats. Why could  $t$ -stats be misleading in this case? The large pool of multiple signals to select from creates opportunities for intentional or unintentional data mining overstating the  $t$ -stats; this issue has been emphasized by Harvey, Liu, and Zhu (2015). Further, from Novy-Marx (2016) we know that combining several uncorrelated factors selected because of their spurious in-sample performance further overstates the  $t$ -stat. For example, if an ex ante random strategy has an in-sample  $t$ -stat larger than 2 with only a meager 5% probability, then a mix of three such strategies selected ex post for best performance out of 20 strategy realizations will register a  $t$ -stat above 2 with a probability of nearly 98%. In reality, this portfolio will offer investors nothing more than noise and unwarranted fees and expenses, suggesting that the process of analyzing and contrasting different quality portfolio methods is both more difficult and more important.

Given the observation that quality is a collection of heterogeneous signals, we examine where the current quality portfolios are on the spectrum of robustness: from being a collection of robust anomalies with a high chance of outperformance, at one end, to being a collection of signals selected due to their spurious in-sample performance with little chance of outperformance out of sample, at the other end. We use the Hsu, Kalesnik, and Viswanathan (2015) method to identify robustness of variables used in quality definitions.<sup>2</sup>

## 2. THE SEVEN DISTINCT CATEGORIES OF QUALITY METRICS

Several major index providers offer quality indices for passive investing. In **Table 1** we list the firm characteristics used to construct quality factor indices by each product provider, categorizing them as a means to compare products. For example, the quality indices that use gross profitability, ROE, or ROA ratios are seeking to proxy company profitability, whereas indices that use debt-to-equity and debt-to-cash-flow ratios are seeking to proxy a corporation's capital financial conservatism.

**Table 1.** Popular Quality Factor Index Definition

Index Provider	Measures Defining Quality	Corresponding Broader Quality Category
MSCI	Return on Equity Debt to Equity EPS Growth	Profitability Capital Structure Growth
S&P	EPS Growth DPS Growth EPS Stability DPS Stability	Growth Growth Earnings Stability Earnings Stability
FTSE	Return on Assets Change in Asset Turnover Debt to Cash Flow Accruals	Profitability Growth Capital Structure Accounting Quality
Deutsche Bank	Return on Invested Capital Accruals	Profitability Accounting Quality
EDHEC	Gross Profitability Growth in Total Assets	Profitability Investment
AQR	Multiple Variables	Profitability Growth Safety Payout

Source: Research Affiliates, LLC.

In total, we identify seven categories of characteristics used by product providers to define quality:

- Profitability
- Earnings Stability
- Capital Structure
- Growth
- Accounting Quality
- Payout/Dilution
- Investment

The six quality products listed in Table 1 use substantially different characteristics in their portfolio construction. For example, a highly profitable company does not necessarily have stable earnings or low leverage, or exhibit fast growth. An examination of the existing literature does not find any research exploring how growth and accounting quality, combined with low debt, would capture a risk exposure or a persistent irrational unwillingness on the part of investors to own this desirable combination of firm attributes. Nor could we find any work in the academic literature that claims these groups of variables might proxy for a common APT style factor.

To empirically study if quality variables are homogenous or heterogeneous, we examine the pairwise correlation of the excess returns produced by quality portfolios. The correlations reported in **Table 2** reveal a lack of similarity, indicating they are not proxies for a common hidden factor<sup>3</sup> and suggesting these leading quality index products are a collection of heterogeneous attributes linked by the theme of financial and accounting quality. No evidence exists that they proxy for a unique homogeneous source of risk or a single anomaly. Therefore, quality indices are more appropriately interpreted as multi-factor portfolios with the primary commonality being that they are constructed mostly from the less popular and less vetted factors; that is, they include a gamut of factors not found among the conventional factors, such as those included in the Fama-French-Carhart four-factor model.

**Table 2** Correlation of Variables Used by Index Providers in Various Quality Categories

	Profitability						Earnings Stability		Capital Structure			Growth in Profitability								Accounting Quality			Payout/Dilution			Investment
	GP	ROE	ROA	ROIC	CP	GM	EPS	DPS	TL	DE		GP	CP	ROE	ROA	GM	AT	DPS	EPS	ACC	NOA	CAC	EQIS	DTIS	NP	AG
<b>Profitability</b>																										
GP	1.0	0.7	0.8	0.7	0.8	0.5	0.1	-0.3	-0.1	0.2		0.3	0.3	0.3	0.3	0.1	0.1	-0.3	0.3	0.7	0.1	0.1	0.3	0.1	0.3	0.0
ROE	0.7	1.0	0.9	0.9	0.8	0.4	0.1	-0.4	-0.1	0.0		0.3	0.4	0.5	0.5	0.2	0.1	-0.3	0.5	0.5	-0.1	0.1	0.2	0.0	0.3	-0.2
ROA	0.8	0.9	1.0	0.8	0.9	0.5	0.1	-0.4	0.0	0.2		0.3	0.4	0.5	0.4	0.2	0.1	-0.3	0.4	0.5	-0.1	0.1	0.3	0.1	0.4	-0.1
ROIC	0.7	0.9	0.8	1.0	0.8	0.5	0.1	-0.1	0.0	0.2		0.3	0.4	0.5	0.5	0.3	0.0	-0.2	0.5	0.6	-0.1	0.1	0.0	0.0	0.0	-0.4
CP	0.8	0.8	0.9	0.8	1.0	0.4	0.0	-0.4	-0.1	0.1		0.3	0.4	0.4	0.4	0.1	0.1	-0.3	0.4	0.7	0.0	0.1	0.3	0.1	0.3	0.0
GM	0.5	0.4	0.5	0.5	0.4	1.0	0.4	0.1	0.4	0.4		0.0	0.1	0.2	0.2	0.2	-0.1	0.2	0.3	0.3	0.1	-0.1	0.0	-0.1	0.1	-0.3
<b>Earnings Stability</b>																										
EPS	0.1	0.1	0.1	0.1	0.0	0.4	1.0	0.2	0.4	0.4		0.0	0.1	0.1	0.1	0.2	-0.2	0.4	0.3	-0.2	0.1	-0.1	-0.1	-0.1	0.0	-0.2
DPS	-0.3	-0.4	-0.4	-0.1	-0.4	0.1	0.2	1.0	0.2	0.4		-0.3	0.0	-0.1	0.0	0.2	-0.1	0.7	-0.1	-0.2	0.1	-0.1	-0.7	-0.1	-0.6	-0.6
<b>Capital Structure</b>																										
TL	-0.1	-0.1	0.0	0.0	-0.1	0.4	0.4	0.2	1.0	0.7		-0.2	0.0	0.0	0.0	0.0	-0.1	0.5	0.0	-0.1	0.4	-0.1	-0.1	0.1	0.2	-0.1
DE	0.2	0.0	0.2	0.2	0.1	0.4	0.4	0.4	0.7	1.0		-0.1	0.1	0.1	0.1	0.1	-0.1	0.6	0.1	0.1	0.4	-0.1	-0.2	0.1	0.1	-0.3
<b>Growth in Profitability</b>																										
GP	0.3	0.3	0.3	0.3	0.3	0.0	0.0	-0.3	-0.2	-0.1		1.0	0.7	0.5	0.6	0.3	0.4	-0.2	0.5	0.2	0.0	0.4	0.2	0.2	0.2	0.2
CP	0.3	0.4	0.4	0.4	0.4	0.1	0.1	0.0	0.0	0.1		0.7	1.0	0.7	0.7	0.5	0.2	0.0	0.5	0.3	0.0	0.4	0.0	0.2	0.1	-0.1
ROE	0.3	0.5	0.5	0.5	0.4	0.2	0.1	-0.1	0.0	0.1		0.5	0.7	1.0	0.8	0.4	0.1	0.0	0.6	0.2	0.0	0.2	0.1	0.1	0.2	-0.1
ROA	0.3	0.5	0.4	0.5	0.4	0.2	0.1	0.0	0.0	0.1		0.6	0.7	0.8	1.0	0.4	0.1	0.0	0.6	0.2	0.0	0.1	-0.1	0.1	0.0	-0.2
GM	0.1	0.2	0.2	0.3	0.1	0.2	0.2	0.2	0.0	0.1		0.3	0.5	0.4	0.4	1.0	-0.1	0.1	0.3	0.1	-0.1	0.2	-0.3	0.0	-0.2	-0.4
AT	0.1	0.1	0.1	0.0	0.1	-0.1	-0.2	-0.1	-0.1	-0.1		0.4	0.2	0.1	0.1	-0.1	1.0	-0.2	0.1	0.1	0.1	0.5	0.2	0.3	0.1	0.3
DPS	-0.3	-0.3	-0.3	-0.2	-0.3	0.2	0.4	0.7	0.5	0.6		-0.2	0.0	0.0	0.0	0.1	-0.2	1.0	0.1	-0.2	0.3	-0.2	-0.5	0.0	-0.2	-0.4
EPS	0.3	0.5	0.4	0.5	0.4	0.3	0.3	-0.1	0.0	0.1		0.5	0.5	0.6	0.6	0.3	0.1	0.1	1.0	0.1	0.0	0.1	0.1	0.0	0.1	-0.2
<b>Accounting Quality</b>																										
ACCR	0.7	0.5	0.5	0.6	0.7	0.3	-0.2	-0.2	-0.1	0.1		0.2	0.3	0.2	0.2	0.1	0.1	-0.2	0.1	1.0	0.0	0.2	0.1	0.1	0.1	-0.1
NOA	0.1	-0.1	-0.1	-0.1	0.0	0.1	0.1	0.1	0.4	0.4		0.0	0.0	0.0	0.0	-0.1	0.1	0.3	0.0	0.0	1.0	0.0	0.1	0.3	0.3	0.2
CACCR	0.1	0.1	0.1	0.1	0.1	-0.1	-0.1	-0.1	-0.1	-0.1		0.4	0.4	0.2	0.1	0.2	0.5	-0.2	0.1	0.2	0.0	1.0	0.1	0.2	0.1	0.1
<b>Payout/Dilution</b>																										
EQIS	0.3	0.2	0.3	0.0	0.3	0.0	-0.1	-0.7	-0.1	-0.2		0.2	0.0	0.1	-0.1	-0.3	0.2	-0.5	0.1	0.1	0.1	0.1	1.0	0.2	0.6	0.7
DTIS	0.1	0.0	0.1	0.0	0.1	-0.1	-0.1	-0.1	0.1	0.1		0.2	0.2	0.1	0.1	0.0	0.3	0.0	0.0	0.1	0.3	0.2	0.2	1.0	0.2	0.4
NP	0.3	0.3	0.4	0.0	0.3	0.1	0.0	-0.6	0.2	0.1		0.2	0.1	0.2	0.0	-0.2	0.1	-0.2	0.1	0.1	0.3	0.1	0.6	0.2	1.0	0.5
<b>Investment</b>																										
AG	0.0	-0.2	-0.1	-0.4	0.0	-0.3	-0.2	-0.6	-0.1	-0.3		0.2	-0.1	-0.1	-0.2	-0.4	0.3	-0.4	-0.2	-0.1	0.2	0.1	0.7	0.4	0.5	1.0

Source: Research Affiliates, LLC, using data from CRSP/Compustat and Worldscope/Datastream.

The other common thread—one which seems driven more by marketing optics than theory or data—is that all of the selected quality characteristics are viewed as being attractive firm attributes, those characteristics investors would generally be willing to “pay up” for. Implicit in the design is that the resulting quality portfolio gives investors access to high-growth, highly profitable firms with a low debt-financing structure and conservative accounting practices that still generate high returns! This should raise alarms for the economists among us. It’s not just a free lunch; it’s a free feast!

Taking to heart Harvey, Liu, and Zhu’s and Novy-Marx’s caution against data-mining bias in multi-signal research,<sup>4</sup> we explore each of the seven categories of quality characteristics identified earlier to determine if a portfolio selecting stocks based on these desirable characteristics could indeed generate meaningful excess returns. The framework we use for validating factor robustness is the three-step procedure identified by Hsu, Kalesnik, and Viswanathan (HKV) (2015). Instead of calculating a single hard number, such as an upward-adjusted  $t$ -stat that can often feel blunt and is still potentially gameable, this method offers a suite of qualitative and quantitative diagnostics to help inform investors on the robustness of a particular factor strategy. Specifically, a return premium is more likely to be “real” if

1. It has been sufficiently explored in peer-reviewed publications,
2. Its empirical estimate remains robust to variations in time periods and geographies, and
3. Its empirical estimate remains robust to perturbations in definitions.

We assess these seven categories of quality attributes using the HKV three-step procedure. The goal is to determine which, if any, of the popular quality attributes are true sources of long-term returns. This will give investors guidance on what special blend of the popular quality attributes would make the most sense. The HKV method is applied by Beck et al. (2016) in their exploration of the robustness of various factors, examining specifically the robustness of the gross profitability characteristic proposed by Novy-Marx (2009). Our study subsumes that result as we explore the broader category of profitability as well as six additional categories of characteristics.

### **3. HKV THREE-STEP FACTOR VALIDATION PROCEDURE**

#### **a. Literature Research**

When a source of excess return is thoroughly explored in the literature it ensures that multiple highly trained economists have examined its merits. Further, it helps to rule out the possibility that the

results were driven by coding error or a glitch in the securities database.<sup>5</sup> In this section we summarize the literature on each of the seven characteristic categories commonly used in constructing quality products.

### ***i. Profitability***

Profitability might be the most commonly used characteristic in the construction of quality portfolios; for example, it is included in five of the six indices we examine. As of the writing of article, at least seven top-tier academic publications study profitability. Among them, Fama and French (2006, 2008, 2014, 2016), Novy-Marx (2013), Hou, Xue, and Zhang (2014), and Ball et al. (2015) find a positive premium associated with the profitability characteristic. Specifically, they find that more-profitable firms earn an excess return versus less-profitable firms and that factor portfolios constructed based on firm profitability have negative correlation with value portfolios.

Theoretically, the following accounting identity derived from the classic Gordon growth model and the clean-surplus-accounting model of Ohlson (1995) and Feltham (1995), first shown in Fama and French (2006), argues that expected returns are positively related to high profitability and negatively related to high investment and high valuation:

$$\frac{M_t}{B_t} = \frac{\sum_{\tau=1}^{\infty} E(Y_{t+\tau} - dB_{t+\tau}) / (1+r)^{\tau}}{B_t}$$

where  $M$  is market price,  $B$  is book equity value,  $Y$  is profits,  $dB$  is new investments, and  $r$  is expected return.

Empirical studies, such as Fama and French (2014), confirm that this time-series relationship holds true in the cross-section of stocks. Intuitively, if two similar firms have the same valuation multiple and make the same investment, the one with the higher return on investment (the one with more profitable projects) will deliver the better return. The million-dollar question is why don't investors recognize this and bid up the price of the more profitable firm, thus increasing its valuation and decreasing its return?

On the one hand, highly profitable projects are generally riskier. On the other hand, Novy-Marx (2013), among others, argues from a mispricing perspective that investors underreact to high profitability as a financial ratio because of its complexity relative to other ratios. An argument is also made that the less-manipulated proxies for corporate profits—excluding highly managed accounting variables such as

depreciation, amortization, and other noncash variables—tend to perform better because investors tend to focus on the also highly managed performance ratios (i.e., management has potentially greater ability to manipulate these ratios higher). This insight has motivated the research into different variants of profitability, including gross versus net versus operating profitability measures as well as different ways to standardize the ratio.

Because growth firms tend to have more profitable investment opportunities, a high-profitability portfolio also tends to be growth oriented and thus negatively correlated with a value portfolio. A related benefit is that a high-profitability portfolio offers a growth portfolio construction that does not depend on valuation ratios. Thus, we see that growth portfolios do not have to be defined simply as low price-to-book stocks, which are known to underperform. Although highly profitable firms do often have higher valuations, and vice versa, the correlation is not sufficiently high to proxy for each other.

A growth portfolio constructed from high-profitability stocks has been shown to typically outperform a growth portfolio constructed from high-valuation stocks; stated more precisely, a high-profitability portfolio has an alpha when adjusted for the HML (value) characteristic. This empirical finding has motivated the enthusiasm around using profitability to diversify the value factor, because doing so is not likely to simultaneously hedge out the value premium like a traditional growth portfolio would tend to do.

## *ii. Earnings Stability*

Dichev and Tang (2009) find earnings-growth volatility contains information on both short-term and long-term earnings growth. Donelson and Resutak (2015) find that earnings uncertainty is correlated with an overly optimistic expectation about earnings growth. Unfortunately, neither research explores the relationship between earnings stability with subsequent returns.

Hsu, Kudo, and Yamada (2014) find that low earnings-growth volatility and the associated analyst and investor optimism are related to the low beta effect. This suggests that earnings-growth stability might be more appropriately categorized as a variant of the low beta characteristic rather than considered a distinct factor characteristic.

## *iii. Capital Structure*

Empirical findings on the relationship between corporate leverage and expected equity returns are, unfortunately, mixed at best. Bhandari (1988) and Fama and French (1992) document a strong and positive relationship between leverage, when computed using market prices for corporate bonds, and



returns. Fama and French (1992), Penman, Richardson, and Tuna (2007), George and Hwang (2010), and Gomes and Schmid (2010) show that when controlling for market leverage, book leverage is negatively related to stock returns. Thus, this finding suggests that the market price of corporate debt contains information on equity prices: potentially positive cash-flow information contained in corporate debt creditworthiness is not fully reflected in equity share prices.

The negative relationship between book leverage and return in the cross-section is likely due to the cross-sectional relationship between volatility and book leverage. High-book-leverage companies also tend to have stocks characterized by high volatility and high beta. The documented low-beta anomaly then suggests low returns for high-book-leverage companies. Again, in this case, book leverage might be more appropriately classified as a variant of the low beta characteristic.

#### *iv. Growth in Earnings*

We were unable to identify papers exploring the relationship between return and past earnings growth.

#### *v. Accounting Quality*

Managers have a few common ways to temporarily boost earnings accounting measures. One way to boost current earnings is to aggressively book accruals that record sales which may never translate into actual cash flows. Implicit in management's choice to incur meaningful costs and risks in order to manipulate earnings is the assumption that investors can be fooled, even if only temporarily.

Sloan (1996), Hirshleifer et al. (2004), Dechow and Ge (2006), and Chan et al. (2006) document that firms with accounting indicators of high accruals tend to have low subsequent returns. Hirshleifer and coauthors attribute this mispricing to market participants' focus on headline earnings, while ignoring indications of manipulation of the headline earnings. The research of Dechow and Ge adds that investors often misunderstand the transitory nature of special items.<sup>6</sup>

#### *vi. Payout/Dilution*

Extensive academic research has investigated payout and issuance anomalies. We group these measures into a single channel because a firm's payout and issuance policies are inherently tied together. Some forms of payout such as repurchases can be viewed as negative issuance.

Boudoukh et al. (2005) show that various measures of payout contain information on future stock returns. Firms that pay out more have higher subsequent returns. Both payout (dividends plus

repurchases) and net payout (dividends plus repurchases minus equity issuance) predict higher stock returns in the cross-section of equities. Moreover, these return premiums can't be explained by standard risk factors.

Loughran and Ritter (1995) document most forms of share issuance lead to underperformance. This holds true for both initial public offerings and secondary issuances. Debt issuance creates a similar effect on subsequent returns. Lee and Loughran (1998) document poor stock and operating performance in the years following convertible bond offerings. Spiess and Affleck-Graves (1999) show that share prices of debt issuers significantly underperform. This effect tends to be strongest for smaller, younger, and Nasdaq-listed firms. Pontiff and Woodgate (2008) find that the share issuance premium is stronger than the size, book-to-market, or momentum premiums. Finally, Fama and French (2008) dissect a number of financial anomalies; a main insight of their study is that the anomalous (negative) returns associated with net stock issues are robust. All these studies find a robust negative relationship between issuance and stock returns.

### *vii. Investment*

Fama and French (2008, 2016) find that firms with a low level of investment tend to achieve superior returns. Titman, Wei, and Xie (2004) and Gulen and Schill (2008) confirm the Fama–French finding. Of the firms having similar valuation multiples and expected to deliver a similar level of profits, those that have a higher level of capital investment are thus likely, based on empirical evidence, to produce a lower expected return to capital. Why do investors willingly buy shares in such firms?

Hou, Xue, and Zhang (2014) argue that these firms are deploying capital into safer projects with more modest payoffs and investing sufficiently heavily to drive profits, a situation comparable to a smaller investment in a few risky projects with high potential payoffs. These firms and their projects are simply less risky. Alternatively, Roll (1982) argues that firms which invest aggressively and produce a lackluster outcome are firms overinvesting due to executive management's hubris or their desire to build an empire.

The expanded seven-factor model includes investment alongside profitability. Current research is exploring whether the investment characteristic contains more information about the riskiness of the firm or the behavior of its CEO vis-à-vis the cost of equity so as to effectively subsume the value factor.

### *viii. Summary of the literature research*

Our literature research indicates that profitability, investment, accounting quality, and payout/dilution are all strongly supported with analysis validating historical cross-sectional patterns and

providing credible models that motivate the phenomenon.<sup>7</sup> Characteristics, such as low book leverage and low earnings-growth volatility, appear to be too related to the low-volatility characteristic to warrant independent consideration and have weak-to-mixed empirical evidence. Characteristics, such as past earnings growth, do not appear to have a place in the mainstream finance research literature.

## **b. Robustness across Geographies and Definitions**

The second and third steps in our methodology test factor robustness by (1) estimating the factor premium associated with different major equity markets, and (2) perturbing the definitions for constructing the factor portfolio. The goal of these two tests is to detect potential data-mining bias.

Most of the empirical research on the cross-section of equity uses US data, which are the most accessible and extend back to the early 1960s. The longer data history is often necessary to establish the significance of a candidate's return factor. If a candidate factor earns a premium in the United States, but no other markets—worse yet, if it earns a negative premium in other markets—it casts doubt on the validity of that factor as a reliable source of excess return. Indeed, it suggests that the US results are likely spurious and data mined, because it is unlikely a behavioral bias or source of risk is unique to the US and not present in other markets that have more uninformed retail trading or lower market completeness for risk sharing. In our study, we examine factor performance in five regions: United States, Global Developed, Japan, Europe, and Asia Pacific excluding Japan.<sup>8</sup>

We recognize that the construction methodology for a particular quality-candidate factor is likely to suffer unintended (or intended) data-mining bias. Because construction methodologies that do not show a strong in-sample  $t$ -stat are never published or proposed for product launches, a natural upward bias exists in the  $t$ -stat of the published and commercialized factors. To combat this upward bias, the HKV robustness test perturbs the candidate methodology to examine the impact on the resulting  $t$ -stat. If a small change in the methodology leads to a very large change in the resulting performance of a factor, it could be a sign of data mining. It would be difficult to explain why the book-to-market ratio should perform very differently from trailing earnings or the cash-flows-to-market ratio; we certainly would not expect the sign of the estimated premiums to change from one definition of value to a nearly equivalent definition of value.

In order to perform the robustness tests for each category, we select three to eight definitions. We follow two guidelines in our selections. First, we include measures used in the index product that we have selected for this examination or that are popular in the practitioner literature. For instance, because

ROE and ROA are both popular definitions of profitability used in many quality index products globally, we include them as perturbations of the profitability construct. Second, we include diverse measures, which are nonetheless highly correlated in the portfolio constituents they generate.

The perturbed variable definitions for the seven categories are listed in **Table 3**. The list includes all variables we find in the index definitions as well as the more common variables in the literature that are used to capture these seven categories. Note that preserving the definitions used in the product design will upward bias the likelihood of observing statistically significant outcomes if data mining is present in the popular index definitions. For companies in our US tests, we use CRSP for stock returns and market capitalization and Compustat for company accounting information, and for companies in our international tests, we use Datastream and Worldscope for stock returns and accounting information, respectively. We exclude companies with negative book values, but do not restrict our sample only to observations for which all necessary data items for each quality measure are available. Instead, we use all available data for each measure.

**Table 3.** Categories of Quality Factor Definitions and Alternative Definitions for Each Category

<b>Growth in Profitability</b>	<b>Payout/Dilution</b>
<i>LT Change in Gross Profitability</i>	<i>Equity Issuance</i>
<i>LT Change in Cashflow Profitability</i>	<i>Debt Issuance</i>
<i>LT Change in Return on Equity</i>	<i>Total Payout</i>
<i>LT Change in Return on Assets</i>	<i>Net Payout</i>
<i>LT Change in Gross Margins</i>	
<i>ST Change in Asset Turnover</i>	<b>Investment</b>
<i>YoY Change in DPS</i>	<i>Low Asset Growth</i>
<i>YoY Change in EPS</i>	<i>Low Book Growth</i>
	<i>Low CapitalEx Growth</i>
	<i>Low Fixed Assets Growth</i>
<b>Accounting Quality</b>	
<i>Accruals</i>	
<i>Accruals2</i>	<b>Capital Structure</b>
<i>Net Operating Assets</i>	<i>Total Leverage</i>
<i>ST Change in Accruals</i>	<i>Debt to Equity</i>
	<i>Financial Leverage</i>
<b>Profitability</b>	
<i>Operating Profitability</i>	<b>Earnings Stability</b>
<i>Gross Profitability</i>	<i>Stability of EPS</i>
<i>Return on Equity</i>	<i>Stability of DPS</i>
<i>Return on Assets</i>	<i>Stability of Gross Profitability</i>
<i>Return on Invested Capital</i>	<i>Stability of Cashflow Profitability</i>
<i>Cashflow Profitability</i>	<i>Stability of Gross Margins</i>
<i>Gross Margins</i>	

Measurement of each quality-related variable depends on specific accounting rules. A firm's assets and equities may be overstated or understated depending on transactions, such as investing in intangibles or inadequate asset write-offs. Some firms operate in highly profitable industries and others in low-margin/high-sales environments. Financial leverage for a bank is a completely different animal than for a utility company. In other words, quality definitions are likely to contain large industry-specific components. These industry-specific features may obscure our robustness checks. Therefore, we use industry-neutral factors in our main analysis. For completeness, we include standard (no industry neutrality) versions of our tests in the appendix.

All of our portfolios are simulated using annual rebalancing at the beginning of July of each year. The market capitalization is measured at the end of June of the same year. Financials are lagged so there are at least six months between the fiscal year-end and the portfolio formation date. We augment the

Fama–French methodology with straightforward sector neutralization to form portfolios. Industries are defined using the Fama–French 12-industry specification. For each industry, we first break the universe of stocks into large size and small size groups. In the US market, large is defined as being larger than the median stock by market capitalization in the NYSE sample for each industry. For the international companies, large is defined as being the largest 90% by market capitalization within industry; all other stocks belong in the small portfolio.

Based on each variable in **Table 4**, we select a high-quality and a low-quality portfolio; the former selects stocks within each industry having the characteristic, as defined, which is aligned with high quality; the latter selects stocks aligned with low quality based on the quality definition. For example, firms with high ROA are high-quality firms, so having a high ROA is a marker for high quality. Firms with high total leverage are low-quality firms, which implies that low leverage is a marker for high quality.

For both large and small stock groups, we select the top (high) 30% and bottom (low) 30% of stocks using the definition for the particular variable, or quality measure. This process produces four groups of stocks (high and low within large and small universes) that we weight proportionally by market capitalization to form four portfolios. Finally, we equally weight the two portfolios with the high (or low) quality characteristic from the large and small groups to form the high (or low) quality portfolio.

For the standard (no industry neutralization) version of our test, portfolios are sorted across the sample. Size- and factor-characteristic breakpoints are determined over all stocks and not within industries, as was the case for industry-neutral portfolios.

In our robustness tests for the high- and low-quality portfolios, we examine three measures of performance:

- 1) *Average portfolio return difference.* We test if the high portfolio outperforms with statistical significance the low portfolio. The practical importance of this test for investors is that statistical significance would indicate the portfolio based on this definition is likely to outperform the benchmark on a stand-alone basis, and also implies that the information ratio of this factor is likely to be reasonably high.
- 2) *Average Fama–French plus momentum four-factor model alphas.* A single factor—for example, if either or both tests 1) and 3) are statistically insignificant—may not lead to outperformance. But if a factor is sufficiently negatively correlated with the four factors commonly believed to be

robust and represented in the four-factor model,<sup>9</sup> this positive multi-factor alpha would indicate the factor could deliver strong diversification benefits by inclusion in the multi-factor portfolio. In this case, investors should expect improved information and Sharpe ratios from the multi-factor portfolio. The opposite can also be true. A factor may show better performance in tests 1) and 3), but if the benefit of the factor is subsumed by other factors, the factor is redundant.

- 3) *Sharpe ratio*. We test if the Sharpe ratio of the high-quality portfolio is significantly higher than that of the low-quality portfolio. The practical importance of this test is that it captures not just performance, but also the risk characteristics of the factor. For some investors, risk reduction may be just as valuable a feature of the factor as improved performance.

The results of the robustness tests for the seven quality factor categories conducted in the five regions we tested are reported in Table 4s. The first observation is that the quality factor as a broad category does not show robustness on any of the three measures of performance: return difference, multi-factor alpha, or Sharpe ratio. This conclusion confirms the finding of Beck et al., with the definitions narrowed to the set of quality categories used by the index providers. Further, Beck and coauthors conduct the return-difference and Sharpe ratio tests, but not the multi-factor tests. The predominant nonsignificant alphas for quality broadly defined imply that these quality definitions likely do *not* justify the diversification benefits of including them in multi-factor portfolios.

**Table 4. Robustness of Quality Categories Used in Product Offerings across Geographies and Definitions**

Panel A United States, 1963 - 2016											
	Factor Return Premium							Sharpe Ratio			
Profitability	High	Low	Tstat	SGN?	Alpha	Tstat	SGN?	High	Low	Tstat	SGN?
Operating Profitability	12.09%	7.94%	3.46	Yes	4.45%	4.65	Yes	0.45	0.17	4.72	Yes
Gross Profitability	12.61%	8.87%	3.74	Yes	4.05%	5.74	Yes	0.49	0.22	5.90	Yes
Return on Equity	11.43%	9.07%	1.60	No	3.19%	3.36	Yes	0.40	0.22	3.39	Yes
Return on Assets	11.44%	8.70%	1.61	No	4.28%	4.84	Yes	0.42	0.19	4.68	Yes
Return on Invested Capital	11.57%	9.34%	1.84	No	3.69%	4.38	Yes	0.40	0.25	2.82	Yes
Cashflow Profitability	11.90%	8.43%	2.64	Yes	4.25%	4.79	Yes	0.44	0.19	4.98	Yes
Gross Margins	10.78%	11.13%	-0.78	No	1.30%	2.17	Yes	0.37	0.36	0.55	No
<b>Earnings Stability</b>											
Stability of EPS	10.42%	11.71%	-2.00	No	-0.15%	-0.23	No	0.34	0.41	-1.00	No
Stability of DPS	10.41%	11.67%	-0.33	No	0.09%	0.11	No	0.28	0.44	-3.53	No
Stability of Gross Profitability	11.03%	10.72%	-0.13	No	0.39%	0.71	No	0.40	0.33	3.01	Yes
Stability of Cashflow Profitability	11.30%	9.86%	1.33	No	1.78%	3.11	Yes	0.41	0.28	4.73	Yes
Stability of Gross Margins	11.24%	10.58%	0.35	No	1.20%	2.15	Yes	0.40	0.32	3.41	Yes
<b>Capital Structure</b>											
Total Leverage	10.10%	11.16%	-1.62	No	0.38%	0.54	No	0.32	0.36	-0.39	No
Debt to Equity	10.93%	10.52%	0.24	No	2.18%	3.19	Yes	0.36	0.32	1.10	No
Financial Leverage	9.56%	10.71%	-1.14	No	-0.25%	-0.38	No	0.26	0.34	-1.92	No
<b>Growth in Profitability</b>											
LT Change in Gross Profitability	13.01%	9.65%	5.10	Yes	2.58%	4.58	Yes	0.51	0.28	5.79	Yes
LT Change in Cashflow Profitability	12.35%	9.63%	4.15	Yes	2.70%	4.75	Yes	0.46	0.28	4.60	Yes
LT Change in Return on Equity	11.69%	11.01%	0.66	No	1.15%	1.85	No	0.42	0.35	2.02	Yes
LT Change in Return on Assets	11.47%	11.12%	0.42	No	0.88%	1.55	No	0.40	0.37	0.98	No
LT Change in Gross Margins	11.51%	11.44%	0.18	No	0.83%	1.43	No	0.40	0.40	-0.14	No
ST Change in Asset Turnover	11.99%	9.60%	3.66	Yes	1.30%	2.27	Yes	0.42	0.28	4.04	Yes
YoY Change in DPS	11.14%	11.24%	0.00	No	1.33%	1.79	No	0.37	0.39	-0.50	No
YoY Change in EPS	11.74%	10.58%	1.53	No	1.47%	2.57	Yes	0.42	0.33	2.82	Yes
<b>Accounting Quality</b>											
Accruals	11.83%	9.47%	3.24	Yes	2.49%	4.05	Yes	0.42	0.27	3.61	Yes
Accruals2	11.33%	9.58%	3.19	Yes	0.89%	1.80	No	0.38	0.28	3.45	Yes
Net Operating Assets	12.17%	8.52%	5.28	Yes	2.99%	5.07	Yes	0.44	0.21	6.17	Yes
ST Change in Accruals	11.75%	10.20%	2.56	Yes	1.13%	2.06	Yes	0.41	0.31	2.88	Yes
<b>Payout/Dilution</b>											
Equity Issuance	13.10%	8.52%	4.55	Yes	3.09%	5.53	Yes	0.55	0.20	7.66	Yes
Debt Issuance	12.22%	9.75%	4.39	Yes	1.68%	3.40	Yes	0.45	0.29	5.20	Yes
Total Payout	12.41%	9.50%	1.91	No	3.21%	4.87	Yes	0.53	0.24	7.05	Yes
Net Payout	12.39%	9.45%	2.58	Yes	2.59%	4.44	Yes	0.52	0.25	7.18	Yes
<b>Investment</b>											
Low Asset Growth	12.90%	8.92%	3.92	Yes	1.89%	3.17	Yes	0.51	0.22	6.01	Yes
Low Book Growth	12.19%	9.82%	2.23	Yes	0.60%	1.00	No	0.45	0.27	3.94	Yes
Low CapitalEx Growth	12.78%	10.63%	2.89	Yes	2.01%	2.91	Yes	0.45	0.34	2.28	Yes
Low Fixed Assets Growth	12.88%	8.77%	4.52	Yes	2.29%	3.82	Yes	0.50	0.22	6.62	Yes



Panel B

Global Developed, 1990 - 2016

Profitability	Factor Return Premium							Sharpe Ratio			
	High	Low	Tstat	SGN?	Alpha	Tstat	SGN?	High	Low	Tstat	SGN?
Operating Profitability	10.23%	6.72%	2.67	Yes	2.96%	3.50	Yes	0.53	0.24	4.45	Yes
Gross Profitability	10.48%	6.39%	4.25	Yes	4.12%	5.94	Yes	0.55	0.22	6.17	Yes
Return on Equity	10.21%	6.92%	2.92	Yes	3.85%	4.56	Yes	0.52	0.26	4.62	Yes
Return on Assets	10.34%	6.60%	2.96	Yes	4.29%	5.49	Yes	0.56	0.23	5.74	Yes
Return on Invested Capital	10.25%	6.88%	3.28	Yes	3.97%	5.12	Yes	0.52	0.26	4.85	Yes
Cashflow Profitability	10.41%	6.44%	3.30	Yes	4.21%	5.27	Yes	0.56	0.22	5.90	Yes
Gross Margins	9.49%	7.97%	2.01	Yes	2.22%	3.76	Yes	0.46	0.34	2.54	Yes
<b>Earnings Stability</b>											
Stability of EPS	10.29%	6.61%	4.76	Yes	3.88%	6.23	Yes	0.53	0.25	5.94	Yes
Stability of DPS	9.31%	7.73%	1.61	No	2.49%	3.33	Yes	0.40	0.36	0.10	No
Stability of Gross Profitability	8.23%	9.06%	-1.51	No	-1.45%	-2.52	No	0.38	0.40	-0.13	No
Stability of Cashflow Profitability	8.54%	8.61%	-0.53	No	-0.37%	-0.61	No	0.43	0.37	1.71	No
Stability of Gross Margins	8.95%	8.85%	-0.27	No	-0.29%	-0.46	No	0.43	0.38	1.53	No
<b>Capital Structure</b>											
Total Leverage	8.45%	8.79%	-0.62	No	0.14%	0.23	No	0.39	0.40	0.08	No
Debt to Equity	8.84%	7.76%	0.86	No	1.96%	3.06	Yes	0.42	0.32	2.03	Yes
Financial Leverage	7.76%	8.28%	-0.60	No	0.45%	0.82	No	0.33	0.36	-0.36	No
<b>Growth in Profitability</b>											
LT Change in Gross Profitability	10.04%	8.03%	3.50	Yes	1.67%	2.95	Yes	0.49	0.37	2.75	Yes
LT Change in Cashflow Profitability	9.45%	8.39%	1.71	No	1.01%	1.76	No	0.46	0.38	1.71	No
LT Change in Return on Equity	9.52%	8.47%	1.31	No	1.35%	2.00	Yes	0.46	0.37	1.96	Yes
LT Change in Return on Assets	9.44%	9.00%	0.62	No	0.77%	1.26	No	0.45	0.42	0.92	No
LT Change in Gross Margins	9.17%	8.85%	0.63	No	0.67%	1.10	No	0.43	0.42	0.00	No
ST Change in Asset Turnover	9.49%	7.29%	4.25	Yes	1.78%	3.63	Yes	0.45	0.30	4.34	Yes
YoY Change in DPS	7.80%	8.90%	-1.38	No	0.26%	0.35	No	0.34	0.40	-0.81	No
YoY Change in EPS	7.14%	8.57%	-2.37	No	-0.65%	-1.07	No	0.31	0.37	-1.06	No
<b>Accounting Quality</b>											
Accruals	9.57%	7.31%	3.51	Yes	2.04%	3.29	Yes	0.46	0.30	3.46	Yes
Accruals2	8.92%	7.66%	2.54	Yes	0.80%	1.77	No	0.41	0.32	2.82	Yes
Net Operating Assets	9.83%	6.95%	3.28	Yes	2.70%	3.66	Yes	0.49	0.27	4.09	Yes
ST Change in Accruals	9.10%	7.74%	3.07	Yes	1.04%	2.41	Yes	0.42	0.33	2.77	Yes
<b>Payout/Dilution</b>											
Equity Issuance	11.93%	8.73%	2.68	Yes	2.78%	3.46	Yes	0.62	0.35	5.11	Yes
Debt Issuance	9.25%	7.31%	3.31	Yes	1.02%	2.05	Yes	0.45	0.31	3.57	Yes
Total Payout	9.84%	7.57%	1.39	No	2.57%	3.11	Yes	0.55	0.29	4.61	Yes
Net Payout	8.78%	7.66%	0.67	No	0.95%	1.42	No	0.45	0.30	3.39	Yes
<b>Investment</b>											
Low Asset Growth	9.70%	6.99%	2.65	Yes	1.63%	2.26	Yes	0.48	0.26	3.94	Yes
Low Book Growth	8.91%	7.54%	1.35	No	0.60%	0.85	No	0.42	0.30	2.47	Yes
Low CapitalEx Growth	10.54%	8.75%	2.96	Yes	1.02%	1.90	No	0.53	0.41	2.83	Yes
Low Fixed Assets Growth	9.26%	6.99%	2.41	Yes	1.19%	1.75	No	0.45	0.27	3.66	Yes

Panel C

Europe, 1990 - 2016

Profitability	Factor Return Premium							Sharpe Ratio			
	High	Low	Tstat	SGN?	Alpha	Tstat	SGN?	High	Low	Tstat	SGN?
Operating Profitability	9.85%	7.03%	2.46	Yes	2.63%	2.72	Yes	0.44	0.25	3.00	Yes
Gross Profitability	10.71%	6.50%	4.39	Yes	4.41%	5.20	Yes	0.51	0.22	5.33	Yes
Return on Equity	9.91%	6.10%	3.28	Yes	4.49%	4.55	Yes	0.44	0.19	3.76	Yes
Return on Assets	10.18%	5.27%	3.43	Yes	5.05%	4.80	Yes	0.48	0.14	4.91	Yes
Return on Invested Capital	10.10%	5.40%	4.47	Yes	4.70%	5.60	Yes	0.45	0.15	4.96	Yes
Cashflow Profitability	10.67%	5.03%	4.16	Yes	5.52%	5.13	Yes	0.51	0.13	5.82	Yes
Gross Margins	9.79%	8.51%	1.09	No	1.05%	1.23	No	0.44	0.33	2.29	Yes
<b>Earnings Stability</b>											
Stability of EPS	9.18%	6.83%	2.18	Yes	2.54%	2.53	Yes	0.39	0.24	2.38	Yes
Stability of DPS	8.63%	7.03%	1.53	No	2.54%	2.52	Yes	0.35	0.26	1.18	No
Stability of Gross Profitability	8.25%	8.91%	-0.95	No	-0.75%	-0.94	No	0.34	0.37	-0.49	No
Stability of Cashflow Profitability	8.63%	8.35%	0.05	No	-0.27%	-0.38	No	0.37	0.33	1.16	No
Stability of Gross Margins	9.15%	9.09%	-0.11	No	0.85%	1.07	No	0.39	0.37	0.47	No
<b>Capital Structure</b>											
Total Leverage	8.06%	7.99%	-0.04	No	0.39%	0.53	No	0.33	0.31	0.48	No
Debt to Equity	8.62%	6.78%	1.50	No	2.59%	3.47	Yes	0.37	0.23	2.97	Yes
Financial Leverage	7.40%	7.76%	-0.76	No	0.65%	1.00	No	0.29	0.28	0.34	No
<b>Growth in Profitability</b>											
LT Change in Gross Profitability	10.08%	8.78%	1.62	No	1.35%	1.74	No	0.45	0.37	1.58	No
LT Change in Cashflow Profitability	9.97%	7.50%	2.80	Yes	2.71%	3.42	Yes	0.44	0.28	2.99	Yes
LT Change in Return on Equity	9.84%	7.94%	1.82	No	2.45%	2.81	Yes	0.44	0.30	2.34	Yes
LT Change in Return on Assets	10.07%	7.80%	2.57	Yes	2.66%	3.44	Yes	0.45	0.30	2.67	Yes
LT Change in Gross Margins	9.40%	8.99%	0.50	No	0.70%	0.80	No	0.40	0.38	0.31	No
ST Change in Asset Turnover	9.04%	7.58%	2.45	Yes	1.10%	1.92	No	0.37	0.28	2.46	Yes
YoY Change in DPS	7.33%	8.07%	-0.83	No	0.31%	0.30	No	0.28	0.31	-0.21	No
YoY Change in EPS	8.23%	7.25%	0.83	No	1.45%	1.53	No	0.34	0.26	1.32	No
<b>Accounting Quality</b>											
Accruals	9.46%	6.23%	4.11	Yes	3.21%	4.27	Yes	0.41	0.21	4.53	Yes
Accruals2	8.76%	7.41%	1.69	No	0.48%	0.63	No	0.36	0.28	1.62	No
Net Operating Assets	9.37%	7.06%	2.76	Yes	1.83%	2.31	Yes	0.40	0.25	2.76	Yes
ST Change in Accruals	8.77%	7.74%	1.72	No	0.46%	0.72	No	0.35	0.30	1.04	No
<b>Payout/Dilution</b>											
Equity Issuance	9.20%	4.01%	3.96	Yes	4.02%	3.36	Yes	0.37	0.07	4.48	Yes
Debt Issuance	9.42%	6.75%	3.18	Yes	1.47%	1.90	No	0.40	0.24	3.44	Yes
Total Payout	10.04%	7.16%	2.04	Yes	3.61%	3.68	Yes	0.48	0.25	3.94	Yes
Net Payout	10.07%	7.63%	1.71	No	2.72%	2.51	Yes	0.47	0.28	3.08	Yes
<b>Investment</b>											
Low Asset Growth	9.21%	6.25%	2.49	Yes	0.99%	1.11	No	0.40	0.20	3.13	Yes
Low Book Growth	7.56%	6.94%	0.42	No	-0.59%	-0.71	No	0.29	0.24	1.00	No
Low CapitalEx Growth	9.68%	7.59%	2.57	Yes	1.18%	1.56	No	0.42	0.29	2.85	Yes
Low Fixed Assets Growth	8.98%	6.52%	2.23	Yes	0.54%	0.64	No	0.38	0.22	2.83	Yes

Panel D

Japan, 1990 - 2016

Profitability	Factor Return Premium							Sharpe Ratio			
	High	Low	Tstat	SGN?	Alpha	Tstat	SGN?	High	Low	Tstat	SGN?
Operating Profitability	3.56%	1.12%	1.06	No	3.17%	1.27	No	0.04	-0.08	1.27	No
Gross Profitability	4.45%	1.65%	1.24	No	3.54%	1.66	No	0.08	-0.05	1.60	No
Return on Equity	3.82%	0.58%	1.04	No	4.82%	1.35	No	0.04	-0.10	1.17	No
Return on Assets	5.22%	0.09%	1.69	No	6.21%	2.04	Yes	0.10	-0.12	2.34	Yes
Return on Invested Capital	4.09%	0.65%	1.29	No	3.70%	1.69	No	0.06	-0.09	1.87	No
Cashflow Profitability	4.46%	-0.09%	1.80	No	4.92%	2.19	Yes	0.08	-0.13	2.55	Yes
Gross Margins	2.87%	1.65%	0.66	No	1.37%	1.17	No	0.01	-0.05	1.08	No
<b>Earnings Stability</b>											
Stability of EPS	4.85%	0.36%	1.83	No	4.85%	1.84	No	0.09	-0.12	2.52	Yes
Stability of DPS	4.57%	1.13%	2.04	Yes	3.57%	2.09	Yes	0.09	-0.08	2.30	Yes
Stability of Gross Profitability	1.49%	4.74%	-1.60	No	-4.44%	-1.85	No	-0.06	0.08	-1.67	No
Stability of Cashflow Profitability	1.87%	3.54%	-1.05	No	-3.20%	-1.35	No	-0.05	0.03	-0.61	No
Stability of Gross Margins	1.50%	1.98%	-0.72	No	-1.30%	-1.34	No	-0.06	-0.04	-0.33	No
<b>Capital Structure</b>											
Total Leverage	2.04%	0.87%	0.22	No	0.56%	0.52	No	-0.04	-0.08	1.10	No
Debt to Equity	2.14%	0.64%	0.37	No	0.79%	0.65	No	-0.03	-0.09	1.26	No
Financial Leverage	1.26%	1.14%	0.03	No	0.10%	0.10	No	-0.07	-0.08	0.09	No
<b>Growth in Profitability</b>											
LT Change in Gross Profitability	3.66%	2.08%	0.98	No	2.58%	1.32	No	0.04	-0.03	0.79	No
LT Change in Cashflow Profitability	3.58%	1.39%	1.06	No	2.91%	1.25	No	0.04	-0.07	1.15	No
LT Change in Return on Equity	3.82%	0.96%	1.17	No	3.46%	1.33	No	0.05	-0.08	1.43	No
LT Change in Return on Assets	3.68%	2.24%	0.68	No	2.66%	1.01	No	0.04	-0.02	0.53	No
LT Change in Gross Margins	4.04%	1.99%	1.05	No	2.57%	1.21	No	0.06	-0.04	1.12	No
ST Change in Asset Turnover	2.66%	0.82%	1.12	No	2.22%	1.18	No	0.00	-0.09	1.15	No
YoY Change in DPS	1.46%	1.27%	-0.17	No	0.38%	0.34	No	-0.07	-0.07	0.21	No
YoY Change in EPS	1.39%	1.23%	-0.12	No	0.14%	0.13	No	-0.07	-0.07	0.23	No
<b>Accounting Quality</b>											
Accruals	4.16%	0.89%	1.67	No	3.71%	1.85	No	0.07	-0.09	2.06	Yes
Accruals2	2.39%	1.48%	1.10	No	0.78%	0.94	No	-0.02	-0.06	1.14	No
Net Operating Assets	2.97%	1.94%	0.48	No	1.10%	0.53	No	0.01	-0.04	0.56	No
ST Change in Accruals	1.58%	0.76%	0.87	No	0.88%	1.02	No	-0.06	-0.10	0.94	No
<b>Payout/Dilution</b>											
Equity Issuance	4.16%	7.16%	-1.21	No	-3.16%	-1.26	No	0.06	0.19	-1.12	No
Debt Issuance	1.65%	2.24%	-0.68	No	-0.62%	-0.72	No	-0.05	-0.02	-0.71	No
Total Payout	4.59%	1.80%	0.97	No	2.74%	0.91	No	0.08	-0.04	1.28	No
Net Payout	2.65%	1.57%	0.59	No	0.44%	0.40	No	0.00	-0.06	1.07	No
<b>Investment</b>											
Low Asset Growth	1.96%	1.52%	0.43	No	-0.05%	-0.04	No	-0.04	-0.06	0.40	No
Low Book Growth	1.16%	3.99%	-0.94	No	-4.77%	-1.29	No	-0.07	0.05	-0.88	No
Low CapitalEx Growth	4.01%	1.49%	1.49	No	2.65%	1.45	No	0.06	-0.06	1.65	No
Low Fixed Assets Growth	0.84%	1.47%	-0.48	No	-0.65%	-0.71	No	-0.09	-0.06	-0.69	No

Panel E

Asia Pacific x Japan, 1990 - 2016

Profitability	Factor Return Premium							Sharpe Ratio			
	High	Low	Tstat	SGN?	Alpha	Tstat	SGN?	High	Low	Tstat	SGN?
Operating Profitability	11.32%	9.04%	0.57	No	4.53%	2.43	Yes	0.44	0.26	2.11	Yes
Gross Profitability	11.97%	9.42%	0.69	No	4.75%	2.59	Yes	0.47	0.28	2.27	Yes
Return on Equity	10.97%	10.27%	0.16	No	1.89%	1.29	No	0.39	0.33	0.98	No
Return on Assets	10.99%	10.84%	-0.07	No	-0.47%	-0.31	No	0.39	0.37	0.43	No
Return on Invested Capital	10.68%	9.63%	0.92	No	0.04%	0.03	No	0.35	0.33	0.11	No
Cashflow Profitability	10.67%	10.58%	-0.37	No	1.41%	0.97	No	0.40	0.34	0.96	No
Gross Margins	11.26%	9.24%	0.92	No	0.86%	0.54	No	0.41	0.29	1.63	No
<b>Earnings Stability</b>											
Stability of EPS	12.03%	8.25%	1.99	Yes	0.71%	0.37	No	0.41	0.27	1.22	No
Stability of DPS	10.25%	9.64%	0.64	No	-2.64%	-1.28	No	0.32	0.36	-0.61	No
Stability of Gross Profitability	9.88%	10.36%	-0.37	No	-1.16%	-0.80	No	0.33	0.35	-0.17	No
Stability of Cashflow Profitability	10.28%	10.40%	-0.21	No	1.19%	0.81	No	0.35	0.34	0.23	No
Stability of Gross Margins	9.84%	10.67%	-0.90	No	0.66%	0.40	No	0.36	0.35	0.40	No
<b>Capital Structure</b>											
Total Leverage	11.32%	9.60%	1.26	No	-0.26%	-0.17	No	0.38	0.33	0.64	No
Debt to Equity	9.66%	10.26%	-0.28	No	-2.16%	-1.37	No	0.32	0.36	-0.55	No
Financial Leverage	9.40%	11.18%	-0.95	No	-2.16%	-1.47	No	0.31	0.41	-1.54	No
<b>Growth in Profitability</b>											
LT Change in Gross Profitability	11.79%	9.22%	1.73	No	2.13%	1.56	No	0.44	0.31	1.75	No
LT Change in Cashflow Profitability	11.15%	9.99%	0.73	No	1.39%	1.07	No	0.40	0.34	0.92	No
LT Change in Return on Equity	11.51%	11.03%	-0.02	No	0.93%	0.59	No	0.44	0.37	0.96	No
LT Change in Return on Assets	11.69%	11.57%	-0.14	No	0.38%	0.24	No	0.44	0.41	0.58	No
LT Change in Gross Margins	11.11%	9.84%	0.97	No	0.71%	0.46	No	0.38	0.35	0.34	No
ST Change in Asset Turnover	11.67%	8.10%	2.53	Yes	2.23%	1.88	No	0.42	0.24	3.03	Yes
YoY Change in DPS	11.98%	9.55%	0.73	No	4.22%	2.37	Yes	0.47	0.30	1.93	No
YoY Change in EPS	8.90%	11.02%	-1.35	No	-1.28%	-0.80	No	0.30	0.38	-0.74	No
<b>Accounting Quality</b>											
Accruals	11.51%	10.41%	0.48	No	3.87%	2.55	Yes	0.42	0.36	0.79	No
Accruals2	11.33%	9.04%	1.10	No	1.63%	1.11	No	0.41	0.28	2.21	Yes
Net Operating Assets	11.96%	8.81%	1.85	No	3.43%	2.54	Yes	0.45	0.27	2.80	Yes
ST Change in Accruals	11.93%	10.26%	1.00	No	1.11%	0.80	No	0.44	0.35	1.47	No
<b>Payout/Dilution</b>											
Equity Issuance	12.60%	8.03%	2.55	Yes	3.02%	1.99	Yes	0.44	0.22	3.58	Yes
Debt Issuance	11.23%	10.33%	0.31	No	1.20%	0.97	No	0.41	0.34	1.60	No
Total Payout	12.70%	7.61%	2.61	Yes	3.56%	2.35	Yes	0.51	0.22	3.64	Yes
Net Payout	10.13%	9.40%	0.12	No	2.08%	1.05	No	0.38	0.30	0.88	No
<b>Investment</b>											
Low Asset Growth	11.39%	8.45%	0.91	No	3.69%	2.09	Yes	0.45	0.24	2.79	Yes
Low Book Growth	11.68%	7.84%	1.64	No	4.39%	2.68	Yes	0.45	0.22	3.08	Yes
Low CapitalEx Growth	10.52%	9.33%	0.90	No	-0.01%	-0.01	No	0.36	0.32	0.48	No
Low Fixed Assets Growth	11.81%	9.13%	0.88	No	3.10%	1.79	No	0.46	0.27	2.62	Yes

Source: Research Affiliates, LLC, using data from CRSP/Compustat and Worldscope/Datastream.

Table 5 reports the percentage of statistically significant measures in each category for each region; return spreads, multi-factor alphas, and Sharpe ratio differences are computed. We use these summary results to determine which categories are robust in each region. The broad umbrella of “quality” covers many nuanced subcategories. The lack of robustness of a randomly selected

subcategory does not necessarily imply each individual subcategory similarly lacks robustness. Next, we examine each of the individual quality categories.

**Table 5.** Summary of Robustness of Quality Categories: Percentage of Tests Statistically Significant at 5%

Profitability				
	Average Return	4-Factor Alpha	Sharpe Ratio	Average
United States	43%	100%	86%	76%
Europe	86%	86%	100%	90%
Asia Pacific x Japan	0%	29%	29%	19%
Japan	0%	29%	29%	19%
Global Developed	100%	100%	100%	100%
Average of Significance	46%	69%	69%	61%

  

Accounting Quality				
	Average Return	4-Factor Alpha	Sharpe Ratio	Average
United States	100%	75%	100%	92%
Europe	50%	50%	50%	50%
Asia Pacific x Japan	0%	50%	50%	33%
Japan	0%	0%	25%	8%
Global Developed	100%	75%	100%	92%
Average of Significance	50%	50%	65%	55%

  

Earnings Stability				
	Average Return	4-Factor Alpha	Sharpe Ratio	Average
United States	0%	40%	60%	33%
Europe	20%	40%	20%	27%
Asia Pacific x Japan	20%	0%	0%	7%
Japan	20%	20%	40%	27%
Global Developed	20%	40%	20%	27%
Average of Significance	16%	28%	28%	24%

  

Payout/Dilution				
	Average Return	4-Factor Alpha	Sharpe Ratio	Average
United States	75%	100%	100%	92%
Europe	75%	75%	100%	83%
Asia Pacific x Japan	50%	50%	50%	50%
Japan	0%	0%	0%	0%
Global Developed	50%	75%	100%	75%
Average of Significance	50%	60%	70%	60%

  

Capital Structure				
	Average Return	4-Factor Alpha	Sharpe Ratio	Average
United States	0%	33%	0%	11%
Europe	0%	33%	33%	22%
Asia Pacific x Japan	0%	0%	0%	0%
Japan	0%	0%	0%	0%
Global Developed	0%	33%	33%	22%
Average of Significance	0%	20%	13%	11%

  

Investment				
	Average Return	4-Factor Alpha	Sharpe Ratio	Average
United States	100%	75%	100%	92%
Europe	75%	0%	75%	50%
Asia Pacific x Japan	0%	50%	75%	42%
Japan	0%	0%	0%	0%
Global Developed	75%	25%	100%	67%
Average of Significance	50%	30%	70%	50%

  

Growth in Profitability				
	Average Return	4-Factor Alpha	Sharpe Ratio	Average
United States	38%	50%	63%	50%
Europe	38%	38%	50%	42%
Asia Pacific x Japan	13%	13%	13%	13%
Japan	0%	0%	0%	0%
Global Developed	25%	38%	38%	33%
Average of Significance	23%	28%	33%	28%

Source: Research Affiliates, LLC, using data from CRSP/Compustat and Worldscope/Datastream.

## i. Profitability

The first measure, return difference, shows that profitability produces a statistically significant return advantage in only two of the five regions: Global Developed and Europe. In the other regions, the return difference is mostly in the same direction, but the difference lacks statistical significance. When measured by multi-factor alpha, profitability is significant in the US, Global Developed, and Europe regions. By Sharpe ratio, profitability offers statistically significant improvements in three of the five regions; the two showing no improvement are Japan and Asia Pacific ex Japan. Overall, 46% of profitability

measures are significant in return differences, 69% are significant in multi-factor alphas, and 69% are significant in Sharpe ratios.

## **ii. Earnings Stability, Capital Structure, and Growth in Profitability**

Very little evidence supports that these factors deliver outperformance whether considered alone, in a multi-factor setting, or on a risk-adjusted basis.<sup>10</sup>

## **iii. Accounting Quality**

Accounting quality measures are overall significant in the US, Global Developed, Europe, and Asia Pacific ex Japan regions, but are not significant based on return differences in Asia Pacific ex Japan. Overall, 50% of accounting quality measures are significant measured by return differences and multi-factor alphas, and 65% are significant measured by Sharpe ratios.

## **iv. Payout/Dilution**

Payout/dilution measures are significant in all regions except Japan. Overall, 50% of these measures are significant by return spreads, 60% are significant by multi-factor alphas, and 70% are significant by Sharpe ratios.

## **v. Investment**

Investment measures are significant in all regions except Japan, with a few exceptions. They are not significant in Asia Pacific ex Japan by the return difference measure. The multi-factor alphas are also insignificant except in the United States. The latter result is mainly due to the high correlation between the low investment factor and the value factor in our multi-factor pricing model.<sup>11</sup> Overall, 50% of investment variables are significant in return spreads, 30% are significant in multi-factor alphas, and 70% are significant in Sharpe ratios.

## **vi. Summary of Robustness Tests**

Profitability seems to bring robust benefits, more so on the risk-adjusted basis or multi-factor basis. This outcome is also true for accounting quality, payout/dilution, and investment except that investment has weaker multi-factor alpha because it is correlated with the value factor. Earnings stability, capital structure, and growth in profitability have no empirical support in producing a benefit for investors.

The empirical evidence matches quite well with our findings from a survey of the literature, which indicates the heaviest research has been done on profitability. We observed an adequate amount of research on accounting quality, payout/dilution, and investment, but very little noncontradictory research

on the other three categories, an indication of their lack of robustness. Based on our literature search, the first step in the HKV methodology, we label profitability, accounting quality, payout/dilution, and investment as robust, and earnings stability, capital structure, and growth in profitability as non-robust. In other words, the winners are profitability, accounting quality, payout/dilution, and investment.

Considering the quality factor indices, we can make the following conclusions about the index products offered by the product providers. We repeat in **Table 6** the index definitions from Table 1 and add an additional column showing the degree of robustness associated with each category. We observe that most of the indices use at least a few non-robust measures in their definitions. The Deutsche Bank index appears to combine a measure of profitability with a measure of accounting quality, and the EDHEC index combines profitability and investment. These two definitions of quality are likely the most robust in this roster of indices.

**Table 6.** Popular Quality Factor Index, Definition, and Degree of Robustness

<b>Index Provider</b>	<b>Measures Defining Quality</b>	<b>Corresponding Broader Quality Category</b>	<b>Robustness of the Broader Category</b>
MSCI	Return on Equity	Profitability	Robust
	Debt to Equity	Capital Structure	Non-Robust
	EPS Growth	Growth in Profitability	Non-Robust
S&P	EPS Growth	Growth in Profitability	Non-Robust
	DPS Growth	Growth in Profitability	Non-Robust
	EPS Stability	Earnings Stability	Non-Robust
	DPS Stability	Earnings Stability	Non-Robust
FTSE	Return on Assets	Profitability	Robust
	Change in Asset Turnover	Growth in Profitability	Non-Robust
	Debt to Cash Flows	Capital Structure	Non-Robust
	Accruals	Accounting Quality	Robust
Deutsche Bank	Return on Invested Capital	Profitability	Robust
	Accruals	Accounting Quality	Robust
EDHEC	Gross Profitability	Profitability	Robust
	Growth in Total Assets	Investment	Robust
AQR	Multiple Variables	Profitability	Robust
		Growth	Non-Robust
		Safety	Non-Robust (potentially overlaps with low beta effect)
		Payout	Robust

Our results on the factors constructed without sector neutrality are reported in the appendix and are similar to our main results.

#### 4. CONCLUSION

Quality as a category, albeit very popular in practitioner circles, lacks a widely accepted definition. Categories of variables used in quality product offerings represent heterogeneous groups of signals and do not proxy a unique source of risk or anomaly in the APT sense. The multi-signal nature of quality products creates the possibility of data mining, potentially overstating the statistical significance of the outperformance of the resulting portfolios. Using the HKV-methodology to test the robustness of the different categories used by “quality” indices to define quality, we make the following observations based on the second and third steps of the methodology:

- 1) Profitability delivers superior performance on a risk-adjusted and multi-factor basis.
- 2) Accounting quality delivers overall superior performance.
- 3) Earnings stability, capital structure, and growth in profitability exhibit no robust evidence of superior performance.
- 4) Payout/dilution delivers overall superior performance.
- 5) Investment delivers superior performance when measured by return spread and Sharpe ratio, but is weak when measured by multi-factor alpha.

Among these groups, profitability, accounting quality, payout/dilution, and investment are examined in many academic studies, while earnings stability, capital structure, and growth in profitability are not well researched. Given this evidence based, which is the first step in the HKV methodology, we label profitability, accounting quality, payout/dilution, and investment as robust and the other three as non-robust.



## 5. APPENDIX

**Table A1.** HKV Three-Step Factor Validation: Standard Factors

Panel A											
United States, 1963 - 2016											
Profitability	Factor Return Premium							Sharpe Ratio			
	High	Low	Tstat	SGN?	Alpha	Tstat	SGN?	High	Low	Tstat	SGN?
Operating Profitability	12.81%	7.66%	2.22	Yes	3.68%	2.57	Yes	0.48	0.13	5.09	Yes
Gross Profitability	12.81%	9.95%	2.34	Yes	4.84%	5.13	Yes	0.45	0.31	1.62	No
Return on Equity	11.97%	8.63%	1.21	No	2.94%	2.09	Yes	0.43	0.17	4.29	Yes
Return on Assets	11.85%	7.98%	1.60	No	3.72%	2.84	Yes	0.42	0.14	4.98	Yes
Return on Invested Capital	12.07%	8.35%	2.12	Yes	3.16%	2.31	Yes	0.41	0.17	3.46	Yes
Cashflow Profitability	12.40%	8.08%	2.32	Yes	4.23%	3.36	Yes	0.45	0.15	4.59	Yes
Gross Margins	11.21%	11.59%	-0.66	No	1.72%	2.70	Yes	0.38	0.39	0.25	No
<b>Earnings Stability</b>											
Stability of EPS	10.63%	12.54%	-2.57	No	-0.30%	-0.43	No	0.35	0.44	-1.40	No
Stability of DPS	10.26%	12.05%	-0.34	No	-0.05%	-0.06	No	0.25	0.47	-4.07	No
Stability of Gross Profitability	11.09%	10.79%	-0.41	No	-1.23%	-1.46	No	0.41	0.30	2.42	Yes
Stability of Cashflow Profitability	11.55%	10.09%	0.21	No	0.08%	0.07	No	0.44	0.25	3.24	Yes
Stability of Gross Margins	11.46%	10.65%	0.32	No	1.66%	2.14	Yes	0.41	0.31	2.85	Yes
<b>Capital Structure</b>											
Total Leverage	10.60%	11.53%	-1.13	No	-0.10%	-0.11	No	0.33	0.37	-0.39	No
Debt to Equity	11.21%	10.89%	0.52	No	3.48%	3.26	Yes	0.33	0.36	-0.80	No
Financial Leverage	8.89%	10.77%	-0.56	No	1.04%	0.97	No	0.19	0.36	-2.54	No
<b>Growth in Profitability</b>											
LT Change in Gross Profitability	13.32%	10.38%	3.30	Yes	1.87%	2.56	Yes	0.50	0.30	4.41	Yes
LT Change in Cashflow Profitability	12.69%	10.51%	2.12	Yes	1.51%	1.87	No	0.46	0.31	3.48	Yes
LT Change in Return on Equity	12.28%	11.10%	0.74	No	1.02%	1.14	No	0.44	0.33	2.55	Yes
LT Change in Return on Assets	11.86%	11.62%	-0.10	No	0.41%	0.48	No	0.41	0.36	1.45	No
LT Change in Gross Margins	11.81%	11.56%	0.28	No	1.11%	1.56	No	0.41	0.39	0.39	No
ST Change in Asset Turnover	12.93%	9.85%	4.17	Yes	1.95%	2.96	Yes	0.45	0.27	4.33	Yes
YoY Change in DPS	12.04%	11.67%	0.37	No	1.24%	1.54	No	0.44	0.41	0.63	No
YoY Change in EPS	12.27%	11.24%	1.03	No	1.37%	2.06	Yes	0.45	0.36	2.59	Yes
<b>Accounting Quality</b>											
Accruals	12.27%	10.48%	1.56	No	2.93%	3.27	Yes	0.43	0.32	1.60	No
Accruals2	11.91%	9.61%	3.59	Yes	1.38%	2.33	Yes	0.40	0.27	3.65	Yes
Net Operating Assets	13.12%	8.58%	5.06	Yes	3.18%	3.76	Yes	0.47	0.22	4.48	Yes
ST Change in Accruals	12.61%	10.60%	2.99	Yes	1.57%	2.48	Yes	0.43	0.32	2.89	Yes
<b>Payout/Dilution</b>											
Equity Issuance	13.86%	8.56%	4.51	Yes	3.03%	4.53	Yes	0.59	0.20	6.70	Yes
Debt Issuance	12.66%	9.91%	4.69	Yes	2.15%	4.01	Yes	0.44	0.29	4.57	Yes
Total Payout	12.70%	9.53%	1.07	No	2.28%	2.54	Yes	0.54	0.22	6.02	Yes
Net Payout	12.49%	9.98%	1.16	No	1.78%	2.53	Yes	0.54	0.26	6.02	Yes
<b>Investment</b>											
Low Asset Growth	13.58%	9.17%	3.65	Yes	1.91%	2.47	Yes	0.50	0.22	5.06	Yes
Low Book Growth	12.64%	10.17%	1.95	No	0.36%	0.46	No	0.45	0.28	3.38	Yes
Low CapitalEx Growth	13.08%	10.52%	3.17	Yes	1.93%	2.51	Yes	0.44	0.33	2.02	Yes
Low Fixed Assets Growth	13.21%	9.11%	4.02	Yes	1.84%	2.64	Yes	0.47	0.22	5.16	Yes

**Panel B**
**Global Developed, 1990 - 2016**

	Factor Return Premium							Sharpe Ratio			
	High	Low	Tstat	SGN?	Alpha	Tstat	SGN?	High	Low	Tstat	SGN?
<b>Profitability</b>											
<i>Operating Profitability</i>	10.18%	6.14%	2.51	Yes	2.83%	2.76	Yes	0.53	0.20	4.11	Yes
<i>Gross Profitability</i>	11.07%	5.31%	4.24	Yes	6.69%	6.47	Yes	0.59	0.16	5.37	Yes
<i>Return on Equity</i>	10.02%	6.12%	2.89	Yes	4.18%	4.26	Yes	0.51	0.20	4.68	Yes
<i>Return on Assets</i>	10.06%	6.49%	2.48	Yes	4.67%	4.97	Yes	0.52	0.22	4.51	Yes
<i>Return on Invested Capital</i>	9.94%	6.04%	3.19	Yes	4.75%	4.95	Yes	0.49	0.20	4.10	Yes
<i>Cashflow Profitability</i>	10.16%	6.27%	2.99	Yes	4.57%	4.77	Yes	0.53	0.22	4.40	Yes
<i>Gross Margins</i>	9.41%	7.77%	1.26	No	2.90%	3.34	Yes	0.46	0.32	2.09	Yes
<b>Earnings Stability</b>											
<i>Stability of EPS</i>	10.46%	5.79%	4.67	Yes	5.41%	7.37	Yes	0.54	0.19	5.74	Yes
<i>Stability of DPS</i>	8.94%	7.30%	1.27	No	3.71%	4.04	Yes	0.36	0.32	-0.02	No
<i>Stability of Gross Profitability</i>	8.16%	8.56%	-0.70	No	-1.92%	-2.36	No	0.39	0.35	0.94	No
<i>Stability of Cashflow Profitability</i>	8.43%	7.94%	-0.08	No	-0.64%	-0.63	No	0.42	0.30	1.57	No
<i>Stability of Gross Margins</i>	8.62%	7.34%	0.86	No	1.21%	1.51	No	0.42	0.28	2.84	Yes
<b>Capital Structure</b>											
<i>Total Leverage</i>	7.83%	9.05%	-1.25	No	-0.63%	-0.73	No	0.33	0.42	-1.51	No
<i>Debt to Equity</i>	8.28%	7.87%	0.29	No	2.78%	3.11	Yes	0.35	0.33	0.09	No
<i>Financial Leverage</i>	7.44%	8.07%	-0.26	No	1.50%	1.87	No	0.29	0.35	-0.80	No
<b>Growth in Profitability</b>											
<i>LT Change in Gross Profitability</i>	10.34%	7.01%	4.15	Yes	2.09%	2.81	Yes	0.51	0.29	3.67	Yes
<i>LT Change in Cashflow Profitability</i>	9.60%	7.42%	2.61	Yes	1.53%	1.94	No	0.46	0.31	2.51	Yes
<i>LT Change in Return on Equity</i>	9.33%	7.59%	1.72	No	1.65%	1.83	No	0.44	0.31	2.06	Yes
<i>LT Change in Return on Assets</i>	9.04%	7.97%	1.15	No	1.06%	1.25	No	0.42	0.34	1.34	No
<i>LT Change in Gross Margins</i>	8.95%	8.16%	1.20	No	1.23%	1.88	No	0.41	0.37	0.82	No
<i>ST Change in Asset Turnover</i>	9.52%	6.87%	3.52	Yes	1.39%	2.07	Yes	0.44	0.27	3.39	Yes
<i>YoY Change in DPS</i>	7.53%	8.27%	-0.86	No	-1.31%	-1.36	No	0.36	0.32	0.99	No
<i>YoY Change in EPS</i>	6.43%	7.69%	-1.68	No	-0.82%	-1.00	No	0.25	0.31	-0.69	No
<b>Accounting Quality</b>											
<i>Accruals</i>	9.59%	7.05%	2.25	Yes	2.84%	3.01	Yes	0.45	0.28	2.17	Yes
<i>Accruals2</i>	8.72%	6.98%	3.02	Yes	1.07%	2.06	Yes	0.39	0.27	3.27	Yes
<i>Net Operating Assets</i>	9.82%	5.99%	3.70	Yes	3.44%	3.49	Yes	0.47	0.21	3.69	Yes
<i>ST Change in Accruals</i>	9.13%	6.95%	3.77	Yes	1.33%	2.55	Yes	0.42	0.27	3.63	Yes
<b>Payout/Dilution</b>											
<i>Equity Issuance</i>	12.50%	6.10%	3.67	Yes	4.53%	4.34	Yes	0.69	0.19	5.86	Yes
<i>Debt Issuance</i>	9.37%	6.76%	4.01	Yes	1.88%	3.31	Yes	0.45	0.27	4.46	Yes
<i>Total Payout</i>	9.56%	6.69%	1.23	No	2.79%	2.84	Yes	0.55	0.22	5.07	Yes
<i>Net Payout</i>	9.18%	6.80%	1.16	No	1.45%	1.67	No	0.50	0.24	3.87	Yes
<b>Investment</b>											
<i>Low Asset Growth</i>	9.57%	5.93%	2.41	Yes	1.45%	1.70	No	0.48	0.19	3.81	Yes
<i>Low Book Growth</i>	8.84%	6.15%	1.82	No	0.93%	1.11	No	0.42	0.20	3.35	Yes
<i>Low CapitalEx Growth</i>	9.95%	8.38%	2.10	Yes	0.89%	1.34	No	0.48	0.38	2.00	Yes
<i>Low Fixed Assets Growth</i>	8.99%	5.96%	2.30	Yes	1.08%	1.35	No	0.43	0.19	3.83	Yes

Panel C

Europe, 1990 - 2016

Profitability	Factor Return Premium							Sharpe Ratio			
	High	Low	Tstat	SGN?	Alpha	Tstat	SGN?	High	Low	Tstat	SGN?
Operating Profitability	8.99%	6.97%	2.11	Yes	1.75%	1.97	Yes	0.38	0.25	2.44	Yes
Gross Profitability	10.69%	5.78%	4.02	Yes	5.11%	5.59	Yes	0.50	0.18	4.49	Yes
Return on Equity	10.40%	5.66%	3.37	Yes	4.87%	4.65	Yes	0.47	0.16	4.21	Yes
Return on Assets	10.71%	4.99%	3.14	Yes	5.22%	4.92	Yes	0.51	0.12	4.86	Yes
Return on Invested Capital	10.43%	5.31%	3.42	Yes	4.99%	5.17	Yes	0.47	0.14	4.44	Yes
Cashflow Profitability	10.48%	4.88%	3.25	Yes	5.04%	4.70	Yes	0.49	0.11	4.61	Yes
Gross Margins	9.87%	7.17%	1.99	Yes	3.26%	3.52	Yes	0.47	0.26	3.22	Yes
<b>Earnings Stability</b>											
Stability of EPS	9.48%	6.26%	2.52	Yes	4.27%	3.98	Yes	0.40	0.20	2.75	Yes
Stability of DPS	8.42%	6.59%	1.44	No	3.33%	3.01	Yes	0.33	0.23	1.09	No
Stability of Gross Profitability	7.87%	8.40%	-0.84	No	-1.53%	-2.08	No	0.32	0.33	-0.02	No
Stability of Cashflow Profitability	7.65%	7.80%	-0.21	No	-0.88%	-0.92	No	0.29	0.29	0.09	No
Stability of Gross Margins	9.33%	7.78%	1.44	No	1.97%	2.30	Yes	0.41	0.29	2.27	Yes
<b>Capital Structure</b>											
Total Leverage	7.12%	7.62%	-0.43	No	-0.12%	-0.12	No	0.25	0.28	-0.42	No
Debt to Equity	9.25%	6.18%	2.06	Yes	3.99%	4.79	Yes	0.40	0.19	3.24	Yes
Financial Leverage	7.49%	7.06%	0.12	No	1.35%	1.61	No	0.29	0.24	0.84	No
<b>Growth in Profitability</b>											
LT Change in Gross Profitability	10.16%	7.41%	3.15	Yes	2.48%	2.91	Yes	0.45	0.28	2.82	Yes
LT Change in Cashflow Profitability	10.38%	6.84%	3.57	Yes	3.04%	3.34	Yes	0.46	0.24	3.62	Yes
LT Change in Return on Equity	9.80%	6.98%	2.32	Yes	3.21%	3.31	Yes	0.43	0.24	2.84	Yes
LT Change in Return on Assets	10.25%	7.00%	2.66	Yes	3.00%	3.16	Yes	0.47	0.24	3.23	Yes
LT Change in Gross Margins	9.05%	7.98%	1.41	No	1.44%	1.97	Yes	0.38	0.32	1.27	No
ST Change in Asset Turnover	9.16%	7.05%	2.74	Yes	1.18%	1.54	No	0.37	0.25	2.30	Yes
YoY Change in DPS	7.11%	7.19%	-0.37	No	0.73%	0.62	No	0.27	0.24	0.64	No
YoY Change in EPS	7.72%	6.61%	0.66	No	1.63%	1.50	No	0.31	0.22	1.45	No
<b>Accounting Quality</b>											
Accruals	9.26%	6.35%	1.90	No	2.91%	2.78	Yes	0.39	0.20	2.52	Yes
Accruals2	8.31%	7.34%	1.22	No	0.30%	0.40	No	0.33	0.27	1.04	No
Net Operating Assets	8.70%	6.60%	2.25	Yes	1.78%	1.97	Yes	0.34	0.23	1.67	No
ST Change in Accruals	9.25%	6.92%	3.18	Yes	1.52%	2.14	Yes	0.38	0.25	2.65	Yes
<b>Payout/Dilution</b>											
Equity Issuance	10.08%	3.75%	4.21	Yes	4.40%	3.68	Yes	0.42	0.05	4.97	Yes
Debt Issuance	9.40%	6.19%	3.78	Yes	1.82%	2.43	Yes	0.40	0.20	4.27	Yes
Total Payout	10.57%	5.26%	2.80	Yes	4.55%	3.96	Yes	0.52	0.13	5.48	Yes
Net Payout	10.16%	6.70%	2.18	Yes	2.82%	2.36	Yes	0.49	0.22	3.56	Yes
<b>Investment</b>											
Low Asset Growth	9.49%	5.69%	2.60	Yes	1.24%	1.18	No	0.41	0.16	3.15	Yes
Low Book Growth	8.19%	6.01%	1.59	No	0.21%	0.22	No	0.32	0.18	2.13	Yes
Low CapitalEx Growth	8.69%	7.32%	1.60	No	-0.07%	-0.09	No	0.34	0.26	1.53	No
Low Fixed Assets Growth	8.50%	5.70%	2.27	Yes	0.31%	0.34	No	0.34	0.16	2.64	Yes

Panel D

Japan, 1990 - 2016

	Factor Return Premium							Sharpe Ratio			
	High	Low	Tstat	SGN?	Alpha	Tstat	SGN?	High	Low	Tstat	SGN?
<b>Profitability</b>											
Operating Profitability	3.82%	0.89%	1.00	No	4.04%	1.18	No	0.04	-0.08	1.11	No
Gross Profitability	5.70%	0.07%	1.84	No	6.66%	2.31	Yes	0.13	-0.12	2.71	Yes
Return on Equity	3.30%	0.68%	0.92	No	4.28%	1.45	No	0.02	-0.09	1.08	No
Return on Assets	4.15%	-0.42%	1.45	No	5.63%	2.08	Yes	0.06	-0.14	2.01	Yes
Return on Invested Capital	3.70%	0.32%	1.10	No	4.56%	1.67	No	0.04	-0.11	1.51	No
Cashflow Profitability	5.27%	-0.32%	1.55	No	6.73%	2.08	Yes	0.11	-0.13	2.34	Yes
Gross Margins	4.35%	2.44%	0.41	No	1.79%	0.73	No	0.08	-0.01	1.28	No
<b>Earnings Stability</b>											
Stability of EPS	4.73%	-0.15%	1.83	No	5.09%	1.93	No	0.09	-0.13	2.64	Yes
Stability of DPS	4.56%	0.40%	2.11	Yes	4.68%	2.25	Yes	0.08	-0.12	2.52	Yes
Stability of Gross Profitability	2.12%	3.89%	-0.96	No	-3.36%	-1.44	No	-0.03	0.05	-0.81	No
Stability of Cashflow Profitability	1.18%	2.74%	-0.98	No	-2.85%	-1.31	No	-0.08	0.00	-0.70	No
Stability of Gross Margins	1.53%	1.82%	-0.48	No	-1.35%	-1.19	No	-0.06	-0.04	-0.16	No
<b>Capital Structure</b>											
Total Leverage	1.55%	2.93%	-0.79	No	-2.24%	-0.80	No	-0.06	0.01	-0.40	No
Debt to Equity	2.86%	0.27%	1.05	No	2.05%	1.53	No	0.01	-0.11	2.15	Yes
Financial Leverage	1.32%	0.61%	0.60	No	1.11%	1.08	No	-0.07	-0.10	0.67	No
<b>Growth in Profitability</b>											
LT Change in Gross Profitability	4.22%	1.62%	1.22	No	3.64%	1.36	No	0.06	-0.06	1.12	No
LT Change in Cashflow Profitability	3.46%	1.89%	0.87	No	2.52%	1.07	No	0.03	-0.04	0.67	No
LT Change in Return on Equity	3.16%	1.03%	0.92	No	2.60%	0.99	No	0.02	-0.08	0.96	No
LT Change in Return on Assets	3.02%	1.79%	0.71	No	2.12%	0.88	No	0.01	-0.05	0.50	No
LT Change in Gross Margins	4.37%	1.19%	1.30	No	3.96%	1.45	No	0.07	-0.07	1.62	No
ST Change in Asset Turnover	3.69%	0.84%	1.41	No	3.51%	1.53	No	0.04	-0.09	1.49	No
YoY Change in DPS	1.50%	1.05%	-0.07	No	0.56%	0.43	No	-0.06	-0.08	0.46	No
YoY Change in EPS	0.64%	0.95%	-0.36	No	0.16%	0.11	No	-0.10	-0.08	-0.15	No
<b>Accounting Quality</b>											
Accruals	5.43%	-0.02%	1.69	No	6.31%	2.07	Yes	0.11	-0.12	2.51	Yes
Accruals2	1.90%	0.75%	1.07	No	1.29%	1.39	No	-0.04	-0.09	1.23	No
Net Operating Assets	2.35%	1.18%	0.75	No	1.71%	0.74	No	-0.02	-0.08	0.52	No
ST Change in Accruals	1.73%	1.20%	0.61	No	0.40%	0.44	No	-0.05	-0.07	0.53	No
<b>Payout/Dilution</b>											
Equity Issuance	4.03%	3.82%	-0.24	No	-1.61%	-0.76	No	0.06	0.05	0.37	No
Debt Issuance	4.00%	1.34%	1.38	No	3.16%	1.44	No	0.06	-0.07	1.66	No
Total Payout	3.54%	-0.39%	1.60	No	2.75%	1.81	No	0.04	-0.14	2.90	Yes
Net Payout	2.69%	0.13%	1.37	No	1.15%	0.99	No	0.00	-0.12	2.09	Yes
<b>Investment</b>											
Low Asset Growth	1.61%	0.58%	0.69	No	-0.43%	-0.32	No	-0.05	-0.10	0.67	No
Low Book Growth	1.65%	0.83%	0.53	No	-0.64%	-0.45	No	-0.05	-0.09	0.45	No
Low CapitalEx Growth	3.34%	2.00%	0.77	No	2.08%	0.88	No	0.03	-0.04	0.61	No
Low Fixed Assets Growth	2.38%	1.36%	0.70	No	0.81%	0.40	No	-0.02	-0.07	0.48	No

Panel E

Asia Pacific x Japan, 1990 - 2016

Profitability	Factor Return Premium							Sharpe Ratio			
	High	Low	Tstat	SGN?	Alpha	Tstat	SGN?	High	Low	Tstat	SGN?
Operating Profitability	11.03%	8.46%	0.70	No	6.79%	4.39	Yes	0.41	0.23	2.20	Yes
Gross Profitability	11.06%	8.02%	0.67	No	7.01%	4.14	Yes	0.42	0.21	2.75	Yes
Return on Equity	10.64%	8.15%	1.13	No	4.52%	3.45	Yes	0.37	0.23	2.34	Yes
Return on Assets	10.43%	10.61%	-0.48	No	0.50%	0.37	No	0.37	0.34	0.61	No
Return on Invested Capital	10.60%	9.65%	0.69	No	1.01%	0.67	No	0.35	0.32	0.44	No
Cashflow Profitability	10.95%	10.43%	-0.21	No	3.95%	2.84	Yes	0.41	0.33	1.36	No
Gross Margins	11.40%	9.05%	1.18	No	0.53%	0.36	No	0.41	0.28	1.80	No
<b>Earnings Stability</b>											
Stability of EPS	12.08%	7.53%	2.20	Yes	1.84%	0.88	No	0.41	0.22	1.89	No
Stability of DPS	8.97%	8.76%	0.54	No	-3.06%	-1.33	No	0.25	0.31	-0.73	No
Stability of Gross Profitability	10.03%	8.88%	0.60	No	-1.91%	-1.12	No	0.32	0.27	0.52	No
Stability of Cashflow Profitability	12.51%	9.10%	1.62	No	2.11%	1.37	No	0.46	0.27	2.58	Yes
Stability of Gross Margins	9.85%	9.55%	-0.42	No	2.22%	1.41	No	0.35	0.28	1.34	No
<b>Capital Structure</b>											
Total Leverage	11.20%	10.12%	0.88	No	-0.95%	-0.68	No	0.38	0.35	0.31	No
Debt to Equity	10.28%	11.07%	-0.50	No	-1.21%	-0.74	No	0.35	0.38	-0.40	No
Financial Leverage	9.61%	11.62%	-1.30	No	-0.87%	-0.64	No	0.31	0.41	-1.46	No
<b>Growth in Profitability</b>											
LT Change in Gross Profitability	11.51%	8.14%	1.92	No	3.69%	2.47	Yes	0.43	0.25	2.60	Yes
LT Change in Cashflow Profitability	11.57%	8.14%	2.51	Yes	3.80%	2.97	Yes	0.42	0.25	2.68	Yes
LT Change in Return on Equity	11.24%	10.40%	0.39	No	2.30%	1.36	No	0.40	0.35	0.68	No
LT Change in Return on Assets	11.35%	10.11%	0.65	No	2.74%	1.71	No	0.41	0.34	0.93	No
LT Change in Gross Margins	12.26%	9.70%	1.74	No	2.47%	1.64	No	0.41	0.31	1.43	No
ST Change in Asset Turnover	11.40%	7.96%	2.51	Yes	1.32%	1.08	No	0.40	0.24	2.84	Yes
YoY Change in DPS	10.98%	9.35%	0.42	No	3.77%	2.17	Yes	0.40	0.28	1.38	No
YoY Change in EPS	7.85%	10.51%	-1.57	No	-1.76%	-1.12	No	0.23	0.34	-1.44	No
<b>Accounting Quality</b>											
Accruals	10.58%	10.88%	-0.34	No	3.72%	2.21	Yes	0.37	0.36	0.26	No
Accruals2	10.87%	9.08%	0.79	No	0.91%	0.60	No	0.38	0.27	1.67	No
Net Operating Assets	12.43%	7.86%	2.00	Yes	5.01%	3.30	Yes	0.47	0.21	3.76	Yes
ST Change in Accruals	10.67%	9.20%	1.08	No	1.12%	0.91	No	0.37	0.29	1.43	No
<b>Payout/Dilution</b>											
Equity Issuance	13.36%	5.49%	3.89	Yes	5.88%	3.59	Yes	0.47	0.11	5.28	Yes
Debt Issuance	10.44%	9.14%	0.42	No	1.15%	0.83	No	0.37	0.27	1.83	No
Total Payout	13.18%	7.01%	2.31	Yes	4.66%	2.73	Yes	0.55	0.18	4.52	Yes
Net Payout	9.22%	7.76%	-0.02	No	3.01%	1.36	No	0.33	0.20	1.65	No
<b>Investment</b>											
Low Asset Growth	11.41%	7.03%	1.53	No	3.57%	2.01	Yes	0.43	0.17	3.42	Yes
Low Book Growth	11.83%	7.60%	1.55	No	2.88%	1.56	No	0.43	0.20	2.98	Yes
Low CapitalEx Growth	10.97%	9.30%	1.54	No	0.23%	0.20	No	0.36	0.31	0.84	No
Low Fixed Assets Growth	11.29%	8.67%	0.83	No	1.66%	0.93	No	0.41	0.24	2.31	Yes

Source: Research Affiliates, LLC, using data from CRSP/Compustat and Worldscope/Datastream.

**Table A2. HKV Three-Step Factor Validation: Standard Factors Summary**

Ratio of Significant Long Short Spreads								
	Average Return	Alpha	Sharpe Ratio		Average Return	Alpha	Sharpe Ratio	
<b>United States, 1963 - 2016</b>				<b>Global Developed 1990 - 2016</b>				
Profitability	57%	100%	71%	Profitability	86%	100%	100%	
Earnings Stability	0%	20%	60%	Earnings Stability	20%	40%	40%	
Capital Structure	0%	33%	0%	Capital Structure	0%	33%	0%	
Growth in Profitability	38%	38%	63%	Growth in Profitability	38%	25%	50%	
Accounting Quality	75%	100%	75%	Accounting Quality	100%	100%	100%	
Payout/Dilution	50%	100%	100%	Payout/Dilution	50%	75%	100%	
Investment	75%	75%	100%	Investment	75%	0%	100%	
<b>Europe, 1990 - 2016</b>				<b>Japan, 1990 - 2016</b>				
Profitability	100%	100%	100%	Profitability	0%	43%	43%	
Earnings Stability	20%	60%	40%	Earnings Stability	20%	20%	40%	
Capital Structure	33%	33%	33%	Capital Structure	0%	0%	33%	
Growth in Profitability	63%	63%	63%	Growth in Profitability	0%	0%	0%	
Accounting Quality	50%	75%	50%	Accounting Quality	0%	25%	25%	
Payout/Dilution	100%	100%	100%	Payout/Dilution	0%	0%	50%	
Investment	50%	0%	75%	Investment	0%	0%	0%	
<b>Asia Pacific x Japan, 1990 - 2016</b>				<b>Average of Significance Over Markets</b>				
Profitability	0%	57%	43%	Profitability	49%	80%	71%	Average 67%
Earnings Stability	20%	0%	20%	Earnings Stability	16%	28%	40%	28%
Capital Structure	0%	0%	0%	Capital Structure	7%	20%	13%	13%
Growth in Profitability	25%	38%	38%	Growth in Profitability	33%	33%	43%	36%
Accounting Quality	25%	50%	25%	Accounting Quality	50%	70%	55%	58%
Payout/Dilution	50%	50%	50%	Payout/Dilution	50%	65%	80%	65%
Investment	0%	25%	75%	Investment	40%	20%	70%	43%

Source: Research Affiliates, LLC, using data from CRSP/Compustat and Worldscope/Datastream.

**Table A3. Pairwise Correlation Matrix for Factor Return Spreads**

Correlation of Factor Returns—Sector Neutral Factors																																				
	OP	GP	ROE	ROA	ROIC	CP	GM	EPS	DPS	GP	CP	GM	TL	DE	FL	GP	CP	ROE	ROA	GM	AT	DPS	EPS	ACC	ACC2	NOA	CAC	EQIS	DTIS	TP	NP	AG	BG	CG	FG	
Profitability																																				
OP	1.0	0.7	0.9	0.8	0.8	0.8	0.3	-0.1	-0.4	0.2	0.3	0.4	-0.2	-0.1	-0.3	0.3	0.3	0.4	0.3	0.1	0.1	-0.4	0.4	0.7	0.0	0.0	0.2	0.3	0.0	0.4	0.2	-0.1	-0.3	-0.3	0.0	
GP	0.7	1.0	0.7	0.8	0.7	0.8	0.5	0.1	-0.3	0.1	0.3	0.5	-0.1	0.2	0.0	0.3	0.3	0.3	0.3	0.1	0.1	-0.3	0.3	0.7	0.0	0.1	0.1	0.3	0.1	0.5	0.3	0.0	-0.2	-0.2	0.1	
ROE	0.9	0.7	1.0	0.9	0.9	0.8	0.4	0.1	-0.4	0.3	0.4	0.5	-0.1	0.0	-0.3	0.3	0.4	0.5	0.5	0.2	0.1	-0.3	0.5	0.5	0.0	-0.1	0.1	0.2	0.0	0.4	0.3	-0.2	-0.4	-0.3	-0.1	
ROA	0.8	0.8	0.9	1.0	0.8	0.9	0.5	0.1	-0.4	0.3	0.4	0.6	0.0	0.2	-0.1	0.3	0.4	0.5	0.4	0.2	0.1	-0.3	0.4	0.5	0.0	-0.1	0.1	0.3	0.1	0.5	0.4	-0.1	-0.3	-0.2	0.0	
ROIC	0.8	0.7	0.9	0.8	1.0	0.8	0.5	0.1	-0.1	0.1	0.2	0.4	0.0	0.2	0.0	0.3	0.4	0.5	0.5	0.3	0.0	-0.2	0.5	0.6	-0.1	-0.1	0.1	0.0	0.0	0.2	0.0	-0.4	-0.6	-0.2	-0.2	
CP	0.8	0.8	0.8	0.9	0.8	1.0	0.4	0.0	-0.4	0.2	0.3	0.5	-0.1	0.1	-0.2	0.3	0.4	0.4	0.4	0.1	0.1	-0.3	0.4	0.7	0.0	0.0	0.1	0.3	0.1	0.5	0.3	0.0	-0.2	-0.3	0.1	
GM	0.3	0.5	0.4	0.5	0.5	0.4	1.0	0.4	0.1	0.2	0.3	0.3	0.4	0.4	0.2	0.0	0.1	0.2	0.2	0.2	-0.1	0.2	0.3	0.3	-0.1	0.1	-0.1	0.0	-0.1	0.2	0.1	-0.3	-0.3	0.0	-0.2	
Earnings Stability																																				
EPS	-0.1	0.1	0.1	0.1	0.1	0.0	0.4	1.0	0.2	0.2	0.3	0.2	0.4	0.4	0.2	0.0	0.1	0.1	0.1	0.2	-0.2	0.4	0.3	-0.2	0.0	0.1	-0.1	-0.1	-0.1	0.0	0.0	-0.2	-0.2	0.1	-0.2	
DPS	-0.4	-0.3	-0.4	-0.4	-0.1	-0.4	0.1	0.2	1.0	-0.5	-0.5	-0.4	0.2	0.4	0.6	-0.3	0.0	-0.1	0.0	0.2	-0.1	0.7	-0.1	-0.2	-0.2	-0.1	0.1	-0.1	-0.7	-0.1	-0.7	-0.6	-0.6	-0.4	0.5	-0.6
GP	0.2	0.1	0.3	0.3	0.1	0.2	0.2	0.2	-0.5	1.0	0.8	0.6	0.1	-0.2	-0.3	0.2	0.1	0.1	0.0	0.0	-0.3	0.2	0.0	0.1	0.0	0.1	0.4	-0.1	0.5	0.5	0.3	0.3	-0.3	0.3	0.3	
CP	0.3	0.3	0.4	0.4	0.2	0.3	0.3	-0.5	0.8	1.0	0.6	0.2	0.0	-0.3	0.1	0.1	0.2	0.1	0.0	-0.1	-0.2	0.2	0.0	0.0	0.0	0.1	0.1	0.4	-0.1	0.6	0.5	0.2	0.1	-0.3	0.2	
GM	0.4	0.5	0.5	0.6	0.4	0.5	0.3	0.2	-0.4	0.6	0.6	1.0	0.0	0.1	-0.2	0.2	0.2	0.3	0.2	0.1	-0.2	0.3	0.3	0.0	0.0	0.0	0.1	0.4	0.0	0.5	0.5	0.1	0.1	-0.2	0.2	
Capital Structure																																				
TL	-0.2	-0.1	-0.1	0.0	0.0	-0.1	0.4	0.4	0.2	0.1	0.2	0.0	1.0	0.7	0.4	-0.2	0.0	0.0	0.0	0.0	-0.1	0.5	0.0	-0.1	0.0	0.4	-0.1	-0.1	0.1	0.1	0.2	-0.1	0.0	0.1	-0.1	
DE	-0.1	0.2	0.0	0.2	0.2	0.1	0.4	0.4	0.4	-0.2	0.0	0.1	0.7	1.0	0.7	-0.1	0.1	0.1	0.1	0.1	-0.1	0.6	0.1	0.1	-0.1	0.4	-0.1	-0.2	0.1	0.0	0.1	-0.3	-0.2	0.3	-0.2	
FL	-0.3	0.0	-0.3	-0.1	0.0	-0.2	0.2	0.2	0.6	-0.3	-0.3	-0.2	0.4	0.7	1.0	-0.2	0.0	-0.1	0.0	0.1	-0.1	0.6	-0.1	0.0	-0.1	0.3	-0.1	-0.4	0.1	-0.4	-0.2	-0.3	-0.3	0.4	-0.3	
Growth in Profitability																																				
GP	0.3	0.3	0.3	0.3	0.3	0.3	0.0	0.0	-0.3	0.2	0.1	0.2	-0.2	-0.1	-0.2	1.0	0.7	0.5	0.6	0.3	0.4	-0.2	0.5	0.2	0.2	0.1	0.0	0.4	0.2	0.2	0.2	0.2	0.0	-0.1	0.2	
CP	0.3	0.3	0.4	0.4	0.4	0.4	0.1	0.0	0.1	0.1	0.1	0.2	0.0	0.1	0.0	0.7	1.0	0.7	0.7	0.5	0.2	0.0	0.5	0.3	-0.1	0.0	0.4	0.0	0.2	0.1	0.1	-0.1	-0.3	0.0	0.0	
ROE	0.4	0.3	0.5	0.5	0.5	0.4	0.2	0.1	-0.1	0.1	0.2	0.3	0.0	0.1	-0.1	0.5	0.7	1.0	0.8	0.4	0.1	0.0	0.6	0.2	-0.1	0.0	0.2	0.1	0.1	0.2	0.2	-0.1	-0.2	-0.1	-0.1	
ROA	0.3	0.3	0.5	0.4	0.5	0.4	0.2	0.1	0.0	0.0	0.1	0.2	0.0	0.1	0.0	0.6	0.7	0.8	1.0	0.4	0.1	0.0	0.6	0.2	-0.1	0.0	0.1	-0.1	0.1	0.0	0.0	-0.2	-0.4	-0.1	-0.2	
GM	0.1	0.1	0.2	0.2	0.3	0.1	0.2	0.2	0.2	0.0	0.0	0.1	0.0	0.1	0.1	0.3	0.5	0.4	0.4	1.0	-0.1	0.1	0.3	0.1	-0.2	-0.1	0.2	-0.3	0.0	-0.2	-0.2	-0.4	-0.4	-0.0	-0.3	
AT	0.1	0.1	0.1	0.1	0.0	0.1	-0.1	-0.2	-0.1	0.0	-0.1	0.1	-0.1	-0.1	-0.1	0.4	0.2	0.1	0.1	-0.1	1.0	-0.2	0.1	0.1	0.2	0.1	0.5	0.2	0.3	0.1	0.1	0.3	0.2	0.1	0.2	
DPS	-0.4	-0.3	-0.3	-0.3	-0.2	-0.3	0.2	0.4	0.7	-0.3	-0.2	0.2	0.5	0.6	0.6	-0.2	0.0	0.0	0.0	0.1	-0.2	1.0	0.1	-0.2	-0.1	0.3	-0.2	-0.5	0.0	-0.4	-0.2	-0.4	-0.2	0.5	-0.4	
EPS	0.4	0.3	0.5	0.4	0.5	0.4	0.3	0.3	-0.1	0.2	0.2	0.3	0.0	0.1	-0.1	0.5	0.5	0.6	0.6	0.3	0.1	0.1	1.0	0.1	0.0	0.0	0.1	0.1	0.0	0.1	0.1	-0.2	-0.3	0.0	-0.1	
Accounting Quality																																				
ACCR	0.7	0.7	0.5	0.5	0.6	0.7	0.3	-0.2	-0.2	0.0	0.0	0.3	-0.1	0.1	0.0	0.2	0.3	0.2	0.2	0.1	0.1	-0.2	0.1	1.0	0.0	0.0	0.2	0.1	0.1	0.2	0.1	-0.1	-0.3	-0.1	-0.1	
ACCR2	0.0	0.0	0.0	0.0	-0.1	0.0	-0.1	0.0	-0.1	0.1	0.0	-0.1	0.0	0.0	-0.1	-0.1	-0.1	-0.1	-0.2	0.2	-0.1	0.0	0.0	1.0	0.2	0.0	0.2	0.3	0.0	0.1	0.3	0.2	0.0	0.0	0.2	
NOA	0.0	0.1	-0.1	-0.1	-0.1	0.0	0.1	0.1	0.1	0.0	0.1	0.0	0.4	0.4	0.3	0.0	0.0	0.0	-0.1	0.1	0.3	0.0	0.0	0.2	1.0	0.0	0.1	0.3	0.1	0.3	0.2	0.2	0.2	0.2	0.2	
CACCR	0.2	0.1	0.1	0.1	0.1	0.1	-0.1	-0.1	-0.1	0.1	0.1	0.1	-0.1	-0.1	-0.1	0.4	0.4	0.2	0.1	0.2	0.5	-0.2	0.1	0.2	0.0	0.0	1.0	0.1	0.2	0.1	0.1	0.1	0.0	0.0	0.1	
Payout/Dilution																																				
EQIS	0.3	0.3	0.2	0.3	0.0	0.3	0.0	-0.1	-0.7	0.4	0.4	0.4	-0.1	-0.2	-0.4	0.2	0.0	0.1	-0.1	-0.3	0.2	-0.5	0.1	0.1	0.2	0.1	0.1	1.0	0.2	0.7	0.6	0.7	0.6	-0.3	0.6	
DTIS	0.0	0.0	0.1	0.0	0.1	-0.1	-0.1	-0.1	-0.1	-0.1	0.1	0.1	0.1	0.2	0.2	0.1	0.1	0.0	0.3	0.0	0.0	0.1	0.3	0.3	0.2	0.2	1.0	0.1	0.2	0.4	0.2	0.1	0.2	0.1	0.4	
TP	0.4	0.5	0.4	0.5	0.2	0.5	0.2	0.0	-0.7	0.5	0.6	0.5	0.1	0.0	-0.4	0.2	0.1	0.2	0.0	-0.2	0.1	-0.4	0.1	0.2	0.0	0.1	0.1	0.7	0.1	1.0	0.8	0.4	0.4	-0.3	0.5	
NP	0.2	0.3	0.3	0.4	0.0	0.3	0.1	0.0	-0.6	0.5	0.5	0.5	0.2	0.1	-0.2	0.2	0.1	0.2	0.0	-0.2	0.1	-0.2	0.1	0.1	0.1	0.3	0.1	0.6	0.2	0.8	1.0	0.5	0.5	-0.2	0.5	
Investment																																				
AG	-0.1	0.0	-0.2	-0.1	-0.4	0.0	-0.3	-0.2	-0.6	0.3	0.2	0.1	-0.1	-0.3	-0.3	0.2	-0.1	-0.1	-0.2	-0.4	0.3	-0.4	-0.2	-0.1	0.3	0.2	0.1	0.7	0.4	0.4	0.5	1.0	0.8	-0.1	0.8	
BG	-0.3	-0.2	-0.4	-0.3	-0.6	-0.2	-0.3	-0.2	-0.4	0.3	0.1	0.1	0.0	-0.2	-0.3	0.0	-0.3	-0.2	-0.4	-0.4	0.2	-0.2	-0.3	-0.3	0.2	0.2	0.0	0.6	0.2	0.4	0.5	0.8	1.0	-0.1	0.6	
CG	-0.3	-0.2	-0.3	-0.2	-0.2	-0.3	0.0	0.1	0.5	-0.3	-0.3	-0.2	0.1	0.3	0.4	-0.1	0.0	-0.1	-0.1	0.0	0.1	0.5	0.0	-0.1	0.0	0.2	0.0	-0.3	0.1	-0.3	-0.2	-0.1	-0.1	1.0	0.0	
FG	0.0	0.1	-0.1	0.0	-0.2	0.1	-0.2	-0.2	-0.6	0.3	0.2	0.2	-0.1	-0.2	-0.3	0.2	0.0	-0.1	-0.2	-0.3	0.2	-0.4	-0.1	-0.1	0.2	0.2	0.1	0.6	0.4	0.5	0.5	0.8	0.6	0.0	1.0	

Source: Research Affiliates, LLC, using data from CRSP/Compustat and Worldscope/Datastream.

	Profitability	Earnings Stability	Capital Structure	Growth in Profitability	Accounting Quality	Payout/Dilution	Investment
Profitability	0.70	0.16	0.02	0.22	0.16	0.22	-0.19
Earnings Stability	0.16	0.16	0.10	0.07	0.00	0.10	-0.03
Capital Structure	0.02	0.10	0.63	0.06	0.06	-0.05	-0.08
Growth in Profitability	0.22	0.07	0.06	0.31	0.09	0.02	-0.10
Accounting Quality	0.16	0.00	0.06	0.09	0.08	0.16	0.07
Payout/Dilution	0.22	0.10	-0.05	0.02	0.16	0.42	0.31
Investment	-0.19	-0.03	-0.08	-0.10	0.07	0.31	0.36

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## Endnotes

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<sup>1</sup> Perhaps another reason for interest in the quality factor is the interest in growth investing. To a degree, smart beta is an attempt to provide in the low-cost, transparent solutions strategies previously implemented by active managers. Investors traditionally categorize active managers into styles: value, small cap, etc. One of these styles is growth – where active managers select companies with the high growth potential. Quality factor is an attempt to map the growth style into the factor framework. Continuity from the active investing is partly responsible for popularity of quality factor.

<sup>2</sup> Harvey, Liu, and Zhu (2016) argue that the cut-off level for *t*-statistics of prospective factor returns should be higher than historical levels (2.0). As more significant factors are discovered, many more factors potentially have been tested, but have not been published, likely increasing the hurdle for factor robustness tests. In our paper, all of the quality measures have been studied by researchers in the past. In this regard, they are all historical factors, and the higher cut-off level of 3.0 *t*-statistics is not applicable.

<sup>3</sup> We provide in Table A3 of the appendix the detailed view of the pairwise correlations of the individual variables as well as a bigger list of variables we will introduce later in this section.

<sup>4</sup> Commercially available quality index simulations invariably show outperformance, at least in the relatively short time periods for which they are provided. As we pointed out earlier, the quality factor is not uniformly defined. The multiplicity of definitions of quality creates the possibility (and perhaps a temptation) to data mine for the best possible outcome which makes a simple comparison of the index performance an unreliable estimate of what to expect on the forward looking basis.

<sup>5</sup> It is surprising how many published results cannot be replicated – see Bailey et al. (2014, 2015) for details.

<sup>6</sup> Special items are nonrecurrent items related to impairment charges, restructuring costs, and so forth. Dechow and Ge (2006) argue that accruals are more likely to reflect transitory special items instead of transitory cash flows as liabilities.

<sup>7</sup> Stambaugh and Yuan (2006) build a four-factor model to explain cross-sectional patterns in stock returns. Along with the market and size factors, they identify management and performance factors. Performance includes profitability, and management includes accounting quality, payout/dilution, and investment. In this regard, management captures corporate decisions such as accounting disclosure and financing.

<sup>8</sup> We follow Fama and French (2016) in the choice of region specification.

<sup>9</sup> Beck et al. (2016) identify five non-quality-related factors that are well explored in the literature (HKV step 1): value, momentum, size, illiquidity, and low beta. Value and momentum are shown to be robust across definitions and geographies (HKV step 2 and 3). Size is interestingly not robust either across definitions or geographies. Beck and coauthors present mixed evidence for illiquidity, which is robust across definitions, but not across geographies.

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The low beta factor is overall robust considering only the Sharpe ratio of the factor return, but the low-beta factor premium is statistically insignificant, even though it is economically large. The reason for this outcome is the large negative correlation of the low beta factor with the equity market (market factor) and its low absolute-risk character.

<sup>10</sup> Kose (2017) documents that the relation between corporate leverage and returns are highly dependent on the maturity structure of company liabilities.

<sup>11</sup> Hsu et al. (2017) show that the correlation between value and investment is mostly driven by similar sector bets the factors take. Gerakos and Linnainmaa (2016) show that changing the profitability factor characteristic from operating profitability to cash profitability also keeps the HML factor from being redundant.