Intangible Capital and the Value-Growth Anomaly

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ABSTRACT

In this chapter, I study the variation of the book-to-market (B/M) ratio across firms and over time. The B/M ratio, a firm characteristic defined as the book value over the market value of equity, plays an important role in finance theory and practice. In this chapter, I first replicate and extend the Chapter of "Value Premium" in Bali, Engle, and Murray (2016). Second, recent work debates on whether the B/M ratio should also account for intangible capital. I estimate three versions of internally generated intangible capital, use it to adjust B/M ratio and confirm that including intangible capital does improve the performance of value strategy. One of the contributions of this paper is to compare methods to estimate intangibles. The long-short value premium and the cumulative return of HML factor favor $bm^{Eisfeldt}$ compared with bm^{Peters} and bm^{Ewens}. Nevertheless, none of them can expand the mean-variance frontier spanned by four other factors, and they all experience persistent drawdowns in recent decades. Third, to delve into the time-series and cross-sectional behavior of B/M ratio and its associated value premium, I conduct two sub-sample analyses: pre- or post-1999 analysis and high tech sector or not analysis. The pre- or post-1999 analysis indicates that the positive relation between all the four versions of B/M and future stock returns is much weaker post-1999. High tech sector or not analysis does not corroborate the argument that the death of value strategy is caused by the conservative accounting biases in book value. The selection of a better estimation method for intangibles is hampered as it changes across contexts. Last, I show that instead of using intangible capital to adjust book value, leveraging the ratio of intangible capital over market value can deliver HML factors which feature much higher cumulative returns and smaller drawdowns in recent decades. The drawdowns of HML factors are closely associated with the change of relative valuation.

Keywords: Book-to-market ratio, Characteristics, Anomalies, Value premium, Intangible capital, Relative valuation.

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1 Introduction

The positive relation between firms' book-to-market ratio and expected stock returns has been documented ever since Fama and French (1992). Based on this empirical founding, both the academic and practical world have seen a growing exploration and implementation of the associated value strategy which takes a long position in value stocks (stocks with a high book-to-market ratio) and a short position in growth stocks (stocks with a low book-to-market ratio). However, the strategy is losing its power in recent decades as growth stocks perform better than value stocks on average. The HML factor experiences a long and persistent drawdowns. To restore the problem, Park (2019) proposes to revise the calculation of book value by taking the intangible assets into consideration and finds that an intangible adjusted book-to-market ratio still predicts stock returns. Ewens, Peters, and Wang (2020), Eisfeldt, Kim, and Papanikolaou (2020), Gulen, Li, Peters, and Zekhnini (2020) have similar observations. Rizova and Saito (2020), on the other hand, disfavor the adjustment because the estimation of intangible assets contains a lot of noise and that the estimated intangible assets provide little additional information about future cash flow and profitability. Arnott, Harvey, Kalesnik, and Linnainmaa (2020) decompose the excess returns and attribute value stocks' underperformance to the tumbled relative valuation besides the failure of book value to capture the intangible assets.

This paper provides a thorough examination of the value strategy. First, I replicate all the tables in Chapter 10 from Bali, Engle, and Murray (2016) to make sure all the tricky procedures are followed correctly by obtaining similar results. Second, selective tables are presented using the later sample period to check its recent variations and to provide new insights. Third, to explore whether the noise in estimating intangible assets matters and which method to estimate intangible assets can beat one another, I construct three versions of intangible adjusted book-to-market ratio ($bm^{Eisfeldt}$, bm^{Peters} and bm^{Ewens}) and compare them thoroughly. Fourth, two sub-sample analyses are conducted to investigate in more detail the performance of intangible adjustment in both time-series and cross-sectional aspects. The appendix C provides the sorting efficiency of bm^{ff} and bm^{Ewens} using a large range of variables in order to inspire further studies. Finally, to answer the question that is the improvement effects totally caused by the positive relation between intangible capital and future stock returns as documented in Eisfeldt and Papanikolaou (2013), I leverage the ratio of intangible capital over market value separately to check the performance of IHML factors constructed and analyse the relative valuation not only for the HML^{FF} as Arnott, Harvey, Kalesnik, and Linnainmaa (2020) do but also for all the variants of ratios used in this paper.

I contribute to the studies relevant to value strategy and especially studies looking into the effects of modifying the book-to-market ratio with intangible assets. This is the first paper that compares across the three most often employed estimation of intangible assets and the first one to divide the whole sample into high tech sector and not high tech sector to examine for the potential reasoning of intangible adjustments. I also provide more detailed examination for the argument of Arnott, Harvey, Kalesnik, and Linnainmaa (2020). The overall observation is that modifying book value by adding estimated intangible assets does improve the performance of value strategy yet there is no clear conclusion on which method to estimate intangibles is best. Besides, even the intangible adjusted HML factors experience persistent and large drawdowns in recent decades. The cross-sectional sub-sample analysis tends to doubt the story of mismeasurement of book value. The ratio of intangible capital over the market value on its own gives rise to HML factors that feature a much higher cumulative returns and smaller drawdowns than all versions of intangible adjusted HML factors, which is a new insight in the literature. Arnott, Harvey, Kalesnik, and Linnainmaa (2020) inspect the relation between excess returns and relative valuation using only traditional BM^{FF}, while in this paper, I present more evidence supporting their argument using all variants of ratios.

The Book-to-market ratio is defined as the book value over the market value of equity of a firm. It plays an important role in finance, both in theory and in practice. In the theory of asset pricing, people find a positive relation between book-to-market ratio and future stock returns. Thus, by leveraging the value strategy, which is long in the stocks with high book-to-market ratio and short in stocks with low book-to-market ratio, one can earn a positive excess return, the value premium. Based on this founding, Fama and French (1993) propose the HML factor calculated using the book-to-market ratio in the famous three-factor models, which is a workhorse in finance since 1993 as an extension of the Sharpe-Lintner-Mossion capital asset pricing model (CAPM). In the theory of corporate finance, especially in the modern theory of firm investment, researchers prove that the investment is only a function of marginal q which represents the marginal increase in firm's value if one more unit of capital is invested, and of the level of capital. Tobin's Q is defined as the market value of firm capital over the replacement cost of firm capital and in empirical study, the book value is often used as a proxy for the replacement cost, thus the book-to-market ratio becomes a popular proxy for the inverse of Tobin's Q. In Peters and Taylor (2017), the authors show that Tobin's Q also explains intangible investment in a better way than it explains the tangible investment. They suggest a simple, new Tobin's Q proxy that accounts for intangible capital, and they show that it is a superior proxy for both physical and intangible investment opportunities. Kogan and Papanikolaou (2014) utilize the book-to-market ratio as one proxy for growth opportunities. In practice, the book-to-market ratio forms the basis for value-growth investment strategies followed by many mutual and hedge funds follow the value strategy, say, Prof. Fama's Dimensional Fund Advisors which is an investment company with 454 billion dollars in firm-wide assets under management. Given the importance of the book-to-market ratio in both theory and practice, I aim to learn stylized facts and recent developments of it and most importantly, the developments relevant to intangibles.

From the last decade of the twenty century, the market has seen a growth of listed firms like Amazon, Google, etc. One feature of these firms is that they own more intangible assets, say, the copyrights, the human resources, the electronic databases, technologies, rather than the tangible assets like buildings, machines, equipment which are the main assets of firms in manufacture. Under the current accounting standards, however, the conservatism principle prevents the internal generated intangible capital from being recorded in the balance sheets. This principle requires company accounts to be prepared with caution and high degrees of verification. While the intangible assets, as its name indicate, are not physical in nature and not financial instruments, thus hard to measure the value. Though current accounting items do have intangible items like patent, brand, trademark, copyright listed under long-term assets on the balance sheet, they are actually mostly acquired from firms outside, and the amount is the costs to buy those externally generated items. Only neglectable direct costs incurred in developing the intangible such as legal costs are capitalized while the rest are all expensed. The internally generated intangible assets, on the other hand, are absent in the financial reports. Instead, the spending in research and development, advertising, training and others relevant to creating internally generated assets is recognized as costs, which actually decrease the firms' assets. It is an indisputable fact that the intangible assets have become increasingly important nowadays. In practice, while traditional firms mainly rely on plant, property and equipment as their main assets, more and more firms like Amazon, Alibaba, Facebook, Apple, Dell and other technology or e-commerce firms nowadays take intangible assets as their crucial assets. The human resources, technology updates, new platform-based, like web-based transactions are the essential competitive power among firms. In theory, many models make an endeavor to the integration of intangible capital in addition to traditional physical capital (see Corrado, Hulten, and Sichel (2009), Eisfeldt and Papanikolaou (2013), Koh, Santaeulàlia-Llopis, and Zheng (2020) for instance).

Though the internally generated intangible assets are listed under cost items in the financial reports, we all know some parts of the expenditure are going to turn into the firms' capital. Taking this fact into consideration, Peters and Taylor (2017) is the first paper that incorporates intangibles into the calculation of book value of equity. Nevertheless, Peters and Taylor (2017) concentrates on the role that Tobin's Q plays in the neoclassical theory of investment while we are more interested in its performance in the context of the stock market. Eisfeldt and Papanikolaou (2013) report a positive relation between organization capital and stock returns. Park (2019) shows that adjusting book value with unrecorded intangibles improves the explanatory power of the book-to-market ratio in the cross-section of stock returns. Similar conclusion is obtained by Ewens, Peters, and Wang (2020), Eisfeldt, Kim, and Papanikolaou (2020) and Gulen, Li, Peters, and Zekhnini (2020). This paper is built on these research and delves more into this adjustment and using intangible capital alone.

The rest parts of this dissertation are organized as follows. Section 2 provides a literature review. Section 3 records the data sources, the variable definitions and methodologies applied. Section 4 displays the results from replication and extension using the later sample period. Section 5 displays the comparison among four versions of the book-to-market ratio. Section 6 demonstrates the two sub-sample analyses. Section 7 provides further analyses exploring the role of intangible capital and relative valuation. Section 8 concludes.

2 Literature review

This paper is closely related to research relevant to the book-to-market ratio and its implications in finance, and more importantly to the re-examination of the value strategy in recent decades.

The book-to-market ratio, as its name indicates, is the book value of equity to the market value of equity. However, its calculation is not as simple as it looks since there are multiple ways to calculate the book value of equity–either to use total assets minus total liabilities to be the book value or use the value of common shares' equity are common choices. In empirical finance, the most commonly implemented calculation of the book-to-market ratio is that of Fama and French (1992) and will be explained in detail in section three. Based on the book-to-market ratio, there are two main fields in academia that leverage this ratio to make extraordinary findings: corporate finance and asset pricing.

In corporate finance, ever since Tobin (1969) developed an intuitive and celebrated theory of investment, Tobin's Q has been playing an important role in investment theory as marginal q which represents the marginal increase in the firm's value from investing one more unit of capital, is not hard to measure. In practice, book-to-market ratio is often applied to be a proxy for Q. There is a large vast of academic work related to it in an equilibrium framework both in corporate finance and macroeconomics. In most recent work, Peters and Taylor (2017) show that Tobin's Q also explains intangible investment in a better way than it explains the tangible investment. They suggest a simple, new Tobin's Q proxy that accounts for intangible capital, and they show that it is a superior proxy for both physical and intangible investment opportunities. The new proxy is just to adjust the denominator, the book value of equity, by adding intangible assets. Kogan and Papanikolaou (2014) utilize the book-to-market ratio as one proxy for growth opportunities.

In asset pricing, it focuses on the value premium and its role in the asset pricing models. As the empirical results in this chapter are mainly related to this field, a more detailed and throughout literature review will be provided below.

Value investing strategy, long in value stocks characterized with high book-to-market ratio, and short in growth stocks characterized with low book-to-market ratio, first appears as a challenge to traditionally assumed and proved (Fama and MacBeth (1973)) market efficiency hypothesis. While the efficient market hypothesis claims that excess returns are not available as market information is totally reflected in the stock prices, Basu (1977) finds a negative relation between investment performance of equity securities and their Price to earnings ratio and that P/E ratio, due to exaggerated investor expectations, may be indicators of future investment performance.

Following that, the academic saw a growing number of papers indicating a similar pattern, i.e. investing in value stocks can earn a higher return than investing in growth stocks. Though the definition of value stocks changes from stocks with low price to earnings ratio (Basu (1977), Jaffe, Keim, and Westerfield (1989)), high book value of equity to price (Barr Rosenberg and Lanstein (1984)), low debt to equity ratio (Bhandari (1988)), it all reflects the fact that those firms have a high book value of equity relative to market value.

The book value of a firm is the difference between total assets and total liabilities and thus reflecting the total value of a company's assets that shareholders of that company would receive if the company were to be liquidated. While lots of characteristics of firms like E/P ratio, leverage, etc. are claimed to have relations with cross-sectional stock returns, Fama and French (1992) suggests that only two measures, size and book-to-market equity are enough to capture all the variations in stock returns. Based on this work, they raise the most famous three-factor model in 1993 (Fama and French (1993)), showing a better and widespread performance of this model compared with the traditional CAPM model. One of the factors is High minus Low factor (HML), calculated based on B/M ratio, which is among the factors that are most often cited and employed as a baseline to evaluate portfolios' performance.

However, the reason why the value strategy works stays controversial. Some scholars (see Fama and French (1993), Chen and Zhang (1998), Lettau and Ludvigson (2001), Zhang (2005) for instance) attribute it to risk while some (see Lakonishok, Shleifer, and Vishny (1994), Porta, Lakonishok, Shleifer, and Vishny (1997), Ali, Hwang, and Trombley (2003) among others) explain it from behavior aspects. Even within these two main categories, the specific interpretations differ from one to another.

Up to recently, academic studies in favor of the value strategy story keep flourishing though they face more challenges than before as there is more evidence showing the failure of this strategy. Over the last two decades, the HML factor experiences a large and long drawdown which leads to the argument that value strategy no longer works. The remedies to value strategy are either to further inspect the driven reasons under value strategy or to modify the calculation of the B/M ratio. Golubov and Konstantinidi (2019) defend the value strategy by decomposing B/M ratio into market-to-value component and value-to-book component, and they find that the former one drives all the value strategy return. They also check four value premium theories based on this decomposition and cast doubt on them. Jaffe, Jindra, Pedersen, and Voetmann (2019) again confirms behavioral explanation for the value premium, also using decomposition approved by Rhodes-Kropf, Robinson, and Viswanathan (2005) as Golubov and Konstantinidi (2019) do. Arnott, Harvey, Kalesnik, and Linnainmaa (2020) use bootstrap to show that seeing large drawdowns in HML factor observed in recent decades is about 1 in 20—unusual but not enough to support structural impairment and thus conclude that reports of Value's death may be greatly exaggerated. Fama and French (2020) claim that the high volatility of monthly premium prevents us from rejecting the hypothesis that expected premiums are the same in both halves of the sample from 1963 to 2019. Besides, they also say that we may conclude the failure of the value strategy in recent decades but only if we assume the coefficients in regression keep constant in different sample periods, which is a too strong assumption. On the other hand, Asness and Frazzini (2013) find that by aligning price data using fewer lags, i.e. timelier price data than traditional approach would forecast true B/P ratio at fiscal year-end and that the value portfolios based on the most timely measures earn statistically significant alphas ranging between 305 and 378 basis point per year against a 5-factor model itself containing the standard measure of value, as well as market, size, momentum and a short term reversal factor.

This paper is closely related to another modification to the calculation of the book-to-market ratio which incorporates the intangible assets. The internal generated intangible capital is not recorded in the balance sheets under the current accounting principle though it is estimated to take up to about 50% of firms' capital stock (see Falato, Kadyrzhanova, and Sim (2013)). Lev, Radhakrishnan, and Zhang (2009) find that organization capital is associated with five years of future operating, stock return performance and executive compensation. Eisfeldt and Papanikolaou (2013) document that firms with more intangible capital as measured by organization capital have average returns which are 4.6% higher due to the firms' higher risk from shareholders' perspective. Peters and Taylor (2017), as mentioned earlier, use intangible assets to adjust Tobin's Q and find inspiring results. Given the increasing share of intangible capital yet its absence in the standard measure of book value in the fiscal report, we would expect new features if it is combined with the value strategy. Indeed, Park (2019) suggests an intangible-adjusted B/M ratio should give higher excess returns than the old one both in the 1976-2017 period and the 1997-2017 period. Eisfeldt, Kim, and Papanikolaou (2020) show that the intangible adjusted HML factor prices standard test assets with lower pricing errors and that it outperforms the traditional HML factor. Ewens, Peters, and Wang (2020) use market prices to estimate parameters needed in calculating intangible capital and find their version of intangible adjusted HML factor performs better than other measurements of intangibles. Gulen, Li, Peters, and Zekhnini (2020) show that incorporating intangibles significantly improves the Fama-French three- and five-factor models and the q-factor model, especially over recent decades, and that the adjusted value factor is no longer redundant in the Fama-French five-factor model. However, Rizova and Saito (2020) disfavors the adjustment as they argue that not only the estimation contains a lof of noise but also the estimated intangible assets provide little additional information about future cash flow and profitability, thus unable to identify differences in expected stock returns. Based on these work, I estimate three versions of internally generated intangible capital, use it to adjust B/M ratio, and confirm that including intangible capital does improve the performance of value strategy. However, there is no clear conclusion on which measure is better.

3 Data and methodology

3.1 Data source

I use data from the center for research in security prices (CRSP) for stocks' prices, returns, delisting returns, delisting reasons, shares outstanding and so on, from Compustat for firms' financial statistics like book value of equity, goodwill, etc., from French's data library for five factors, 5 industry categories and risk-free rate, from the Bureau of Labor Statistics website for Consumer price index. The depreciation parameters depreciation and accumulation to estimate intangible assets come from Li (2012) and Ewens, Peters, and Wang (2020). Information of firms' founding yeas are from Jay Ritter's website.

3.2 Variables Calculation

The way I construct the book-to-market ratio is explained in detail in Bali, Engle, and Murray (2016). Book value is the total parent stockholders' equity (SEQ) adjusted by tax effects and the book value of preferred stocks. To be explicit, we take the sum of the parent stockholders' equity (SEQ), deferred taxes (TXDB), investment tax credit (ITCB) and then subtract the book value of preferred stocks. All the variables mentioned are recorded in CPSP from 1961. Market capitalization is the absolute value of the product of alternate price (ALTPRC) and the number of shares outstanding (SHROUT) divided by 1000 to make it in $ millions. Size of the stocks is just taking the logarithm of market capitalization. These variables come from the monthly stock file in CRSP. The market value of equity is calculated in the same way except that we only use data on the last trading day in December of a given year. The tricky part here is how to align annual records of book equity with market value of equity. The BM for stock i from June of year y to May of year y+1 is taken be the book value ending in year y-1 over the market value in December of year t-1. We do this to make sure all the statistics we use when forming our portfolios are actually available to us as firms usually fail to report the required data in time.

In the accounting standards, the conservatism principle prevents the internal generated intangible capital from being recorded in the balance sheets. For example, the R&D expenses will be viewed as expenses rather than capital, though some of the expenses will actually turn into technological accumulation and work as parts of the firm's total capital. Many scholars have argued the missing records of intangible assets lead to the bias of the book value, and a popular approach, perpetual inventory method, is applied to estimate the internally generated intangible assets (see Li (2012), Eisfeldt and Papanikolaou (2013), Li and Hall (2016), Peters and Taylor (2017), Park (2019), Eisfeldt, Kim, and Papanikolaou (2020), Ewens, Peters, and Wang (2020) for example). However, it differs from one to another when the parameters' choice and the selection of initial values are considered. In this paper, three ways of estimating internally generated intangible assets are used to compare with BM from Bali, Engle, and Murray (2016) which is formalized by Fama (hereafter, BM and BM^{FF} refer to the same ratio). They come from the method to estimate main or baseline internally generated intangible assets from Peters and Taylor (2017), Ewens, Peters, and Wang (2020) and Eisfeldt, Kim, and Papanikolaou (2020) respectively. The authors in their paper sometimes consider alternative ways to allow for situations where if goodwill should be included, if expenses on research and development should be separately adjusted, if other often applied parameters should be used, and they argue that their main results are robust to these variations. Given the length of this paper, only the ways to construct their main measure of internally generated intangible assets are used here. Though the detail of calculation is not recorded in this paper, I offer an overview for the differences to calculate internally generated intangible assets. Peters and Taylor (2017) and Ewens, Peters, and Wang (2020) use the sampling method to account for the initial value of intangible assets and accumulate organization (O_{it}) and knowledge capital (K_{it}) separately while using different set of parameters. Eisfeldt, Kim, and Papanikolaou (2020) on the other hand, initialize internally generated intangible assets as $SG\&A/0.3$ where $SG\&A$ is the first observation for selling and general administrative expenses when the firm first appears in Compustat, and they do not consider research and development expenses separately. I call the intangible adjusted book value of equity as $be^{Eisfeldt}$, be^{Peters} and be^{Ewens} respectively.
Beta is from the most well-known capital asset pricing model (CAPM): $E[R_{i,t}] = R_{f,t} + \beta_i(E[R_{m,t}] - R_{f,t})$. In practice, we just run the following regression at the last trading day of every month to get the monthly estimated beta for each stock:

$$r_{i,t} = \alpha_i + \beta_i MKT_t + \varepsilon_{i,t}$$

where $r_{i,t}$ is the excess return for stock i during period t, MKT_t is the Fama-French market excess return (market factor). Notice that in this paper, previous one-year daily data, with minimum of 200 days non-missing values are required to the do estimation.

The following equations basically summarize the variables mentioned except beta.

$$BE = BE^{FF} = SEQ + TXDB + ITCB - BVPS$$
$$Int_{it}^{Eisfeldt} = 0.8 \times Int_{i,t-1}^{Eisfeldt} + SG\&A$$
$$Int_{it}^{Peters} = [(1 - \delta_{Li,2012})G_{i,t-1} + R\&D] + [0.8 \times O_{i,t-1} + 0.3 \times SG\&A_{xrddeducted}]$$
$$Int_{it}^{Ewens} = [(1 - \delta_{Ewens})G_{i,t-1} + R\&D] + [0.8 \times O_{i,t-1} + \gamma_{Ewens} \times SG\&A_{xrddeducted}]$$
$$BE^{Eisfeldt} = BE^{FF} + Int^{Eisfeldt} - GDWL$$
$$BE^{Peters} = BE + Int^{Peters}$$
$$BE^{Ewens} = BE + Int^{Ewens}$$
$$ME = \frac{|ALTPRC_{Dec.} \times SHROUT_{Dec.}|}{1000}$$
$$BM = BM^{FF} = \frac{BE}{ME}; BM^{Eisfeldt} = \frac{BE^{Eisfeldt}}{ME}; BM^{Peters} = \frac{BE^{Peters}}{ME}; BM^{Ewens} = \frac{BE^{Ewens}}{ME}$$
$$IM^{Eisfeldt} = \frac{Int^{Eisfeldt}}{ME}; IM^{Peters} = \frac{Int^{Peters}}{ME}; IM^{Ewens} = \frac{Int^{Ewens}}{ME}$$
$$size = log(\frac{|ALTPRC \times SHROUT|}{1000})$$
$$r_{i,t} = \alpha_i + \beta_i MKT_t + \varepsilon_{i,t}$$

3.3 Methodology

3.3.1 Portfolios analysis

Portfolio analysis is a standard technique usually leveraged in the empirical asset pricing to check the future return predictability. It has the advantages of nonparametric regression and diversification away the idiosyncratic risk. It does not require any assumptions in parameter distribution, regression form, etc. By taking averages of stock returns within each portfolio, it enables us to ignore the idiosyncratic risk which is the risk associated with a specific stock. However, it also has a downside of running out of degrees of freedom rapidly. To explain what it means, assume that there are 10000 stocks in total. If we use univariate analysis and divide stocks into 10 portfolios, then under each portfolio there will be 1000 stocks. But if now we care about two characteristics and do the bivariate portfolio analysis, divide stocks into 10 groups with each characteristic, then it results in $10^2 = 100$ portfolios with only 100 stocks in each portfolio. The number of stocks in one portfolio decreases dramatically from 1000 to 100, which gives rise to the problem of freedom and the conclusion obtained using much fewer stocks is not reliable. Things are even worse when we are interested in three or more characteristics.

How do we do the analysis? In univariate analysis, for each period, stocks are sorted by one of the characteristics from low to high, say in this paper, the book-to-market ratio as the characteristic, and then stocks are divided into different groups by the sorting order to form portfolios. In independent bivariate analysis, stocks are ranked independently by two characteristics and then divided into groups.

To assign stocks into groups, we first need to decide how many groups, i.e. portfolios we would like to generate. Usually, it is 10 for univariate analysis and 5×5 groups in bivariate analysis. Next, we need to calculate the breakpoints, i.e. the percentiles of the characteristics, and distribute the stocks. In independent bivariate analysis, for example, we calculate the 20th, 40th, 60th, 80th percentiles using full sample, or using only NYSE stocks, of the two characteristics denoted by X_1 and X_2. A stock i is divided into the first group of X_1 and the second group of X_2, group $P_{1,2}$ if its X_1 is smaller or equal to the 20th percentile of X_1 and its X_2 is between 20th and 40th percentiles (20th and 40th percentiles included) of X_2. Following this procedure until we get all the 5×5 groups.

Within each group, the average value of the one-month-ahead excess return is calculated, either use equal-weighted method or value-weighted method. After obtaining the time-series excess returns for every portfolio, the time-series means are taken, and then we can compare the one-month-ahead excess returns across different portfolios.

3.3.2 Fama-Macbeth Regression

Fama and MacBeth (1973) propose another procedure, Fama-Macbeth regression, to examine the relation between future excess returns and stocks' characteristics. Unlike portfolio analysis which limits the number of variables in which we are interested, Fama-Macbeth allows controlling for more sets of variables. We first run cross-sectional regression at each time period t:
$r_{i,t+1} = \alpha_{0,t} + \alpha_{1,t} X1_{i,t} + \alpha_{2,t} X2_{i,t} + \alpha_{3,t} X3_{i,t} + ... + \epsilon_{i,t}$

Then, given the time-series of each estimated coefficients, adjusted R^2, number of observations, we just regress each of them on 1, with standard errors adjusted following Newey and West (1987) to get the final estimated coefficients.

Notice that the Fama-Macbeth coefficients can be explained as long-short portfolio returns. To see it, assume that we have only one independent variable, in each t, the following regression in run: $r_{i,t} = \alpha_{0,t} + \alpha_{1,t} X_{i,t-1} + \epsilon_{i,t}$, then we have

$$\hat{\alpha}_{1,t} = \frac{\sum_i (X_{i,t-1} - \bar{X}_{t-1})(r_{i,t} - \bar{r}_t)}{\sum_i (X_{i,t-1} - \bar{X}_{t-1})^2} = \frac{\sum_i (X_{i,t-1} - \bar{X}_{t-1}) r_{i,t}}{\sum_i \left(X_{i,t-1} - \bar{X}_{t-1}\right) X_{i,t-1}}$$

We can write $\hat{\alpha}_{1,t} = \sum_i w_{i,t}^{\alpha} r_{i,t}$, where

$$w_{i,t}^{\alpha} = \frac{\left(X_{i,t-1} - \bar{X}_{t-1}\right)}{\sum_i \left(X_{i,t-1} - \bar{X}_{t-1}\right) X_{i,t-1}}$$

It is obvious that $\sum_i w_{i,t}^{\alpha} = 0$ which implies that $\hat{\alpha}_{1,t}$ represents an zero-investment portfolio return by long in stocks with above average characteristic $X_{i,t-1}$ and short in stocks with below average characteristic $X_{i,t-1}$.

3.3.3 Spanning test

Spanning test, also known as mean-variance efficiency test, is a time-series regression series regression proposed by Gibbons, Ross, and Shanken (1989) and Huberman and Kandel (1987) and extended by Kan and Zhou (2012), Gungor and Luger (2015) etc. The regression is as following:

$$r_t = \alpha + \beta r_{k,t} + \varepsilon_t$$

We are interested in the relation between the mean-variance frontier spanned by original K benchmark factors and the frontier spanned by K assets plus the tested asset on the left-hand side of the regression. If the regression produces a significantly positive intercept, it means adding the tested asset into original assets could expand the mean-variance frontier and thus improve the highest Sharpe ratio the investor could achieve. See more details in Gibbons, Ross, and Shanken (1989), Kan and Zhou (2012) and Gungor and Luger (2016).

4 Replication and extension using later sample period

The appendix presents tables I replicated from Chapter 10: the value premium in Bali, Engle, and Murray (2016). These numbers are quite similar to those in the book with moderate differences due to several reasons.

First, observe that in the summary table A.1, the maximum of BM is 18.64 which exhibits a significant discrepancy in the magnitude with 32.92 in the book. The reason for it is that I take a different manner to deal with multiple stocks issued by the same firm. While most firms only issue one class share, some firms may choose to issue more classes even we have confined the stocks to be common stocks. Besides, firms are also allowed to be listed in more than one exchange. Bali, Engle, and Murray (2016) calculate BM at the stock level while what I do, following another most often used method, is to sum all the market capitalization of stocks belonging to the same firm, make it the market capitalization of the stock with the largest market value and calculate BM at the firm level, leading to smaller values for this ratio. This approach, from my point of view, is more reasonable as the book value of equity is at the firm level and certain stocks for the same firm present quite a small market capitalization which causes some BM to be extreme values (while the 95 percentile of BM is around 2.3, BM at stock level presents extreme BM more than 100). Table A.2 delivers almost the identical numbers as Bali, Engle, and Murray (2016) once stock level is applied. Another reason for the huge difference for the maximum statistics is that it takes an average for only 49 or 50 values and therefore is susceptible to extreme values. Why is that? Because though BM is filled to monthly frequency but it is actually at a yearly frequency as implied by its calculation.

Nevertheless, the divergence should not affect other results significantly in principle, otherwise, it will at least imply the non-robustness of the value premium. The similarity in numbers or patterns between my replication results and the results in Bali, Engle, and Murray (2016) confirms this argument.

Second, Bali, Engle, and Murray (2016) take an additional approach, using the CUSIP to merge Compustat and CRSP data besides the approach using CRSP/Compustat link table while I only leverage the link table as CUSIP changes over time and is not credible. This explains the smaller value of the average number of stocks in table A.2 compared with 3409 in the book.

Third, as explained above, treating BM at the firm level has another side effect: only one stock with the largest market capitalization among other stocks belonging to the same firm is kept, giving rise to the vanishment of returns for those stocks deleted.

Fourth, negligible differences also exist for β and Market capitalization. So, when we do bivariate portfolio sorting using these additional variables, with each group consisting of only a small portion of stocks in the market (around the whole number of stocks divided by 25), the divergence accumulates. As we can see from the comparison between my replication results and those in Bali, Engle, and Murray (2016), the univariate sorting shows more similarity than bivariate sorting does.

We regard the arguments above reasonable and the replication results acceptable. Based on that, I then do the same analyses using the later sample period, i.e. from 1980 to 2019, to check if the stock market still exhibits value premium and how its magnitude has changed. Table 1 to table 8 display these results. The summary table, table 1 shows that the mean BM ratio in the later sample is 0.81, a little bit smaller than 0.90 for the period 1964 to 2012. While most statistics for BM are smaller, its maximal value and kurtosis become larger, indicating the distribution of BM ratio in later sample period is more subtle to extreme values. If we look at book value and market value separately and compare them with those in table A.1, we could figure that the decline in most statistics of BM ratio is caused by the disproportional variation of these two values: book values' mean, 95th percentile and maximum increase around one fifth, while market capitalization's statistics almost doubled except its skewness ad kurtosis. The cross-sectional correlation of BM ratio with β and size keeps analogous and the time series persistence of BM ratio declines only a little as we can see by comparing table 2, table 3 with table A.3 and table A.4.

After an overview of relevant statistics about BM ratio, what we care more about is the value premium associated. Table 4 displays the univariate portfolio analysis of BM ratio and future stock returns. Panel A presents the results using BM decile breakpoints calculated using all stocks in the three exchange markets while only a subset of stocks listed in NYSE stock market is used to calculate the decile breakpoints in panel B. Again, compared with tables generated by the sample period from 1963 to 2012, the BM ratio's magnitude only declines a little for each portfolio but market capitalization doubled. β for each portfolio shows minor changes compared with replication results. The negative relation between BM and size, between BM and β obtained in table 2 accords with this. From portfolio 1 to 10, as BM ratio increases, the market capitalization and β decrease. Within each group, the percentage of stocks listed in NYSE market decreases regardless of which method is applied to calculate breakpoints. For example, in portfolio 1, the percentage of stock numbers listed in NYSE for the sample period 1963 to 2012 is 28.55%, 31.29% separately, while it is now 17.58% and 21.36% for the later sample period. This indicates that the number of stocks issued in another two markets, AMEX and NASDAQ increases.

The general positive relation between BM ratio and future stock returns still holds for equal weighted portfolios, from excess return 0.01 for portfolio 1 to 1.3 for portfolio 10 in panel A and from 0.2 to 1.2 in panel B. Even we use CAPM to adjust the excess returns, this positive relation is still true as we can see from the increase of CAPM α for equal weighted portfolio. However, value-weighted portfolios, which is the focus as it is more indicative about the returns an investor can achieve by following the portfolio strategy, tells a different story. Though in Bali, Engle, and Murray (2016), the value-weighted portfolio delivers a substantial reduction in the average excess return and CAPM alpha for portfolios, especially the long-short portfolio, the positive relation between BM and future stock returns is strong and statistically significant. However, in the later sample period, we can see from the table that, excess return and CAPM α fail to exhibit monotonic increase. The long-short portfolio (10-1 column in the table) is not only smaller but also not significant any more. This suggests a weaker performance of value strategy in more recent time. Bivariate sorting results basically agrees with this indication.

Table 8 gives Fama-Macbeth regression results. When only BM ratio or its log form is used as the independent variable, its associated coefficients are 0.37, 0.40 respectively with R^2 near 0 and 0.01, which are smaller compared with 0.48, 0.44 with R^2 near 0.01 and 0.01. When β and size are also included as independent variables, the coefficients associated with BM ratio or its log form are also significantly positive. The predictive power of BM for future stock returns still exists in general for the universe of all stocks. But as we can see from the table, its R^2 is so small as stock level returns contain too much noise.

As said in the literature review part, the HML factor constructed using BM ratio after controlling for the size effect experiences a large and long drawdown over the last two decades. Our results above suggest it if not show it apparently. The deteriorating performance of value strategy, however, can be seen clearly from the cumulative returns and its associated drawdown in figure 1 and figure 2. In the later sample period covering 1980 to 2019, the cumulative returns of the HML factor exhibit several huge drops and this drop becomes more frequent and significant from 2007. Another drop that calls for our attention is the one starting between 1998 and 1999. It is one of the reasons why I divide the sample period into pre and post 1999 in later analysis. Another reason is that, coinciding with the big drop of cumulative returns, the number of stocks listed in the three major exchange markets reaches the highest in November 1997 and decreases ever since.

What causes value premium to crumble? One possible explanation is that the current accounting principle prevents us from recording and calculating book value precisely as internally generated intangible assets like human capital, research and development costs which usually brings potential future earnings and which shall also be considered to be part of firms' assets, are actually recorded as costs or expenses which in contrast, decreases firms' assets and hence book value of equity. The accounting principle of conservatism requires firms to prepare their accounting report with caution and high degrees of verification. Therefore, for research and development expenses that may bring large revenues in the future, firms cannot confirm the gains associated due to its uncertainty until the gains are fully realized. This principle has its own pros and cons which are not the concern of this paper, but its effects on the mismeasurement of BM ratio become evident in recent decades. While traditional firms mainly rely on plant, property and equipment as their main assets, more and more firms like Amazon, Alibaba, Facebook, Apple, Dell and other technology or e-commerce firms nowadays take intangible assets as their crucial assets. Therefore, some researchers propose to estimate internally generated intangible assets and adjust the book value accordingly. The following section considers three alternative measures of intangible assets, calculates corresponding book-to-market ratio and compares them with the original BM ratio defined by Fama and French (1993).

5 Comparison between four versions of book-to-market ratio

The construction of these four versions of the book-to-market ratio has been explained in detail in variables calculation. In this part, we focus on the comparison between them and check if one version outperforms another in several aspects such as if its long-short portfolio premium beats others, if it predicts future stock returns better.

Table 9 displays the summary statistics from 1976 to 2019. By construction, as we add missing internally generated intangible assets to book value of equity, $bm^{Eisfeldt}$, bm^{Peters} and bm^{Ewebs} are all large than the original defined BM bm^{FF}. Meanwhile, they are also more volatile and have larger kurtosis. The average monthly count of stocks is also larger. When bm^{FF} is non-positive and deleted from analyses, the other three versions of the book-to-market ratio could be positive and kept in the sample. The extremely large average monthly maximum of $bm^{Eisfeldt}$, 144.44, is caused by the reason explained. When the stock's book value of equity is negative, its market value falls to the bottom as the market price decreases a lot. While this stock with negative bm^{FF} will not be considered anymore when forming portfolios and will be deleted from the sample when we use bm^{FF}, it gets a chance to exhibit a large book-to-market ratio once its estimated intangible assets value is large enough to generate a large 'book' value of equity and therefore is kept for further analyses. From the table, we see that the average monthly statistics of $bm^{Eisfeldt}$ are the largest with most percentiles nearly doubled than bm^{FF}. However, it is the most volatile and vulnerable to more extreme values. Though table 9 presents a basic overview of average statistics of book-to-market ratio, it hides the time series evolution of the ratio. Figure 3 to figure 4 fill this gap. Consistent with table 9, all ratios are positively skewed. Though sometimes volatile, the mean of cross-sectional book-to-market ratio is smaller in the later sample period. $bm^{Eisfeldt}$ has more number of stocks with the book-to-market ratio larger than 3.

The correlation between these four versions of the book-to-market ratio is presented in table 10. The Spearman rank correlation is presented in the above diagonal entries while Pearson product-moment correlation is below-diagonal entries. As we see from the table, these four versions of the book-to-market ratio are highly positively correlated, leading it hard to distinguish the effect of one and the other when they are included as independent variables at the same time. Spearman rank correlation is overall larger than Pearson product-moment correlation but it is not too large to conclude a monotonic but non-linear relation between the variables. Bm^{Ewens} is most closely related to bm^{Peters} which is not surprising as the only change in these two versions is the variation of parameters we use when estimating intangible assets. The Spearman correlation between bm^{Peters} and bm^{Ewens} is 0.99, indicating the results of portfolio sorting would be nearly identical for these two variables. Table 11 demonstrate the time persistence, i.e. the time series correlation for different book-to-market ratios. $Bm^{Eisfeldt}$ is the most persistent one. Its ratio exhibits an average correlation to the ratio one year later ($\tau = 12$) of 0.816, larger than 0.762 for bm^{FF}, 0.769 for bm^{Peters} and 0.761 for bm^{Ewens}. For longer lags of months, the persistence of $bm^{Eisfeldt}$ is also stronger than others. At five years lag, the correlation for $bm^{Eisfeldt}$, 0.490, remains sizable. This phenomenon suggests two directions of reasoning. The fact that all versions of the book-to-market ratio are rather persistent suggests the value premium be due to the book-to-market ratio representing risk factor sensitivities. The logic behind it is that if the value premium is caused by mispricing, the market should correct it and thus the time-series correlation shall either be small or even negative. Another deduction from the more persistent behavior of $bm^{Eisfeldt}$ than others is that we could potentially benefit from using $bm^{Eisfeldt}$ as the definition of book-to-market ratio if mispricing tells the story of value premium as the correction for $bm^{Eisfeldt}$ is slower than others.

The univariate sorting portfolio analyses are shown in table 12. Consistent with the previous discussion, the value-weighted excess return for bm^{Peters} and bm^{Ewens} is close to each other for every portfolio. Using the sample period from 1976 to 2019, only the long-short portfolio constructed using $bm^{Eisfeldt}$ is significantly positive. The univariate portfolio analysis for bm^{FF} corresponds to our extension results using the sample period from 1980 to 2019. The adjustment for the book value of equity using estimation of intangible assets proposed by Peters and Taylor (2017) and Ewens, Peters, and Wang (2020) seems not to perform better, at least for the whole sample period we look into.

Table 13 displays results of Fama-Macbeth regression. The coefficient for logbm^{Ewens} is 0.39 with t statistic of 6.12, the largest and the most significant among 0.27 for logbm^{FF}, 0.26 for logbmEisfeldt, 0.38 for logbm^{Peters}. When all the four book-to-market ratios are included to be independent variables, it is again logbm^{Ewens} that delivers the most significant coefficients. We do not care too much about R^2 here because stock level regression contains too much noise and is susceptible to extreme values. As Park (2019) argues that intangible adjusted book-to-market ratio outperforms book-to-market ratio since the coefficients associated with the intangible adjusted book-to-market ratio is larger and more significant. Table 13 shows us bm^{Peters} and bm^{Ewens} outperform bm^{FF} (0.38, 0.39 v.s. 0.27) while the coefficient for log$bm^{Eisfeldt}$ is 0.26, similar to 0.27 for bm^{FF}. It is confounding with the results in 12. To delve more into that, we organize sub-sample analyses in the later section.

Figure 7 and figure 8 draw the cumulative returns and drawdowns of four HML factors respectively. The HML factor formed by $bm^{Eisfeldt}$ generates higher cumulative returns than others at any time point. The cumulative returns of HML^{Peters} and HML^{Ewens} are similar to each other, both perform better than HML^{FF}. Yet the intangible adjusted HML factors fail to avoid losses in the recent decade as we see their cumulative returns decline in general from 2014 or so. The figure 8 displays the losses more clearly. The intangible adjusted HML factors usually present smaller drawdowns than traditionally defined HML^{FF}. In more recent decades, $HML^{Eisfeldt}$'s drawdown is usually the smallest one but all of them experience persistent and even increasing drawdown, which is why we say value strategy deteriorates.

Table 14 presents the spanning tests of HML factors constructed. The dependent variable in column 1 to 4 is HML^{FF}, $HML^{Eisfeldt}$, HML^{Peters} and HML^{Ewens} respectively. Numbers in parentheses are p-values associated. As explained in the methodology part, a significant positive intercept implies that adding the tested assets into original assets can expand the mean-variance frontier and thus improve the highest Sharpe ratio the investor can obtain. Regretfully, none of the intercepts, -0.1, 0.04, 0.04, 0.06 are significant. The non-significant intercept for the HML factor is expected as Fama and French (2015) argue that the HML factor becomes redundant in the five-factor model and that its average return is captured by its exposure to RMW and CMA. However, the usage of intangible assets to adjust the book value of equity also cannot deliver a more serviceable HML factor, which means that it is infeasible to increase the power of four factors (market factor, SMB, RMW, CMA) to explain the average returns by adding HML factor. But the redundancy of HML factors does not mean in any sense that the value premium disappears. The value premium emphasizes the positive relation between the book-to-market ratio and stock returns. As long as the positive relation still holds, investors can expect benefits by applying the value strategy. To summarize, we have the following observations: (1) $bm^{Eisfeldt}$ makes the book-to-market ratio the largest among others, (2) $bm^{Eisfeldt}$ delivers higher long-short premium in univariate sorting, brings the highest cumulative return and lower drawdowns in most of the time, (3) None of the intangible adjusted HML factors can expand the mean-variance frontier, (4) the intangible adjustments do generate higher cumulative returns but they still experience persistent drawdowns in the recent decade.

6 Sub-sample analyses

To delve into the book-to-market ratio more closely, we conduct sub-sample analyses. The first sub-sample analysis is to explore the time dimension as the sample is divided by period, either it is before 1999 or post 1999. The second sub-sample analysis is to explore the cross-sectional dimension as the sample is divided by characteristic, either it is a high-tech firm or not.

6.1 Pre and post 1999

The motivation for dividing the sample period to before or after 1999 is based on the stock market fact that the number of listed firms reaches the peak in 1997 and decreases rapidly afterward and that the publicly listed firms are larger and older on average. Kahle and Stulz (2017) and Davydiuka, Glovera, and Szymanskia (2020) document in detail the empirical evolution of public firms. While their interest is to portray the features of the stock market and explore the mechanism behind it, we try to check if the value strategy exhibits a structural change.

The figure 9 displays the time series of listed firms in NYSE, NASDAQ and AMEX exchanges. The first two sharp jumps are due to the inclusion of AMEX stocks in July 1962 and NASDAQ in December 1972. After that, the listed number of firms peaks and downs but with the tendency of increasing, it reaches the peak in November 1997 with 7376 firms. Ever since that, the market has seen a dramatic drop in the number of listed firms and it steadies at around 3600 firms in the recent decade. The average market capitalization, on the other hand, increases significantly and displays more volatility since November 1997. Comparing the average market capitalization with the average value after deleting the largest 20 firms, we can see the gap between the two lines is expanding, indicating the largest 20 firms' market value still growing.

Table 15 shows the summary statistics of book-to-market ratio and market value of equity from 1976 to 2019 divided by the year 1999. The reason we use 1999 instead of 1998 is that the peak appears at the end of 1997 and the one-year lag is to ensure the public availability of book value of equity information. The mean of bm^{FF} is 0.95 in the pre-1999 sample period and 0.76 for the later sample period. While its percentiles decrease in general, bm^{FF} now is more skewed and its kurtosis is larger. The smaller percentiles of the book-to-market ratio is a common phenomenon across all versions. While bm^{FF} and bm^{Peters} have larger kurtosis after 1999, $bm^{Eisfeldt}$ and bm^{Ewens} post 1999 exhibit smaller kurtosis. The market value of equity, which is the market capitalization in December, is around 8 times larger in post 1999 period than before. Combining with the overall decrease in book-to-market ratio, it implies that the book value of equity is also increasing, but not as rapidly as the market value does. Table 16 and table 17 displays the cross-sectional correlation between versions of book-to-market ratio and the time-series correlation within each ratio. The correlation decreases by a small magnitude in the later sample period.

The results of univariate portfolio analysis are presented in table 18. From panel A, we can see that the positive relation between book-to-market ratio and future stock returns holds in a general way but is not monotonic. The long-short portfolio delivers significant positive values, confirming the existence of value premium. The intangible adjusted book-to-market ratio all produces a larger long-short return than bm^{FF} does. In panel B, things change dramatically. The positive relationship is much weaker in the later sample period. Though the return of portfolio one (with the lowest book-to-market ratio) is usually the smallest, the highest return shows in portfolios 6, 6, 7, 7 respectively which are usually discarded when forming HML factor. The long-short return is not significantly different from 0 anymore. Comparing A with B, we have several observations remarkable. First, the value-weighted excess returns for every portfolio all decrease. Take bm^{FF} for example, the excess return for portfolio 1 is 0.7 pre-1999 v.s. 0.49 post-1999, excess returns for other portfolios are 0.69 v.s. 0.54, 0.81 v.s. 0.53, 0.85 v.s. 0.52, 0.86 v.s. 0.52, 0.78 v.s. 0.55, 0.90 v.s. 0.49, 0.85 v.s. 0.49, 0.91 v.s. 0.55, 0.92 v.s. 0.51 respectively. Second, the excess returns for the portfolio are more significant in the earlier sample period. Third, the value premium delivered by the long-short portfolio is small and not significant post 1999.

Table 19 says that if we use bm^{FF} as the book-to-market ratio, its predictive power for future stock returns fades. Before 1999, the coefficient of logbm^{FF} is 0.41 with the t value of 5.02. However, after 1999, the coefficient is not only much smaller but also not significant (0.12 with t value 1.23 associated). The reduction of coefficients of book-to-market ratio in both the magnitude and t values associated is also present for intangible adjusted ratios. Yet the intangible adjusted book-to-market ratios still have certain predictive power for future returns at the stock level post 1999. Table 20 shows the results of spanning tests. To our surprise, it is the HML factor constructed by bm^{FF} that can expand the efficient frontier spanned by the other four factors in both sub-sample period while among the intangible adjusted HML factors, bm^{Peters} and bm^{Ewens} can deliver value factors which have significant and positive intercepts, but only before 19999. Comparing pre- and post- 1999 panels, we see that RMW, CMA and market factors exhibit positive relation with HML factor in the later sample period while some of them are either negatively related to or have no relation to HML factor.

Overall, what we can take from this sub-sample analyses is that: (1) the book-to-market ratio decreases in recent decades as the book value is not increasing as rapidly as the market value does, (2) the value-weighted excess returns for each portfolio formed by sorting book-to-market ratio are all smaller post-1999 than those pre-1999, (3) the positive relation between book-to-market ratio and future stock returns is much weaker after 1999, even when intangible assets are included to adjust the book value of equity, (4) HML factors in recent decades shows a more positive relation with the other factors but the intangible adjusted ones still fail to expand the efficient frontier spanned by the other factors, (5) there is no generally better intangible adjusted version as $bm^{Eisfeldt}$ outperforms others in univariate sorting, bm^{Ewens} and bm^{Peters} work similarly in Fama Macbeth regression and spanning tests.

6.2 High tech industry and traditional industry

If the death of value strategy is indeed caused by the mismeasurement of the book value of equity, it is reasonable to deduce that the adjustment of intangible assets will restore the problem for firms that are technology-intensive or brain-intensive and spend more portions of total assets in research and development. For the firms belonging to the more traditional industries like manufacturing, mines, construction, and alike, even they may also rely more on intangible assets nowadays, the improvement of value strategy brought by adjusting intangible assets is expected to be much less significant compared with technology or brain intensive industries. Therefore, this sub-sample analysis is cross-sectional division induced by industry and works as an examination for the reasoning of intangible adjustments.

The first question here is how to divide firms into the high tech industry and the traditional industry. Based on the five industries classified by Fama, Ewens, Peters, and Wang (2020) revise it by moving $sic >= 8000 \& sic <= 8099$ that are originally classified into health care, medical equipment and drugs into industry5 referring to other–mines, construction, construction materials, etc, and moving some "high-tech" TV/radio providers into the consumer sector. We use the five industries as Ewens, Peters, and Wang (2020). Intuitively, among those five industry classes, we expect high tech industry involving computer programming and data processing, computer integrated systems design and others, and health industry involving healthcare, medical equipment and drugs to be technology and brain intensive. Figure 10 and 11 support this thought. Compustat item 'ppegt' records the value of plant, property and equipment which are major physical assets for traditional industries. Figure 10 plots the average of how much a firm's physical assets (proxied by Compustat item 'ppegt') takes up in total assets (Compustat item 'at'). It is clear from the picture that 'Manuf' and 'Cnsmr' industries have more portion of assets as their physical assets and this portion is either stable or even increasing in the past years. Industries 'HiTec', 'Hlth' and 'Other', on the other hand, not only have a smaller portion of physical assets but also see this portion decreasing over time. Figure 11 displays the average of how much expenses on research and development accounting for total assets. The portion for industry 'Cnsmr', 'Manuf' and 'Other' is less than 2.5% while it is increasing for 'HiTec' and 'Hlth' sectors. Combining the two plots together, it is reasonable to include 'HiTec' and 'Hlth' sectors into the high tech industry and others into the traditional industry. Figure 12 plots the average portion of intangible assets (both externally obtained and internally generated if estimated) over the intangible adjusted total assets for four versions. As we can see, the portion of intangible assets for the high tech industry is higher than the traditional industry. The highest ratio in the FF version for the high tech is the minimum ratio in other versions for high tech industry. Besides, two more phenomena are notable here. First, in the first subplot with title FF, the portions of (mainly externally obtained) intangible assets over total assets in both sectors are close to each other until around the year 2000 since which the high tech sector firms' start to have far more intangible assets. Second, the intangible assets are forming a greater part of total assets except we use the version of intangible assets estimated by Eisfeldt which does not accumulate knowledge and organization capital separately but directly accumulates Compustat item $sg\&a$ which in most times also includes expenses on research.

After classifying firms into two categories, we do similar analyses and check how the adjustment of intangibles differs and how the value premium within the two sectors differs from each other. The basic summary statistics are shown in table 21. Across panels, the average number of firms belonging to the traditional sector is more than double that of firms in the high tech sector. While the average and maximal market value of equity for both sectors are similar in magnitude, the 5th, 25th, 50th, 75th and 95th percentiles of ME for high tech firms are all smaller than those in panel B, implying the existence of a small number of giant high tech conglomerates taking up the majority of market value. Whichever version of book-to-market ratio we use, that ratio is larger in traditional sector than in high tech sector. Within each panel, for the high tech sector, the intangible adjusted book-to-market ratios are in general twice or more than twice as large as bm^{FF} while for the traditional sector, the intangible adjusted ratios are in general 1.5 times or more than 1.5 times as large as bm^{FF}. Table 22 shows that no significant differences in the correlation between versions of book-to-market ratio are exhibit comparing panel A and panel B. From table 23 we can see that the traditional sector features a more persistent book-to-market ratio.

Table 24 displays the univariate portfolio analysis results. We can observe that some exceptions are present for the positive relation between ratios and future stock returns. Will it be caused by fewer number of stocks? Given that the traditional sector comprises more firms than the high tech sector does, yet the positive relation is challenged by more objections and that the long-short return is smaller, we tend to drop this argument. The excess returns for every portfolio in the high tech sector are larger than those in the traditional sector. The long-short returns are positive though sometimes not significant in the traditional sector. What are the outcomes of intangibles adjustment? For the high tech sector, the returns of long-short portfolio are similar in magnitude (0.42 v.s. 0.42 v.s 0.44 v.s. 0.41) across versions of book-to-market ratio but they are more significant (1.9 v.s. 2.44 v.s. 2.33 v.s. 0.41) when intangibles are used to adjust for book value of equity. For the traditional sector, $bm^{Eisfeldt}$ delivers larger and more significant long-short portfolio returns while bm^{Peters} and bm^{Ewens} do not perform better than bm^{FF}. Table 25 shows the Fama Macbeth regression results after controlling for β and size. As all coefficients associated with the book-to-market ratio are significantly positive, it confirms the existence of value premium at least for the whole sample period from 1976 to 2019. For both sectors, bm^{Peters} and bm^{Ewens} rather $bm^{Eisfeldt}$ have larger and more significant coefficients than bm^{FF} do. When four versions of ratios are included in the regression, it becomes hard to explain the results. Within the high tech sector, logbm^{Peters} and logbm^{Ewens} subsume logbm^{FF} and log$bm^{Eisfeldt}$ but for the two significant coefficients, their sign are opposite which may be caused by their high similarity (0.96 Pearson-product correlation). Within the traditional sector, on the other hand, the coefficients of all versions of the book-to-market ratio are not significant.

Figure 13, 14, 15, 16 plots the cumulative returns, drawdowns within the high tech sector and the traditional sector. Though the intangible adjusted HML factors generate much higher cumulative returns in both sectors, they sometimes generate larger drawdowns and in the recent decade, all HML factors experience persistent drawdowns. HML^{Peters} outperforms within the high tech sector while $HML^{Eisfeldt}$ outperforms within the traditional sector. While the distinct improvement brought by intangible adjustment started from around 1986 in the traditional sector, it started 10 years later for HML^{Peters} in the high tech sector and started only around 2001 for the other two. The spanning tests are shown in table 26. The intercept in column (3) within the high tech sector is 0.29 with a p-value of 0.058. None of the other intercepts are significantly different from 0.

From the analyses of sub-sample for high tech and traditional sector, we have the following arguments: (1) the book-to-market ratios are higher, more volatile and more persistent in traditional sector than in high tech sector, (2) the high tech sector exhibits higher value-weighted returns for every portfolio formed by sorting book-to-market ratios and the traditional sector can hardly create significantly positive long-short premium, (3) intangible adjusted HML factors generates much higher cumulative returns in both sectors but also experience persistent drawdowns in recent decades, say the one from around 1989 for high tech sector, and the one from 2010 for traditional sector, (4) there is no generally better intangible adjusted version as $bm^{Eisfeldt}$ outperforms others in univariate sorting but only for traditional sector, bm^{Ewens} and bm^{Peters} work similarly in Fama Macbeth regression with coefficients larger and more significant than $bm^{Eisfeldt}$, only bm^{Peters} expand the mean-variance frontier in the spanning tests. While high tech sector favors bm^{Peters} in the sense of higher cumulative returns, the traditional sector favors $bm^{Eisfeldt}$.

7 Further analyses

7.1 The role of intangible assets

In previous sections, we observe that adjusting book value of equity with estimated intangible assets contributes to a higher cumulative return of HML factor and the resurgence of value strategy across time and across cross-section. However, it leads to the question that is the improvement effects totally caused by the positive relation between intangible capital and future stock returns as documented in Eisfeldt and Papanikolaou (2013)? To explore this possibility, I use the ratio of the intangible capital over the market value of equity (IM) to replace the book-to-market ratio.
Table 27 displays the Fama Macbeth regression results using independent variables shown in the first column. The significantly positive coefficients (0.19 for $IM^{Eisfeldt}$, 0.21 for IM^{Peters} and 0.22 for IM^{Ewens}) confirms the results in Eisfeldt and Papanikolaou (2013). Though these coefficients are smaller than 0.27, it does not imply fewer effects of intangible capital on one-month-ahead excess returns. Combined with the standard deviation of these ratios (0.885, 5.3, 1.756, 1.327) in summary statistics which are not listed in this paper, they indicate that a one standard deviation difference in BM or IM, is associated with an increase in expected stock returns of 0.236%, 1.01%, 0.35%, and 0.295% respectively. When all versions of ratios are contained in the specification (column (5)), the inclusion of bm^{FF} does not make all other coefficients redundant.
The HML factors are then constructed using IM ratios. The results of the spanning test are shown in table 28. The intercept for dependent variable $IHML^{Peters}$ and $IHML^{Ewens}$ are significantly, which means that they can expand the original mean-variance efficient frontier spanned by the other four factors. Besides, the explanatory power of the other four factors also declines for the IHML factors.

The cumulative returns and drawdowns are displayed in Figure 17, 18 separately. First, notice that the cumulative returns of IHML factors are even higher than intangible adjusted HML factors (2.23, 12.12, 14.12, 15.74 v.s. 2.23, 8.77, 5.72, 5.43 in figure7). Second, the IHML factors do not exhibit large drawdowns in recent decades as HML^{FF} and intangible adjusted HML factors do. The analyses above inspire us to use estimated intangible capital over market value instead of adjusting the book value (of mostly tangibles) over the market value.

7.2 Relative valuation

The cross-sectional sub-sample analysis in section 6.2 is prone to decline the story of mismeasurement of the book value. Arnott et al. (2020) propose another explanation for the value's underperformance–the valuations of value stocks relative to growth stocks have tumbled. They argue that the relative valuation for the value factor is at the lowest level in recent decades, i.e., the value factor is much cheaper, and the revaluation component is the largest contributor to value's underperformance. In this section, I examine this demonstration.

To construct the relative valuation, stocks are sorted into value (growth) portfolio each month if their IM or book-to-market ratios are higher than 70 percentile (lower than 30 percentile). Then, we calculate the sum of intangible capital or (intangible adjusted) book value over the sum of market capitalization for the two portfolios. The relative valuation is just the ratio of the growth portfolio over that of the value portfolio. It is smaller than 1 by construction and measures the relative market price for unit book value or intangible capital of value portfolio to growth portfolio. For example, the ratio of 0.25 implies that the price of unit book value or intangible capital of value portfolio is only $1/4$ of the price of growth portfolio.

Figure 19 plots the cumulative returns (left axis) and relative valuation (right axis) of HML factors specified in each subplot constructed using bm^{FF}, $bm^{Eisfeldt}$, bm^{Peters} and bm^{Ewens} from July 1976 to November 2019, while figure 20 portrays the those using IM ratios. The same pattern is observed across book-to-market or intangible capital over market value specifications. In the short run, the relative valuation moves together with the cumulative returns. In the long run, they diverge in figure 19. It is consistent with the results from Arnott et al. (2020) though we examine the relationship not only for bm^{FF} but also for all other variants of ratio (intangible adjusted, using only intangible capital).

Figure 19 explains why even HML factors constructed using the intangible adjusted book-to-market ratio still experience large drawdowns in recent decades, why the long-short premium post-1999 is smaller and why the positive relation between ratios and one-month ahead excess returns is weaker after 1999. The relative valuation is smaller compared with the early time period, and the relative valuation is almost at its lowest level in recent decades and continues to fall.

It means that the growth stocks are priced much more expensive than value stocks are compared with early days. We see the relative valuation fall from around 0.25 to around 0.1 in the first subplot. Those numbers translate to the fact that the growth stocks which were about 4 times more expensive than value stocks are now nearly 10 times more expensive than value stocks. Adding estimated intangible capital to the book value of equity only mitigates the pricing gap but does not work strong enough to avoid the large drawdowns in recent decades. The Rˆ2 shown in the picture is the adjusted R^2 from regression of annual returns in July (in log form) on the difference of log relative valuation between the current year and the previous year. The change in the relative valuation explains approximately half of the variance in excess returns.
IHML factors, on the other hand, exhibits stable relative valuation in recent decades. For IHML constructed using $Int^{Eisfeldt}/M$, the relative ratio is around 0.07 in recent decades, smaller than 0.1 from the earlier sample period. It is consistent with the worse performance and larger drawdowns of $IHML^{Eisfeldt}$ as shown in figure 18. The relative valuation for the other IHML factors is around 0.1 in the last 10 years, which is at its highest level. Associated with that, the cumulative returns keep increasing and delivers small drawdowns.
In summary, we see no additional benefits of using intangible capital to adjust book value. Instead, the ratio of IM on its own can give rise to a HML factor that features much higher cumulative returns and smaller drawdowns in recent decades. The performance of $IHML^{Peters}$ and $IHML^{Ewens}$ is better than $IHML^{Eisfeldt}$. The relative valuation explains the persistent and large drawdowns of HML^{FF} and other intangible adjusted HML factors. Given the fact that growth stocks are priced more expensive than value stocks are, if the mean reversion of pricing occurs in the future, the value strategy is expected to gain positive returns in the future.

8 Conclusion

The univariate portfolio sorting indicates the value premium is much weaker in the sample period from 1980 to 2019 than from 1963 to 2012. The HML factor constructed using BM experiences large and persistent drawdowns in recent decades, leading to the view of the death of value strategy. To restore the strategy, researchers propose to estimate the internally generated intangible assets which are missing in the accounting report and include them into the computation of book value. For the sample period from 1976 to 2019, all the three versions of intangible adjusted book-to-market ratio, $bm^{Eisfeldt}$, bm^{Peters} and bm^{Ewens} perform better than the traditional defined bm^{FF} in the sense that they deliver larger and more significant long-short premia, generate HML factors which bring much higher cumulative returns and smaller drawdowns. However, the long-short premium obtained using bm^{Peters} and bm^{Ewens} is hardly significantly different from 0. None of the intangible adjusted ratios can pass the spanning tests. They also suffer from persistent drawdowns in the recent two decades. For the comparison across three methods to estimate internally generated intangible assets, $bm^{Eisfeldt}$ outperforms the other two in general.

The sub-sample analysis of pre and post 1999 is conducted to explore if the sudden drop of listed firms causes a structural change in book-to-market ratio and the performance of the value strategy. We find that the average book-to-market ratio after 1999 is smaller than the earlier sample period as the book value of equity increases more slowly than the market value does. While the number of listed firms falls for around 15 years and keeps steady with around 3800 firms from 2013, the average market capitalization amplifies dramatically at the same time. Though the inclusion of estimated intangible assets improves the performance of value strategy, the positive relation between the book-to-market ratio and future stock returns is much weaker, and the average value-weighted long-short returns are not significantly different from 0 after 1999. It is the HML factor constructed using bm^{FF} that passes spanning tests in both sub-periods. As for the intangible adjusted factors, bm^{Peters} and bm^{Ewens} can span the mean-variance frontier but only before 1999. It is hard to compare among these four versions of ratios, as the long-short premium and cumulative returns of HML factor will favor $bm^{Eisfeldt}$ yet none of them beats bm^{FF} in spanning tests.

To investigate if the death of value strategy is caused by the conservative accounting biases in book value, we classify firms into the high tech sector which is more vulnerable to this bias and the traditional sector which is less vulnerable to the bias. While the statistics of book-to-market ratio and the univariate portfolio returns exhibit diversity, the improvement brought by adjusting intangibles in the performance of value strategy is significant in both sectors. Therefore, we tend to cast doubt on the story of mismeasurement of the book value.

Last but not least, instead of using intangible capital to adjust book value of equity, we leverage the estimated intangible capital separately to construct intangible capital over market value (IM) ratios. The positive relation between intangible capital and future stock returns is confirmed. More than that, we find that the IHML factors constructed using IM ratios generate much higher cumulative returns and smaller drawdowns in recent decades. Both $IHML^{Peters}$ and $IHML^{Ewens}$ expand the mean-variance frontier spanned by the other four factors. The relative valuation explains half of the variation in excess returns. The persistent and large drawdowns of HML factors are associated with the fact that growth stocks are priced more expensive than value stocks are.

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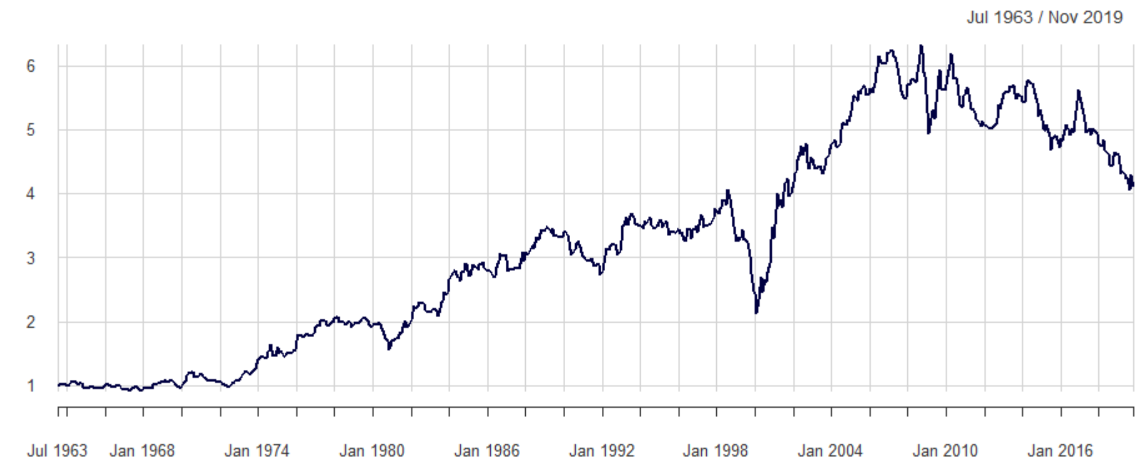

Figure 1. The cumulative returns of HML factor from 1963 to 2019
This figure plots the cumulative returns of HML factor constructed following Fama and French (1993) from July 1963 to November 2019.

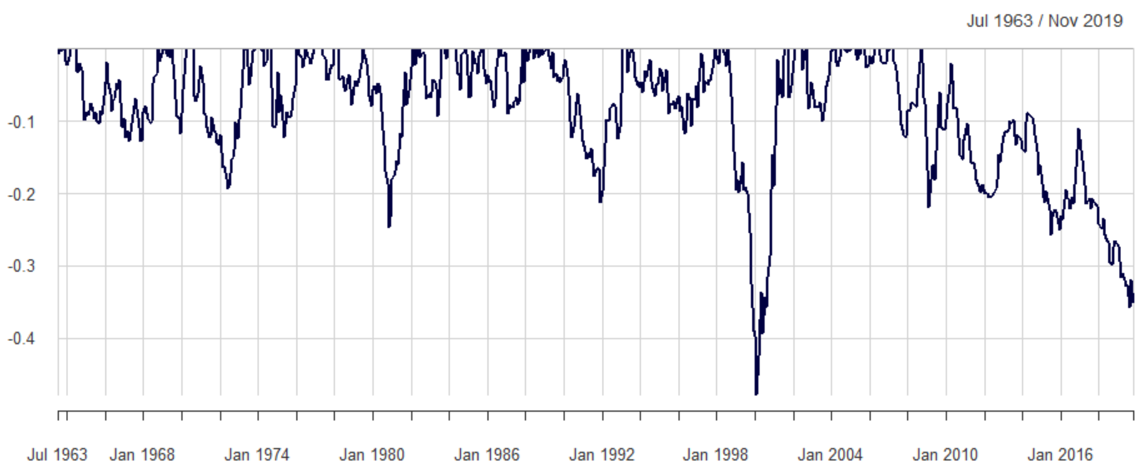

Figure 2. The drawdowns of HML factor from 1963 to 2019
This figure plots the drawdowns of HML factor constructed following Fama and French (1993) from July 1963 to November 2019.

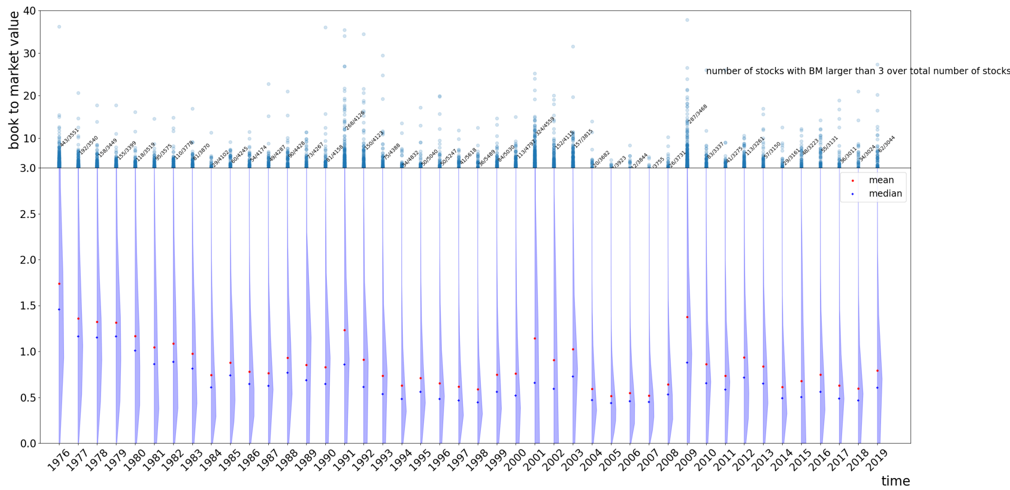

Figure 3. The time series of cross-sectional distribution of bm^{FF} from 1976 to 2019
This figure plots the time-series of annual 'distribution' of bm^{FF} from 1976 to 2019. Each year only data in June are used to draw the picture. The lower part is the distribution up to the value of 3 with red points indicating the means and blue points indicating the medians. The upper part draws the scatter with labels associated indicating the number of stocks with $BM > 3$ over the number of stocks in June.

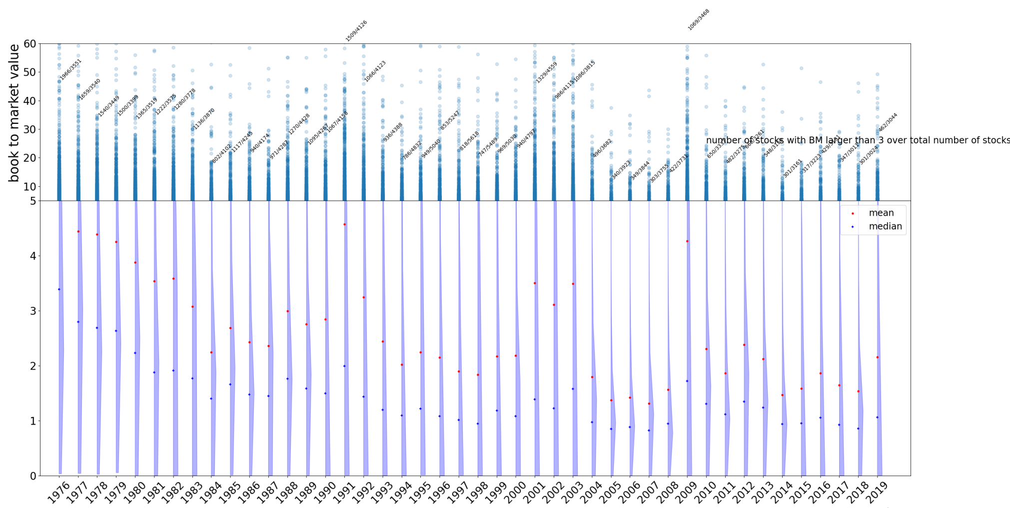

Figure 4. The time series of cross-sectional distribution of $bm^{Eisfeldt}$ from 1976 to 2019
This figure plots the time series of annual 'distribution' of $bm^{Eisfeldt}$ from 1976 to 2019. Each year only data in June are used to draw the picture. The lower part is the distribution up to the value of 5 with red points indicating the means and blue points indicating the medians. The upper part draws the scatter with labels associated indicating the number of stocks with $bm^{Eisfeldt} > 3$ over the number of stocks in June.

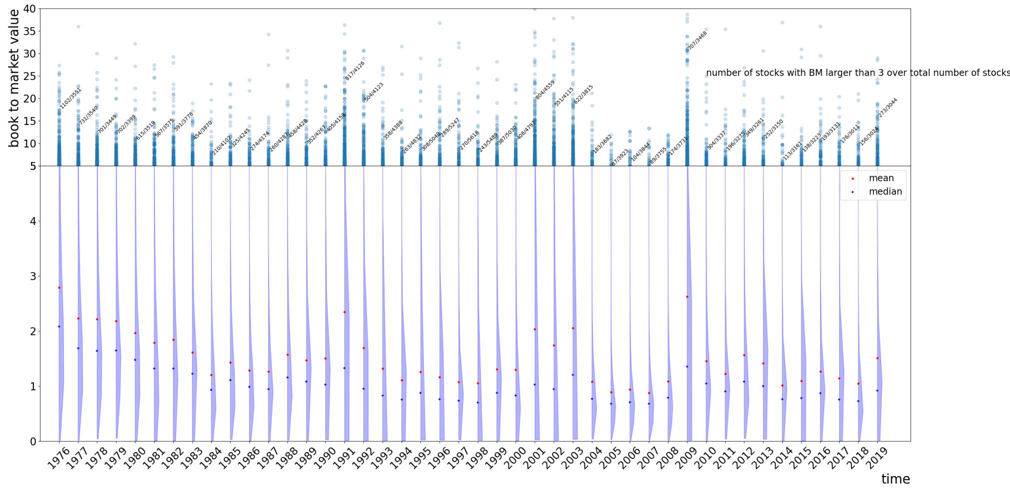

Figure 5. The time series of cross-sectional distribution of bm^{Peters} from 1976 to 2019
This figure plots the time series of annual 'distribution' of bm^{Peters} from 1976 to 2019. Each year only data in June are used to draw the picture. The lower part is the distribution up to the value of 5 with red points indicating the means and blue points indicating the medians. The upper part draws the scatter with labels associated indicating the number of stocks with $bm^{Peters} > 3$ over the number of stocks in June.

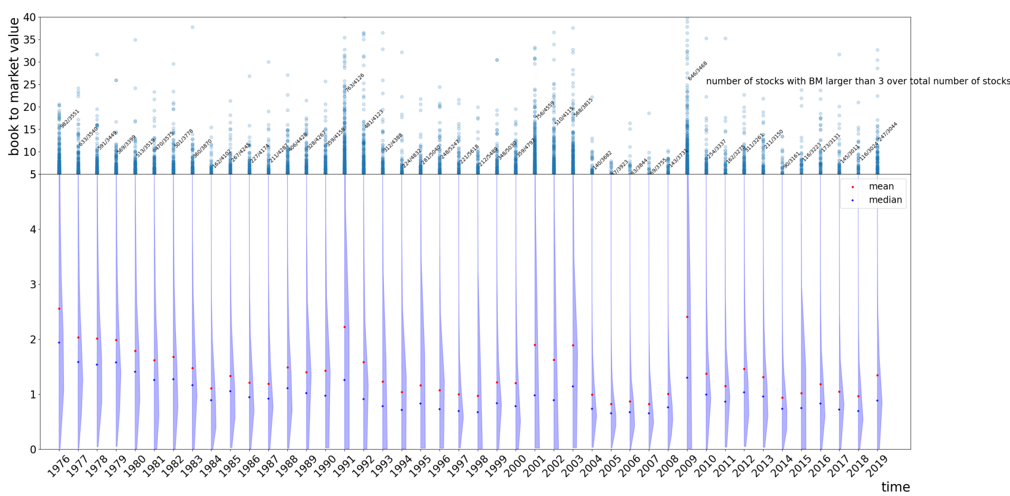

Figure 6. The time series of cross-sectional distribution of bm^{Ewens} from 1976 to 2019
This figure plots the time series of annual 'distribution' of bm^{Ewens} from 1976 to 2019. Each year only data in June are used to draw the picture. The lower part is the distribution up to the value of 5 with red points indicating the means and blue points indicating the medians. The upper part draws the scatter with labels associated indicating the number of stocks with $bm^{Ewens} > 3$ over the number of stocks in June.

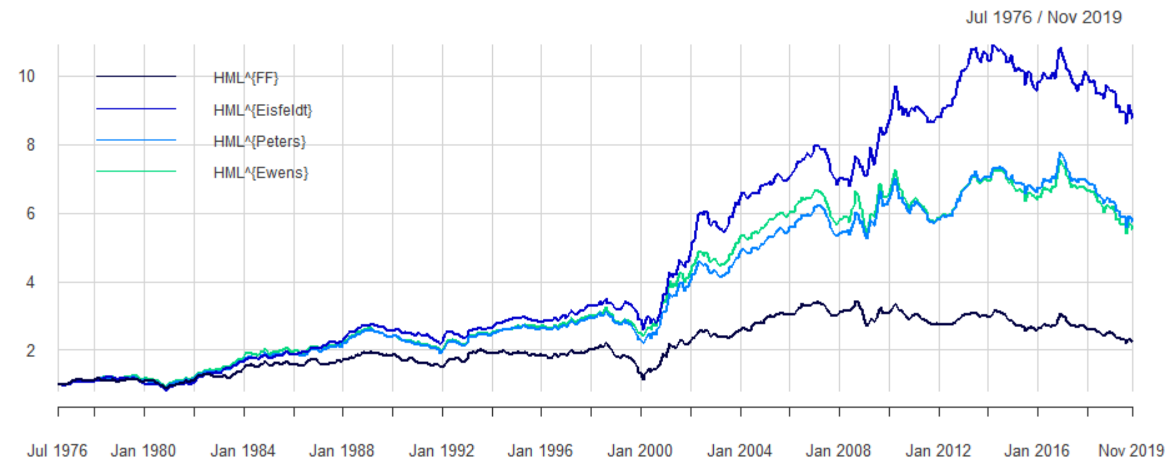

Figure 7. The cumulative returns of four HML factors from 1976 to 2019
This figure draws the cumulative returns of HML factors constructed using bm^{FF} (dark line), $bm^{Eisfeldt}$ (blue line), bm^{Peters} (light blue line) and bm^{Ewens} (green line) from July 1976 to November 2019.

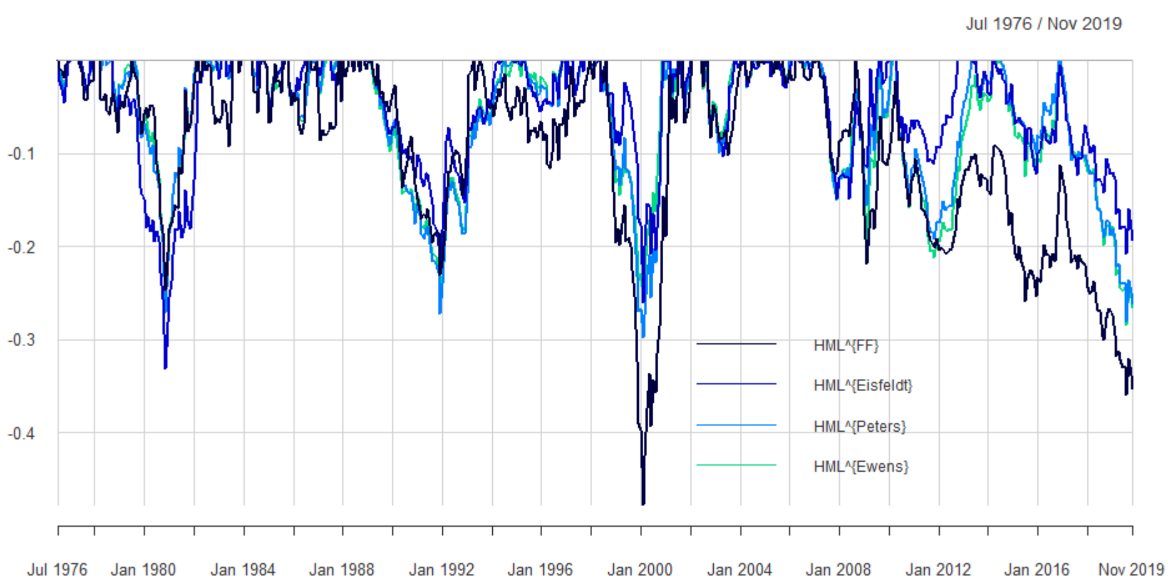

Figure 8. The drawdowns of four HML factors from 1976 to 2019
This figure draws the drawdowns of HML factors constructed using bm^{FF} (dark line), $bm^{Eisfeldt}$ (blue line), bm^{Peters} (light blue line) and bm^{Ewens} (green line) from July 1976 to November 2019.

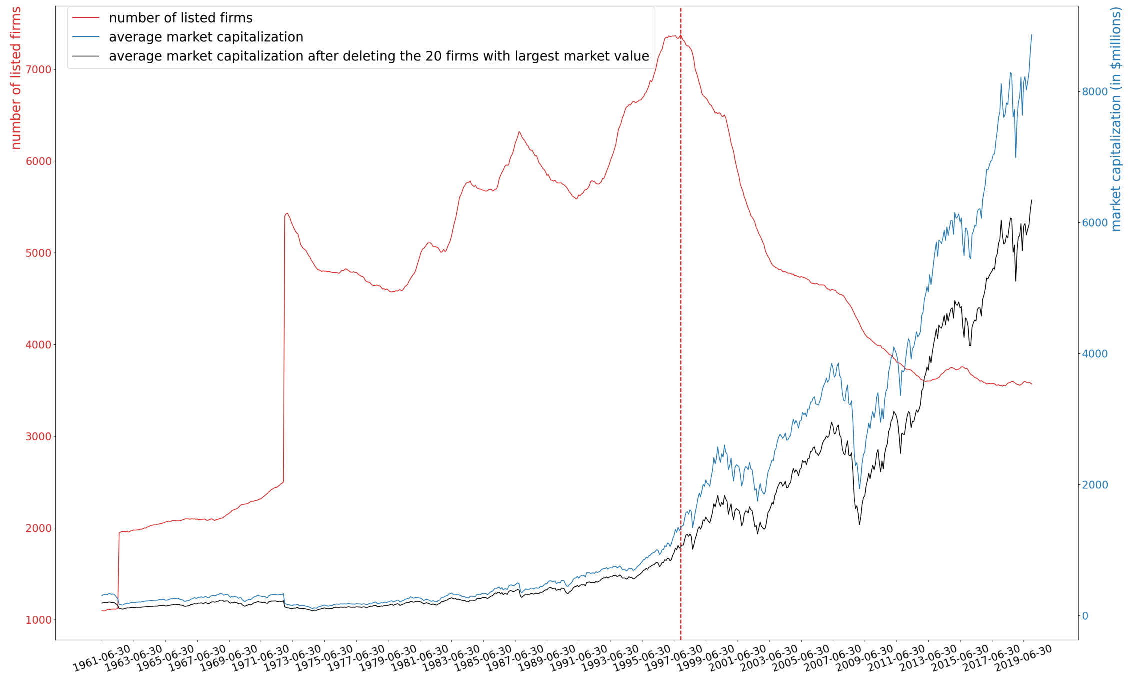

Figure 9. The number of firms listed and average market capitalization from 1961 to 2019
This figure plots the time series of the number of listed firms in NYSE/AMEX/Nasdaq (red line), the average market capitalization of the stocks (blue line), and the average market capitalization of the stocks after deleting the largest 20 firms in each month (black).

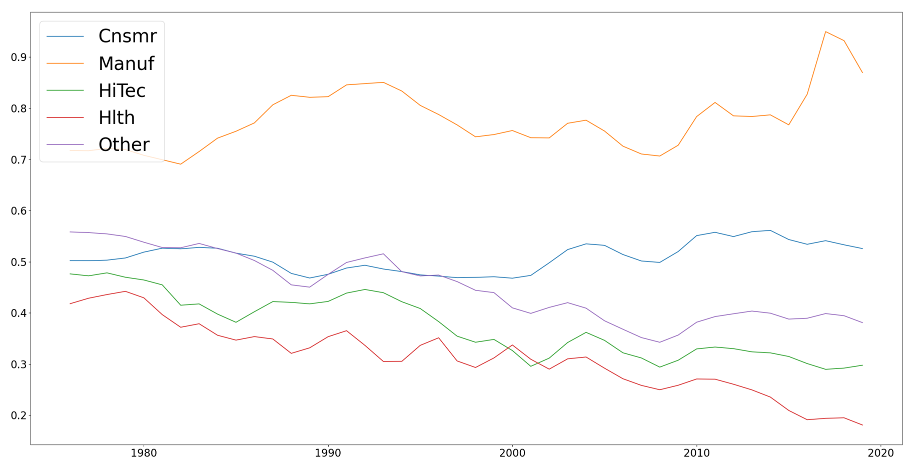

Figure 10. The average of firms' percentage of property, plant and equipment over total assets
This figure plots the time series of the average firms' percentage of PP&E (property, plant and equipment) over total assets for five general sectors classified by Fama and French from 1976 to 2019. Each year, we calculate the value of PP&E over total assets for each firm and then take the averages using all the firms belonging to the same sector.

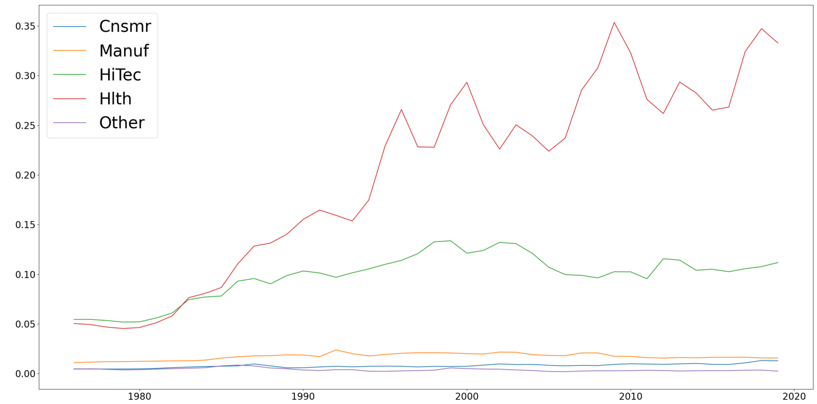

Figure 11. The average of firms' percentage of expense on research and development over total assets

This figure plots the time series of the average of firms' percentage of expense on research and development over total assets for five general sectors classified by Fama and French from 1976 to 2019. Each year, we calculate the value of the expense on research and development over total assets for each firm and then take the averages using all the firms belonging to the same sector.

Figure 12. The average of firms' percentage of intangible assets over intangible adjusted total assets

This figure plots the time series for the average of firms' percentage of the intangible assets (both externally obtained assets and estimated internally generated assets) over the intangible adjusted total assets for the traditional sector (blue line) and the high tech sector (orange line) defined in this paper from 1976 to 2918. The titles of sub-plots indicate the version of estimated intangible assets.

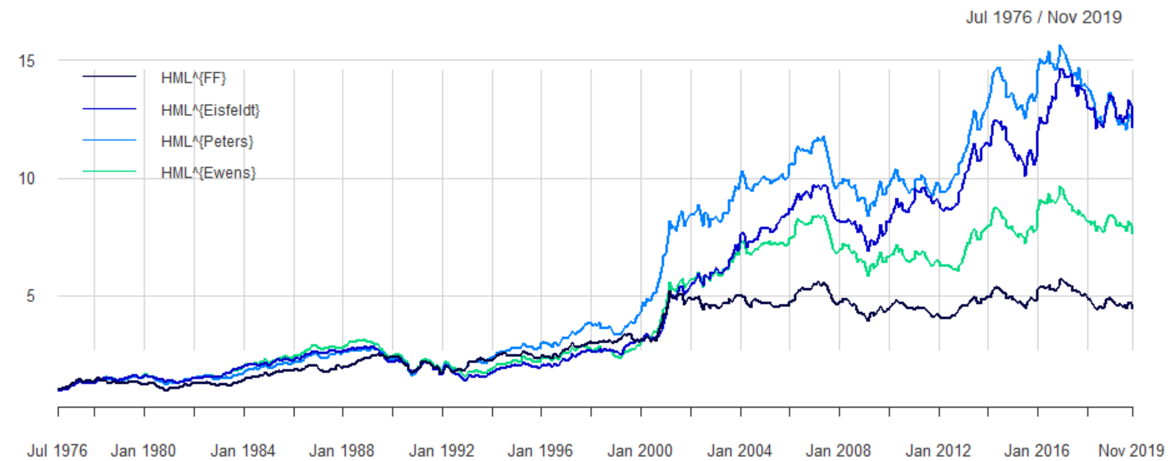

Figure 13. The cumulative returns of four HML factors from 1976 to 2019 within the high tech sector

This figure draws the cumulative returns of HML factors constructed in the high tech sector using bm^{FF} (dark line), $bm^{Eisfeldt}$ (blue line), bm^{Peters} (light blue line) and bm^{Ewens} (green line) from July 1976 to November 2019.

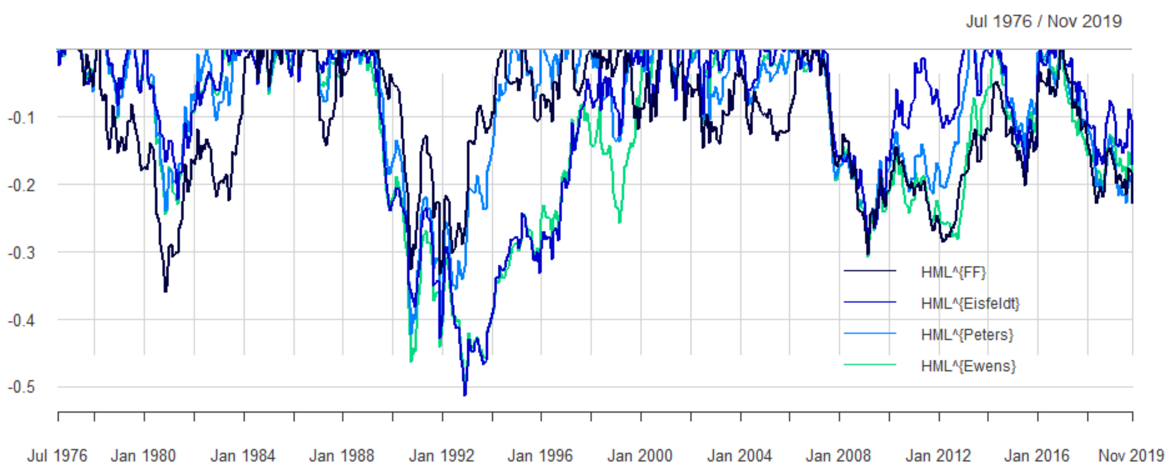

Figure 14. The drawdowns of four HML factors from 1976 to 2019 within the high tech sector

This figure draws the drawdowns of HML factors constructed in the high tech sector using bm^{FF} (dark line), $bm^{Eisfeldt}$ (blue line), bm^{Peters} (light blue line) and bm^{Ewens} (green line) from July 1976 to November 2019.

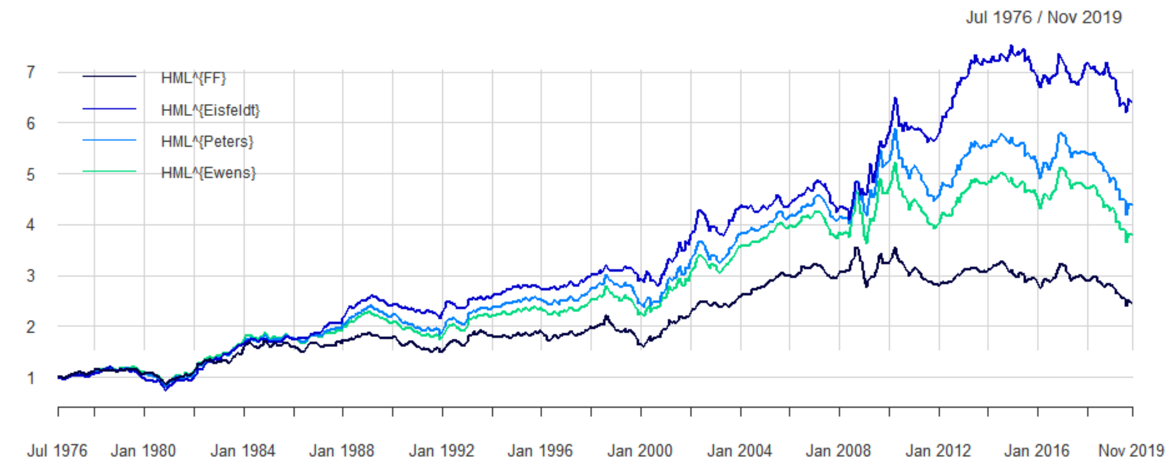

Figure 15. The cumulative returns of four HML factors from 1976 to 2019 within the traditional sector

This figure draws the cumulative returns of HML factors constructed in the traditional sector using bm^{FF} (dark line), $bm^{Eisfeldt}$ (blue line), bm^{Peters} (light blue line) and bm^{Ewens} (green line) from July 1976 to November 2019.

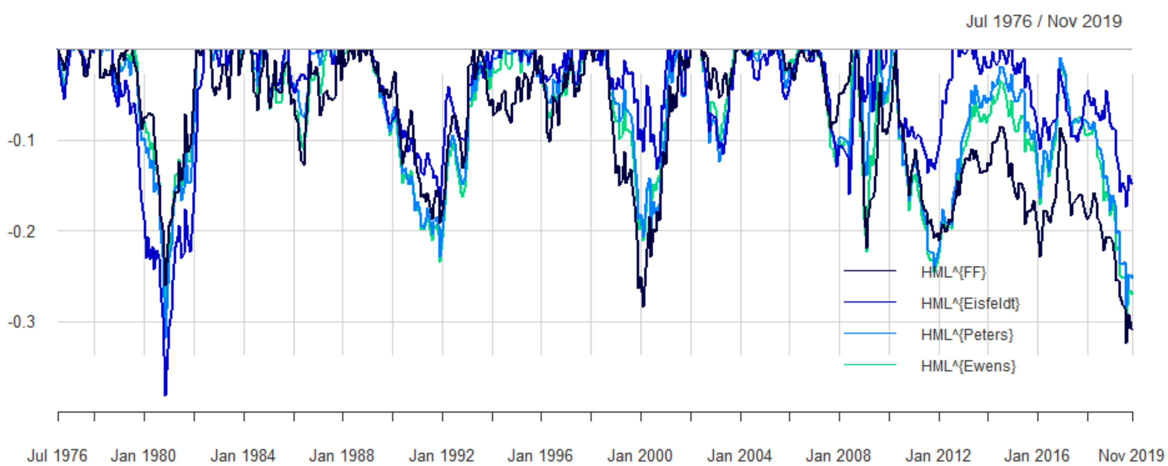

Figure 16. The drawdowns of four HML factors from 1976 to 2019 within the traditional sector

This figure draws the drawdowns of HML factors constructed in the traditional sector using bm^{FF} (dark line), $bm^{Eisfeldt}$ (blue line), bm^{Peters} (light blue line) and bm^{Ewens} (green line) from July 1976 to November 2019.

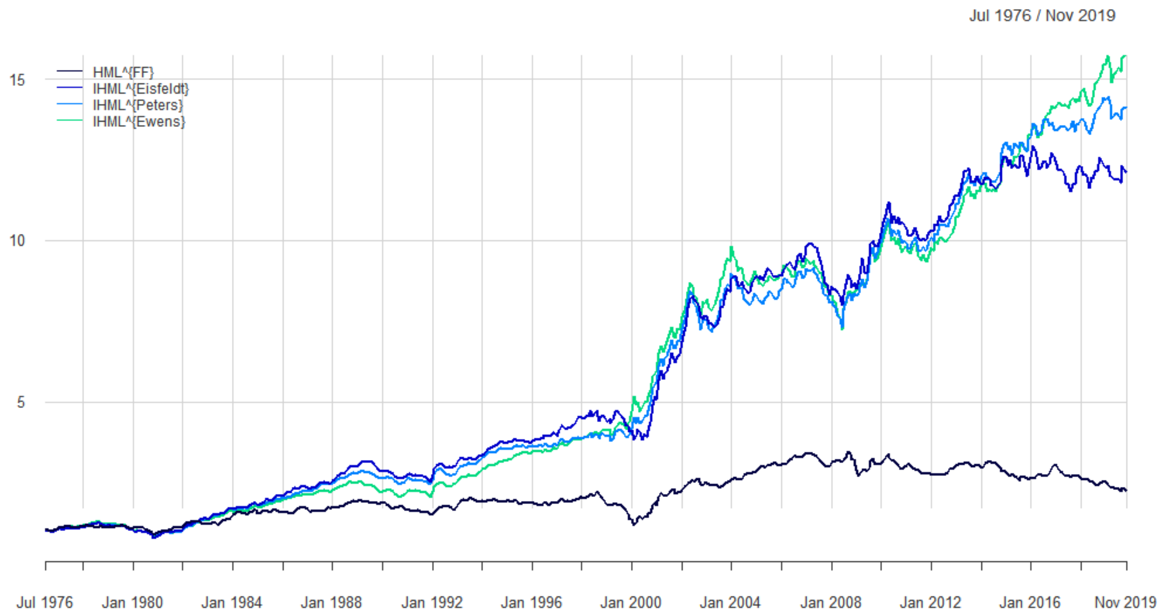

Figure 17. The cumulative returns of HML, IHML factors from 1976 to 2019
This figure draws the cumulative returns of HML, and IHML factors constructed using bm^{FF} (dark line), $im^{Eisfeldt}$ (blue line), im^{Peters} (light blue line) and im^{Ewens} (green line) from July 1976 to November 2019.

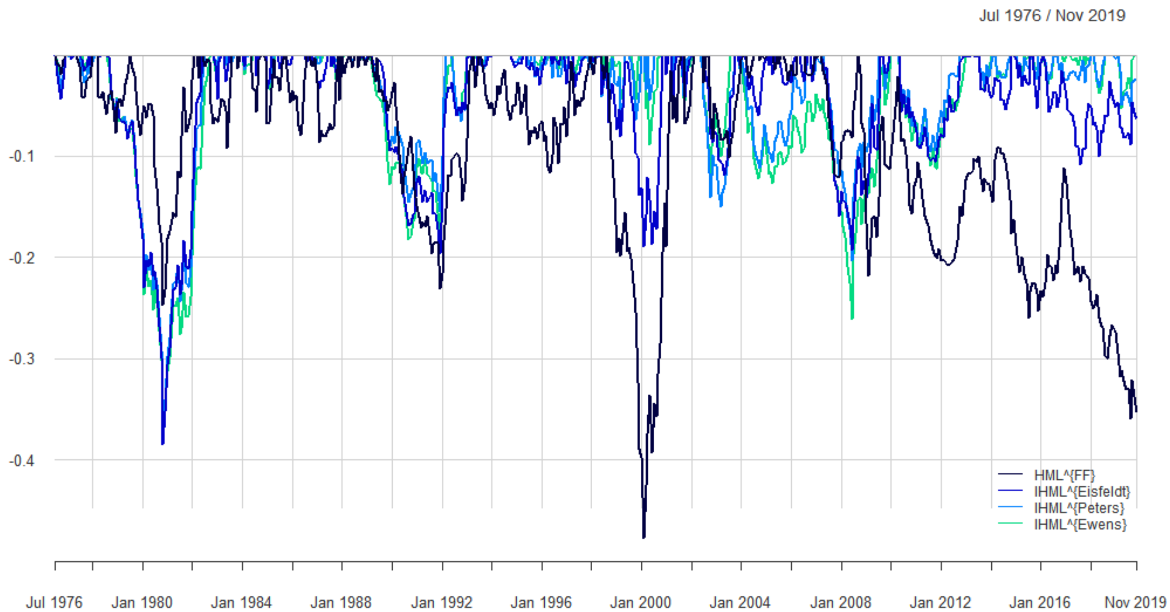

Figure 18. The drawdowns of HML, IHML factors from 1976 to 2019
This figure draws the drawdowns of HML, IHML factors constructed using bm^{FF} (dark line), $im^{Eisfeldt}$ (blue line), im^{Peters} (light blue line) and im^{Ewens} (green line) from July 1976 to November 2019.

Figure 19. The cumulative returns and relative valuations of four HML factors from 1976 to 2019 This figure draws the cumulative returns (left axis) and relative valuation (right axis) of HML factors specified in each subplot constructed using bm^{FF}, $bm^{Eisfeldt}$, bm^{Peters} and bm^{Ewens} from July 1976 to November 2019. The Rˆ2 is the adjusted R^2 from regression of annual returns in July (in log form) on the difference of log relative valuation between the current year and the previous year.

Figure 20. The cumulative returns and relative valuations of HML, IHML factors from 1976 to 2019

This figure draws the cumulative returns (left axis) and relative valuation (right axis) of HML or IHML factors specified in each subplot constructed using bm^{FF}, $im^{Eisfeldt}$, im^{Peters} and im^{Ewens} from July 1976 to November 2019. The Rˆ2 is the adjusted R^2 from regression of annual returns in July (in log form) on the difference of log relative valuation between the current year and the previous year.

Table 1: Summary statistics

This table presents the summary statistics for variables relevant to the book-to-market ratio calculated using the CRSP, Compustat. The sample period is from 1980 to 2019. Each month, the mean (mean), standard deviation (std), skewness (skew), excess kurtosis (kurtosis), minimum (min), fifth percentile (5%), 25th percentile (25%), median (median), 75th percentile (75%), 95th percentile (95%), and maximum (max), number of stocks (count) of the cross-sectional distribution of each variable are calculated. The table presents the time-series means for each cross-sectional value. BM for months from June of year y through May of year y + 1 is calculated as the book value of common equity as of the end of the fiscal year ending in calendar year y-1 to the market value of common equity as of the end of December of year y-1. lnBM is the natural log of BM. BEadj and MEadj are the book value and market value adjusted to reflect the 2012 dollar using the consumer price index and recorded in millions of dollars. MktCap is the share price times the number of shares outstanding.

	mean	std	skew	kurt	min	5%	25%	median	75%	95%	max	count
BM	0.81	0.87	7.18	142.18	0.00	0.11	0.33	0.62	1.02	2.03	20.09	3884
lnBM	-0.62	0.93	-0.89	3.00	-7.24	-2.23	-1.12	-0.51	-0.01	0.67	2.83	3884
BE	1254	6039	15	363	0	6	37	136	534	4793	155398	3884
ME	2732	13085	15	313	1	12	66	271	1128	10186	329579	3884
Mktcap	2607	12414	14	304	1	10	59	256	1095	9851	307561	3883

Table 2: Correlations

This table presents the time-series averages of the annual cross-sectional Pearson product–moment (below-diagonal entries) and Spearman rank (above-diagonal entries) correlations between pairs BM, ln BM, β, and size. The sample period is from 1980 to 2019.

	BM	lnBM	β	size
BM		1.00	-0.25	-0.24
lnBM	0.83		-0.25	-0.24
β	-0.22	-0.24		0.40
size	-0.27	-0.21	0.38	

Table 3: Persistence

This table presents the results of persistence analyses of BM and ln BM. Each month t, the cross-sectional Pearson product–moment correlation between the month t and month $t + \tau$ values of the given variable is calculated. The table presents the time-series averages of the monthly cross-sectional correlations. The column labeled τ indicates the lag at which the persistence is measured. The sample period is from 1980 to 2019.

τ	BM	lnBM
12	0.755	0.793
24	0.607	0.668
36	0.507	0.586
48	0.437	0.526
60	0.387	0.477
120	0.305	0.375

Table 4: Univariate Portfolio Analysis

This table presents the results of univariate portfolio analyses of the relation between the book-to-market ratio and future stock returns. The sample period is from 1980 to 2019. Panel A displays the average values within each portfolio formed by sorting BM using all stocks in the sample while panel B displays the same statistics within portfolios formed by sotting BM using NYSE-listed stocks. The Characteristics section of each panel shows the average values of BM, lnBM, MktCap, and β, the percentage of stocks that are listed on the New York Stock Exchange, and the number of stocks for each decile portfolio. The EW portfolios (VW portfolios) section in each panel shows the average equal-weighted (value-weighted) one-month-ahead excess return and CAPM alpha (in percent per month) for each of the 10 decile portfolios as well as for the long-short zero-cost portfolio that is long the 10th decile portfolio and short the first decile portfolio (column $10-1$). Newey and West (1987) t-statistics, adjusted using six lags, testing the null hypothesis that the average portfolio excess return or CAPM alpha is equal to zero, are shown in parentheses.

Panel A: NYSE/AMEX/NASDAQ Breakpoints												
	Value	1	2	3	4	5	6	7	8	9	10	10-1
Characteristics	BM	0.11	0.23	0.34	0.44	0.56	0.69	0.84	1.02	1.31	2.52	
	lnBM	-2.46	-1.51	-1.13	-0.85	-0.61	-0.40	-0.21	-0.01	0.23	0.78	
	Mktcap	4426	4633	3999	3014	2569	2038	1886	1676	1365	636	
	β	1.01	0.98	0.92	0.88	0.84	0.79	0.74	0.68	0.61	0.56	
	%NYSE	17.58%	26.01%	31.83%	35.11%	36.85%	37.80%	37.13%	36.40%	33.25%	25.22%	
	n	386	386	386	386	386	386	386	386	386	386	
EW portfolios	Excess return	0.01	0.37	0.57	0.74	0.84	0.93	0.92	0.96	1.06	1.30	1.30
		(0.01)	(1.11)	(1.97)	(2.65)	(3.0)	(3.46)	(3.5)	(3.6)	(3.93)	(3.53)	(4.96)
	CAPM α	-0.92	-0.50	-0.24	-0.04	0.09	0.23	0.26	0.33	0.45	0.66	1.58
		(-4.18)	(-2.95)	(-1.58)	(-0.26)	(0.62)	(1.54)	(1.73)	(2.1)	(2.65)	(2.54)	(5.69)
VW portfolios	Excess return	0.57	0.56	0.69	0.67	0.67	0.70	0.73	0.62	0.80	0.92	0.34
		(2.0)	(2.47)	(3.37)	(3.08)	(3.17)	(3.48)	(3.43)	(2.73)	(4.04)	(3.35)	(1.27)
	CAPM α	-0.19	-0.13	0.04	-0.01	0.02	0.09	0.15	0.03	0.23	0.26	0.45
		(-1.29)	(-1.46)	(0.65)	(-0.17)	(0.27)	(0.92)	(1.21)	(0.2)	(1.57)	(1.42)	(1.53)
Panel B: NYSE Breakpoints												
	Value	1	2	3	4	5	6	7	8	9	10	10-1
Characteristics	BM	0.15	0.30	0.41	0.51	0.61	0.72	0.85	1.00	1.22	2.22	
	lnBM	-2.09	-1.25	-0.94	-0.72	-0.53	-0.36	-0.20	-0.03	0.17	0.68	
	Mktcap	4677	4225	3864	2888	2410	2215	1897	1748	1433	689	
	β	1.00	0.93	0.89	0.85	0.82	0.78	0.73	0.68	0.63	0.57	
	%NYSE	21.36%	30.06%	34.51%	37.20%	38.10%	38.53%	38.43%	37.44%	34.99%	26.63%	
	n	616	412	360	331	323	319	318	328	355	480	
EW portfolios	Excess return	0.20	0.59	0.70	0.80	0.91	0.90	0.90	0.93	1.05	1.20	1.20
		(0.58)	(2.0)	(2.54)	(2.86)	(3.34)	(3.36)	(3.52)	(3.66)	(3.9)	(3.46)	(4.44)
	CAPM α	-0.70	-0.22	-0.07	0.04	0.19	0.22	0.26	0.31	0.42	0.57	1.26
		(-3.65)	(-1.46)	(-0.48)	(0.29)	(1.27)	(1.44)	(1.77)	(2.04)	(2.58)	(2.36)	(5.23)
VW portfolios	Excess return	0.61	0.74	0.69	0.63	0.69	0.67	0.75	0.66	0.72	0.87	0.25
		(2.5)	(3.57)	(3.4)	(2.91)	(3.32)	(3.32)	(3.58)	(3.14)	(3.61)	(3.4)	(1.09)
	CAPM α	-0.10	0.08	0.04	-0.04	0.06	0.07	0.19	0.09	0.16	0.22	0.32
		(-0.98)	(1.2)	(0.52)	(-0.5)	(0.6)	(0.75)	(1.46)	(0.62)	(1.15)	(1.3)	(1.29)

Table 5: Bivariate Dependent-Sort Portfolio Analysis

This table presents the results of bivariate dependent-sort portfolio analyses of the relation between BM and future stock returns after controlling for the effect of each of β and MktCap (control variables) from 1980 to 2019. Each month, all stocks in the CRSP sample are sorted into five groups based on an ascending sort of one of the control variables. Within each control variable group, all stocks are sorted into five portfolios based on an ascending sort of BM. The quintile breakpoints used to create the portfolios are calculated using all stocks in the CRSP sample. Panel A presents the average return and CAPM alpha (in percent per month) of the long-short zero-cost portfolios that are long the fifth BM quintile portfolio and short the first BM quintile portfolio in each quintile, as well as for the average quintile, of the control variable. Panel B presents the average return and CAPM alpha for the average control variable quintile portfolio within each BM quintile, as well as for the difference between the fifth and first BM quintiles. Results for equal-weighted (Weights = EW) and value-weighted (Weights = VW) portfolios are shown. Newey and West (1987) t-statistics using six lags, testing the null hypothesis that the average return or alpha is equal to zero, are shown in parentheses.

Panel A: BM Difference Portfolios								
Control	Weights	Value	Control1	Control2	Control3	Control4	Control5	ControlAvg
β	EW	Return	1.04	0.81	0.64	0.75	0.92	0.83
			(5.17)	(4.43)	(4.06)	(3.99)	(3.41)	(5.02)
		CAPM α	1.16	0.89	0.74	0.83	0.97	0.92
			(5.69)	(4.89)	(4.51)	(4.2)	(3.55)	(5.39)
	VW	Return	0.49	0.43	0.08	0.15	-0.03	0.22
			(2.03)	(2.3)	(0.48)	(0.78)	(-0.11)	(1.47)
		CAPM α	0.44	0.51	0.12	0.21	0.01	0.26
			(1.77)	(2.77)	(0.68)	(1.0)	(0.04)	(1.62)
Mktcap	EW	Return	1.03	1.30	0.95	0.57	0.17	0.80
			(3.65)	(5.0)	(3.64)	(2.14)	(0.77)	(3.61)
		CAPM α	1.28	1.53	1.22	0.86	0.43	1.07
			(4.73)	(5.77)	(4.53)	(3.05)	(1.8)	(4.63)
	VW	Return	1.14	1.19	0.89	0.54	0.03	0.76
			(4.18)	(4.47)	(3.38)	(2.06)	(0.15)	(3.44)
		CAPM α	1.37	1.43	1.16	0.83	0.16	0.99
			(5.03)	(5.19)	(4.29)	(2.98)	(0.7)	(4.24)
Panel B: Avarage Control Variable Portfolios								
Control	Weights	Value	BM1	BM2	BM3	BM4	BM5	BM5-1
β	EW	Return	0.30	0.69	0.82	0.94	1.13	0.83
			(0.89)	(2.45)	(3.09)	(3.51)	(3.38)	(5.02)
		CAPM α	-0.52	-0.06	0.10	0.24	0.40	0.92
			(-2.79)	(-0.39)	(0.73)	(1.75)	(1.96)	(5.39)

Table 5 continued from previous page								
	VW	Return	0.60	0.63	0.69	0.69	0.83	0.22
			(2.81)	(3.18)	(3.61)	(3.66)	(3.72)	(1.47)
		CAPM α	-0.02	0.02	0.10	0.14	0.23	0.26
			(-0.33)	(0.35)	(1.59)	(1.67)	(1.85)	(1.62)
Mktcap	EW	Return	0.24	0.72	0.91	0.96	1.05	0.80
			(0.66)	(2.41)	(3.33)	(3.64)	(3.57)	(3.61)
		CAPM α	-0.66	-0.07	0.19	0.31	0.40	1.07
			(-3.16)	(-0.42)	(1.33)	(2.04)	(2.18)	(4.63)
	VW	Return	0.14	0.61	0.78	0.88	0.90	0.76
			(0.39)	(2.16)	(2.98)	(3.48)	(3.15)	(3.44)
		CAPM α	-0.74	-0.16	0.08	0.24	0.25	0.99
			(-3.83)	(-1.14)	(0.62)	(1.75)	(1.43)	(4.24)

Table 6: Bivariate Independent-Sort Portfolio Analysis–Control for β

This table presents the results of bivariate independent-sort portfolio analyses of the relation between BM and future stock returns after controlling for the effect of β from 1980 to 2019. Each month, all stocks in the CRSP sample are sorted into five groups based on an ascending sort of β. All stocks are independently sorted into five groups based on an ascending sort of BM. The quintile breakpoints used to create the groups are calculated using all stocks in the CRSP sample. The intersections of the β and BM groups are used to form 25 portfolios. The table presents the average one-month-ahead excess return (in percent per month) for each of the 25 portfolios as well as for the average β quintile portfolio within each quintile of BM and the average BM quintile within each β quintile. Also shown are the average return and CAPM alpha of a long-short zero-cost portfolio that is long the fifth BM (β quintile portfolio and short the first BM (β quintile portfolio in each β(BM) quintile. Newey and West (1987) t-statistics using six lags, testing the null hypothesis that the average return or alpha is equal to zero, are shown in parentheses. Panel A presents results for equal-weighted portfolios. Panel B presents results for value-weighted portfolios.

Panel A: Equal-Weighted Portfolios								
	β1	β2	β3	β4	β5	βAvg	β5-1	β5-1CAPMα
BM1	0.21	0.34	0.47	0.23	0.05	0.26	-0.16	-0.69
							(-0.69)	(-2.76)
BM2	0.66	0.68	0.72	0.71	0.58	0.67	-0.08	-0.65
							(-0.38)	(-3.02)
BM3	1.07	0.83	0.86	0.91	0.76	0.89	-0.31	-0.95
							(-1.43)	(-4.06)
BM4	1.02	0.92	0.93	0.87	0.82	0.91	-0.20	-0.85
							(-0.73)	(-3.33)
BM5	1.30	1.25	1.18	1.06	0.87	1.13	-0.43	-1.05
							(-1.48)	(-3.8)
BMAvg	0.85	0.80	0.83	0.76	0.61		-0.24	-0.84
							(-1.15)	(-4.06)
BM5-1	1.10	0.91	0.70	0.83	0.83	0.87		
	(4.79)	(4.46)	(3.81)	(4.18)	(2.85)	(4.95)		
BM 5-1	1.27	1.01	0.79	0.92	0.92	0.98		
CAPM	(5.95)	(4.89)	(4.18)	(4.32)	(3.11)	(5.45)		
Panel B: Value-Weighted Portfolios								
	β1	β2	β3	β4	β5	βAvg	β5-1	β5-1CAPMα
BM1	0.46	0.48	0.71	0.57	0.53	0.55	0.07	-0.57
							(0.2)	(-1.82)
BM2	0.47	0.69	0.62	0.84	0.55	0.64	0.08	-0.44
							(0.31)	(-1.66)

Table 6 continued from previous page

BM3	0.73	0.70	0.70	0.59	0.70	0.68	-0.03	-0.60
							(-0.12)	(-2.25)
BM4	0.84	0.69	0.71	0.67	0.64	0.71	-0.20	-0.84
							(-0.73)	(-3.86)
BM5	0.93	0.86	0.85	0.91	0.48	0.80	-0.45	-1.15
							(-1.45)	(-3.63)
BMAvg	0.69	0.68	0.72	0.71	0.58		-0.11	-0.72
							(-0.44)	(-3.31)
BM5-1	0.47	0.38	0.14	0.35	-0.05	0.25		
	(1.79)	(2.06)	(0.8)	(1.7)	(-0.18)	(1.69)		
BM 5-1	0.50	0.46	0.18	0.38	-0.08	0.29		
CAPM	(1.87)	(2.59)	(1.04)	(1.78)	(-0.29)	(1.87)		

Table 7: Bivariate Independent-Sort Portfolio Analysis–Control for Mktcap
This table presents the results of bivariate independent-sort portfolio analyses of the relation between BM and future stock returns after controlling for the effect of Mktcap from 1980 to 2019. Each month, all stocks in the CRSP sample are sorted into five groups based on an ascending sort of Mktcap. All stocks are independently sorted into five groups based on an ascending sort of BM. The quintile breakpoints used to create the groups are calculated using all stocks in the CRSP sample. The intersections of the Mktcap and BM groups are used to form 25 portfolios. The table presents the average one-month-ahead excess return (in percent per month) for each of the 25 portfolios as well as for the average Mktcap quintile portfolio within each quintile of BM and the average BM quintile within each Mktcap quintile. Also shown are the average return and CAPM alpha of a long-short zero-cost portfolio that is long the fifth BM (Mktcap) quintile portfolio and short the first BM (Mktcap) quintile portfolio in each Mktcap (BM) quintile. Newey and West (1987) t-statistics using six lags, testing the null hypothesis that the average return or alpha is equal to zero, are shown in parentheses. Panel A presents results for equal-weighted portfolios. Panel B presents results for value-weighted portfolios.

Panel A: Equal-Weighted Portfolios

	Mktcap 1	Mktcap 2	Mktcap 3	Mktcap 4	Mktcap 5	Mktcap Avg	Mktcap 5-1	Mktcap 5-1 CAPM α
BM1	0.76	-0.39	-0.07	0.34	0.60	0.25	-0.16	-0.10
							(-0.38)	(-0.24)
BM2	0.87	0.33	0.66	0.77	0.71	0.67	-0.16	-0.16
							(-0.49)	(-0.48)
BM3	1.34	0.76	0.85	0.86	0.79	0.92	-0.54	-0.55
							(-1.8)	(-1.86)
BM4	1.33	0.78	0.92	0.94	0.73	0.94	-0.60	-0.59
							(-2.31)	(-2.22)
BM5	1.63	0.89	0.89	0.84	0.84	1.02	-0.79	-0.81
							(-2.77)	(-2.75)
BMAvg	1.19	0.47	0.65	0.75	0.73		-0.45	(-0.44)
							(-1.53)	(-1.52)
BM5-1	0.87	1.28	0.96	0.50	0.24	0.77		
	(2.83)	(4.93)	(3.53)	(1.83)	(1.11)	(3.36)		
BM 5-1	1.19	1.53	1.21	0.75	0.48	1.03		
CAPM α	(4.15)	(5.81)	(4.32)	(2.53)	(2.06)	(4.38)		

Panel B: Valuel-Weighted Portfolios

Table 7 continued from previous page

	Mktcap 1	Mktcap 2	Mktcap 3	Mktcap 4	Mktcap 5	Mktcap Avg	Mktcap 5-1	Mktcap 5-1 CAPM α
BM1	0.00	-0.30	-0.02	0.37	0.62	0.14	0.62	0.77
							(1.46)	(1.95)
BM2	0.22	0.36	0.66	0.77	0.67	0.54	0.46	0.55
							(1.46)	(1.74)
BM3	0.81	0.73	0.88	0.85	0.66	0.78	-0.15	-0.09
							(-0.51)	(-0.31)
BM4	0.81	0.80	0.92	0.93	0.63	0.82	-0.19	-0.16
							(-0.71)	(-0.61)
BM5	1.14	0.86	0.88	0.84	0.76	0.90	-0.38	-0.38
							(-1.43)	(-1.41)
BMAvg	0.59	0.49	0.66	0.75	0.67		0.07	0.14
							(0.26)	(0.5)
BM5-1	1.14	1.17	0.89	0.47	0.14	0.76		
	(3.8)	(4.42)	(3.27)	(1.73)	(0.66)	(3.33)		
BM 5-1	1.43	1.41	1.16	0.72	0.28	1.00		
CAPM α	(5.01)	(5.21)	(4.08)	(2.47)	(1.2)	(4.19)		

Table 8: Fama-MacBeth Regression Analysis

This table presents the results of Fama and MacBeth (1973) regression analyses of the relation between expected stock returns and book-to-market ratio using sample period from 1980 to 2019. Each column in the table presents results for a different cross-sectional regression specification. The dependent variable in all specifications is the one-month-ahead excess stock return. The independent variables are indicated in the first column. Independent variables are winsorized at the 0.5% level on a monthly basis. The table presents average slope and intercept coefficients along with t-statistics (in parentheses), adjusted following Newey and West (1987) using six lags, testing the null hypothesis that the average coefficient is equal to zero. The rows labeled Adj.R^2 and n present the average adjusted R-squared and the number of data points, respectively, for the cross-sectional regressions.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
BM	0.37	0.32	0.30	0.25				
	(4.2)	(3.84)	(3.12)	(3.02)				
lnBM					0.40	0.35	0.34	0.30
					(5.19)	(5.26)	(3.89)	(4.23)
β		-0.20		-0.11		-0.15		-0.04
		(-1.4)		(-0.53)		(-1.14)		(-0.24)
Size			-0.07	-0.06			-0.07	-0.07
			(-1.41)	(-0.98)			(-1.35)	(-1.08)
Intercept	0.45	0.66	0.84	0.93	0.98	1.08	1.27	1.28
	(1.52)	(2.68)	(1.64)	(2.01)	(3.41)	(4.14)	(2.69)	(2.9)
Adj. R^2	0.00	0.02	0.01	0.03	0.01	0.02	0.01	0.03
n	3885	3862	3885	3862	3885	3862	3885	3862

Table 9: Summary Statistics for Comparison Between the Four Versions of Book-to-Market Ratio

This table presents summary statistics for four versions of book-to-market ratios (bm^{FF}, $bm^{Eisfeldt}$, bm^{Peters} and bm^{Ewens} and $logbm^{FF}$ (the natural log of bm^{FF}) and market value of equity (ME) from period June 1976 to December 2019. ME is adjusted to reflect the 2021 dollar using the consumer price index and recorded in millions of dollars.

	mean	std	skew	kurtosis	min	5%	25%	median	75%	95%	max	count
logbm^{FF}	-0.56	0.91	-0.89	3.01	-7.09	-2.14	-1.05	-0.45	0.04	0.71	2.85	3849
bm^{FF}	0.86	0.88	6.97	135.60	0.00	0.13	0.37	0.67	1.09	2.14	20.38	3849
$bm^{Eisfeldt}$	2.67	5.07	11.59	294.90	0.01	0.27	0.76	1.44	2.84	8.51	144.44	3932
bm^{Peters}	1.48	1.97	9.11	201.43	0.01	0.22	0.58	1.02	1.71	4.13	48.55	3934
bm^{Ewens}	1.37	1.65	7.25	125.08	0.01	0.21	0.56	0.97	1.61	3.75	36.95	3929
ME	2224	10402	15	355	1	10	53	222	941	8435	265186	4397

Table 10: Correlation Between the Four Versions of Book-to-Market Ratio

This table presents the time-series averages of cross-sectional Pearson product-moment (below-diagonal entries) and Spearman rank (above-diagonal entries) correlations between the four versions of book-to-market ratio for the sample period from June 1976 to December 2019.

	bm^{FF}	$bm^{Eisfeldt}$	bm^{Peters}	bm^{Ewens}
bm^{FF}	1.00	0.73	0.87	0.89
$bm^{Eisfeldt}$	0.66	1.00	0.91	0.90
bm^{Peters}	0.81	0.92	1.00	0.99
bm^{Ewens}	0.84	0.90	0.97	1.00

Table 11: Persistence of the Four Versions of Book-to-Market Ratio

This table presents the results of persistence analyses of four versions of book-to-market ratio for the sample period from June 1976 to December 2019. Each month t, the cross-sectional Pearson product–moment correlation between the month t and month $t + \tau$ values of the given variable is calculated. The table presents the time-series averages of the monthly cross-sectional correlations. The column labeled τ indicates the lag at which the persistence is measured.

τ	bm^{FF}	$bm^{Eisfeldt}$	bm^{Peters}	bm^{Ewens}
12	0.762	0.816	0.769	0.761
24	0.616	0.692	0.626	0.613
36	0.517	0.610	0.532	0.516
48	0.447	0.546	0.464	0.447
60	0.395	0.490	0.405	0.387
120	0.301	0.366	0.287	0.269

Table 12: Univariate Portfolio Analysis for Comparison Between the Four Versions of Book-to-Market Ratio

This table presents the averages of value-weighted one-month-ahead excess returns and corresponding Newey and West (1987) t-statistics using 6 lags within portfolios formed by sorting different book-to-market ratios indicated by the columns from low to high. The sample period is from June 1976 to December 2019.

	bm^{FF}		$bm^{Eisfeldt}$		bm^{Peters}		bm^{Ewens}	
	VW excess return	t VW	VW excess return	t VW	VW excess return	t VW	VW excess return	t VW
1	0.60	(2.6)	0.55	(2.34)	0.57	(2.42)	0.59	(2.53)
2	0.62	(2.96)	0.62	(2.94)	0.63	(3.01)	0.61	(2.9)
3	0.68	(3.4)	0.65	(3.34)	0.62	(3.08)	0.62	(3.07)
4	0.69	(3.36)	0.65	(3.53)	0.71	(3.69)	0.70	(3.68)
5	0.70	(3.45)	0.68	(3.52)	0.64	(3.37)	0.67	(3.51)
6	0.67	(3.38)	0.75	(3.91)	0.71	(3.59)	0.69	(3.48)
7	0.70	(3.41)	0.77	(3.71)	0.73	(3.63)	0.72	(3.5)
8	0.67	(3.26)	0.75	(3.44)	0.73	(3.46)	0.74	(3.57)
9	0.74	(3.67)	0.76	(3.44)	0.76	(3.38)	0.74	(3.31)
10	0.72	(3.27)	0.74	(3.27)	0.73	(3.2)	0.73	(3.17)
10-1	0.13	(1.4)	0.19	(2.15)	0.16	(1.8)	0.14	(1.55)

Table 13: Fama MacBeth Regression Using Four Versions of Book-to-Market Ratio
This table presents the results of Fama and MacBeth (1973) regression analyses of the relation between expected stock returns and book-to-market ratio using the sample period from June 1976 to December 2019. Each column in the table presents results for a different cross-sectional regression specification. The dependent variable in all specifications is the one-month-ahead excess stock return. The independent variables are indicated in the first column. Independent variables are winsorized at the 0.5% level on a monthly basis. The table presents average slope and intercept coefficients along with t-statistics (in parentheses), adjusted following Newey and West (1987) using six lags, testing the null hypothesis that the average coefficient is equal to zero. The rows labeled Adj. R^2 and n present the average adjusted R-squared and the number of data points, respectively, for the cross-sectional regressions.

	(1)	(2)	(3)	(4)	(5)
logbm^{FF}	0.27				-0.26
	(3.98)				(-1.79)
log$bm^{Eisfeldt}$		0.26			-0.23
		(4.6)			(-1.93)
logbm^{Peters}			0.38		-0.04
			(5.97)		(-0.16)
logbm^{Ewens}				0.39	0.92
				(6.12)	(3.18)
β	0.00	-0.02	0.01	0.01	-0.02
	(0.02)	(-0.1)	(0.05)	(0.04)	(-0.1)
Size	-0.09	-0.06	-0.05	-0.05	-0.05
	(-1.49)	(-0.98)	(-0.92)	(-0.88)	(-0.96)
Intercept	1.35	0.98	1.04	1.06	1.07
	(3.27)	(2.31)	(2.52)	(2.56)	(2.86)
Adj. R^2	0.03	0.03	0.03	0.03	0.03
n	3851	3934	3936	3931	3785

Table 14: Spanning Tests for the Four Versions of HML Factor
This table presents the spanning tests for the four versions of HML factor constructed using bm^{FF}, $bm^{Eisfeldt}$, bm^{Peters} and bm^{Ewens} respectively. The dependent variable is indicated by the column and the non-constant dependent variables are the other four factors from Fama and French (2015). The sample period is from June 1976 to December 2019. p-values are shown in parentheses.

	HML^{FF}	$HML^{Eisfeldt}$	HML^{Peters}	HML^{Ewens}
SMB	-0.05	0.19	0.12	0.11
	(0.406)	(0.0)	(0.004)	(0.009)
RMW	0.23	0.36	0.15	0.11
	(0.063)	(0.0)	(0.08)	(0.155)
CMA	0.99	0.86	0.92	0.91
	(0.0)	(0.0)	(0.0)	(0.0)
mkt	-0.02	0.07	0.04	0.03
	(0.659)	(0.054)	(0.228)	(0.384)
Intercept	-0.10	0.04	0.04	0.06
	(0.431)	(0.705)	(0.67)	(0.574)
Adj. R^2	0.53	0.50	0.50	0.48

Table 15: Summary Statistics for pre-1999 and post-1999 Periods
This table presents summary statistics for four versions of book-to-market ratios (bm^{FF}, $bm^{Eisfeldt}$, bm^{Peters} and bm^{Ewens} and $logbm^{FF}$ (the natural log of bm^{FF}) and market value of equity (ME). Panel A covers the sample period from June 1976 to December 1998 and panel B covers the sample period from January 1999 to December 2019. ME is adjusted to reflect the 2021 dollar using the consumer price index and recorded in millions of dollars.

Panel A: pre 1999												
	mean	std	skew	kurtosis	min	5%	25%	median	75%	95%	max	count
logbm^{FF}	-0.43	0.89	-0.95	2.92	-6.84	-2.00	-0.90	-0.31	0.17	0.79	2.87	4092
bm^{FF}	0.95	0.89	6.33	122.19	0.00	0.15	0.43	0.77	1.23	2.28	19.81	4092
$bm^{Eisfeldt}$	3.17	5.84	11.94	337.19	0.01	0.32	0.92	1.75	3.47	9.94	167.37	4180
bm^{Peters}	1.62	1.99	8.49	185.21	0.01	0.23	0.65	1.15	1.93	4.39	47.76	4165
bm^{Ewens}	1.50	1.71	7.33	140.70	0.01	0.23	0.62	1.10	1.81	3.99	39.42	4161
ME	538	2520	18	469	0	3	14	53	230	2160	74430	4608
Panel B: post 1999												
	mean	std	skew	kurtosis	min	5%	25%	median	75%	95%	max	count
logbm^{FF}	-0.70	0.93	-0.83	3.11	-7.36	-2.30	-1.21	-0.59	-0.10	0.62	2.83	3588
bm^{FF}	0.76	0.88	7.66	150.02	0.00	0.10	0.30	0.56	0.93	1.98	21.00	3588
$bm^{Eisfeldt}$	2.13	4.25	11.21	249.42	0.00	0.20	0.59	1.10	2.16	6.97	119.78	3666
bm^{Peters}	1.33	1.94	9.78	218.88	0.01	0.21	0.51	0.87	1.47	3.85	49.39	3686
bm^{Ewens}	1.23	1.59	7.16	108.28	0.00	0.20	0.48	0.83	1.39	3.48	34.29	3681
ME	4037	18878	13	232	1	16	95	403	1705	15184	470323	4169

Table 16: Correlation for pre-1999 and post-1999 Periods
This table presents the time-series averages of cross-sectional Pearson product-moment (below-diagonal entries) and Spearman rank (above-diagonal entries) correlations between the four versions of the book-to-market ratio for the sample period from June 1976 to December 1998 (Panel A) and from January 1999 to December 2019 (Panel B).

Panel A: pre 1999				
	bm^{FF}	$bm^{Eisfeldt}$	bm^{Peters}	bm^{Ewens}
bm^{FF}	1.00	0.75	0.89	0.90
$bm^{Eisfeldt}$	0.66	1.00	0.93	0.92
bm^{Peters}	0.82	0.94	1.00	0.99
bm^{Ewens}	0.84	0.90	0.98	1.00
Panel B: post 1999				
	bm^{FF}	$bm^{Eisfeldt}$	bm^{Peters}	bm^{Ewens}
bm^{FF}	1.00	0.69	0.83	0.87
$bm^{Eisfeldt}$	0.66	1.00	0.88	0.88
bm^{Peters}	0.80	0.91	1.00	0.98
bm^{Ewens}	0.84	0.90	0.97	1.00

Table 17: Persistence of Book-to-Market Ratio for pre-1999 and post-1999 Periods
This table presents the results of persistence analyses of four versions of the book-to-market ratio for the sample period from June 1976 to December 1998 (Panel A) and from January 1999 to December 2019 (Panel B). Each month t, the cross-sectional Pearson product–moment correlation between the month t and month $t + \tau$ values of the given variable is calculated. The table presents the time-series averages of the monthly cross-sectional correlations. The column labeled τ indicates the lag at which the persistence is measured.

Panel A: pre 1999				
τ	bm^{FF}	$bm^{Eisfeldt}$	bm^{Peters}	bm^{Ewens}
12	0.781	0.844	0.811	0.798
24	0.634	0.724	0.674	0.654
36	0.528	0.639	0.577	0.551
48	0.449	0.572	0.500	0.470
60	0.390	0.513	0.437	0.403
120	0.274	0.393	0.308	0.264
Panel B: post 1999				
τ	bm^{FF}	$bm^{Eisfeldt}$	bm^{Peters}	bm^{Ewens}
12	0.746	0.788	0.726	0.724
24	0.603	0.663	0.578	0.575
36	0.516	0.585	0.490	0.488
48	0.457	0.527	0.433	0.432
60	0.410	0.475	0.378	0.381
120	0.327	0.351	0.268	0.279

Table 18: Univariate Portfolio Analysis for pre-1999 and post-1999 Periods
This table presents the averages of value-weighted one-month-ahead excess returns and corresponding Newey and West (1987) t-statistics using 6 lags within portfolios formed by sorting different book-to-market ratios indicated by the columns from low to high. The sample periods are from June 1976 to December 1998 (Panel A) and from January 1999 to December 2019 (Panel B) respectively.

Panel A: pre 1999								
	bm^{FF}		$bm^{Eisfeldt}$		bm^{Peters}		bm^{Ewens}	
	VW excess return	t VW	VW excess return	t VW	VW excess return	t VW	VW excess return	t VW
1	0.70	(2.14)	0.64	(1.94)	0.67	(2.03)	0.69	(2.1)
2	0.69	(2.32)	0.72	(2.41)	0.71	(2.28)	0.66	(2.19)
3	0.81	(2.85)	0.80	(2.91)	0.76	(2.71)	0.78	(2.78)
4	0.85	(2.95)	0.77	(3.15)	0.88	(3.31)	0.87	(3.33)
5	0.86	(3.1)	0.82	(3.19)	0.77	(2.96)	0.81	(3.05)
6	0.78	(2.93)	0.90	(3.39)	0.89	(3.36)	0.88	(3.36)
7	0.90	(3.23)	0.94	(3.26)	0.88	(3.33)	0.87	(3.13)
8	0.85	(3.18)	0.91	(2.92)	0.92	(3.12)	0.93	(3.29)
9	0.91	(3.3)	0.97	(3.04)	0.98	(3.07)	0.96	(3.05)
10	0.92	(2.97)	0.92	(2.78)	0.92	(2.79)	0.92	(2.75)
10-1	0.23	(1.73)	0.28	(2.2)	0.25	(2.14)	0.23	(1.87)
Panel B: post 1999								
	bm^{FF}		$bm^{Eisfeldt}$		bm^{Peters}		bm^{Ewens}	
	VW excess return	t VW	VW excess return	t VW	VW excess return	t VW	VW excess return	t VW
1	0.49	(1.52)	0.46	(1.36)	0.46	(1.38)	0.48	(1.46)
2	0.54	(1.83)	0.52	(1.72)	0.55	(1.94)	0.55	(1.88)
3	0.53	(1.88)	0.49	(1.77)	0.47	(1.64)	0.44	(1.54)
4	0.52	(1.77)	0.52	(1.87)	0.53	(1.88)	0.52	(1.86)
5	0.52	(1.76)	0.54	(1.81)	0.51	(1.79)	0.53	(1.89)
6	0.55	(1.86)	0.60	(2.08)	0.52	(1.74)	0.50	(1.63)
7	0.49	(1.61)	0.58	(1.92)	0.57	(1.83)	0.56	(1.81)
8	0.49	(1.52)	0.58	(1.88)	0.53	(1.72)	0.53	(1.74)
9	0.55	(1.85)	0.54	(1.75)	0.52	(1.64)	0.51	(1.58)
10	0.51	(1.61)	0.56	(1.77)	0.52	(1.67)	0.52	(1.66)
10-1	0.02	(0.18)	0.10	(0.82)	0.06	(0.47)	0.04	(0.35)

Table 19: Fama MacBeth Regression for pre-1999 and post-1999 Periods

This table presents the results of Fama and MacBeth (1973) regression analyses of the relation between expected stock returns and book-to-market ratio using sample period from June 1976 to December 1999 (Pre 1999) and from January 1999 to December 2019 (Post 1999). Each column in the table presents results for a different cross-sectional regression specification. The dependent variable in all specifications is the one-month-ahead excess stock return. The independent variables are indicated in the first column. Independent variables are winsorized at the 0.5% level on a monthly basis. The table presents average slope and intercept coefficients along with t-statistics (in parentheses), adjusted following Newey and West (1987) using six lags, testing the null hypothesis that the average coefficient is equal to zero. The rows labeled Adj. Adj. R^2 and n present the average adjusted R-squared and the number of data points, respectively, for the cross-sectional regressions.

	Pre 1999					Post 1999				
	(1)	(2)	(3)	(4)	(5)	(1)	(2)	(3)	(4)	(5)
logbm^{FF}	0.41				-0.17	0.12				-0.33
	(5.02)				(-1.16)	(1.23)				(-1.31)
log$bm^{Eisfeldt}$		0.33			-0.30		0.18			-0.15
		(4.57)			(-1.96)		(2.21)			(-0.83)
logbm^{Peters}			0.47		-0.11			0.29		0.02
			(5.85)		(-0.35)			(3.09)		(0.06)
logbm^{Ewens}				0.49	1.07				0.29	0.75
				(6.12)	(3.25)				(3.04)	(1.56)
β	0.01	-0.05	-0.01	-0.01	-0.01	-0.03	-0.01	0.01	0.01	-0.04
	(0.07)	(-0.27)	(-0.06)	(-0.07)	(-0.07)	(-0.09)	(-0.02)	(0.02)	(0.02)	(-0.14)
Size	-0.06	-0.03	-0.03	-0.03	-0.04	-0.10	-0.07	-0.06	-0.06	-0.05
	(-0.83)	(-0.4)	(-0.45)	(-0.39)	(-0.58)	(-1.07)	(-0.75)	(-0.63)	(-0.63)	(-0.58)
Intercept	1.14	0.71	0.84	0.86	1.01	1.50	1.18	1.16	1.18	1.06
	(2.31)	(1.35)	(1.66)	(1.68)	(2.11)	(2.21)	(1.72)	(1.74)	(1.76)	(1.79)
Adj. R^2	0.02	0.02	0.02	0.02	0.03	0.03	0.03	0.03	0.03	0.04
n	4088	4176	4161	4156	4034	3590	3669	3688	3683	3511

Table 20: Spanning Tests for pre-1999 and post-1999 Periods

This table presents the spanning tests for the four versions of HML factor constructed using bm^{FF}, $bm^{Eisfeldt}$, bm^{Peters} and bm^{Ewens} respectively. The sample periods are from June 1976 to December 1999 (Pre 1999) and from January 1999 to December 2019 (Post 1999). The dependent variables are indicated by the column and the non-constant dependent variables are the other four factors from Fama and French (2015). p-values are shown in parentheses.

	Pre 1999				Post 1999			
	HML^{FF}	$HML^{Eisfeldt}$	HML^{Peters}	HML^{Ewens}	HML^{FF}	$HML^{Eisfeldt}$	HML^{Peters}	HML^{Ewens}
SMB	-0.10	0.19	0.10	0.08	0.03	0.23	0.18	0.17
	(0.021)	(0.0)	(0.014)	(0.043)	(0.659)	(0.001)	(0.001)	(0.003)
RMW	-0.32	0.12	-0.15	-0.15	0.55	0.55	0.36	0.32
	(0.0)	(0.219)	(0.085)	(0.083)	(0.0)	(0.0)	(0.0)	(0.0)
CMA	0.89	0.90	0.89	0.90	0.83	0.73	0.79	0.78
	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)
mkt	-0.13	0.01	-0.03	-0.04	0.15	0.18	0.17	0.16
	(0.0)	(0.791)	(0.221)	(0.11)	(0.023)	(0.0)	(0.0)	(0.003)
Intercept	0.27	0.17	0.26	0.27	-0.34	-0.07	-0.12	-0.12
	(0.032)	(0.205)	(0.034)	(0.024)	(0.042)	(0.586)	(0.345)	(0.372)
Adj. R^2	0.68	0.44	0.57	0.57	0.57	0.59	0.54	0.49

Table 21: Summary Statistics Within the High Tech Sector and the Traditional Sector

This table presents summary statistics for four versions of book-to-market ratios (bm^{FF}, $bm^{Eisfeldt}$, bm^{Peters} and bm^{Ewens} and $logbm^{FF}$ (the natural log of bm^{FF}) and market value of equity (ME). Panel A covers the sample of the high tech sector stocks and panel B covers the sample of the traditional sector. ME is adjusted to reflect the 2021 dollar using the consumer price index and recorded in millions of dollars.

Panel A: High tech sector												
	mean	std	skew	kurtosis	min	5%	25%	median	75%	95%	max	count
logbm^{FF}	-0.91	0.94	-0.80	2.54	-6.37	-2.51	-1.45	-0.83	-0.27	0.43	1.96	1113
bm^{FF}	0.62	0.63	4.72	60.05	0.00	0.09	0.25	0.46	0.80	1.60	8.73	1113
$bm^{Eisfeldt}$	2.09	3.16	6.18	74.08	0.02	0.21	0.60	1.20	2.40	6.67	48.70	1149
bm^{Peters}	1.28	1.54	5.07	55.72	0.02	0.19	0.47	0.85	1.54	3.69	21.83	1154
bm^{Ewens}	1.30	1.55	4.84	48.56	0.02	0.19	0.47	0.86	1.58	3.77	20.47	1152
ME	2399	12456	12	203	1	8	42	164	663	7529	233763	1205
Panel B: Traditional sector												
	mean	std	skew	kurtosis	min	5%	25%	median	75%	95%	max	count
logbm^{FF}	-0.41	0.85	-0.93	3.58	-6.38	-1.89	-0.86	-0.32	0.12	0.78	2.78	2736
bm^{FF}	0.95	0.94	6.52	111.37	0.00	0.16	0.44	0.76	1.17	2.30	19.21	2736
$bm^{Eisfeldt}$	2.87	5.60	11.11	251.27	0.01	0.31	0.85	1.53	2.99	9.08	143.54	2783
bm^{Peters}	1.54	2.07	9.09	185.15	0.01	0.25	0.64	1.07	1.75	4.21	47.15	2780
bm^{Ewens}	1.39	1.66	7.52	127.66	0.01	0.23	0.60	1.00	1.61	3.67	34.77	2777
ME	2145	9249	14	279	1	11	61	260	1082	8689	226719	3191

Table 22: Correlation Between Variables Within the High Tech Sector and the Traditional Sector

This table presents the time-series averages of cross-sectional Pearson product-moment (below-diagonal entries) and Spearman rank (above-diagonal entries) correlations between the four versions of book-to-market ratio for sample period from June 1976 to December 2019 within the high tech sector (Panel A) and the traditional sector (Panel B).

Panel A: High Tech Sector				
	bm^{FF}	$bm^{Eisfeldt}$	bm^{Peters}	bm^{Ewens}
bm^{FF}	1.00	0.77	0.84	0.86
$bm^{Eisfeldt}$	0.70	1.00	0.87	0.92
bm^{Peters}	0.77	0.88	1.00	0.98
bm^{Ewens}	0.80	0.95	0.96	1.00
Panel B: Traditional Sector				
	bm^{FF}	$bm^{Eisfeldt}$	bm^{Peters}	bm^{Ewens}
bm^{FF}	1.00	0.71	0.88	0.91
$bm^{Eisfeldt}$	0.65	1.00	0.92	0.89
bm^{Peters}	0.83	0.94	1.00	0.99
bm^{Ewens}	0.87	0.90	0.98	1.00

Table 23: Persistence of Book-to-Market Ratio Within the High Tech Sector and the Traditional Sector

This table presents the results of persistence analyses of four versions of the book-to-market ratio for the sample period from June 1976 to December 2019 within the high tech sector (Panel A) and the traditional sector (Panel B). Each month t, the cross-sectional Pearson product–moment correlation between the month t and month $t + \tau$ values of the given variable is calculated. The table presents the time-series averages of the monthly cross-sectional correlations. The column labeled τ indicates the lag at which the persistence is measured.

Panel A: High tech sector				
	bm^{FF}	$bm^{Eisfeldt}$	bm^{Peters}	bm^{Ewens}
12	0.73	0.77	0.72	0.73
24	0.59	0.64	0.56	0.58
36	0.49	0.55	0.46	0.49
48	0.43	0.48	0.39	0.42
60	0.37	0.42	0.32	0.36
120	0.24	0.27	0.18	0.22
Panel B: Traditional sector				
	bm^{FF}	$bm^{Eisfeldt}$	bm^{Peters}	bm^{Ewens}
12	0.76	0.83	0.79	0.78
24	0.61	0.71	0.65	0.64
36	0.50	0.63	0.56	0.54
48	0.43	0.56	0.49	0.47
60	0.38	0.51	0.44	0.41
120	0.30	0.39	0.33	0.31

Table 24: Univariate Portfolio Analysis Within the High Tech Sector and the Traditional Sector

This table presents the averages of value-weighted one-month-ahead excess returns and corresponding Newey and West (1987) t-statistics using 6 lags within portfolios formed by sorting different book-to-market ratios indicated by the columns from low to high. The sample period is from June 1976 to December 2019. Panel A covers the sample of the high tech sector stocks and panel B covers the sample of the traditional sector.

Panel A: High tech sector

	bm^{FF}		$bm^{Eisfeldt}$		bm^{Peters}		bm^{Ewens}	
	VW excess return	t VW	VW excess return	t VW	VW excess return	t VW	VW excess return	t VW
1	0.60	(1.85)	0.71	(2.1)	0.68	(2.04)	0.68	(2.04)
2	0.78	(2.95)	0.67	(2.5)	0.61	(2.19)	0.64	(2.3)
3	0.74	(2.94)	0.68	(2.79)	0.75	(3.1)	0.75	(3.1)
4	0.68	(2.67)	0.81	(3.37)	0.72	(2.93)	0.76	(3.16)
5	0.82	(3.44)	0.79	(3.49)	0.77	(3.16)	0.79	(3.33)
6	0.89	(3.55)	0.94	(3.8)	0.93	(3.8)	0.91	(3.6)
7	0.86	(3.38)	0.81	(3.18)	0.95	(3.74)	0.92	(3.59)
8	0.87	(3.17)	0.97	(3.6)	0.85	(3.12)	0.85	(3.1)
9	0.95	(3.55)	1.08	(3.81)	1.02	(3.74)	1.08	(3.96)
10	1.02	(3.77)	1.13	(4.01)	1.12	(4.01)	1.09	(3.89)
10-1	0.42	(1.9)	0.42	(2.44)	0.44	(2.33)	0.41	(2.31)

Panel B: Traditional sector

	bm^{FF}		$bm^{Eisfeldt}$		bm^{Peters}		bm^{Ewens}	
	VW excess return	t VW	VW excess return	t VW	VW excess return	t VW	VW excess return	t VW
1	0.59	(2.77)	0.54	(2.4)	0.57	(2.67)	0.58	(2.74)
2	0.57	(2.8)	0.61	(2.95)	0.59	(2.78)	0.60	(2.86)
3	0.65	(3.12)	0.58	(2.97)	0.61	(3.0)	0.59	(2.95)
4	0.68	(3.35)	0.64	(3.34)	0.65	(3.36)	0.67	(3.37)
5	0.65	(3.11)	0.67	(3.34)	0.63	(3.18)	0.62	(3.14)
6	0.67	(3.27)	0.73	(3.69)	0.65	(3.27)	0.64	(3.15)
7	0.64	(3.08)	0.70	(3.32)	0.73	(3.53)	0.71	(3.44)
8	0.67	(3.27)	0.74	(3.38)	0.68	(3.17)	0.70	(3.26)
9	0.67	(3.23)	0.71	(3.15)	0.71	(3.13)	0.69	(3.03)
10	0.69	(3.08)	0.68	(2.99)	0.66	(2.89)	0.66	(2.89)
10-1	0.09	(1.18)	0.14	(1.82)	0.09	(1.14)	0.08	(1.03)

Table 25: Fama MacBeth Regression Within the High Tech Sector and the Traditional Sector

This table presents the results of Fama and MacBeth (1973) regression analyses of the relation between expected stock returns and book-to-market ratio using sample period from June 1976 to December 2019 within the high tech sector and the traditional sector. Each column in the table presents results for a different cross-sectional regression specification. The dependent variable is the one-month-ahead excess stock return. The independent variables are indicated in the first column and are winsorized at the 0.5% level on a monthly basis. The table presents average slope and intercept coefficients along with t-statistics (in parentheses), adjusted following Newey and West (1987) using six lags, testing the null hypothesis that the average coefficient is equal to zero. The rows labeled Adj. Adj. R^2 and n present the average adjusted R-squared and the number of data points, respectively, for the cross-sectional regressions.

	High tech sector					Traditional Sector				
	(1)	(2)	(3)	(4)	(5)	(1)	(2)	(3)	(4)	(5)
logbm^{FF}	0.36				0.09	0.33				0.02
	(5.57)				(0.86)	(5.65)				(0.16)
log$bm^{Eisfeldt}$		0.29			0.02		0.29			-0.02
		(4.81)			(0.16)		(5.41)			(-0.19)
logbm^{Peters}			0.49		1.34			0.37		0.15
			(7.32)		(2.78)			(5.9)		(0.41)
logbm^{Ewens}				0.43	-0.98				0.39	0.23
				(6.58)	(-2.08)				(6.04)	(0.59)
β	-0.05	-0.07	-0.03	-0.03	-0.04	-0.07	-0.11	-0.10	-0.09	-0.07
	(-0.34)	(-0.44)	(-0.17)	(-0.21)	(-0.25)	(-0.42)	(-0.63)	(-0.55)	(-0.52)	(-0.42)
Size	-0.16	-0.13	-0.11	-0.12	-0.13	-0.03	-0.01	-0.01	-0.01	-0.02
	(-2.36)	(-1.79)	(-1.63)	(-1.68)	(-2.0)	(-0.63)	(-0.14)	(-0.21)	(-0.19)	(-0.33)
Intercept	2.16	1.63	1.66	1.68	1.84	1.01	0.65	0.77	0.80	0.83
	(3.94)	(2.83)	(3.01)	(3.0)	(3.6)	(2.82)	(1.8)	(2.16)	(2.22)	(2.43)
Adj. R^2	0.03	0.02	0.02	0.02	0.03	0.03	0.03	0.03	0.03	0.03
n	1113	1149	1154	1153	1094	2738	2785	2782	2778	2691

Table 26: Spanning Tests Within the High Tech Sector and the Traditional Sector

This table presents the spanning tests for the four versions of HML factor constructed using bm^{FF}, $bm^{Eisfeldt}$, bm^{Peters} and bm^{Ewens} respectively within the high tech sector and the traditional sector. The sample period is from June 1976 to December 2019. The dependent variables are indicated by the column and the non-constant dependent variables are the other four factors from Fama and French (2015). p-values are shown in parentheses.

	High tech sector				Traditioanl sector			
	HML^{FF}	$HML^{Eisfeldt}$	HML^{Peters}	HML^{Ewens}	HML^{FF}	$HML^{Eisfeldt}$	HML^{Peters}	HML^{Ewens}
SMB	0.02	0.15	0.20	0.22	-0.05	0.19	0.12	0.09
	(0.753)	(0.037)	(0.007)	(0.005)	(0.337)	(0.0)	(0.015)	(0.051)
RMW	-0.03	0.13	-0.04	0.03	-0.09	0.08	-0.04	-0.07
	(0.744)	(0.057)	(0.629)	(0.737)	(0.325)	(0.368)	(0.72)	(0.437)
CMA	0.76	0.78	0.81	0.79	0.73	0.60	0.71	0.74
	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)
mkt	-0.03	0.06	0.03	0.06	-0.05	0.04	0.04	0.03
	(0.506)	(0.113)	(0.421)	(0.14)	(0.211)	(0.225)	(0.284)	(0.498)
Intercept	0.18	0.23	0.29	0.17	0.09	0.14	0.10	0.10
	(0.261)	(0.138)	(0.058)	(0.291)	(0.411)	(0.173)	(0.377)	(0.417)
Adj. R^2	0.21	0.19	0.23	0.20	0.39	0.28	0.31	0.32

Table 27: Fama MacBeth Regression Using Int-to-Market Ratio

This table presents the results of Fama and MacBeth (1973) regression analyses of the relation between expected stock returns and intangible capital over market value using the sample period from June 1976 to December 2019. Each column in the table presents results for a different cross-sectional regression specification. The dependent variable in all specifications is the one-month-ahead excess stock return. The independent variables are indicated in the first column. Independent variables are winsorized at the 0.5% level on a monthly basis. The table presents average slope and intercept coefficients along with t-statistics (in parentheses), adjusted following Newey and West (1987) using six lags, testing the null hypothesis that the average coefficient is equal to zero. The rows labeled Adj. R^2 and n present the average adjusted R-squared and the number of data points, respectively, for the cross-sectional regressions.

	(1)	(2)	(3)	(4)	(5)
$logbm^{FF}$	0.27				0.22
	(3.98)				(3.48)
$logim^{Eisfeldt}$		0.19			-0.22
		(4.78)			(-2.49)
$logim^{Peters}$			0.21		-0.04
			(5.27)		(-0.33)
$logim^{Ewens}$				0.22	0.43
				(5.52)	(2.83)
β	0.00	-0.03	-0.04	-0.05	-0.04
	(0.02)	(-0.14)	(-0.23)	(-0.25)	(-0.24)
Size	-0.09	-0.05	-0.05	-0.04	-0.05
	(-1.49)	(-0.92)	(-0.87)	(-0.75)	(-0.93)
Intercept	1.35	1.08	1.30	1.32	1.69
	(3.27)	(2.72)	(3.19)	(3.22)	(3.72)
$Adj.R^2$	0.03	0.03	0.03	0.03	0.03
n	3851	3774	3968	3967	3213

Table 28: Spanning Tests for IHML Factor

This table presents the spanning tests for the HML factor constructed using bm^{FF}, $im^{Eisfeldt}$, im^{Peters} and im^{Ewens} respectively. The dependent variable is indicated by the column and the non-constant dependent variables are the other four factors from Fama and French (2015). The sample period is from June 1976 to December 2019. p-values are shown in parentheses.

	$IHML^{FF}$	$IHML^{Eisfeldt}$	$IHML^{Peters}$	$IHML^{Ewens}$
SMB	-0.05	0.20	0.24	0.22
	(0.406)	(0.0)	(0.0)	(0.0)
RMW	0.23	0.31	-0.02	-0.11
	(0.063)	(0.0)	(0.765)	(0.138)
CMA	0.99	0.76	0.65	0.53
	(0.0)	(0.0)	(0.0)	(0.0)
mkt	-0.02	0.05	0.03	0.03
	(0.659)	(0.082)	(0.174)	(0.292)
Intercept	-0.10	0.15	0.31	0.40
	(0.431)	(0.144)	(0.001)	(0.0)
$Adj.R^2$	0.53	0.42	0.37	0.29

Appendix

A Replication tables

The tables are my replication to all the tables of Chapter 10 in Bali, Engle, and Murray (2016) with the titles indicating the corresponding tables.

Table A.1: Replication to table 10.1 in Bali et al. (2016)

	mean	std	skew	kurt	min	5%	25%	median	75%	95%	max	count
BM	0.90	0.86	6.00	109.38	0.01	0.15	0.41	0.72	1.14	2.22	18.64	3357
lnBM	-0.49	0.86	-0.75	2.43	-6.09	-1.98	-0.96	-0.40	0.07	0.73	2.68	3357
BE	1028	4702	17	453	1	11	50	158	539	3909	129749	3357
ME	2060	9752	15	342	2	17	77	272	1032	7265	246203	3357
Mktcap	1249	6111	15	332	1	7	34	129	535	4598	159004	3356

Table A.2: Replication to table 10.1 in Bali et al. (2016) using exactly the same procedure described in the book

	mean	std	skew	kurtosis	min	5%	25%	median	75%	95%	max	count
BM	0.94	1.13	9.27	239.53	0.01	0.15	0.42	0.72	1.15	2.31	31.18	3393
lnBM	-0.47	0.87	-0.66	2.42	-6.09	-1.97	-0.95	-0.39	0.08	0.77	3.02	3393
BE	1043.78	4796.39	16.94	448.32	0.82	11.20	50.22	159.17	544.44	3950.07	129749.12	3393
ME	2039.75	9666.34	15.48	346.93	2.31	16.98	76.79	270.21	1024.87	7225.90	246203.29	3393
Mktcap	1232.37	6035.45	15.27	337.19	0.67	6.62	33.58	127.87	529.61	4567.99	159003.98	3392

Table A.3: Replication to table 10.2 in Bali et al. (2016)

	BM	lnBM		size
BM		1.00	-0.23	-0.26
lnBM	0.85		-0.23	-0.26
β	-0.20	-0.22		0.32
Size	-0.28	-0.24	0.30	

Table A.4: Replication to table 10.3 in Bali et al. (2016)

τ	BM	lnBM
12	0.778	0.812
24	0.633	0.686
36	0.537	0.599
48	0.471	0.540
60	0.423	0.491
120	0.324	0.382

Table A.5: Replication to table 10.4 in Bali et al. (2016)

Panel A: NYSE/AMEX/NASDAQ Breakpoints												
	Value	1	2	3	4	5	6	7	8	9	10	10-1
Characteristics	BM	0.15	0.29	0.41	0.53	0.65	0.79	0.94	1.14	1.46	2.65	
	lnBM	-2.17	-1.32	-0.96	-0.71	-0.49	-0.31	-0.12	0.07	0.31	0.83	
	Mktcap	2195	2223	1698	1437	1295	1038	937	816	619	283	
	β	1.06	0.98	0.91	0.85	0.81	0.78	0.74	0.70	0.66	0.60	
	%NYSE	29.05%	35.87%	40.78%	43.60%	45.93%	47.45%	45.68%	44.43%	40.51%	32.53%	
	n	334	334	333	334	334	333	333	334	333	334	
EW portfolios	Excess return	0.01	0.33	0.45	0.57	0.70	0.78	0.89	0.93	1.07	1.35	1.35
		(0.02)	(1.05)	(1.59)	(2.12)	(2.59)	(3.04)	(3.47)	(3.51)	(3.98)	(4.03)	(6.24)
	CAPM α	-0.64	-0.28	-0.12	0.04	0.18	0.29	0.42	0.46	0.60	0.88	1.51
		(-3.25)	(-1.79)	(-0.84)	(0.29)	(1.33)	(2.17)	(3.06)	(3.14)	(3.82)	(4.04)	(6.77)
VW portfolios	Excess return	0.31	0.32	0.44	0.44	0.43	0.50	0.62	0.58	0.74	0.84	0.53
		(1.2)	(1.51)	(2.2)	(2.11)	(2.14)	(2.64)	(3.15)	(2.73)	(3.77)	(3.36)	(2.25)
	CAPM α	-0.19	-0.16	-0.01	-0.02	0.00	0.09	0.22	0.17	0.31	0.36	0.55
		(-1.54)	(-2.1)	(-0.19)	(-0.34)	(-0.02)	(1.04)	(2.09)	(1.38)	(2.47)	(2.39)	(2.27)
Panel B: NYSE Breakpoints												
	Value	1	2	3	4	5	6	7	8	9	10	10-1
Characteristics	BM	0.18	0.35	0.47	0.58	0.69	0.80	0.93	1.09	1.35	2.37	
	lnBM	-1.88	-1.12	-0.82	-0.60	-0.43	-0.28	-0.12	0.04	0.24	0.73	
	Mktcap	2383	1941	1607	1341	1223	1085	945	868	673	315	
	$/beta$	1.05	0.94	0.88	0.83	0.80	0.76	0.73	0.70	0.67	0.61	
	%NYSE	32.23%	39.27%	43.33%	45.05%	47.16%	48.02%	47.93%	45.53%	42.23%	34.05%	
	n	514	353	313	292	280	273	273	284	315	425	
EW portfolios	Excess return	0.17	0.49	0.60	0.59	0.78	0.79	0.83	0.90	1.04	1.27	1.27
		(0.52)	(1.69)	(2.17)	(2.15)	(2.92)	(3.05)	(3.35)	(3.54)	(3.91)	(3.95)	(5.83)
	CAPM α	-0.46	-0.09	0.05	0.06	0.27	0.30	0.37	0.44	0.57	0.80	1.25
		(-2.65)	(-0.62)	(0.35)	(0.44)	(1.97)	(2.25)	(2.85)	(3.14)	(3.78)	(3.94)	(6.4)
VW portfolios	Excess return	0.36	0.47	0.46	0.40	0.46	0.49	0.62	0.62	0.63	0.83	0.47
		(1.53)	(2.32)	(2.3)	(1.89)	(2.41)	(2.58)	(3.09)	(3.14)	(3.13)	(3.49)	(2.3)
	CAPM α	-0.12	0.00	0.00	-0.06	0.05	0.09	0.22	0.21	0.21	0.35	0.48
		(-1.31)	(0.04)	(0.04)	(-0.72)	(0.52)	(0.97)	(2.02)	(1.83)	(1.84)	(2.5)	(2.25)

Table A.6: Replication to table 10.5 in Bali et al. (2016)

Panel A: BM Difference Portfolios								
Control	Weights	Value	Control1	Control2	Control3	Control4	Control5	ControlAvg
β	EW	Return	0.90	0.79	0.75	0.87	1.28	0.92
			(5.06)	(4.74)	(5.02)	(5.26)	(6.85)	(6.56)
		CAPM α	0.95	0.84	0.78	0.91	1.31	0.96
			(5.28)	(5.06)	(5.17)	(5.37)	(7.03)	(6.76)
	VW	Return	0.52	0.47	0.36	0.43	0.39	0.43
			(2.51)	(2.76)	(2.22)	(2.23)	(1.69)	(3.14)
		CAPM α	0.47	0.51	0.34	0.43	0.41	0.43
			(2.28)	(3.02)	(2.09)	(2.18)	(1.72)	(3.07)
Mktcap	EW	Return	0.80	1.19	0.94	0.69	0.28	0.78
			(3.41)	(5.17)	(4.07)	(3.09)	(1.41)	(4.11)
		CAPM α	0.95	1.33	1.11	0.87	0.43	0.94
			(4.14)	(5.76)	(4.97)	(3.94)	(2.17)	(5.02)
	VW	Return	0.90	1.15	0.89	0.68	0.17	0.76
			(3.77)	(4.87)	(3.84)	(3.09)	(0.91)	(4.03)
		CAPM α	1.04	1.29	1.07	0.86	0.24	0.90
			(4.38)	(5.41)	(4.74)	(3.93)	(1.24)	(4.78)
Panel B: Avarage Control Variable Portfolios								
Control	Weights	Value	BM1	BM2	BM3	BM4	BM5	BM5-1
β	EW	Return	0.26	0.57	0.70	0.86	1.18	0.92
			(0.84)	(2.09)	(2.68)	(3.26)	(3.74)	(6.56)
		CAPM α	-0.31	0.04	0.18	0.36	0.65	0.96
			(-1.87)	(0.3)	(1.51)	(2.7)	(3.61)	(6.76)
	VW	Return	0.32	0.39	0.47	0.57	0.75	0.43
			(1.54)	(2.0)	(2.47)	(3.02)	(3.45)	(3.14)
		CAPM α	-0.12	-0.04	0.05	0.17	0.31	0.43
			(-1.84)	(-0.74)	(0.87)	(2.14)	(2.78)	(3.07)
Mktcap	EW	Return	0.27	0.60	0.80	0.86	1.05	0.78
			(0.79)	(2.07)	(2.99)	(3.35)	(3.85)	(4.11)
		CAPM α	-0.36	0.05	0.29	0.39	0.58	0.94
			(-1.87)	(0.33)	(2.17)	(2.86)	(3.74)	(5.02)
	VW	Return	0.17	0.48	0.68	0.75	0.92	0.76
			(0.5)	(1.76)	(2.64)	(3.09)	(3.49)	(4.03)
		CAPM α	-0.44	-0.06	0.18	0.30	0.46	0.90
			(-2.48)	(-0.43)	(1.47)	(2.39)	(3.08)	(4.78)

Table A.7: Replication to table 10.6 in Bali et al. (2016)

Panel A: Equal-Weighted Portfolios								
	β1	β2	β3	β4	β5	βAvg	β5-1	β5-1CAPMα
BM1	0.36	0.35	0.41	0.19	0.01	0.26	-0.35	-0.72
							(-1.59)	(-3.26)
BM2	0.51	0.57	0.60	0.59	0.48	0.55	-0.03	-0.43
							(-0.16)	(-2.2)
BM3	0.84	0.65	0.75	0.81	0.74	0.76	-0.10	-0.52
							(-0.46)	(-2.47)
BM4	0.83	0.89	0.89	0.90	0.92	0.89	0.09	-0.35
							(0.38)	(-1.67)
BM5	1.19	1.19	1.26	1.14	1.18	1.19	-0.01	-0.41
							(-0.06)	(-1.84)
BMAvg	0.75	0.73	0.78	0.73	0.66		-0.08	-0.49
							(-0.41)	(-2.68)
BM5-1	0.83	0.84	0.85	0.95	1.17	0.93		
	(3.99)	(4.48)	(5.06)	(5.53)	(5.5)	(6.15)		
BM 5-1	0.91	0.89	0.88	0.99	1.22	0.98		
CAPMα	(4.52)	(4.79)	(5.2)	(5.59)	(5.74)	(6.44)		

Panel B: Value-Weighted Portfolios								
	β1	β2	β3	β4	β5	βAvg	β5-1	β5-1CAPMα
BM1	0.34	0.27	0.41	0.25	0.21	0.29	-0.13	-0.52
							(-0.43)	(-1.94)
BM2	0.22	0.46	0.38	0.60	0.32	0.40	0.09	-0.26
							(0.39)	(-1.17)
BM3	0.45	0.41	0.50	0.45	0.58	0.48	0.13	-0.25
							(0.53)	(-1.04)
BM4	0.59	0.56	0.61	0.62	0.62	0.60	0.03	-0.40
							(0.12)	(-1.98)
BM5	0.75	0.72	0.88	0.83	0.60	0.76	-0.16	-0.58
							(-0.59)	(-2.2)
BMAvg	0.47	0.48	0.55	0.55	0.47		-0.01	-0.40
							(-0.02)	(-2.11)
BM5-1	0.42	0.45	0.47	0.58	0.39	0.46		
	(1.81)	(2.66)	(2.85)	(2.99)	(1.62)	(3.34)		
BM 5-1	0.42	0.49	0.46	0.57	0.35	0.46		
CAPMα	(1.82)	(2.97)	(2.76)	(2.83)	(1.46)	(3.3)		

Table A.8: Replication to table 10.7 in Bali et al. (2016)

Panel A: Equal-Weighted Portfolios

	Mktcap 1	Mktcap 2	Mktcap 3	Mktcap 4	Mktcap 5	Mktcap Avg	Mktcap 5-1	Mktcap 5-1 CAPM α
BM1	1.02	-0.18	-0.01	0.25	0.37	0.29	-0.65	-0.57
							(-1.68)	(-1.55)
BM2	1.02	0.30	0.51	0.56	0.49	0.58	-0.52	-0.49
							(-1.69)	(-1.61)
BM3	1.31	0.73	0.69	0.66	0.58	0.79	-0.73	-0.67
							(-2.59)	(-2.49)
BM4	1.36	0.71	0.86	0.89	0.62	0.89	-0.74	-0.69
							(-2.96)	(-2.84)
BM5	1.62	0.97	0.88	0.91	0.71	1.02	-0.90	-0.90
							(-3.36)	(-3.34)
BMAvg	1.27	0.51	0.59	0.65	0.56		-0.71	(-0.66)
							(-2.58)	(-2.51)
BM5-1	0.60	1.15	0.89	0.67	0.34	0.73		
	(2.2)	(4.9)	(3.71)	(2.87)	(1.76)	(3.68)		
BM 5-1	0.79	1.30	1.06	0.82	0.46	0.88		
CAPM α	(3.03)	(5.57)	(4.5)	(3.44)	(2.37)	(4.55)		

Panel B: Valuel-Weighted Portfolios

	Mktcap 1	Mktcap 2	Mktcap 3	Mktcap 4	Mktcap 5	Mktcap Avg	Mktcap 5-1	Mktcap 5-1 CAPM α
BM1	0.36	-0.14	0.04	0.26	0.35	0.17	-0.01	0.13
							(-0.02)	(0.36)
BM2	0.50	0.31	0.50	0.55	0.43	0.46	-0.07	0.02
							(-0.23)	(0.06)
BM3	0.81	0.72	0.71	0.64	0.43	0.66	-0.38	-0.27
							(-1.33)	(-1.03)

Table A.8 continued from previous page								
BM4	0.92	0.72	0.86	0.88	0.51	0.78	-0.41	-0.34
							(-1.56)	(-1.33)
BM5	1.16	0.96	0.89	0.90	0.61	0.90	-0.55	-0.53
							(-2.12)	(-2.08)
BMAvg	0.75	0.51	0.60	0.65	0.46		-0.28	-0.20
							(-1.02)	(-0.76)
BM5-1	0.80	1.10	0.85	0.64	0.25	0.73		
	(2.98)	(4.63)	(3.48)	(2.75)	(1.32)	(3.67)		
BM 5-1	0.97	1.25	1.02	0.78	0.31	0.86		
CAPM α	(3.74)	(5.23)	(4.28)	(3.33)	(1.55)	(4.41)		

Table A.9: Replication to table 10.8 in Bali et al. (2016)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
BM	0.48	0.41	0.34	0.27				
	(5.63)	(5.46)	(3.75)	(3.67)				
lnBM					0.44	0.40	0.33	0.29
					(6.3)	(6.58)	(4.07)	(4.51)
β		-0.11		0.03		-0.07		0.08
		(-0.85)		(0.17)		(-0.53)		(0.49)
Size			-0.12	-0.13			-0.12	-0.13
			(-2.37)	(-2.2)			(-2.29)	(-2.25)
Intercept	0.31	0.47	0.99	1.07	0.93	0.96	1.42	1.42
	(1.1)	(2.09)	(1.98)	(2.48)	(3.4)	(4.08)	(3.14)	(3.46)
Adj. R^2	0.01	0.02	0.02	0.04	0.01	0.02	0.02	0.04
n	3356	3337	3356	3337	3356	3337	3356	3337

B Note on intangible capital

B.1 Why do we need to estimate intangible assets

B.1.1 Accounting principle

In the current accounting standards, the conservatism principle prevents the internal generated in-tangible capital from being recorded in the balance sheets. Conservatism requires company accounts to be prepared with caution and high degrees of verification. While the intangible assets, as its name indicate, are not physical in nature and not financial instruments, thus hard to measure its value. Though current accounting items do have intangible items like patent, brand, trademark, copyright listed under long-term assets on the balance sheet, they are actually mostly acquired from firms outside and the amount is the costs to buy that externally generated items. Only a neglectable direct costs incurred in developing the intangible such as legal costs is capitalized while the rest are all expensed. From now on, we regard this item (INTAN) as value of externally obtained intangible assets. Goodwill, which is the excess price higher than the sum of fair value of another firm bought, is also recorded as intangible assets. On the other hand, if firms plan to generate intangible assets inside, like developing a new system, machine, medicine, applying for a new patent and so on, the expenses from this process will be expensed, which decreases the net book value of the firm. But the intangible assets shall not be recorded in the accounting.

While we cannot deny the revenue brought by and the significance of intangible assets, there is no doubt that the process to create intangible assets such as development and research face too much uncertainty or risk or even fail in most of times and that the intangible assets do not usually have fair value associated. Allowing the inclusion of internally generated intangible assets would either overestimate its value or susceptible to the manipulation of management out of the purpose to present a perfect though inappropriate accounting reports, which would seriously impair the quality of reports and market confidence in making investment choices based on these reports. They may justify the reasons why the current accounting principles still impede the listing of internally generated intangible assets.

B.1.2 The need for an estimation

In spite of its absence in financial reports, it is an indisputable fact that the intangible assets have become increasingly important nowadays. In practice, while traditional firms mainly rely on plant, property and equipment as their main assets, more and more firms like Amazon, Alibaba, Facebook, Apple, Dell and other technology or e-commerce firms nowadays take intangible assets as their crucial assets. The human resources, technology updates, new platform-based, like web-based transactions are the essential competitive power among firms. In theory, many models make an endeavor to the integration of intangible capital in addition to traditional physical capital. Besides, what comes to the topic of this note is the measure of book to market ratio and its affiliated value strategy.

The value strategy, which can be simply understood as long in stocks with high book to market ratio and short in stocks with low book to market ratio, experiences persistent and large drawdowns in recent decades. One possible explanation for this phenomenon is that the current accounting principle prevents us from recording and calculating book value precisely as internally generated intangible assets like human capital, research and development costs which usually brings potential future earnings and which shall also be considered to be part of firms' assets, are actually recorded as costs or expenses which in contrast, decreases firms' assets and hence book value of equity. Therefore, some researchers propose to estimate internally generated intangible assets and adjust the book value accordingly.

B.2 Literature review on intangible assets

The intangible capital is estimated to take up to about 50% of firms' capital stock (see Falato, Kadyrzhanova, and Sim (2013)). Though it is now raising more and more people's attention, there is no strict and explicit definition to it. The initial awareness to the intangible capital is mainly associated with the emergence of firms' acquisitions with intangibles and firms' activities of research and development (see Griliches (1979)). Some researchers understand it mainly from the perspective of human resources like the high-skilled staff (key talent, organization capital) and inputs like equity-based compensation to maintain these labor (see Corrado, Hulten, and Sichel (2009), Eisfeldt and Papanikolaou (2013), Eisfeldt, Falato, and Xiaolan (2021)). Some focus on the information technology (digital capital) (see Tambe, Hitt, Rock, and Brynjolfsson (2020)). Others include both the human capital and the technology development.

Below I offer a literature review classified into three aspects: the intangible assets' effects on the macroeconomy, its application in corporate finance, and in asset pricing.

B.2.1 Macroeconomy

This strand of papers mainly focuses on the inclusion of intangible capital into classical models and explore its importance and influences on the macroeconomy. Corrado, Hulten, and Sichel (2009) add the estimated aggregate intangible capital stocks to the standard sources-of-growth framework used by BLS and find that this inclusion makes a significant difference in the observed patterns of US economic growth. Lall and Zeng (2020) incorporate the intangible capital into the standard AS-AD framework to explain the causes underlying low inflation after global financial crisis and highlight the possibility that the technological change and a large portion of intangible investment lead to wage stagnation and greater market concentration. Gareis and Mayer (2020) develop an extended real business cycle model with intangible capital and study the relative dynamics of tangible and intangible investment in response to financial shocks. Döttling and Ratnovski (2021) document that the stock prices of firms with more intangible assets react less to monetary policy shocks show that the total investment in firms with more intangible assets respond less to monetary policy shocks than tangible assets and investments. Chiavari and Goraya (2020) augment a standard production function with intangible capital and find that its input share has increased at the expense of labor in production. The intangible capital entails higher investment adjustment costs than traditional capital and tends to be misallocated. They further show that the shift of input in production can explain some of the major trends for the US economy such as the rising average firm size.

B.2.2 Corporate finance

When it comes to the capital structure of firms, the intangible capital is examined for its adjustment costs, its resistance to financial constraints and is most often considered from the wage, the equity compensation and human resources aspect.

Sun and Xiaolan (2019) provide the theoretical and empirical analysis on firms' dynamic capital structure decision with the presence of intangible capital accumulation and find that the intangible capital overhang effect dominates the precautionary effect. Eisfeldt and Papanikolaou (2013) argue that organization capital is a production factor embodied in the firm's key talent and that both shareholders and key talent have a claim to its cash flows. They develop a model and document that firms with more intangible capital have higher average returns as the outside option of key talent determines the share of firm cash flow that accrue to shareholders and thus represents a higher risk from shareholders' perspective.

For the neoclassical theory of investment, Peters and Taylor (2017) show that Tobin's Q also explains intangible investment in a better way than it explains the tangible investment. They suggest a simple, new Tobin's Q proxy that accounts for intangible capital, and they show that it is a superior proxy for both physical and intangible investment opportunities. The new proxy is just to adjust the denominator, the book value of equity, by adding intangible assets.

B.2.3 Asset pricing

Researches relevant to asset pricing either modify, develop new asset pricing models by combining intangible capital, or to revise the book-to-market ratio to remedy the value strategy.

Ahn (2016) proposes an investment-based asset pricing model augmented with intangible capital and transient volatility shock. The author argues that the intangible capital mitigates the negative impact of temporary volatility shock on output and thus, the physical-capital-intensive value firms are more exposed to volatility risk and require more premium (which is contrary to the conclusion of Eisfeldt and Papanikolaou (2013)).

Gulen, Li, Peters, and Zekhnini (2020) include intangible capital into the factor model. Several recent papers apply intangible capital to adjust the book-to-market ratio and show that it improves the performance of the value strategy significantly (see Eisfeldt, Kim, and Papanikolaou (2020), Arnott, Harvey, Kalesnik, and Linnainmaa (2020), Amenc, Goltz, and Luyten (2020), Park (2019)). Dugar and Pozharny (2021) show that the relationship between financial variables and contemporaneous stock prices has weakened for high intangible intensity companies.

B.3 An overview of estimation methods

Corrado, Hulten, and Sichel (2009) use the input-based approach to estimate the investment in certain broad groups of business intangibles and then estimate the intangible capital at the aggregate level. Squicciarini and Le Mouel (2012) use the microdata to develop a task-based approach to quantify investment in organizational capital and find that previous measures seemingly underestimate investment in organizational capital at the macro level. At the firm level, researchers usually capitalizing relevant expenditures to estimate the intangible capital which will be discussed in detail in this note (see Lev and Sougiannis (1996), Eisfeldt and Papanikolaou (2013), Peters and Taylor (2017), Park (2019)). Lev and Radhakrishnan (2009) simultaneously estimate the production function and the selling, general administrative expenses to get the annual extra revenues which is the difference between the predicted revenue with and without organization capital. Then they capitalize the annual extra revenue to get an estimate of organization capital. When estimating the firms' missing internally generated intangible assets, researchers can impute intangible capital as a latent variable based on other moments or use inventory or exploiting asset prices to compute intangible capital directly. The most popular one applied in the field of value strategy is the perpetual inventory method described following:

$$X_{t+1} = (1 - \delta)X_t + \gamma \cdot G_t$$

where X_t is the intangible capital stock, G_t is the relevant expenditures, δ is the depreciation rate and γ is the transformation rate. The diversification among the estimates employed by different authors mainly lies in the selection of initial stock X_0, further classification of X_{it} into knowledge K_{it} and organization capital O_{it}, and the parameters δ, γ.

B.4 Preliminary on Compustat items

When calculating intangible adjusted book value of equity, we use several items from Compustat:
Those related to book value of equity defined by Fama and French are parent stockholders' equity (SEQ), deferred taxes (TXDB), investment tax credit (ITCB), and book value of preferred stocks (PRTKRV, PSTKL, PSTK).
Those related to intangible assets are total intangible assets (INTAN), goodwill (GDWL) which is part of INTAN, selling, general and administrative expense (XSGA) and research and development expense (XRD).
INTAN item contains mostly the value of externally obtained intangible capital but a neglectable portion of internally generated one. So we usually regard it as the value of externally obtained intangible capital. Besides, as it is under long-term assets which is part of book value of equity, it is not separately listed or cited to calculate intangible adjusted book to market ratio.
XSGA item displays the costs not directly related to making a product or performing a service like indirect selling expenses such as advertising, marketing, telephone bills, travel costs, and salaries of staff, commissions, utilities, rent which is not part of manufacturing. Its portion over revenue is usually highest among health care and financial industries. This item is essential for estimation of organization capital as it can be viewed as a proxy for investment in human capital, brand, customer relationships etc.
XRD item displays the expenses relevant to the process of exploring and creating new products, services, technologies. Tech firms exhibit large expenses on this item as developing facial recognition, AI techniques.
One thing calls for our attention: while firms typically report SG&A and R&D expenses separately, Compustat, however, almost always adds them together under item XSGA. Therefore, when dealing knowledge capital and organization capital separately, we need to subtract XRD from XSGA.
Another issue with Compustat records is that it incorporates firms not as soon as the firms are founded but may contain several years gap between a firm's foundation and the same firm's appearance in Compustat.

B.5 Three measures of internally generated intangible assets

Here I first offer a sketch for the differences among three measures and then detail its process one by one. Peters and Taylor (2017) and Ewens, Peters, and Wang (2020) use the sample method to account for the initial value of intangible assets and accumulate organization (O_{it}) and knowledge capital (K_{it}) separately but use different set of parameters. Eisfeldt, Kim, and Papanikolaou (2020) on the other hand, initialize internally generated intangible assets as $\frac{SG\&A}{0.3}$ where SG&A is the first observation for selling and general administrative expenses when the firm appears in Compustat for the first time and they do not consider research and development expenses separately in their main measure. The authors in their paper sometimes consider alternative approaches like if goodwill should be included, if expenses on research and development should be separately adjusted, if other often applied parameters should be used, and they argue that their main results are robust to these variations. Given the length of this note, only the ways to construct their main measures of internally generated intangible assets are used here.

B.5.1 Eisfeldt, Kim, and Papanikolaou (2020)'s estimation of externally generated intangible assets:

$$Int_{it}^{Eisfeldt} = 0.8 \cdot Int_{i,t-1}^{Eisfeldt} + SG\&A$$

where SG&A is Compustat item XSGA replaced by 0 if missing. The initial stock is assumed to be $\frac{SG\&A_1}{0.3}$ with $SG\&A_1$ is the first record of this firm in Compustat under item XSGA. Therefore, the $Int_{i1}^{Eisfeldt}$, the first estimation in the first record of this firm would be $0.8 \cdot \frac{SG\&A_1}{0.3} + SG\&A_1$.
As the authors note in their paper, goodwill is subtracted. Then the overall intangible capital used to adjust the book equity of Fama and French in the same fiscal year is:

$$Intit = Int_{it}^{Eisfeldt} - GDWL$$

B.5.2 Peters and Taylor (2017)'s estimation of externally generated intangible assets:

As pointed above, Peter and Taylor (2017) and Ewens, Peters, and Wang (2020) further divide internally generated intangible capital into knowledge capital and organization capital.

$$K_{it} = (1 - \delta_{Li,2012} K_{i,t-1} + R\&D)$$

$$O_{it} = 0.8 \cdot O_{i,t-1} + 0.3 \cdot SG\&A$$

$$Int_{it}^{Peters} = K_{it} + O_{it}$$

where R&D is Compustat item XRD. SG&A is $XSGA - XRD - RDIP$ (XRD, RDIP should be replaced by 0 if missing), or XSGA itself replaced by 0 if missing when $COGS > XRD > XSGA$. The detailed argument for the implementation can be found in the original paper. The table for $\delta_{Li,2012}$ is attached at the end.
The adjustment for missing XRD and XSGA for existing records in Compustat is subtle: Peters and Taylor set them to 0 when missing except the years when the firm's assets are also missing. For these years, they interpolate these two variables using their nearest non-missing values.
The estimation for firms' initial capital stock is a little bit tricky. Basically speaking, it includes the following steps:
1, estimate AgeSinceIPO-specific (age) growth rates and PreIPO growth rates for R&D and SG&A;
2, use the estimated growth rates to estimate R&D and SG&A for years when firms are founded yet not listed in Compustat;
3, assume firm is founded with no intangible capital and apply the perpetual inventory method to the estimated statistics to calculate the stock of intangible capital at the first Compustat record.
The detailed process for estimating the initial knowledge-capital stock below is copied from Peters and Taylor (2017). The method for organization capital is similar:
1, Define age since IPO as number of years elapsed since a firm's IPO. Using the full Compustat database, compute the average log change in R&D in each yearly category of age since IPO. Apply these age-specific

growth rates to fill in missing R&D observations before 1977.

2, Using the full Compustat database, isolate records for firms' IPO years and the previous two years. (Not all firms have pre-IPO data in Compustat.) Compute the average log change in R&D within this pre-IPO subsample, which equals 0.348. (The corresponding pre-IPO average log change in SG&A equals 0.333.)

3. If firm i's IPO year is in Compustat, go to Step 5. Otherwise go to the next step.

4. This step applies almost exclusively to firms with IPOs before 1950. Estimate firm i's R&D spending in each year between the firm's IPO year and first Compustat year, assuming the firm's R&D grows at the average age-specific rates estimated in Step 1.

5. Obtain data on firm i's founding year from Jay Ritter's website. For firms with missing founding year, estimate the founding year as the minimum of (a) the year of the firm's first Compustat record and (b) firm's IPO year minus eight, which is the median age between founding and IPO for IPOs from 1980 to 2012 (from Jay Ritter's website).

6. Estimate the firm i's R&D spending in each year between the firm's founding year and IPO year assuming the firm's R&D grows at the estimated pre-IPO average rate from Step 2.

7. Assume the firm is founded with no capital. Apply the perpetual inventory method to the estimated R&D spending from the previous steps to obtain K_{i0}, the stock of knowledge capital at the beginning of the firm's first Compustat record. As explained in above, INTAN is a long-term assets and already included in the book equity of Fama and French, then we simply add Int_{it}^{Peters} to book equity of the firm i in the same fiscal year t to get intangible adjusted book value of equity.

B.5.3 Ewens, Peters, and Wang (2020)'s estimation of intangible assets

The only difference between Ewens et al. (2020) and Peters and Taylor (2017) is the parameter selection. The computation of initial stock capital, the measure for current period's inputs are exactly the same.

$$K_{it} = (1 - \delta_{Ewens})K_{i,t-1} + R\&D$$

$$O_{it} = 0.8 \cdot Oi, t-1 + \gamma_{Ewens} \cdot SG\&A$$

$$Int_{it}^{Ewens} = K_{it} + O_{it}$$

The table for δ_{Ewens} and γ_{Ewens} are attached at the end. We only need to add Int_{it}^{Ewens} to obtain the intangible adjusted book value of equity.

C Other variables and sorting efficiency

In this section, we compare the characteristics between the standard $bm^f f$ ratio and BM^{Ewens} in long leg and short leg to explore the reasons why they deliver different performances other than relative valuation. The data come from Compustat, CRSP, IBES, FRED, Refinitiv, French Kenneth's library, Robert F. Stambaugh's website. We acknowledge that the construction of many variables closely follows the codes

$\delta_{Li,2012}$, R&D depreciate rate for estimating knowledge capital		
Industry	SIC codes	$\delta_{Li,2012}$
Computers and peripheral equipment	3570-3579, 3680-3689 and 3695	40%
Software	7372	22%
Pharmaceuticals	2830, 2831 and 2833 - 2836	10%
Semiconductor	3661-3666 and 3669-3679	25%
Aerospace product and parts	3720, 3721, 3724, 3728 and 3760	22%
Communication equipment	3576, 3661, 3663, 3669 and 3679	27%
Computer system design	7370, 7371 and 7373	36%
Motor vehicles, bodies, trailers, and parts	3585, 3711, 3713 and 3716	31%
Navigational, measuring, electromedical, and control instruments	3812, 3822, 3823, 3825, 3826, 3829, 3842, 3844 and 3845	29%
Scientific research and development	8731	16%
Others	Others	15%

$\delta_{Ewens}, \gamma_{Ewens}$			
Industry	SIC codes	δ_{Ewens}	γ_{Ewens}
Consumer	0100-0999, 2000-2399, 2700-2749, 3100-3199, 3940-3989, 2500-2519, 2590-2599, 3630-3659, 3710-3711, 3714, 3716, 3750, 3751, 3792, 3900-3999, 5000-5999, 7200-7299, 7600-7699, 8000-8099, 4813, 4812, 4841, 4833, 4832	0.33	0.19
Manufacturing	2520-2589, 2600-2699, 2750-2769, 2800-2829, 3000-3099, 3200-3569, 3580-3621, 3623-3629, 3700-3709, 3712-3713, 3715, 3717-3749, 3752-3791, 3793-3799, 3860-3899, 1200-1399, 2900-2999, 4900-4949	0.42	0.22
High Tech	3570-3579, 3622, 3660-3692, 3694-3699, 3810-3839, 7370-7379, 7391, 8730-8734, 4800-4899	0.46	0.44
Health	2830-2839, 3693, 3840-3859	0.34	0.49
Other	Other	0.3	0.34

by Chen and Zimmermann (Forthcoming) but is subject to changes to adapt our purpose.

Table A.10 provides the description for variables used in this part. A 98% winsorization is applied to all ratio variables each year to mitigate the problem caused by extreme values. Table A.11 is similar to table 12 in Eisfeldt et al. (2020) but we provide with more variables covering not only firms' accounting characteristics but also other indicators representing systematic risk, distress risk, mispricing scores etc. For each variable in the first column, we first calculate the cross-sectional average each year within long or short leg sorted by using $bm^f f$ or BM^{Ewens}. Then the table displays the time-series average of each variable in the first column in the long leg (the second and seventh columns), short leg (the third and eighth columns), the ratio of the difference between the long and the short leg over the mean in the short leg (the fourth and ninth columns), the difference between the two legs (the fifth and tenth columns), the p value testing that the difference is significantly different from zero (the sixth and eleventh columns).

We observe several patterns some of which are detailed below.

- Both versions of the book-to-market ratio can deliver similar sorting effects on the variable: for the long-term EPS forecast (fgr5yr), the difference between long and short leg is -12.6223 for $bm^f f$, -11.0667 for BM^{Ewens}, and both are significantly different from zero. For the residual momentum of the past 11 months (RMom11), the difference between the long and the short leg is 0.0342, 0.0550, respectively, but both are not significantly different from 0, meaning that both ratios do not sort the residual momentum of the past 11 months efficiently.

- The ratio of difference over mean in the short leg changes a lot though the sorting direction is the same: for mean estimated earnings to price (sfe), sfe is larger in short legs for both book-to-market ratios. However, when using BM^{Ewens}, the mean sfe in the short leg is much larger (-0.0485 v.s. -0.1727), and the mean sfe in the long leg is much smaller (-0.3922 v.s. -0.2017).

- The sorting direction of variables is the same, but the significance changes: for the industry-adjusted change in capital investment (ChInvIA), it is smaller in the long leg compared to the short leg for both book-to-market ratios, but the difference between the long and the short leg when using $bm^f f$ is not significant while the difference when using BM^{Ewens} is significant. For earnings predictability (ErnPred), the situation reverses.

- The sorting direction of variables changes: for operating leverage (OPLenerage), the stocks in the long leg of $bm^f f$ exhibit smaller leverage than those in the short leg do, but the stocks in the long of BM^{Ewens} have larger leverage than those in the short leg do.

Table A.10

Variables	Description
ChInvIA	Industry adjusted change in capital investment

Table A.10 continued from previous page	
Herf	Industry concentration (Herfindahl) sales
covana	Number of eps estimates in IBES for one-quarter ahead earnings for the firm
fgr5yrLag	Long-term EPS forecast
UpForecast	Binary variable equal to 1 if the mean estimation for eps increases from lagged mean estimates
sfe	The ratio of mean estimated earnings to price
sueana	Standardized unexpected earnings calculated as the difference between the mean estimation and actual eps, divided by fiscal annual closing price
FDLT	Long-term EPS forecast dispersion, standardized by mean estimation
FD	EPS forecast dispersion, standardized by mean estimation
CashProd	Cash Productivity, calculated as the difference between market value of equity and total assets, divided by cash and short-term investments
AdExp	Advertising expense adjusted by market value
SP	Ratio of annual sales to market value of equity
EP	Ratio of earnings to market value of last December
RMom6	Residual momentum of past 11 months
RMom11	Residual momentum of past 6 months
UpsideBeta	Beta on adjusted market returns when the excess market return is above its mean
DownsideBeta	Beta on adjusted market returns when the excess market return is below its mean
PriceDelayRsq	Price delay measured by the fraction of variation of contemporaneous individual stock returns explained by lagged market returns
PriceDelayAdj	Price delay adjusted by standard error
PriceDelay	Price delay measured using betas on past four periods' market returns
betaVIX	Systematic volatility measured as beta on changes in the VIX index
skew3F	Skewness of daily idiosyncratic returns measured using residuals from FF three factor model
skewCAPM	Skewness of daily idiosyncratic returns measured using residuals from CAPM
rmse3F	The mean of root-mean-square error from FF three factor model
rmsecapm	The mean of root-mean-square error from CAPM
ill	Illiquidity measured as the mean of absolute return over market value
ShareIss5Y	The growth in number of shares during the past five years
ShareIss1Y	The growth in number of shares in the past year
roa	Return on assets defined as the net income over total assets
roe	Return on equity defined as the net income over market value of equity
roi	Return on investments defined as the net income over invested capital
SurpriseRD	Binary variable equal to 1 if there is an unexpected R&D increase
ChNNCOA	Change in net noncurrent operating assets

Table A.10 continued from previous page	
ChNWC	Change in net working capital
NOA	Net working capital adjusted by previous total assets
cashdebt	Cash flow to debt
Cash	Cash to assets
AssetTurnover	Asset Turnover calculated as sales over average assets
DelNetFin	Change in net financial assets
AssetGrowth	Asset growth
DelSTI	Change in short-term investment
Accruals	Annual change in current total assets, with annual change in cash and short-term investements, in current liabilities, in income taxes (txp) excluded, and then divided by average total assets
Investment	Investment to revenue
GrSaleToGrInv	Sales growth minus inventory growth
MRankRevgrw	Weighted mean revenue growth rank
payout	Payout ratio calculated as the total payout over earnings
ShareRepurchase	Binary variable equal to 1 if firm repurchases stocks in cash
op	Operating profitability over book value of equity
prof	Profitability over total assets
gp	Gross profitability over total assets
pm	Profit margin
sueac	Standardized unexpected earnings calculated as the difference between current and privous eps, divided by fiscal annual closing price
ErnSm	Earnings smoothness
ErnPred	Earnings predictability
ErnPers	Earnings persistence,
eps	Earnings per share
ZScore	Altman Z score which measures the financial strength
OScore	Ohlson O score which measures the financial distress
EquityDuration	Measure of a share's cash-flow maturity
XFIN	Net external financing, scaled by total assets
OPLeverage	Operating leverage, ths sum of administrative expensesand cost of goods sold , scaled by total assets
BookLeverage	Total assets divided by book value of equity plus deferred taxes and preferred stock
BrandCapital	Brand capital to assets
mispscore_avg	The average of monthly mispricing score which is constructed based on averaging anomaly rankings

Table A.11

	long_v1	short_v1	ratio_v1	delta_v1	p_delta_v1	long_v4	short_v4	ratio_v4	delta_v4	p_delta_v1
ChInvIA	-0.8179	-0.6278	0.3029	-0.1902	0.4810	-0.9927	-0.5409	0.8354	-0.4518	0.0064
Herf	0.3652	0.3114	0.1728	0.0538	0.0000	0.3581	0.3298	0.0856	0.0282	0.0000
covana	4.9439	8.4439	-0.4145	-3.5000	0.0000	3.6760	9.0694	-0.5947	-5.3933	0.0000
fgr5yr	11.8069	24.4295	-0.5167	-12.6226	0.0000	13.1314	24.1981	-0.4573	-11.0667	0.0000
UpForecast	0.4026	0.7747	-0.4803	-0.3721	0.0000	0.4409	0.8012	-0.4497	-0.3603	0.0000
sfe	-0.2017	-0.1727	0.1680	-0.0290	0.5231	-0.3922	-0.0485	7.0774	-0.3436	0.0004
sueana	0.1808	0.0475	2.8079	0.1333	0.0002	0.1895	0.0447	3.2427	0.1448	0.0001
FDLT	0.3473	0.2289	0.5175	0.1184	0.0000	0.3091	0.2250	0.3738	0.0841	0.0187
FD	0.4804	0.1870	1.5687	0.2934	0.0000	0.5330	0.1411	2.7771	0.3919	0.0000
CashProd	-47.4783	28.0521	-2.6925	-75.5305	0.0000	-40.1379	30.9008	-2.2989	-71.0387	0.0000
AdExp	0.1805	0.0237	6.6152	0.1568	0.0000	0.2044	0.0130	14.6947	0.1914	0.0000
SP	6.5244	0.6319	9.3245	5.8925	0.0000	7.5407	0.4065	17.5494	7.1342	0.0000
EP	-0.2793	-0.0501	4.5788	-0.2292	0.0001	-0.4023	-0.0023	170.3313	-0.4000	0.0000
RMom6	0.0988	-0.1001	-1.9875	0.1989	0.0000	0.1115	-0.1353	-1.8236	0.2468	0.0000
RMom11	0.0632	0.0289	1.1837	0.0342	0.2845	0.0723	0.0173	3.1810	0.0550	0.1612
UpsideBeta	0.0044	0.0083	-0.4761	-0.0040	0.0000	0.0042	0.0088	-0.5248	-0.0046	0.0000
DownsideBeta	0.0070	0.0119	-0.4096	-0.0049	0.0000	0.0072	0.0120	-0.3965	-0.0047	0.0000
PriceDelayRsq	0.7121	0.6180	0.1522	0.0941	0.0000	0.7354	0.5937	0.2388	0.1417	0.0000
PriceDelayAdj	2.5150	2.5602	-0.0176	-0.0452	0.5470	2.5211	2.5161	0.0020	0.0050	0.9376
PriceDelay	1.5380	1.2554	0.2251	0.2826	0.0022	1.6030	1.1635	0.3777	0.4395	0.0000
betaVIX	0.0004	0.0004	-0.0435	0.0000	0.9182	0.0004	0.0004	-0.1576	-0.0001	0.7147
skew3F	0.8017	0.7089	0.1309	0.0928	0.0197	0.9404	0.5984	0.5716	0.3420	0.0000
skewCAPM	0.8003	0.6866	0.1656	0.1137	0.0044	0.9407	0.5734	0.6405	0.3673	0.0000
rmse3F	0.0438	0.0382	0.1468	0.0056	0.0023	0.0497	0.0339	0.4670	0.0158	0.0000
rmsecapm	0.0442	0.0388	0.1390	0.0054	0.0036	0.0500	0.0345	0.4517	0.0156	0.0000
ill	0.0000	0.0000	5.6428	0.0000	0.0000	0.0000	0.0000	12.8380	0.0000	0.0000
roa	-0.0417	-0.1344	-0.6897	0.0927	0.0000	-0.0984	-0.0426	1.3089	-0.0558	0.0005
roe	-0.0965	-0.4634	-0.7918	0.3669	0.0000	-0.2890	-0.1346	1.1471	-0.1544	0.0003
roi	-0.0684	-0.2647	-0.7416	0.1963	0.0000	-0.1878	-0.0771	1.4346	-0.1107	0.0001
SurpriseRD	0.2382	0.3357	-0.2904	-0.0975	0.0000	0.2459	0.3183	-0.2273	-0.0724	0.0000
ChNNCOA	0.0025	-0.0006	-5.0185	0.0032	0.0987	-0.0043	0.0099	-1.4341	-0.0142	0.0000
ChNWC	-0.0023	-0.0036	-0.3588	0.0013	0.3603	-0.0068	0.0015	-5.5969	-0.0082	0.0000
NOA	0.5595	0.4932	0.1346	0.0664	0.0014	0.4938	0.6063	-0.1856	-0.1125	0.0000
cashdebt	-0.0579	-0.3173	-0.8177	0.2595	0.0000	-0.1822	-0.0706	1.5793	-0.1116	0.0141
Cash	0.1057	0.2939	-0.6403	-0.1882	0.0000	0.1352	0.2785	-0.5146	-0.1433	0.0000
AssetTurnover	2.2003	4.1358	-0.4680	-1.9355	0.0000	3.2318	3.5518	-0.0901	-0.3200	0.0298
DelNetFin	-0.0088	-0.0301	-0.7080	0.0213	0.0000	-0.0081	-0.0241	-0.6623	0.0159	0.0065
AssetGrowth	0.0287	0.2801	-0.8975	-0.2513	0.0000	-0.0207	0.3743	-1.0554	-0.3950	0.0000
DelSTI	-0.0028	0.0067	-1.4235	-0.0095	0.0004	-0.0071	0.0159	-1.4448	-0.0229	0.0000
Accruals	-0.0039	0.0140	-1.2786	-0.0179	0.0000	-0.0124	0.0212	-1.5841	-0.0336	0.0000

Table A.11 continued from previous page

Investment	0.9158	0.9582	-0.0443	-0.0424	0.0002	0.9086	0.9941	-0.0860	-0.0855	0.0000
GrSaleToGrInv	-0.0724	0.0423	-2.7113	-0.1148	0.0003	-0.0460	0.0148	-4.1067	-0.0608	0.0193
MRankRevgrw	3412.7610	2770.1946	0.2320	642.5663	0.0000	3549.7422	2494.2944	0.4231	1055.4479	0.0000
payout	0.2128	0.2612	-0.1854	-0.0484	0.1323	0.1495	0.2974	-0.4975	-0.1480	0.0002
ShareRepurchase	0.3241	0.2782	0.1648	0.0459	0.0019	0.2815	0.3105	-0.0934	-0.0290	0.1314
op	0.0379	-0.0537	-1.7065	0.0916	0.0276	-0.0626	0.1276	-1.4903	-0.1902	0.0000
prof	-0.0430	-0.1371	-0.6865	0.0942	0.0000	-0.0999	-0.0450	1.2213	-0.0549	0.0007
gp	0.2401	0.3591	-0.3315	-0.1190	0.0000	0.3802	0.3130	0.2145	0.0671	0.0000
pm	-0.3252	-1.6388	-0.8016	1.3136	0.0000	-0.6387	-1.1177	-0.4285	0.4790	0.0013
sueac	-0.0446	0.2608	-1.1709	-0.3054	0.0235	0.3728	0.0235	14.8530	0.3493	0.2707
ErnSm	0.3321	0.5986	-0.4452	-0.2665	0.0000	0.3248	0.7218	-0.5501	-0.3971	0.0000
ErnPred	0.6469	0.7933	-0.1845	-0.1463	0.0000	0.7141	0.7215	-0.0102	-0.0073	0.5826
ErnPers	1863.3591	2110.3577	-0.1170	-246.9986	0.4691	2551.1611	909.7246	1.8043	1641.4365	0.0000
eps	-3.2537	-3.9969	-0.1859	0.7431	0.1610	-5.2805	-1.7981	1.9367	-3.4824	0.0001
ZScore	2.4464	9.9147	-0.7533	-7.4684	0.0000	1.7051	13.5605	-0.8743	-11.8554	0.0000
OScore	-0.7833	-0.9922	-0.2105	0.2089	0.2075	-0.1185	-2.3603	-0.9498	2.2418	0.0000
EquityDuration	-21.0499	15.1144	-2.3927	-36.1642	0.0000	-19.0594	14.6181	-2.3038	-33.6775	0.0000
XFIN	0.0093	0.1754	-0.9469	-0.1661	0.0000	0.0156	0.1635	-0.9045	-0.1479	0.0000
OPLeverage	0.9674	1.0645	-0.0912	-0.0971	0.0430	1.3454	0.8729	0.5413	0.4725	0.0000
BookLeverage	3.7554	4.7794	-0.2142	-1.0240	0.0000	3.9128	3.5240	0.1103	0.3888	0.0565
BrandCapital	0.0586	0.0796	-0.2633	-0.0209	0.0000	0.0866	0.0626	0.3842	0.0240	0.0000
mispscore_avg	50.7295	54.4542	-0.0684	-3.7247	0.0001	48.4602	54.7235	-0.1145	-6.2633	0.0000