Boston College

Carroll School of Management

Department of Finance

Essays in Empirical Asset Pricing

Mathias Hasler

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Essays in Empirical Asset Pricing

AUTHOR:

Mathias Hasler

COMMITTEE:

Jeffrey Pontiff (Chair), Ronnie Sadka, Alan Marcus, Vincent Bogousslavsky

ABSTRACT:

My dissertation includes three chapters on the value premium. In the first chapter, I study whether seemingly innocuous decisions in the construction of the original HML portfolio (Fama and French, 1993) affect our inference on the value premium. I find that the value premium is dramatically smaller than we thought. In sample, the average estimate of the value premium is 0.09% per month smaller than the original estimate of the value premium. Out of sample, however, the difference is statistically insignificant. The results suggest that the original value premium estimate is upward biased because of a chance result in the original research decisions.

In the second chapter, I propose an estimate for intangible assets and growth opportunities and examine if this estimate improves book-to-market equity as a measure of value. I find that portfolios sorted on book equity plus the estimate to market equity have lower returns than portfolios sorted on book-to-market equity. The results suggest that intangible assets and growth opportunities diminish book-to-market equity as a measure of value because investors value intangible assets and growth opportunities in an overly optimistic way.

In my third chapter, I simultaneously study nine explanations of the value effect to better understand what the dominant value explanation is. I find that duration accounts for most of the value effect and that the eight other explanations account for a negligible part of it. The results suggest that duration is the dominant explanation of the value effect.

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Chapter 1: Is the Value Premium Smaller Than We Thought?

1 Introduction

The value premium compensates investors for a unit exposure to the value factor. Fama and French (1993) propose the HML portfolio as a proxy for the value factor and estimate a statistically significant value premium of 0.40% per month using data from July 1963 to December 1991.

The construction of this HML portfolio includes seemingly innocuous decisions that could easily have been replaced with alternatives that are just as reasonable. For example, the decision to sort stocks into portfolios once a year at the end of June is just as reasonable as the alternative to sort stocks into portfolios at the end of each month. I expect ex ante that these decisions and their alternatives produce estimates of the value premium that are the same. Empirically, however, they may not be the same. If the decisions and their alternatives produce estimates of the value premium that are different, then the difference serves as an estimate for the bias that is due to chance in the original decisions. This new approach can be extended to any empirical study.

I study the original value premium estimate because of its academic importance. The Fama and French (1993) three-factor model, which includes the original HML portfolio as a proxy for the value factor, has been serving as a benchmark asset pricing model in empirical finance. Mutual fund studies on performance evaluation, for example Fama and French (2010), include the original HML portfolio as a right-hand side variable to proxy for the value factor. Theory papers, such as Zhang (2005), provide rationales for why the HML portfolio is a systematic risk factor. Bias in the original value premium estimate may therefore affect our inference of the three-factor model's importance as an asset pricing model, on mutual fund managers' abilities, and on the relevance of rationales for why the value factor is systematic.

I estimate the bias of the original value premium estimate that is due to chance in the original decisions, because a chance result is always possible in empirical research. Moreover, many statistical biases are inherent to research and lead to biased estimates in published papers. Harvey's (2017) AFA Presidential Address elaborates on the file drawer effect, data-mining, multiple hypothesis testing, data-snooping, etc. McLean and Pontiff (2016), Harvey, Liu and Zhu (2016), and Linnainmaa and Roberts (2018) provide empirical evidence that statistical biases explain much of the anomaly returns in published papers.

In this paper, I focus on six seemingly innocuous decisions in the construction of the original HML portfolio. The first decision is about the timing of market equity, the second decision is about the timing of book equity, the third decision is about negative book equity, the fourth decision is about financial firms, the fifth decision is about portfolio sorting breakpoints, and the sixth decision is about the timing of market equity to account for the size effect. I propose alternatives that are just as reasonable, form all possible combinations of these six decisions and their alternatives, construct 96 HML portfolios, and collapse all HML portfolios in each month into an equally weighted average portfolio. This average HML portfolio is a valuable proxy for the value factor because it reflects an average decision that mitigates a bias due to chance in research decisions. The average return difference between the original HML portfolio and the average HML portfolio is therefore an estimate for the bias of the original value premium estimate.

I start my empirical analysis with the replication of the original HML portfolio as described in Fama and French (1993). I report that I can largely, but not perfectly, replicate the original HML portfolio. The HML portfolio has an average monthly return of 0.40% per month in the original study's sample from July 1963 to December 1991. The replicated HML portfolio has an average monthly return of 0.35% per month in the same sample period. The difference may be a result of updating the CRSP and Compustat datasets, different links for the merging of both datasets, adjusting returns for delisting, or omitting details of the precise construction.

In the baseline empirical test, I calculate the average monthly returns of the average HML portfolio and of the original HML portfolio in the original sample's study from July 1963 to December 1991. I find that the average HML portfolio has an average monthly return of 0.27% per month (*t*-statistic of 1.79). The original HML portfolio has an average monthly return of 0.35% per month (*t*-statistic of 2.53). The average return difference between the original HML portfolio and the average HML portfolio is 0.09% per month (*t*-statistic of 1.88). These findings suggest that the original value premium estimate is upward biased, and they also raise doubts as to whether the original value premium may even be a false positive.

I also perform a White (2000) Reality Check Bootstrap to test the null hypothesis that the value premium is zero. This is important because the *t*-statistic of the average HML portfolio does not account for the fact that we have more information than just the average portfolio and because the *t*-statistic of the original HML portfolio does not account for the fact that a researcher has the freedom to choose the HML portfolio with the highest *t*-statistic as a proxy for the value factor. I find that the *t*-statistic of the original HML portfolio exceeds the critical value from the Reality Check Bootstrap assuming a confidence level of 95%, and thus it rejects the null hypothesis that the value premium is zero.

I compare the standard deviations of the original HML portfolio and the average HML portfolio to better understand whether the positive return difference is compensation for more risk. The original HML portfolio has a lower standard deviation than the average HML portfolio (2.57% versus 2.76% per month), and thus suggests that the positive return difference is not compensation for more risk.

I perform a principal component analysis of the monthly returns of the 96 HML portfolios to better understand whether the HML portfolios may be proxying for more than one underlying factor. The first principal component explains 91% of the variation of the HML portfolios, and thus suggests that they are proxying for one underlying factor.

I estimate the main empirical test using data that is out of sample. If the return difference between the original and the average HML portfolio is a bias that is due to chance in research decisions, then I expect the return difference to be zero out of sample. In the pre-sample, from July 1926 to June 1963, the return difference between the original and the average HML portfolio is 0.08% per month (*t*-statistic 1.48). This pre-sample result is somewhat at odds with the idea of a bias. The pre-sample estimate, however, may include hindsight biases because Graham and Dodd (1934, 1962) and Graham (1949) already reported on value investing back then. In the post-sample, from January 1992 to December 2019, the return difference between the original and the average HML portfolio is 0.06% per month (*t*-statistic 0.84). The post-sample result is consistent with a bias.

I also estimate the main empirical test using the full sample from July 1926 to December 2019. The average HML portfolio has an average monthly return of 0.25% per month (*t*-statistic of 2.21). The original HML portfolio has an average monthly return of 0.33% per month (*t*-statistic of 3.31). The return difference between the original and the average HML portfolio on average is 0.08% per month (*t*-statistic of 2.27). The full sample results suggest that the original value premium estimate is upward biased.

In my last empirical test, I use the approach in Barillas and Shanken (2017) and the factors in Fama and French (2015) augmented with momentum to better understand if the original HML portfolio and the average HML portfolio are spanned. I find that the original and the average HML portfolios have almost the same intercepts and that both intercepts are statistically significant. I also find that the original HML portfolio's beta with the momentum factor is much more negative than the average HML portfolio's beta with momentum. These findings suggest that, unconditionally, the original HML portfolio has a higher average monthly return than the average HML portfolio because it avoids trading against momentum.

2 Related Literature

2.1 Robustness of the Original Value Premium Estimate

This paper is related to the literature on the robustness of the original value premium estimate to address concerns put forth by Black (1993) and by Lo and MacKinlay (1990) that the value premium is not real.

The tenor of this literature is that the original value premium estimate is robust. Davis, Fama, and French (2000) document a significant value premium estimate in the US equity market in the sample from 1929 to 1963 that precedes the original study's sample. Barber and Lyon (1997) document a significant value effect in the holdout sample of financial firms in the US equity market. Chan, Hamao, and Lakonishok (1991) report a significant value premium estimate in Japan's equity market, which is the second largest equity market in 1990. Fama and French (1998) document significant value premium estimates in international equity markets. Asness, Moskowitz, and Pedersen (2013) report significant value premium estimates in other asset classes. Fama and French (1992) report a significant value effect that is robust to the return predictability of leverage, as reported in Bhandari (1988), and of earnings to price, as reported in Basu (1977, 1983). Asness and Frazzini (2013) report a significant value premium estimate for an updated HML portfolio conditional on momentum. Kessler, Scherer, and Harries (2019) find significant returns for valuation-based portfolios with different "design choices." Fama and French (2008) report that the value effect exists in microcap stocks, small stocks, and big stocks, using portfolio sorts and cross-sectional regressions conditional on other stock return predictors, but Phalippou (2008) documents that the value effect exists only among some of the smallest stocks in the US equity market. Studies with more recent samples, however, find insignificant value premium estimates. Schwert (2003), Linnainamaa and Roberts (2018), and Fama and French (2020) report insignificant value premium estimates in the US equity market in samples that follow the original sample's study. But Fama and French (2020) report a significant value premium estimate for the full sample from 1963 to 2019.

My contribution to the literature is the empirical finding that the value premium is smaller than we thought: The construction of the original HML portfolio (Fama and French, 1993) includes six seemingly innocuous decisions that could easily have been replaced with alternatives that are just as reasonable. In sample, the average estimate of the value premium is dramatically smaller than the original estimate of the value premium. The difference is 0.09% per month and statistically significant. Out of sample, the estimates of the value premium are similar. These results suggest that the original value premium estimate is upward biased due to chance in the original decisions. The result has far-reaching academic implications: An upward bias in the original value premium estimate reduces the importance of the Fama and French (1993) three-factor model as a benchmark asset pricing model, it affects our inference of mutual fund managers' abilities, and it reduces the importance of theories on why the value factor is a systematic risk factor.

2.2 Approaches to Address Chance or Statistical Biases

This paper is also related to the literature on approaches to address bias in estimates of published papers that are due to chance or statistical biases.

Harvey, Liu, and Zhu (2016) propose a *t*-statistic of 3 as a simple critical value for future empirical asset pricing factors to account for multiple testing. They use the number of published empirical asset pricing factors over time as a conservative estimate for the number of tested asset pricing factors and study the approaches by Bonferroni (1936), Holmes (1979), and Benjamini and Yekutieli (2001). Chordia, Goyal, and Saretto (2020) simulate 2.4 million trading strategies, use a model to infer the number of strategies that are tested by financial economists, and propose a *t*-statistic of 3.8 as a critical value for hypothesis tests. Harvey and Liu (2020) use a bootstrap approach and propose *t*-statistics as critical values that depend on the researcher's prior belief of the fraction of real anomalies and on their type I and type II error requirements. Harvey (2017) proposes Bayesianized *p*-values that take prior beliefs into account.

My contribution to the literature is a new approach to estimating the bias in the original estimate of the value premium that is attributable to chance in research decisions. This new approach is simple and intuitive: Ex ante, I expect that the decisions and their reasonable alternatives produce estimates of the value premium that are the same. If they are not the same, then the original estimate may be biased or even a false positive that occurs because of a chance result in the original decisions. This new approach is applicable in sample, and it can be extended to any empirical study.

My approach is related to robustness tests in general. Fama and French (1992), for example, report that the book-to-market effect is robust to replacing end of December market equity with fiscal year-end market equity. Pontiff and Singla (2019), as another example, report that the original estimate of the liquidity premium (Pastor and Stambaugh, 2003) is statistically insignificant when they introduce four modifications into the construction of the liquidity factor proxy that are expected to improve statistical power or to reduce estimation error. My approach is different, however, because it studies seemingly innocuous decisions that have alternatives that are just as reasonable and because it aggregates all decisions and alternatives into one estimate.

3 HML Portfolios

3.1 Definition of the Original HML Portfolio

The original HML portfolio is defined in Fama and French (1993). It uses data from the intersection of CRSP and Compustat. The sample is restricted to common ordinary US stocks (share code 10 or 11) that are trading on the NYSE, the NASDAQ, and the Amex (exchange code 1, 2, or 3) with non-missing and non-negative book equity, non-missing market equity at the end of December of year *t-1* and at the end of June of year *t*, and with at least two years of available Compustat data.

The original HML portfolio is the average return of a small and a big value portfolio minus the average return of a small and a big growth portfolio in each month. Formally, HML = 1/2 (Small Value + Big Value) - 1/2 (Small Growth + Big Growth). Stocks are sorted into six portfolios by independently sorting them on market equity into small and big stocks using the median market capitalization of all stocks traded on the NYSE as breakpoint and by independently sorting them on book-to-market equity into value, neutral, and growth stocks using the 30^{th} and 70^{th} percentiles of book-to-market equity of all stocks traded on the NYSE as breakpoints. The portfolios are constructed at the end of June of year *t* and are held from July of year *t* to June of year *t+1*. Market equity observed at the end of June of year *t* is used to sort stocks on size. The book equity of a firm's last fiscal year with fiscal year-end before the end of December of year *t-1* divided by market equity at the end of December of year *t-1* is used to sort stocks on value. The two neutral portfolios (Small Neutral and Big Neutral) are not used. The six portfolios are value weighted.

Book equity is defined as stockholder equity (*seq*), plus balance sheet deferred taxes and investment tax credit (*txditc*) if available, minus the book value of preferred stock. The book value of preferred stock is the redemption (*pstkrv*), liquidation (*pstkl*), or par value (*pstk*), if available, in that order. Market equity is price times shares outstanding.

3.2 Alternatives that are Just as Reasonable

The construction of the original HML portfolio includes seemingly innocuous decisions that could easily have been replaced with alternatives that are just as reasonable. I identified the following six decisions, and I propose alternatives that are just as reasonable.

The first decision is about the timing of book equity. The original HML portfolio uses the book equity of a firm's last fiscal year with fiscal year-end before the end of December of year *t-1* to sort stocks into value and growth portfolios from July of year *t* to June of year *t+1*. As an alternative that is just as reasonable, I use the book equity of a firm's last fiscal year six months after its fiscal year-end. Both specifications impose a minimum gap of six months for accounting information to become publicly available in order to address reporting issues documented in Alford, Jones, and Zmijewski (1992). Apple Inc., for example, has its last fiscal year-end on September 28th, 2019. The firm's press release on October 30th, 2019 gives relevant accounting information, including shareholders' equity. The original HML portfolio uses this book equity observation at the end of June of year 2020 for portfolio sorts, nine months after Apple Inc.'s fiscal year ended. The alternative decision uses book equity at the end of March 2020 for portfolio sorts, six months after the firm's fiscal year ended.

The second decision is about the timing of market equity. The original HML portfolio uses market equity at the end of December of year *t-1* as a simple way to match the timing of book equity. Specifically, market equity at the end of December of year *t-1* is used in the denominator of book-to-market equity to sort stocks into value and growth portfolios from July of year *t* to June of year *t+1*. As an alternative that is just as reasonable, I use market equity from the most recent month and skip one month. I skip one month to avoid the negative first-order serial correlation in monthly stock returns documented in Jegadeesh (1990). The alternative is similar to Asness and Frazzini (2013), who use market equity from the most recent month in the denominator of book-to-market equity to have a more updated value portfolio. They argue that a stock may be a growth stock at the end of December, but a value stock at the end of June or later if negative information about the firm emerges. They report average portfolio returns conditional on momentum, but they do not report average portfolio returns unconditionally and they do not motivate momentum as a right-hand side variable. Also, Fama and French (1992, p. 430) include a short discussion about potential issues regarding the timing of market equity. They mention that their results are robust to using market equity of a firm's fiscal year-end in the denominator of book-to-market equity, but they do not mention the robustness to using market equity of a firm's more recent month.

The third decision is about firms with negative book equity. The original HML portfolio excludes stocks with negative book equity observations. As an alternative, I include them. Firms can naturally and legally have negative book equity under US GAAP. Revlon Inc., for example, reported negative shareholder equity in 2013. Hewlett-Packard, as another example, reported negative shareholder equity in 2016.

The fourth decision is about financial firms. The original HML portfolio includes financial firms. As an alternative, I exclude financial firms (defined as firms with a one-digit SIC code of 6). This alternative is consistent with the decision to exclude financial firms in Fama and French (1992, p. 429) "… because the high leverage that is normal for these firms probably does not have the same meaning as for nonfinancial firms, where high leverage more likely indicates distress." Barber and Lyon (1997) study the book-to-market equity effect for the holdout sample of financial firms and find empirical support for the value effect. They do not reject the null hypothesis that financial firms and non-financial firms have differential value effects.

The fifth decision is about the book-to-market equity breakpoints that are used to sort stocks into value, neutral, and growth portfolios. The original HML portfolio uses the 30^{th} and 70^{th} percentiles of book-to-market equity of all stocks trading on the NYSE as breakpoints. As an alternative, I use the 20^{th} and 80^{th} percentiles and the 40^{th} and 60^{th} percentiles of book-to-market equity of all stocks trading on the NYSE as breakpoints.

The sixth decision is about the timing of market equity to sort stocks into small and big portfolios in order to account for the size effect. The original HML portfolio uses market equity at the end of June of year *t*. As an alternative, I use market equity at the end of December of year *t-1*. Banz (1981) is the first study on the size effect, and it uses market equity at the end of December of year *t-1* as a proxy for the size effect.

Many decisions in the definition of the original HML portfolio do not have an alternative that is just as reasonable. The decision to use book equity, for example, does not have an alternative that is just as reasonable because book equity is the firm's accounting value and it matches market equity as the firm's market value. Earnings, cashflows, or dividends are different accounting variables and lead to different anomaly portfolios, and thus they are not alternatives that are just as reasonable. If the value premium estimate decreases upon replacing book equity with earnings, cashflows, or dividends, then this decrease is not about a chance result in research decisions but about different anomaly portfolios. As a second example, replacing book-to-market equity with an industry-demeaned book-to-market equity, as in Asness, Porters, and Stevens (2000), is not an alternative that is just as reasonable because it accounts for the heterogeneity in accounting practices across industries. As a third example, excluding penny stocks is not an alternative that is just as reasonable because this is about stock return predictability among illiquid stocks and because it leaves out information in the construction of a proxy for a systematic risk factor. As a fourth example, using breakpoints that are not based on stocks trading on the NYSE is not an alternative that is just as reasonable because this is about stock return predictability among stocks that are costly to trade. See Hou, Xue, and Zhang (2018).

Kessler, Scherer, and Harries (2019) study how "design choices" affect valuation-based portfolio returns. These design choices are not about alternatives that are just as reasonable. The design choices include different accounting variables (book equity, cyclically adjusted earnings, operating earnings, earnings, dividends, cash flows, earnings to growth, etc.), different sector adjustments (unadjusted, subtract the industry median, etc.), different transformations (unadjusted, z-score, percentile rank, etc.), using a different portfolio for the short leg (shorting the growth portfolio, shorting the market portfolio, etc.), different exposures (cash neutral, beta neutral, risk neutral, etc.), and different rebalancing frequencies (monthly, quarterly, annual).

3.3 Snapshot of Decisions in the Literature

Table I provides a snapshot of the decisions in the empirical literature on the value effect in the 1980s and early 1990s. The heterogeneity in researchers' decisions is consistent with alternatives that are just as reasonable.

[Table I]

The table reports all empirical studies on the value effect that are referenced in Fama and French (1992, 1993) in order to include the most relevant of a large number of empirical studies. Column (1) lists the author(s), the publication year, and the academic journal. Column (2) reports the month in which the portfolio is rebalanced. Most studies rebalance their portfolios once a year at the end of December, March, April, or June. Rosenberg, Reid, and Lanstein (1985) sort stocks into portfolios at the end of each month. Column (3) reports on the timing of the accounting information. Studies use accounting information from fiscal year-ends before the end of December or March, from the previous fiscal year, or hand-collected accounting information from fiscal year-ends from the previous month. Column (4) reports on the timing of market equity. Studies use market equity at the end of December, June, March, or the previous month. Column (5) reports if observations with negative accounting information are excluded. Some studies include negative observations, some exclude negative observations, and some sort them into a separate portfolio. Column (6) reports if financial firms are excluded. Some studies include financial firms and some exclude them. Column (7) reports on the timing of market equity to account for the size effect. Studies use market equity at the end of December, March, June, or the previous month.

3.4 Replication Validation of the Original HML Portfolio

Table II reports the average monthly return of the original HML portfolio as reported in Fama and French (1993, p. 13) and the average monthly return of my replicated HML portfolio in the original study's sample from July 1963 to December 1991. The original HML portfolio has an average monthly return of 0.40%. The replicated HML portfolio has an average monthly return of 0.35% over the same time period. The difference is 0.05% per month. Therefore, I report that I can largely but not perfectly replicate the original HML portfolios.

[Table II]

Next, I compare the average monthly return of my replicated HML portfolio with the average monthly return of the HML portfolios of eight studies that also replicate the original HML portfolio. Table II reports that my replicated HML portfolio has a monthly return that is, on average, 0.04% per month below that of the eight other studies.

What explains this difference? One explanation for the difference is the way CRSP and Compustat is merged. I merge them using links from the CRSP/Compustat Merged Database available on WRDS because the permno-gvkey links are researched by CRSP or by Compustat. A second explanation is that I use returns that are adjusted for delistings and for missing delistings. A third explanation for the difference is that the CRSP and Compustat datasets are updated over time. A fourth explanation is the details about the construction are left out, similar to many other studies.

I also noticed that the last five of the eight studies (marked with an asterisk) in Table II say that they replicate the HML portfolio as in Fama and French (1993) but then mention that they are using the book equity definition found in Davis, Fama, and French (2000). This book equity definition is more inclusive of smaller stocks for which the value effect is more pronounced. This is another explanation for why the average monthly return of my replicated HML portfolio is lower compared to the other studies. The average difference is reduced to 0.01% per month once I use book equity as defined in Davis, Fama, and French (2000).

4 Is the Original Value Premium Estimate Biased?

4.1 Main Empirical Findings

Table III reports Fama and MacBeth (1973) regressions of the monthly returns of the 96 HML portfolios on a constant and a dummy variable that is one for the original HML portfolio and zero otherwise, from July 1963 to December 1991. Equation (1) defines the regression specification. The dependent variable, R_{it}, is the return of HML portfolio *i* in month *t*.

$$R_{it} = Constant + \beta \cdot Original\ HML\ Dummy_{it} + e_{it} \tag{1}$$

The constant is the average monthly return of the average HML portfolio, and thus an estimate for the value premium. If the value premium exists, I expect to find a constant that is statistically significant. If the value premium does not exist, however, I expect to find a constant that is insignificant.

The slope on the dummy variable for the original HML portfolio is the average monthly return difference between the original HML portfolio and the average HML portfolio in each month, and thus an estimate of the bias due to chance in the original decisions. If the original value premium estimate is biased, then I expect to find a slope estimate that is statistically significant. If the original value premium estimate is not biased due to chance in the original decisions, I expect to find a slope estimate that is insignificant.

Fama and MacBeth (1973) regressions produce *t*-statistics that account for the contemporaneous correlation in the residuals. Petersen (2009) shows analytically and numerically that the standard errors of these estimates account for the cross-sectional correlation in the residuals.

[Table III]

Column (1) estimates a constant of 0.27% per month with a *t*-statistic of 1.79 when all HML portfolios are used as proxies for the value factor. Column (2) estimates a value premium of 0.35% per month with a *t*-statistic of 2.53 when only the original HML portfolio is used as a proxy for the value factor. Column (3) reports a slope estimate of 0.09% per month with a *t*-statistic of 1.88. These findings suggest therefore that the original estimate of the value premium is upward biased. They also raise doubts as to the statistical significance of the original estimate.

My empirical findings are robust to using the book equity definition of Davis, Fama, and French (2000) in the definition of the HML portfolio. See Table II in the Appendix for the results.

4.2 <u>Illustration of the Main Finding</u>

Figure I shows a histogram of the monthly average returns of each of the 96 HML portfolios from July 1963 to December 1991. The original HML portfolio is marked with "HML", and the average HML portfolio is marked with "AHML".

The average monthly returns of the 96 HML portfolios range from 0.16% to 0.40%. I find that 86 of the 96 HML portfolios have returns that are below the original value premium estimate and that 10 HML portfolios have returns that are above it. The average return of the average HML portfolio is 0.27% per month and much lower than the average return of the original HML portfolio. This is consistent with the idea that the original estimate of the value premium is upward biased because of a chance result in the original decisions.

[Figure I]

4.3 <u>White (2000) Reality Check Bootstrap</u>

I additionally perform the White (2000) Reality Check Bootstrap to test the null hypothesis that the value premium is zero. This is important because the *t*-statistic of the constant estimate does not account for the fact that we have more information that the just average portfolio (Table III, column 1) and because the *t*-statistic on the slope estimate (Table III, column 2) does not account for the fact that a researcher has the freedom to choose the HML portfolio with the highest *t*-statistic as a proxy for the value factor.

The White (2000) Reality Check Bootstrap provides a way to calculate a critical value for the null hypothesis that the value premium is zero that accounts for the researcher's freedom to choose the HML portfolio with the highest *t*-statistic as a proxy for the value factor. The bootstrap procedure works as follow: I first demean each of the 96 HML portfolios so that no value effect exists in my sample by construction. I then draw a random sample of months with replacement, calculate the average returns and the *t*-statistics of each of the 96 HML portfolios, and take the highest *t*-statistic as the t_{max}-statistic. I repeat this bootstrap 1,000 times. Eventually, I calculate the 95th percentile of all the t_{max}-statistics and use it as the critical value for the hypothesis test.

Figure II shows the histogram of the bootstrapped t_{max}-statistics under the null hypothesis that no value premium exists from July 1963 to December 1991. The 95th percentile of the t_{max}-statistics is 2.12. The original HML portfolio has a *t*-statistic of 2.53. This *t*-statistic exceeds the critical value and leads therefore to the rejection of the null hypothesis that the value premium is zero.

[Figure II]

4.4 Compensation for Risk

To address the concern that the higher returns of the original relative to the average HML portfolio may be compensation for more risk, I compare the return standard deviation and the Sharpe ratio of the original HML portfolio with the average HML portfolio (AHML) for the sample from July 1963 to December 1991. If the higher returns of the original HML portfolio are compensation for more risk, I expect to find a higher return standard deviation and a similar

Sharpe ratio. Table IV reports that the standard deviation of the HML portfolio is lower than that of the average HML portfolio (2.57% versus 2.76% per month) and that the Sharpe ratio of the original HML portfolio is larger than that of the average HML portfolio (0.14 versus 0.10). These findings are difficult to reconcile with a risk explanation, but they are consistent with the explanation of a result occurring due to chance in research decisions.

[Table IV]

4.5 One Common Factor

I study the common variation in the monthly returns of the 96 HML portfolios to better understand whether the 96 HML portfolios are proxying for one or for many risk factors.

Specifically, I perform a principal component analysis of the monthly returns of the 96 HML portfolios from July 1963 to December 1991. Table V reports that the first principal component explains 91% of the variation in the monthly returns, the second principal component explains 5%, the third principal component explains 1%, and each of the remaining 93 principal components explain less than 1% of the variation. These findings suggest that the 96 HML portfolios are proxying for one underlying risk factor and not for multiple risk factors.

[Table V]

I also find an average pairwise correlation of 0.91 for the monthly returns of the 96 HML portfolios from July 1963 to December 1991. This correlation is high compared to the average pairwise correlations among different anomaly portfolios, and it suggests that the 96 HML portfolios are all proxies for one common factor. McLean and Pontiff (2016) report an average correlation of 0.03 across 97 different anomaly portfolios, and Green, Hand, and Zhang (2017) report an average correlation of 0.09 among 60 different predictor portfolios.

4.6 Out-Of-Sample Evidence

I estimate the main empirical test using data that is outside of the original study's sample period. If the value premium exists, I expect to find statistically significant constants out of sample. If the value premium does not exist, however, I expect to find constants that are statistically insignificant out of sample. If the original value premium estimate is biased due to a chance result in the original decisions, I expect to find an insignificant slope estimate out of sample. Otherwise, I expect to find a statistically significant slope estimates out of sample.

Table VI reports Fama and MacBeth (1973) regressions of the monthly returns of the 96 HML portfolios on a constant and a dummy variable that is one for the original HML portfolio and zero otherwise. The pre-sample is July 1926 to June 1963, and the post-sample is January 1992 to December 2019. The pre-Compustat book equity data is from Kenneth French's webpage, and I hand-collected fiscal year-end months from the Moody's Manuals that are available to me.

[Table VI]

Columns (1) and (4) estimate a value premium of 0.33% per month with a *t*-statistic of 1.45 in the pre-sample and a value premium of 0.14% per month with a *t*-statistic of 0.75 in the post-sample. The pre-sample *t*-statistic suggests that the value premium exists, but the post-sample *t*-statistic suggests that the value premium does not exist.

Columns (2) and (5) estimate a value premium of 0.41% per month with a *t*-statistic of 1.99 in the pre-sample and 0.20% per month with a *t*-statistic of 1.16 in the post-sample when the original HML portfolio is used as a proxy for the underlying value factor. The pre-sample finding is consistent with Davis, Fama, and French (2000). The post-sample result is consistent with Fama and French (2020). They report an insignificant value premium of 0.10% per month for the post-sample period using the difference between a market value and a market growth portfolio as a proxy for the value factor (Table 1 on p. 15, MV-MG = 0.11-0.01 = 0.10). The post-sample findings are also consistent with Linnainmaa and Roberts (2018), who report that the original HML portfolio has an average monthly return of 0.31% per month with a *t*-statistic of 1.71 in the post-sample, and they are consistent with Schwert (2003), who reports an insignificant value effect for the sample from 1994 to 2002.

Columns (3) and (6) estimate a bias of 0.08% per month with a *t*-statistic of 1.69 in the pre-sample and a bias of 0.06% per month with a *t*-statistic of 0.76 in the post-sample. The pre-sample slope estimate is similar to the in-sample slope estimate, which is at odds with an estimation bias in the original value premium estimate. It is not clear, however, whether the pre-sample produces an independent estimate of the value premium because Graham and Dodd (1934, 1962) and Graham (1949) already reported on value investing for the pre-sample. The post-sample estimate is smaller and statistically insignificant, and thus suggests that the return difference between the original and the average HML portfolios is an estimate for the bias due to chance in the original decisions.

I also study the robustness of my findings to using different start dates. Davis, Fama, and French (2000) use July 1929 as a start date because they need the first three years to estimate betas. My results are robust to using July 1929 as start date. Cohen, Polk, and Vuolteenaho (2003) report that the Securities Exchange Act of 1934 was enacted to ensure accurate accounting information. They characterize the first two years after that act as an enforcement period and determine that accounting information from 1937 is of sufficiently high quality for empirical research. My results are robust to using July 1938 as the start date.

I also acknowledge that the positive return difference between the original and the average HML portfolio in the pre- and in the original sample period, and the lower return difference in the post-sample period are consistent with McLean and Pontiff's (2016) assertion that sophisticated investors learn about stock return predictability due to mispricing and start to trade on it. Fama and French (2020) argue that the post-sample decline of value minus growth portfolios is economically large but not statistically significant.

4.7 Individual Decisions

I study how much each of the six decisions accounts for the return difference between the original and the average HML portfolio. Table VII reports Fama and MacBeth (1973) regressions of the monthly returns of the 96 HML portfolios on a constant and six dummy variables for each of the six decisions, from July 1963 to December 1991.

[Table VII]

Columns (1) to (5) report estimates of the six dummy variables individually, and column (6) reports estimates for the six dummy variables jointly. Four out of six slope estimates are close to zero, which is consistent with the researcher's expectation that alternative decisions will lead to the same empirical finding as the original decisions. The slope on the second dummy variable about the timing of market equity in the denominator of book-to-market equity is 0.11% per month with a *t*-statistic of 1.62. This effect is economically large but is not statistically significant at the 95 percent confidence level. The slope on the sixth dummy variable about the timing of market equity to account for the size effect is 0.05% per month with a *t*-statistic of 2.96. This effect is statistically significant at the 5% significance level. This finding is related to Gerakos and Linnainmaa (2018), who report that most of the value premium estimate is driven by changes in market equity. The empirical findings also suggest that decisions with more "degrees of freedom", for example decisions that use monthly stock market data compared to annual accounting data, are more likely to pick up a result due to chance in research decisions.

4.8 Robustness to Cross-Sectional Slope Estimates

The empirical tests use monthly portfolio returns as the dependent variable. As a robustness test, I use the monthly slope estimates from cross-sectional regressions of one-month ahead returns on each of the individual value measures as the dependent variable. Fama (1976) argues that these slope estimates are returns from long-short portfolios with an exposure of one to the underlying value factor.

Specifically, I estimate monthly cross-sectional regressions of one-month ahead returns on the natural logarithm of each of 48 value measures and on the natural logarithm of market equity using all but microcap stocks from July 1963 to December 1991. Microcap stocks are defined as stocks with market equity below the 20th percentile of market equity using all stocks trading on the NYSE. I have 48 value measures compared to the 96 HML portfolios, because the fifth decision on breakpoints to sort stocks into value, neutral, and growth portfolios is not used in cross-sectional regressions. I exclude microcap stocks as a simple way to account for the unique weighting that is used in the construction of the original HML portfolio. The original HML portfolio is constructed by equal weighting two long and two short portfolios (Small Value and Big Value, Small Growth and Big Growth), and these four portfolios are constructed by value weighting stocks.

Table VIII reports Fama and MacBeth (1973) regressions of the monthly slope estimates on a constant and a dummy variable that is one for the slope estimates that are consistent with the original HML portfolio returns. The *t*-statistics are based on Newey-West adjusted standard errors with six monthly lags.

[Table VIII]

Column (1) estimates a value premium of 0.18% per month with a *t*-statistic of 1.94. Column (2) estimates a value premium of 0.26% per month with a *t*-statistic of 2.83 for the value measure that is consistent with the original HML portfolio. Column (3) estimates a bias of 0.08% per month with a *t*-statistic of 3.68. My main results are therefore robust to using monthly slope estimates from cross-sectional regressions instead of portfolios returns.

4.9 Full Sample Evidence

I estimate the main regression specification using data from the full sample from July 1926 to December 2019. Table IX reports the empirical results. Column (1) estimates a value premium of 0.25% per month with a *t*-statistic of 2.06. Column (2) estimates a value premium of 0.33% per month with a *t*-statistic of 2.85 when the original HML portfolio is used as a proxy for the value factor. Column (3) estimates a bias of 0.08% per month with a *t*-statistic of 2.32. These findings suggest that the value premium exists, but that the original estimate of the value premium is upward biased due to chance in the original decisions.

Figure III shows the histogram of the t_{max}-statistics from the White (2000) Reality Check Bootstrap under the null hypothesis that no value premium exists from July 1926 to December 2019. The 95th percentile of the t_{max}-statistics is 1.95. The original HML portfolio has a *t*-statistic of 3.13. This *t*-statistic exceed the critical value and leads therefore to the rejection of the null hypothesis that the value premium is zero.

[Figure III]

5 Spanning Regressions

I use the approach in Barillas and Shanken (2017) and the Fama and French (2015) five-factor model augmented with momentum to assess whether the original HML portfolio and the average

HML portfolio are spanned by the model. I use asset pricing factor returns from Kenneth French's website.

[Table X]

Table X reports the empirical results. First, I find that the original HML portfolio and the average HML portfolio are not priced by the five-factor model augmented with momentum in most of the subsamples and in the full sample. The portfolios, however, are priced in the post-sample. And the original HML portfolio is also priced in the Compustat sample. This is consistent with Fama and French's (2015) finding that the HML portfolio is redundant in the five-factor model. This finding suggests that the original and the average HML portfolio help explain expected returns conditional on the factors in the augmented five-factor model.

Second, I find that the intercepts of the average HML portfolio are similar or slightly larger than the intercepts of the original HML portfolio. This suggests that the incremental value of the average HML portfolio over the original HML portfolio is zero or small conditional on the augmented five-factor model.

Third, I find that the average HML portfolio has a much more negative beta with the momentum factor compared to the original HML portfolio. This suggests that the original HML portfolio has higher unconditional returns than the average HML portfolio, because it avoids trading against momentum.

The question whether momentum is an asset pricing factor is under debate. On the one hand, Fama and French (2018, p. 237) are reluctant to accept momentum as an asset pricing factor, arguing that momentum lacks economic motivation as an asset pricing factor and that recognizing momentum as an asset pricing factor marks the beginning of mining the data for factors. Griffin, Ji, and Martin (2003) argue that international momentum portfolios are not related to macroeconomic risk factors. On the other hand, Barberis, Jin, and Wang (2019) argue that momentum can be motivated as an asset pricing factor in a model in which investors evaluate risk according to prospect theory. Jegadeesh and Titman (2010) document that momentum returns are also statistically significant after the publication of their 1993 paper.

6 Conclusion

The value premium compensates investors for a unit exposure to the value factor. Fama and French (1993) propose the HML portfolio as a proxy for the value factor and estimate a statistically significant value premium of 0.40% per month using data from July 1963 to December 1991.

The construction of this HML portfolio includes seemingly innocuous decisions that could easily have be replaced with alternatives that are just as reasonable. I expect ex ante that these decisions and their alternatives produce estimates of the value premium that are the same. If the estimates are not the same, however, then the difference is an estimate for the bias that is due to chance in the original decisions. This new approach can be extended to any empirical study.

I study the value premium because of its academic importance. Bias in the original value premium estimate affects our inference on the importance of the Fama and French (1993) three-factor model, on the abilities of mutual fund managers, and on the relevance of theories that provide rationales for why the value factor is a systematic risk factor. I study the bias of the original value premium estimate that is due to chance in research decisions, because a chance result is always possible in empirical research. Moreover, many statistical biases are inherent to research and lead to biased estimates in published papers. Harvey's (2017) AFA Presidential Address elaborates on some of these biases, including the file drawer effect, data-mining, multiple hypothesis testing, data-snooping, etc.

In this paper, I focus on six seemingly innocuous decisions in the construction of the original HML portfolio. The first decision is about the timing of market equity, the second decision is about the timing of book equity, the third decisions is about negative book equity, the fourth decision is about financial firms, the fifth decision is about portfolio sorting breakpoints, and the sixth decision is about the timing of market equity to account for the size effect. I propose alternatives that are just as reasonable, create all possible combinations of the decisions and their alternatives, construct 96 HML portfolios, and eventually collapse the 96 HML portfolio in each month into an average HML portfolio. This average HML portfolio is a valuable proxy for the value factor because it reflects an average decision that mitigates a bias due to chance in research decisions. The average return difference between the original HML portfolio and the average HML portfolio is therefore an estimate for the bias of the original value premium estimate.

The average HML portfolio has an average monthly return of 0.27% per month (*t*-statistic of 1.79) in the original study's sample. The original HML portfolio has an average monthly return of 0.35% per month (*t*-statistic of 2.53). The average return difference between the original and the average HML portfolio is 0.09% per month (*t*-statistic of 1.88). These findings suggest that the original value premium is positively biased.

The White (2000) Reality Check Bootstrap also leads to the rejection of the null hypothesis that the value premium is zero. This is important because the *t*-statistic of the average HML portfolio does not account that we have more information than just the average portfolio and because the *t*-statistic of the original HML portfolio does not account for a researcher's freedom in choosing the HML portfolio with the highest *t*-statistic as a proxy for the underlying value factor.

I estimate the main empirical test using data that is out of sample. If the return difference between the original and the average HML portfolio is a bias that is due to chance in research decisions, then I expect the return difference to be zero out of sample. In the pre-sample, from July 1926 to June 1963, the return difference between the original and the average HML portfolio is 0.08% per month (*t*-statistic of 1.48). This pre-sample result is somewhat at odds with the idea of a bias. The pre-sample estimate, however, may include hindsight biases, because Graham and Dodd (1934, 1962) and Graham (1949) already reported on value investing back then. In the post-sample, from January 1992 to December 2019, the return difference between the original and the average HML portfolio is 0.06% per month (*t*-statistic of 0.84). The post-sample result is consistent with a bias.

In the full sample, from July 1927 to December 2019, the average HML portfolio has an average monthly return of 0.25% (*t*-statistic of 2.21) and the average return difference between the original and the average HML portfolio is 0.08% per month (*t*-statistic of 2.27). This suggests that the original value premium estimate is upward biased but the original estimate is not a false positive.

In my last empirical test, I use the approach in Barillas and Shanken (2017) and the factors in Fama and French (2015) augmented with momentum to better understand if the original HML portfolio and the average HML portfolio are spanned. I find that the original and the average HML portfolios have almost the same intercepts and that both intercepts are statistically significant. I also find that the original HML portfolio's beta with the momentum factor is much more negative than the average HML portfolio's beta with momentum. These findings suggest that, unconditionally, the original HML portfolio has a higher average monthly return than the average HML portfolio because it avoids trading against momentum.

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Figure I

Seemingly Innocuous Decisions in the Construction of the HML Portfolio, 1963 to 1991

This histogram shows the average monthly returns of 96 HML portfolios from July 1963 to December 1991. The construction of the original HML portfolio (Fama and French, 1993) includes six seemingly innocuous decisions that could easily have been replaced with alternatives that are just as reasonable. I propose such alternatives, form all possible combinations of the six decisions and their alternatives, and construct 96 HML portfolios. The original HML portfolio (marked as "HML") has an average monthly return of 0.35% per month (*t*-statistic of 2.53). The average HML portfolio (marked as "AHML") has an average monthly return of 0.27% per month (*t*-statistic of 2.53). The average return difference between the original and the average HML portfolio is 0.09% per month (*t*-statistic of 1.88).

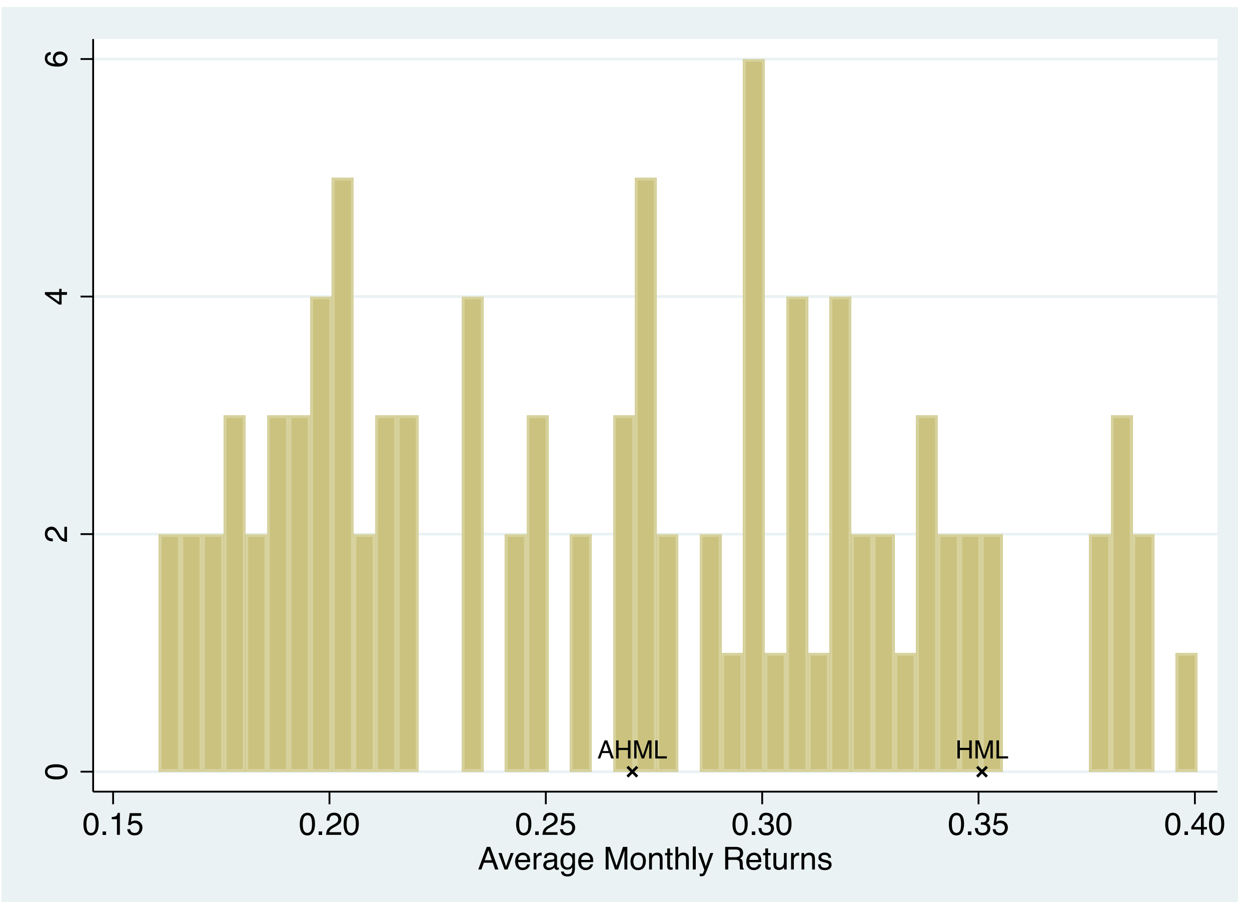

Figure II
Reality Check Bootstrap for the Original HML Portfolio, 1963 to 1991

This histogram shows bootstrapped t_{max}-statistics of a White (2000) Reality Check Bootstrap for the 96 HML portfolios under the null hypothesis that the value premium is zero. The original HML portfolio (marked as "HML") has *t*-statistic of 2.53. The 95th percentile of the t_{max}-statistics is 2.12 and marked with a red line. It serves as the critical value of a hypothesis test that considers multiple testing and that assumes a confidence level of 95%. The White (2000) reality check bootstrap procedure is as follows: I first demean each of the 96 HML portfolios. I then bootstrap months with replacement, calculate the mean return and its *t*-statistic for each of the 96 portfolios, and use the largest absolute *t*-statistics as the t_{max}-statistic. I repeat the bootstrap 1,000 times.

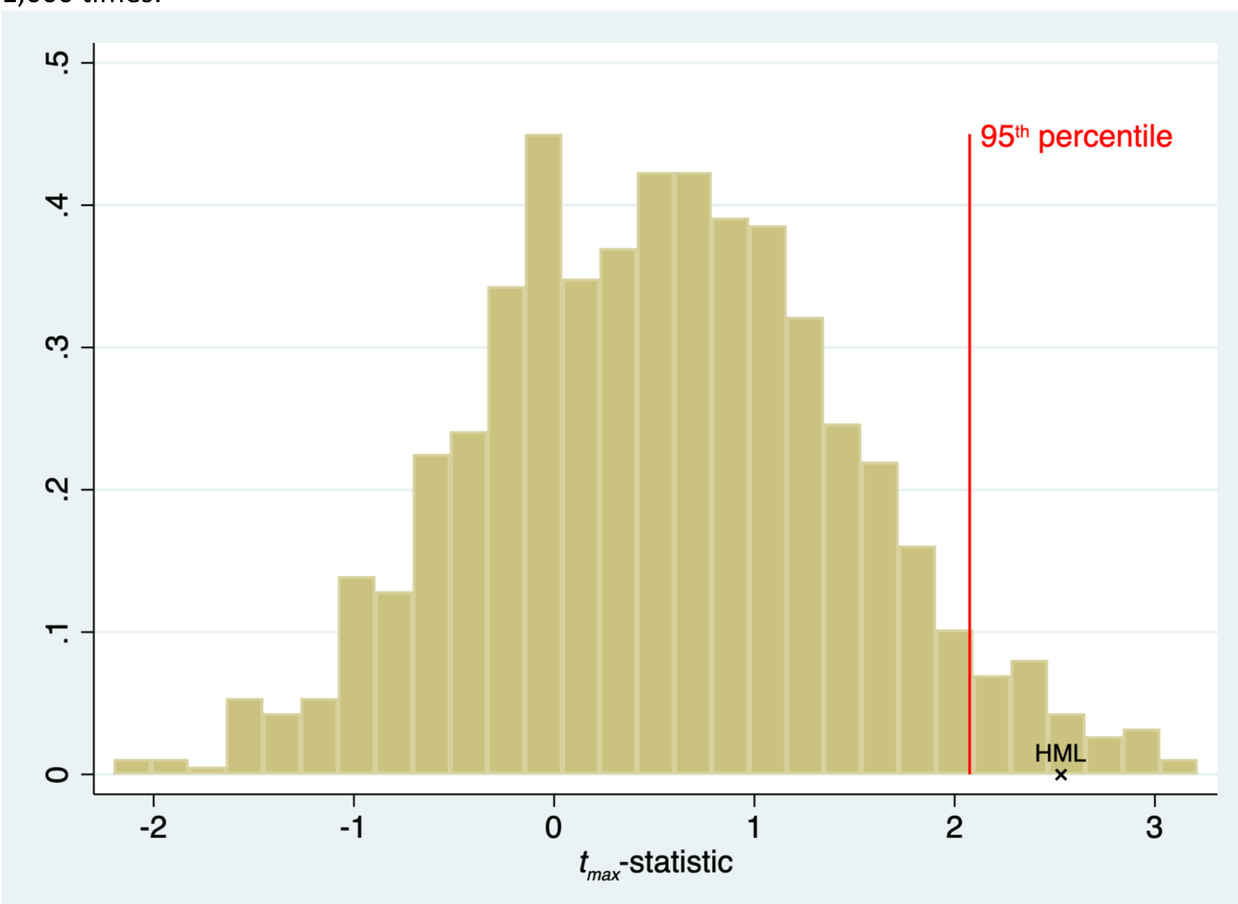

Figure III

Reality Check Bootstrap for the Original HML Portfolio, 1963 to 2019

This histogram shows bootstrapped t_{max}-statistics of a White (2000) Reality Check Bootstrap for the 96 HML portfolios under the null hypothesis that the value premium is zero. The original HML portfolio (marked as "HML") has *t*-statistic of 3.13. The 95th percentile of the t_{max}-statistics is 1.95 and marked with a red line. It serves as the critical value of a hypothesis test that considers multiple testing and that assumes a confidence level of 95%. The White (2000) reality check bootstrap procedure is as follows: I first demean each of the 96 HML portfolios. I then bootstrap months with replacement, calculate the mean return and its *t*-statistic for each of the 96 portfolios, and use the largest absolute *t*-statistics as the t_{max}-statistic. I repeat the bootstrap 1,000 times.

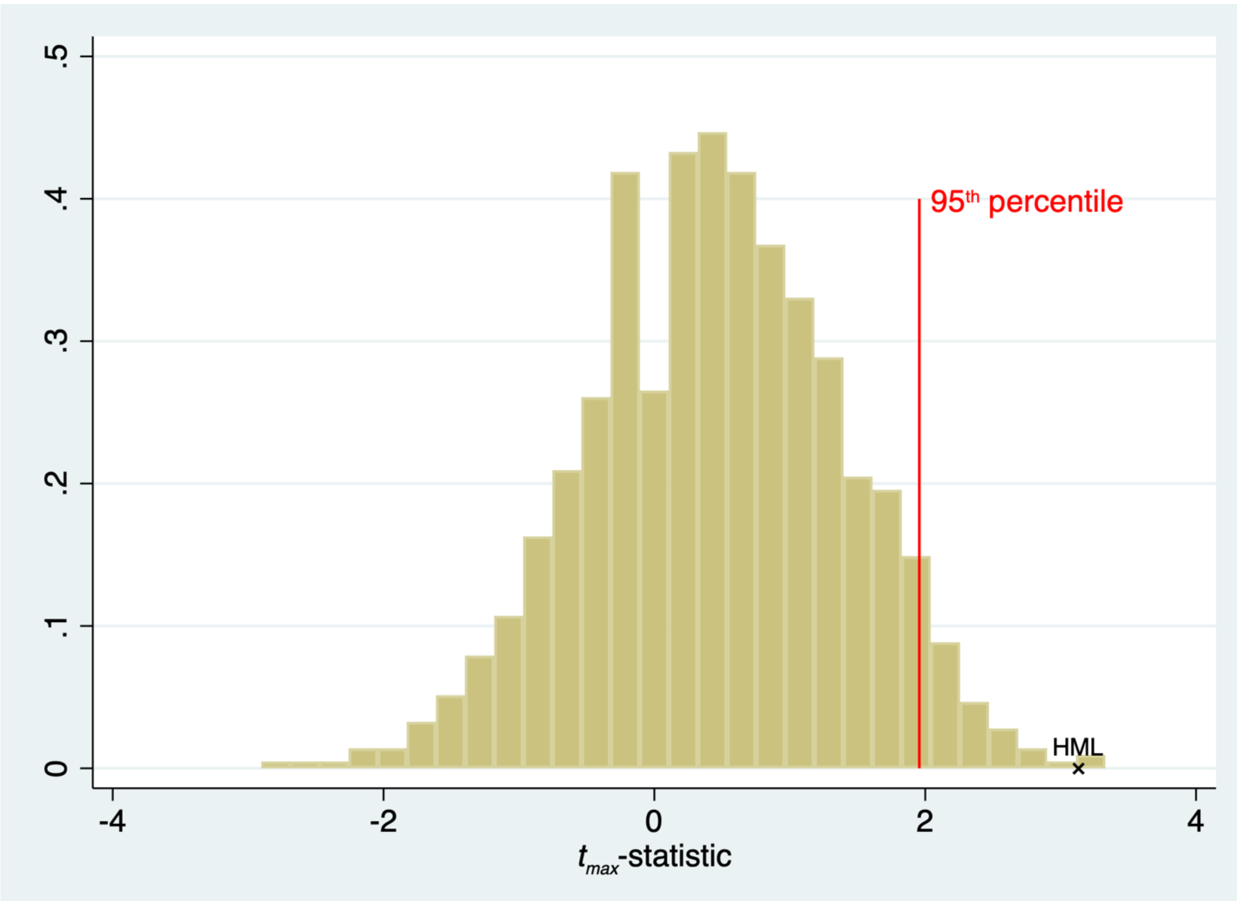

Table I

Snapshot of Decisions in the Related Studies, 1981 to 1993

This table provides a snapshot of the decisions in the empirical literature. I report all empirical studies on valuation anomalies that are referenced in Fama and French (1992, 1993) to include the most relevant empirical studies as of the beginning of the early 1990s. Column (1) names the author(s), the publication year, and the academic journal. Column (2) reports the month in which stocks are sorted into portfolios. Column (3) reports the month from which the accounting variable is that is used for the portfolio sorts. Column (4) reports the month from which month market equity is that is used for the portfolio sorts. Column (5) reports if observations with negative accounting information are excluded. Column (6) reports if financial firms are excluded. Column (7) reports the month from which market equity is to control for the size effect.

(1) Study	(2) Rebalancing Month	(3) Timing of Accounting	(4) Timing of ME	(5) Negative Accounting	(6) Financial Firms	(7) Timing of Size Effect
Fama and French (1993, JFE)	Jun t	Dec t-1	Dec t-1	Exclude	Include	Jun t
Fama and French (1992, JF)	Jun t	Dec t-1	Dec t-1	Exclude	Exclude	Jun t
Chan, Hamao, and Lakonishok (1991, JF)	Jun t	Mar t	Jun t	Separate	Include	Jun t
Jaffe, Keim, and Westerfield (1989, JF)	Mar t	Dec t-1	Mar t	Separate	Include	Mar t
Bhandari (1988, JF)	Dec t	Prev. FYE	Prev. FYE	Include	Include	Dec t
Banz and Breen (1986, JF)	Dec t	Prev. FYE	Prev. FYE	Separate	Include	Dec t
Rosenberg, Reid, and Lanstein (1985, JPM)	Monthly	Prev. Month	Prev. Month	Include	Include	Prev. Month
Basu (1983, JFE)	Apr t	Dec t-1	Dec t-1	Exclude	Exclude	Dec t-1

Table II
Replication Validation

This table reports the average monthly return (in percentages) of the original HML portfolio reported in Fama and French (1993, p. 13) and compares it with the average monthly return of the replicated HML portfolio, as well as with the average monthly returns of HML portfolios reported in eight additional papers. Column (1) names the authors, the publication year, and the academic journal of the study. Column (2) reports the time horizon that is used in each study. Column (3) reports the average monthly return of the HML portfolio over the time horizon of the study as reported in the study. Column (4) reports the average monthly return of my replicated HML portfolio over the same time horizon as in each study. The last five studies use the book equity definition as in Davis, Fama, and French (2000), which is different from the book equity definition that is used for the original HML portfolio as in Fama and French (1993). I mark these five studies with an asterisk.

Study	Time Period of Each Study	HML Return in Each Study	Replicated HML Return	Diff.
Fama and French (1993, JFE)	07/63-12/91	0.40	0.35	-0.05
Fama and French (1995, JF)	07/63-12/92	0.44	0.40	-0.04
Fama and French (1996, JF)	07/63-12/93	0.46	0.43	-0.03
Fama and French (1997, JFE)	07/63-12/94	0.45	0.41	-0.04
Davis, Fama, and French (2000, JF)*	07/63-06/97	0.43	0.39	-0.04
Fama and French (2015, JFE)*	07/63-12/13	0.37	0.35	-0.02
Linnainmaa and Roberts (2018, RFS)*	07/63-12/16	0.36	0.34	-0.02
Gerakos and Linnainmaa (2018, RFS)*	07/63-12/16	0.37	0.34	-0.03
Ball, Gerakos, Linnainmaa, and Nikolaev (2019, JFE)*	07/64-12/17	0.37	0.31	-0.06
Average		0.41	0.37	-0.04

Table III

Seemingly Innocuous Decisions in the Construction of the HML Portfolio, 1963 to 1991

This table reports Fama and MacBeth (1973) regressions of the monthly returns (in percentage) of 96 HML portfolios on a constant and on a dummy variable that is one for the original HML portfolio, from July 1963 to December 1991.

$$R_{it} = Constant + \beta \cdot Original\ HML\ Dummy_{\mathrm{it}} + e_{it}$$

The construction of the original HML portfolio (Fama and French, 1993) includes six seemingly innocuous decisions that could easily have been replaced with alternatives that are just as reasonable. I propose such alternatives, form all possible combinations of the six decisions and their alternatives, and construct 96 HML portfolios. Note that column (2) suppresses the constant in the regression. *t*-statistics are reported in parentheses. White (2000) Reality Check Bootstrap *p*-values are reported in square brackets.

	(1)	(2)	(3)
Constant	0.27		0.27
	(1.79)		(1.79)
Original HML Dummy		0.35	0.09
		(2.53)	(1.88)
Months	342	342	342

Table IV

Compensation for Risk Explanation, 1963 to 1991

This table reports the average monthly return, standard deviation, and the Sharpe ratio of the original HML portfolio and of the average HML portfolio in the original study's sample from July 1963 to December 1991. The construction of the original HML portfolio includes six seemingly innocuous decisions that could easily have been replaced with alternatives that are just as reasonable. I propose such alternatives, form all possible combinations of the six decisions and their alternatives, construct 96 HML portfolios, and finally collapse the 96 HML portfolios in each month into an equally weighted average HML portfolio.

Portfolio	Average	Standard Deviation	Sharpe Ratio
Original HML Portfolio	0.35	2.57	0.14
Average HML Portfolio	0.27	2.76	0.10

Table V

Principal Component Analysis of 96 HML Portfolios, 1963 to 1991

This table reports estimation results of a principal component analysis of the monthly returns of 96 HML portfolio in the original study's sample from July 1963 to December 1991. The construction of the original HML portfolio includes six seemingly innocuous decisions that could easily have been replaced with alternatives that are just as reasonable. I propose such alternatives, form all possible combinations of the six decisions and their alternatives, construct 96 HML portfolios. Note that I only report the first three principal components, because the other principal components account for less than one percent of the variation.

Principal Component	Proportion of Variance Explained
First	0.91
Second	0.05
Third	0.01

Table VI
Pre- and Post-Sample Evidence, 1926 to 1963 and 1992 to 2019

This table reports Fama and MacBeth (1973) regressions of the monthly returns (in percentage) of 96 HML portfolios on a constant and a dummy variable that is one for the original HML portfolio using out of sample data. The pre-sample is July 1926 to June 1963, and the post-sample is January 1992 to December 2019.

$$R_{it} = Constant + \beta \cdot Original\ HML\ Dummy_{\mathrm{it}} + e_{it}$$

The construction of the original HML portfolio includes six seemingly innocuous decisions that could easily have been replaced with alternatives that are just as reasonable. I propose such alternatives, form all possible combinations of the six decisions and their alternatives, and construct 96 HML portfolios. Note that columns (2,5) suppress the constant in the regression. *t*-statistics are reported in parentheses. White (2000) Reality Check Bootstrap *p*-values are reported in square brackets.

	(1)	(2)	(3)	(4)	(5)	(6)
Sample	July 1926 to June 1963			January 1992 to December 2019		
Constant	0.33		0.33	0.14		0.14
	(1.45)		(1.45)	(0.75)		(0.75)
Original HML Dummy		0.41	0.08		0.20	0.06
		(1.99)	(1.48)		(1.16)	(0.84)
Months	444	444	444	336	336	336

Table VII
Individual Decisions, 1963 to 1991

This table reports Fama and MacBeth (1973) regressions of the monthly returns (in percent) of 96 HML portfolios on a constant and six dummy variables for each of the six decisions of the original HML portfolio from July 1963 to December 1991. The construction of the original HML portfolio includes six seemingly innocuous decisions that could easily have been replaced with alternatives that are just as reasonable. I propose such alternatives, form all possible combinations of the six decisions and their alternatives, and construct 96 HML portfolios.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Constant	0.26	0.21	0.27	0.26	0.26	0.24	0.18
	(1.79)	(1.28)	(1.80)	(1.74)	(1.77)	(1.62)	(1.09)
Dummy for Timing of BE	0.00						0.00
	(0.28)						(0.28)
Dummy for Timing of ME		0.11					0.11
		(1.50)					(1.50)
Dummy for Neg. BE			-0.00				-0.00
			(-0.66)				(-0.66)
Dummy for Financials				0.00			0.00
				(0.17)			(0.17)
Dummy for BE/ME Breakpoints					0.00		0.00
					(0.09)		(0.09)
Dummy for Timing of Size						0.05	0.05
						(3.35)	(3.35)
Months	342	342	342	342	342	342	343

Table VIII

Robustness to Cross-sectional Slope Estimates, 1963 to 1991

This table reports Fama and MacBeth (1973) regressions of monthly slope estimates on a constant and a dummy variable that is one for the value measure that is consistent with the original HML portfolio and zero otherwise.

$$\hat{\gamma}_{it} = Constant + \beta \cdot Original\ HML\ Dummy_{\mathrm{it}} + e_{it}$$

The dependent variable, $\hat{\gamma}_{it}$, is the monthly slope estimates of monthly cross-sectional regressions in which one-month ahead returns are regressed on a constant, on the natural logarithm of each of 48 value measures, and on the natural logarithm of market equity, excluding microcap stocks. Microcap stocks are defined as stocks with end of June market capitalization below the 20 percent breakpoint of all stocks trading on the NYSE. Fama (1976) shows that these slope coefficients are returns of long-short portfolios with an exposure of one to the value measure. I exclude microcaps as a simple way to account for the equal and value weighting of stocks that is used in the construction of the original HML portfolio. I have 48 value measures (instead of 96 HML portfolios) because the fifth decision about the breakpoints to sort stocks into value and growth portfolios is not applicable here. t-statistics are reported in parentheses.

	(1)	(2)	(3)
Constant	0.18		0.18
	(1.94)		(1.91)
Original HML Dummy		0.26	0.08
		(2.83)	(3.68)
Months	342	342	342

Table IX

Full Sample Evidence, 1926 to 2019

This table reports Fama and MacBeth (1973) regressions of the monthly returns (in percentage) of 96 HML portfolios on a constant and on a dummy variable that is one for the original HML portfolio, from July 1926 to December 2019.

$$R_{it} = Constant + \beta \cdot Original\ HML\ Dummy_{\mathrm{it}} + e_{it}$$

The construction of the original HML portfolio (Fama and French, 1993) includes six seemingly innocuous decisions that could easily have been replaced with alternatives that are just as reasonable. I propose such alternatives, form all possible combinations of the six decisions and their alternatives, and construct 96 HML portfolios. Note that column (2) suppresses the constant in the regression. *t*-statistics are reported in parentheses. White (2000) Reality Check Bootstrap *p*-values are reported in square brackets.

	(1)	(2)	(3)
Constant	0.25		0.25
	(2.21)		(2.21)
Original HML Dummy		0.33	0.08
		(3.13)	(2.27)
Months	1,122	1,122	1,122

Table X

Spanning Regressions, 1927 to 2019

This table reports spanning regressions of the original and the average HML portfolios using the approach in Barillas and Shanken (2017) and the factors in Fama and French (2015) augmented with momentum over different time periods from January 1927 to December 2019. The construction of the original HML portfolio includes six seemingly innocuous decisions that could easily have been replaced with alternatives that are just as reasonable. I propose such alternatives, form all possible combinations of the six decisions and their alternatives, construct 96 HML portfolios, and finally collapse the 96 HML portfolios in each month into an average HML portfolio ("AHML"). The factor returns are from Kenneth French's webpage. *t*-statistics are reported in parentheses.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Sample	1927 to 1963		1963 to 1991		1992 to 2019		1927 to 2019		1963 to 2019	
Portfolio	AHML	HML	AHML	HML	AHML	HML	AHML	HML	AHML	HML
Constant	0.41	0.38	0.32	0.24	-0.06	-0.14	0.52	0.47	0.12	0.04
	(2.21)	(2.02)	(3.12)	(2.35)	(-0.55)	(-1.13)	(4.92)	(4.17)	(1.61)	(0.47)
Mkt-RF	0.20	0.20	-0.09	-0.06	0.03	0.07	0.03	0.05	-0.04	0.00
	(4.86)	(4.90)	(-3.10)	(-2.07)	(0.75)	(1.74)	(1.03)	(1.54)	(-1.48)	(-0.09)
SMB	0.23	0.23	0.05	0.03	-0.04	-0.06	0.04	0.02	-0.02	-0.04
	(3.14)	(2.85)	(1.21)	(0.65)	(-0.91)	(-1.44)	(0.52)	(0.33)	(-0.54)	(-1.05)
CMA			0.76	0.77	0.87	0.92			0.95	0.99
			(11.36)	(10.85)	(14.70)	(13.30)			(21.85)	(20.83)
RMW			-0.34	-0.33	0.37	0.38			0.19	0.20
			(-4.74)	(-4.34)	(6.13)	(5.69)			(3.03)	(3.25)
UMD	-0.44	-0.30	-0.23	-0.05	-0.34	-0.12	-0.45	-0.28	-0.32	-0.12
	(-6.20)	(-3.82)	(-5.58)	(-1.42)	(-13.02)	(-4.73)	(-8.89)	(-4.81)	(-12.08)	(-4.81)
Months	438	438	342	342	336	336	1'116	1'116	678	678

Appendix - Table I
Replication Methodology, 1963 to 1991

This table compares the summary statistics of the reported and the replicated HML portfolios. Column (1) reports summary statistics of the HML portfolio as reported in Fama and French (1993, p. 13, Table 2). Column (2) reports the summary statistics of the replicated HML portfolio. Column (3) reports the summary statistics of the replicated HML portfolio, but uses the book equity definition, as in Davis, Fama, and French (2000). The sample goes from July 1963 to December 1991. Note: Fama and French (1993) define book common equity as stockholder equity (*seq*), plus balance-sheet deferred taxes and investment tax credit (*txditc*) if available, minus the book value of preferred stock. The value of preferred stock is the redemption (*pstkrv*), liquidation (*pstkl*), or par value (*pstk*), if available, in that order. Davis, Fama, and French (2000) define book equity as stockholder book equity plus balance sheet deferred taxes and investment tax credit (*txditc*), if available, minus the book value of preferred stock. Stockholder equity is the value reported by Compustat (*seq*). If not available, stockholders' equity is measured as the book value of common equity (*ceq*) plus the par value of preferred stock (*pstk*), or the book value of assets minus total liabilities (*at-lt*), in that order. The book value of preferred stock is measured as redemption (*pstkrv*), liquidation (*pstkl*), or par value (*pstk*), if available and in that order, for the book value of preferred stock.

	(1)	(2)	(3)
Methodology	Original HML portfolio as Reported in Fama and French (1993, p. 13, Table 2)	Replication of the original HML portfolio as in Fama and French (1993)	Replication of the original HML portfolio, but using the book equity definition as in Davis, Fama, and French (2000)
Mean	0.40	0.35	0.39
St. Dev.	2.54	2.56	2.53
t-statistic	2.91	2.52	2.86
Autocorr. Lag 1	0.18	0.17	0.17
Autocorr. Lag 2	0.06	0.03	0.04
Autocorr. Lag 12	0.07	0.08	0.09
Corr. with SMB	-0.08	-0.10	-0.11
Corr. with MKTRF	-0.38	-0.36	-0.37
Observations	342	342	342

Appendix - Table II
Robustness Test for Seemingly Innocuous Variation in the Construction of the Original HML Portfolio, 1963 to 1991

This table reports Fama and MacBeth (1973) regressions of the monthly returns (in percentage) of 96 HML portfolios on a constant and on a dummy variable that is one for the original HML portfolio from July 1963 to December 1991. The construction of the original HML portfolio includes six seemingly innocuous decisions that could easily have been replaced with alternatives that are just as reasonable. I propose such alternatives, form all possible combinations of the six decisions and their alternatives, and construct 96 HML portfolios.

$$R_{it} = Constant + \beta \cdot Original\ HML\ Dummy_{\mathrm{it}} + e_{it}$$

I define book equity as in Davis, Fama, and French (2000) as stockholders' book equity plus balance sheet deferred taxes and investment tax credit (if available) minus the book value of preferred stock. Stockholder equity is the value reported by Compustat. If not available, stockholder equity is measured as the book value of common equity plus the par value of preferred stock, or the book value of assets minus total liabilities (in that order). The book value of preferred stock is measured as redemption, liquidation, or par value (if available, in that order). Note that column (2) suppresses the constant in the regression. *t*-statistics are reported in parentheses.

	(1)	(2)	(3)
Constant	0.30		0.30
	(2.07)		(2.07)
Original HML Dummy		0.39	0.09
		(2.87)	(1.97)
Months	342	342	342

Appendix - Table III
Robustness Test for Post-Sample Evidence, 1992 to 2019

This table reports Fama and MacBeth (1973) regressions of the monthly returns (in percentage) of 96 HML portfolios on a constant and on a dummy variable that is one for the original HML portfolio from January 1992 to December 2019. The construction of the original HML portfolio includes six seemingly innocuous decisions that could easily have been replaced with alternatives that are just as reasonable. I propose such alternatives, form all possible combinations of the six decisions and their alternatives, and construct 96 HML portfolios.

$$R_{it} = Constant + \beta \cdot Original\ HML\ Dummy_{\mathrm{it}} + e_{it}$$

I define book equity as in Davis, Fama, and French (2000) as stockholders' book equity plus balance sheet deferred taxes and investment tax credit (if available) minus the book value of preferred stock. Stockholder equity is the value reported by Compustat. If not available, stockholder equity is measured as the book value of common equity plus the par value of preferred stock, or the book value of assets minus total liabilities (in that order). The book value of preferred stock is measured as redemption, liquidation, or par value (if available, in that order). Note that column (2) suppresses the constant in the regression. *t*-statistics are reported in parentheses.

	(1)	(2)	(3)
Sample		January 1992 to December 2019	
Constant	0.13		0.13
	(0.75)		(0.75)
Original HML Dummy		0.20	0.06
		(1.16)	(0.84)
Months	336	336	336

Chapter 2: Intangible Assets and Growth Opportunities for Book-to-Market Equity as a Measure of Value

1. Introduction

Fama and French (1992, 1993) report that stocks with high book-to-market equity (value stocks) on average have higher returns than stocks with low book-to-market equity (growth stocks). One issue with book-to-market equity as a measure of value is that book equity does not account for intangible assets and growth opportunities because of US GAAP's conservative accounting principle. I therefore propose an estimate for intangible assets and growth opportunities and examine if this estimate improves book-to-market equity as a measure of value.

I estimate a firm's intangible assets and growth opportunities as the average difference of market equity minus book equity averaged over the previous five years. This estimate relies on one of the fundamental roles of financial markets: to aggregate information into prices. If markets are efficiently pricing information about intangible assets and growth opportunities, the difference of market equity minus book equity averaged over the previous five years serves as an estimate of the value of intangible assets and growth opportunities. I take an average over five years to smooth out some of the noise that is inherent in the financial market data.

The main advantage of this estimate is that it accounts for a broader set of intangible assets and for growth opportunities compared to existing estimates, and therefore this estimate should improve book-to-market equity as a measure of value. Eisfeldt, Kim, and Papanikolaou (2020), Park (2019), and Enache and Srivastava (2018), for example, estimate intangible assets by capitalizing SG&A and R&D expenditures. Their estimates account for a firm's organizational and knowledge capital, but they do not account for many intangible assets such as Warren Buffett's management integrity and intellect as CEO of Berkshire Hathaway, Pfizer's patent to manufacture and distribute the blockbuster drug Lipitor, Facebook's user data that allows them to run targeted ads, etc. Additionally, their estimates do not account for growth opportunities.

The main disadvantage of my estimate is its reliance on the financial market's ability to efficiently price information about intangible assets and growth opportunities. If investors are irrationally exuberant about intangible assets and growth opportunities, then the estimate reflects an upward biased value of intangible assets and growth opportunities and may therefore not help improve book-to-market equity as a measure of value. Lakonishok, Shleifer, and Vishny (1994), for example, argue that investors are excessively optimistic about growth stocks because investors wrongly extrapolate the past growth of growth stocks into the future.

I start the empirical analysis by comparing the magnitude of the estimates for intangible assets and growth opportunities, organizational and knowledge capital, and book equity. The average firm has intangible assets and growth opportunities of 1.78 billion dollars, organizational and knowledge capital of 0.8 billion dollars, and book equity of 1.12 billion dollars averaged over the years between 1976 and 2019. (The sample starts in 1976 because the estimate for organizational and knowledge capital is not available before FASB No. 2 was issued in 1975.) The findings suggest that intangible assets and growth opportunities are economically important and should thus be accounted for in measures for value. This is consistent with Eisfeldt, Kim, and Papanikolaou (2020), Park (2019), and Enache and Srivastava (2018), all of whom add an estimate for organizational and knowledge capital to the nominator of book-to-market equity to improve book-to-market equity as a measure of value. Additionally, the findings suggest that intangible assets and growth opportunities are about twice as large as organizational and knowledge capital. This suggests either that intangible assets and growth opportunities are economically important and should be accounted for in measures of value, or it suggests that investors are valuing intangible assets and growth opportunities overly optimistically and thus that such adjustments may not help improve book-to-market equity as a measure of value.

Do intangible assets and growth opportunities improve book-to-market equity as a measure of value? Empirically, book-to-market equity sorted quintile portfolios have a return spread of 0.17% per month (*t*-statistic 1.08) from July 1976 to December 2019. Adding intangible assets and growth opportunities to the nominator of book-to-market equity results in an economically smaller and statistically less significant quintile spread of 0.07% per month (*t*-statistic 0.36). This suggests therefore that intangible assets and growth opportunities do not improve book-to-market equity as a measure of value because they are overvalued.

Fama and MacBeth (1973) regression results are consistent with the results from the portfolio sorts. The slope estimate on the natural logarithm of book-to-market equity is 0.16 (*t*-statistic 2.34) using data from July 1976 to December 2019. Adding intangible assets and growth opportunities to the nominator of the natural logarithm of book-to-market equity leads to a somewhat larger slope estimate of 0.21 and a smaller *t*-statistic of 1.67. The slope estimate is somewhat larger because the adjusted variable has a smaller standard deviation than book-to-market equity.

The regression results are similar when the sample is restricted to larger stocks for which more information is available and for which arbitrage costs are lower. The findings suggest therefore that the investors are not only overvaluing intangible assets and growth opportunities of microcap stocks, but also of larger stocks.

In the last empirical test, I study if the ratio of intangible assets and growth opportunities to market equity predicts returns negatively. A negative effect is consistent with the correction of the overvaluation of intangible assets and growth opportunities. Empirically, portfolios sorted on the ratio of intangible assets and growth opportunities to market equity have a quintile spread of -0.26% per month with a *t*-statistic of -1.91. The quintile spread has a Fama and French (1993) three-factor model of 0.01% per month with a *t*-statistic of 0.10. This may alternatively suggest that intangible assets and growth opportunities have lower returns because they are more negatively exposed to the underlying value factor.

2. Data

I use data from the intersection of CRSP and Compustat. The sample is restricted to common ordinary US stocks (share code 10 or 11) that are trading on the NYSE, the NASDAQ, and the Amex (exchange code 1, 2, or 3).

I estimate intangible assets and growth opportunities once a year at the end of June as the difference between the market equity and book equity of each firm averaged over its previous five years. To be consistent with Fama and French (1992, 1993), market equity is price times share outstanding at the end of December of the previous year and book equity is shareholders' equity of the firm's last fiscal year available at the end of December of the previous year. This can be formally written as

$$I_{i,t} = \frac{1}{5} \cdot \sum_{\tau=t-4}^{t} (M_{i,\tau} - B_{i,\tau}).$$

Accordingly, book equity is defined as stockholders' equity (seq), plus balance sheet deferred taxes and investment tax credit (txditc) if available, minus the book value of preferred stock. The book value of preferred stock is the redemption (pstkrv), liquidation (pstkl), or par value (pstk), if available, in that order. I require non-missing book equity and market equity in the previous five years in order to estimate intangible assets and growth opportunities.

Additionally, I use data on organizational and knowledge capital available on WRDS. Organizational capital is calculated as in Eisfeldt and Papanikolaou (2013), using the perpetual inventory method specified as $O_{it} = 0.3 \cdot SG\&A_{it} + 0.8 \cdot O_{it-1}$ and an initial value of three times $SG\&A$. Knowledge capital is calculated as in Peters and Taylor (2017), using the perpetual inventory method specified as $K_{it} = R\&D_{it} + \delta \cdot K_{it-1}$ with industry-specific depreciation rates. Organizational and knowledge capital require non-missing and non-negative book equity and revenue, firms with more than 5 million dollars in property, plant and equipment, and are available after FASB No 2 was issued in 1975. Organizational and knowledge capital are not available for financial firms (first digit sic of 6), regulated industries (first two digits sic of 49), and public service firms (first digit sic of 9).

Also, I use the monthly factor returns of the Fama and French (1993) three-factor model from Kenneth French's webpage.

3. Summary Statistics

Table I reports summary statistics for the average firm from July 1976 to December 2019. Panel A estimates that the average firm has intangible assets and growth opportunities of 1.78 billion dollars, organizational and knowledge capital of 0.80 billion dollars, and book equity of 1.18 billion dollars.

[Table I]

The finding that the estimated intangible assets and growth opportunities, as well as the estimated organization and knowledge capital, are as large or larger than book equity is consistent with the view that book equity does not account for a large amount of non-capitalized assets because of US GAAP's conservative accounting principle and that they are important in constructing a measure of value.

The finding that the estimate for intangible assets and growth opportunities is twice as large as the estimate for organization and knowledge capital is on the one hand consistent with the view of a broader estimate for intangible assets and of an estimate that includes growth opportunities, and on the other hand consistent with the view that investors are overvaluing intangible assets and growth opportunities.

Panels B and C report summary statistics and correlations of the natural logarithms of book-to-market equity, book equity plus intangible assets and growth opportunities to market equity, and book equity plus organizational and knowledge capital to market equity. The three value measures have pairwise correlations of 0.69, 0.79, and 0.69. This suggests that they share a large amount of common variation with book-to-market equity and that they also bring new variation to book-to-market equity.

4. Empirical Tests

<u>Portfolio Sorts</u>

Table II reports the average returns of portfolios sorted on the three value measures from July 1976 to December 2019. The portfolios are formed once a year at the end of June and are value-weighted. The breakpoints are based on stocks trading on the NYSE at the end of June of each year.

[Table II]

Panel A reports the average returns of portfolios sorted on book-to-market equity. The portfolio with the lowest quintile of book-to-market equity has an average return of 0.95% per month, and the portfolio with the highest quintile of book-to-market equity has an average return of 1.13% per month. The quintile spread is 0.17% per month with a *t*-statistic of 1.08. These findings are consistent with Fama and French (1992, 1993) and Davis, Fama, and French (2000) who report that stocks with high book-to-market equity on average have higher returns in the US equity market.

The quintile spread of 0.17% per month is economically smaller and statistically less significant than reported in the above-mentioned studies. This is not a result of my sampling procedure, which excludes firms with missing book equity and market equity in the previous five years. Instead, the smaller quintile spread is a result of the more recent sample that starts in July 1976. The smaller quintile spread is therefore consistent with Fama and French's (2020) argument that the value premium is smaller because of the large amount of noise in monthly returns, and it is consistent with McLean and Pontiff's (2016) argument that the average anomaly portfolio return is smaller post-publication because of sophisticated investors' arbitrage activity.

Panel B reports the average returns of portfolios sorted on book equity plus the estimated value of intangible assets and growth opportunities to market equity. The portfolio with the lowest quintile has an average return of 1.07% per month, and the portfolio with the highest quintile has an average return of 1.14% per month. The quintile spread is 0.07% per month with a *t*-statistic of 0.36. The smaller quintile spread therefore suggests that adding the estimate for intangible assets and growth opportunities to the nominator of book-to-market equity does not improve book-to-market equity as a measure of value because the estimate reflects an overly optimistic valuation of intangible assets and growth opportunities.

Panel C reports the average returns of portfolios sorted on book equity plus the estimated value of organizational and knowledge capital to market equity. The portfolio with the lowest quintile has an average return of 0.96% per month, and the portfolio with the highest quintile has an average return of 1.30% per month. The quintile spread is 0.34% per month with a *t*-statistic of 1.98. The larger quintile spread suggests that adding organizational and knowledge capital to the nominator of book-to-market equity improves book-to-market equity as a measure of value, as already documented in Eisfeldt, Kim, and Papanikolaou (2020), Park (2019), and Enache and Srivastava (2018).

Cross-Sectional Regressions

Table III reports Fama and MacBeth (1973) regression results in which I regress monthly returns on each of the value measures from July 1976 to December 2019. I include the natural logarithm of market equity at the end of June as a right-hand side variable to account for the size effect. All right-hand side variables are winsorized at 0.5 and at 99.5% in each month to account for outliers.

[Table III]

Column (1) reports a slope estimate of 0.16 with a *t*-statistic of 2.34 for the natural logarithm of book-to-market equity. Column (2) reports that adding the estimate for intangible assets and growth opportunities to the nominator of the natural logarithm of book-to-market equity results in a slope estimate of 0.21 with a *t*-statistic of 1.67. The slope estimate is somewhat larger but statistically less significant. The economic magnitude of a one standard deviation change is the same, however, because book-to-market equity has a somewhat larger standard deviation (0.16*0.71=0.11 versus 0.21*0.50=0.11). The findings therefore suggest that adding the estimate for intangible assets and growth opportunities to the nominator of book-to-market equity does not improve book-to-market equity as a measure of value because the estimate reflects an overly optimistic valuation of intangible assets and growth opportunities.

Column (3) reports that adding organizational and knowledge capital to the nominator of book-to-market equity leads to a slope estimate of 0.28 with a *t*-statistic of 3.91. The slope estimate is economically larger and statistically more significant. Adding organizational and knowledge capital to the nominator of book-to-market equity therefore improves book-to-market equity as a measure of value as reported in Eisfeldt, Kim, and Papanikolaou (2020), Park (2019), and Enache and Srivastava (2018). Additionally, columns (4) to (6) report that book equity plus organizational and knowledge capital to market equity explains most of the stock return predictability of the two other value measures.

Non-Microcap Stocks

Table IV estimates the same regression specifications as before but excludes microcap stocks, which are defined as stocks with market equity smaller than the 20^{th} percentile of market equity of all stocks trading on the NYSE according to Fama and French (2008). The overly optimistic valuation of intangible assets and growth opportunities may only be a result of microcap stocks because microcap stocks have less information available and higher arbitrage costs.

[Table IV]

The estimation results for non-microcap stocks in Table IV are similar to the estimation results for all stocks in Table III. The findings therefore suggest that, even for larger stocks, adding the estimate for intangible assets and growth opportunities to the nominator of book-to-market equity does not improve book-to-market as a measure of value because intangible assets and growth opportunities are overvalued.

Reversal and Momentum Effects

Reversal and momentum effects may explain why adding intangible assets and growth opportunities to book-to-market equity results in a smaller value effect, because intangible assets and growth opportunities are estimated for each firm over the firm's previous five years. I define short-term reversal as the return in month *t* as in Jegadeesh (1990), momentum as the cumulative monthly return from *t*-12 to *t*-2 as in Jegadeesh and Titman (1993), and long-term reversal as the cumulative monthly return from *t*-60 to *t*-2 as in DeBondt and Thaler (1985).

Table V reports Fama and MacBeth (1973) regression results in which I regress monthly returns on book equity plus the estimate for intangible assets and growth opportunities to market equity, conditional on momentum and reversal effects from July 1976 to December 2019.

[Table V]

Column (1) reports a slope estimate on book equity plus intangible assets and growth opportunities of 0.21 with a *t*-statistic of 1.67. Column (2) reports an unchanged slope estimate of 0.20 with a *t*-statistic of 1.66 conditional on the short-term reversal effect. Column (3) reports a larger slope estimate of 0.28 with a *t*-statistic of 2.36 conditional on momentum. This is consistent with Asness (1997) and Asness, Moskowitz, and Pedersen (2013), who report a negative correlation between book-to-market equity and momentum. Column (4) reports a smaller slope estimate of 0.10 with a *t*-statistic of 0.75 conditional on the long-term reversal effect. This is consistent with Gerakos and Linnainmaa's (2018) argument that the value effect is a result of changes in market equity.

Overall, the empirical findings do not suggest that reversal and momentum effects explain why adding intangible assets and growth opportunities to book-to-market equity results in a smaller value effect.

Share Issuance Effects

Share issuance effects may explain why adding intangible assets and growth opportunities to book-to-market equity results in a smaller value effect, because intangible assets and growth opportunities are estimated for each firm over the firm's previous five years.

Table VI reports Fama and MacBeth (1973) regression results in which I regress monthly returns on book equity plus the estimate for intangible assets and growth opportunities to market equity conditional on share issuance effects from July 1976 to December 2019. I define share issuance as in Pontiff and Woodgate (2008) from *t*-17 to *t*-6 and from *t*-65 to *t*-6.

[Table VI]

Column (1) reports a slope estimate on book equity plus intangible assets and growth opportunities of 0.20 with a *t*-statistic of 1.60. Column (2) reports a somewhat smaller slope estimate of 0.16 with a *t*-statistic of 1.25 conditional on share issuance from *t*-17 to *t*-6. Column

(3) also reports a somewhat smaller slope estimate of 0.17 with a *t*-statistic of 1.36 conditional on share issuance from *t*-65 to *t*-6. Column (4) reports a slope estimate of 0.16 with a *t*-statistic of 1.27 conditional on both share issuance variables.

Overall, the empirical findings do not suggest that share issuance effects explain why adding intangible assets and growth opportunities to book-to-market equity results in a smaller value effect.

5. Are Intangible Assets and Growth Opportunities Overvalued?

If the estimate for intangible assets and growth opportunities reflects an overly optimistic valuation, then the correction of the overvaluation should predict returns negatively.

Table VII reports monthly returns of portfolios sorted on the difference between the two adjusted book-to-market equity variables, $\frac{B+I+G}{M} - \frac{B+O+K}{M} = \frac{(I+G)-(O+K)}{M}$, from July 1976 to December 2019. Portfolios are formed once a year at the end of June and are value-weighted, with breakpoints based on stocks trading on the NYSE.

Panel A reports that the portfolio with the low difference has an average return of 1.24% per month, and that the portfolio with the high difference has an average return of 0.97% per month. The quintile spread is -0.26 with a *t*-statistic of -1.91. These empirical findings are consistent with the behavioral view that investors price intangible assets and growth opportunities in an overly optimistic way.

Panel B reports monthly returns in excess of the Fama and French (1993) three-factor model. The alpha of the portfolio with the low difference has an average return of 0.38% per month, and the alpha of the portfolio with the high difference has an average return of 0.39% per month. The quintile spread is 0.01 with a *t*-statistic of 0.10. This empirical finding suggests that the overly optimistic valuation of intangible assets and growth opportunities may not reflect overvaluation but rather unobserved exposure to the underlying value factor.

6. Conclusion

One concern with book-to-market equity as a measure of value is that book equity does not account for intangible assets and growth opportunities because of US GAAP's conservative accounting principle. I therefore propose an estimate for intangible assets and growth opportunities and examine if that estimate improves book-to-market equity as a measure of value.

I estimate a firm's intangible assets and growth opportunities as the average difference between market equity and book equity averaged over the previous five years. This estimate rests on one of the central roles of financial markets: to aggregate information into prices. If markets are efficiently pricing information about intangible assets and growth opportunities, the difference of market equity minus book equity averaged over the previous five years serves as an estimate for the value of intangible assets and growth opportunities. I take an average over five years to smooth out some of the noise that is inherent in the financial market data.

The main advantage over existing estimates for intangible assets, such as those by Eisfeldt, Kim, and Papanikolaou (2020), Park (2019), and Enache and Srivastava (2018), is that the estimate reflects a broader set of intangible assets and growth opportunities because prices in efficient markets incorporate information about firms' intangible asset and growth opportunities. The main disadvantage over existing estimates, however, is that the estimate relies on efficient markets. If markets are not fully efficient and investors value intangible assets and growth opportunities in an irrationally exuberant way, such as in Lakonishok, Shleifer, and Vishny (1994), the estimate will reflect a biased estimate of the value of intangible assets and growth opportunities.

Do intangible assets and growth opportunities improve book-to-market equity as a measure of value? My empirical findings overall suggest that they don't result in a better measure of value, because investors overvalue intangible assets and growth opportunities. Portfolios sorted on the adjusted book-to-market equity measure have lower return spreads than portfolios sorted on book-to-market equity using data from July 1976 to December 2019. The Fama and MacBeth (1973) slope estimate of the logarithm of the adjusted book-to-market equity variable is about as large as the slope estimate of the logarithm of book-to-market equity. The results are similar for larger stocks for which more information is available and for which arbitrage costs are lower. The lower returns of the adjusted book-to-market equity variable are also not a result of return reversal effects, nor are they a result of share issuance effects.

Do investors overvalue intangible assets and growth opportunities? Consistent with correction of overvaluation, I find that the difference between the book-to-market equity variable adjusted for intangible assets and growth opportunities and the book-to-market equity variable adjusted for organizational and knowledge capital predicts returns negatively.

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Table I
Summary Statistics, 1976–2019

This table reports summary statistics for the estimates of intangible assets and growth opportunities (I+G), organizational and knowledge capital (O+K), book equity (B), and market equity (M) from July 1976 to December 2019. The summary statistics are time-series averages of annual cross-sectional means, standard deviations, and correlations. Intangible assets and growth opportunities are estimated as the average difference of market equity minus book equity averaged over a firm's previous five years. Formally, $(I_{i,t} + G_{i,t}) = \frac{1}{5} \cdot \sum_{\tau=t-4}^{t}(M_{i,\tau} - B_{i,\tau})$. Organizational and knowledge capital are estimated using the perpetual inventory model applied to a firm's research and development spending (R&D) and a fraction of selling, general and administrative spending (SG&A), as in Peters and Taylor (2017). Book equity and market equity are defined as in Davis, Fama, and French (2000).

Panel A: Assets (in millions of dollars)

	Mean	St. Deviation
Intangible Assets and Growth Opportunities (I+G)	1,679.60	4,927.73
Organizational and Knowledge Capital (O+K)	806.10	2,211.50
Book Equity (B)	1,180.61	3,212.82
Market Equity (M)	4,102.82	15,303.35

Panel B: Value Measures

	Mean	St. Deviation
ln(B/M)	-0.69	0.71
ln((B+I)/M)	-0.01	0.50
Ln((B+O+K)/M)	-0.09	0.71
ln(M)	6.07	1.82

Panel C: Correlation of Value Measures

	ln(B/M)	ln((B+I)/M)	Ln((B+O+K)/M)	ln(M)
ln(B/M)	1.00			
ln((B+I+G)/M)	0.67	1.00		
Ln((B+O+K)/M)	0.79	0.67	1.00	
ln(M)	-0.36	-0.33	-0.45	1.00

Table II
Portfolio Sorts, 1976–2019

This table reports monthly returns of portfolios sorted on book-to-market equity, book equity plus intangible assets to market equity, and book equity plus knowledge and organizational capital to market equity from July 1976 to December 2019. Portfolios are value-weighted and based on NYSE breakpoints. Intangible assets and growth opportunities are estimated as the average difference of market equity minus book equity averaged over a firm's previous five years. Formally, $(I_{i,t} + G_{i,t}) = \frac{1}{5} \cdot \sum_{\tau=t-4}^{t} (M_{i,\tau} - B_{i,\tau})$. Organizational and knowledge capital are estimated using the perpetual inventory model applied to a firm's past research and development spending (R&D) and a fraction of past selling, general and administrative spending (SG&A), as in Peters and Taylor (2017). Book equity and market equity are defined as in Davis, Fama, and French (2000). *t*-statistics are shown in parenthesis.

	(1)	(2)	(3)	(4)	(5)	(5)-(1)
Panel A: Sorted on (B/M)						
Mean	0.95	1.08	1.04	1.12	1.13	0.17
t-statistic	(4.59)	(5.479	(5.08)	(5.35)	(4.84)	(1.08)
Panel B: Sorted on (B+I+G)/M						
Mean	1.07	0.98	1.07	1.11	1.14	0.07
t-statistic	(4.46)	(4.93)	(5.63)	(5.65)	(4.66)	(0.36)
Panel C: Sorted on (B+O+K)/M						
Mean	0.96	0.99	1.12	1.19	1.30	0.34
t-statistic	(4.40)	(5.09)	(5.78)	(5.54)	(5.18)	(1.98)

Table III

Fama and MacBeth Regressions, 1976–2019

This table reports results of Fama and MacBeth (1973) regressions in which one-month ahead returns are regressed on a constant, the natural logarithms of book-to-market equity, book equity plus intangible assets and growth opportunities to market equity, and book equity plus organizational and knowledge capital to market equity from July 1976 to December 2019. Intangible assets and growth opportunities are estimated as the average difference of market equity minus book equity averaged over a firm's previous five years. Formally, $(I_{i,t} + G_{i,t}) = \frac{1}{5} \cdot \sum_{\tau=t-4}^{t}(M_{i,\tau} - B_{i,\tau})$. Organizational and knowledge capital are estimated using the perpetual inventory model applied to a firm's past research and development spending (R&D) and a fraction of past selling, general and administrative spending (SG&A), as in Peters and Taylor (2017). Book equity and market equity are defined as in Davis, Fama, and French (2000). *t*-statistics are shown in parenthesis.

	(1)	(2)	(3)	(4)	(5)	(6)
ln(B/M)	0.16			0.12	-0.15	
	(2.34)			(1.52)	(-1.59)	
ln((B+I+G)/M)		0.21		0.10		-0.03
		(1.67)		(0.65)		(-0.24)
ln((B+O+K)/M)			0.28		0.40	0.26
			(3.91)		(4.01)	(3.63)
ln(M)	-0.05	-0.05	-0.02	-0.05	-0.02	-0.03
	(-1.36)	(-1.38)	(-0.63)	(-1.35)	(-0.64)	(-0.78)
Constant	1.62	1.47	1.36	1.52	1.27	1.35
	(4.30)	(4.10)	(3.74)	(4.31)	(3.55)	(3.74)

Table IV
Non-Microcap Stocks, 1976–2019

This table reports Fama and MacBeth (1973) regressions of one-month ahead returns on a constant, on the natural logarithms of book-to-market equity, book equity plus intangible assets to market equity, and book equity plus organizational and knowledge capital to market equity for non-microcap stocks (with market equity below the 20^{th} percentile of market equity of NYSE traded stocks) from July 1976 to December 2019. Intangible assets and growth opportunities are estimated as the average difference of market equity minus book equity averaged over a firm's previous five years. Formally, $(I_{i,t} + G_{i,t}) = \frac{1}{5} \cdot \sum_{\tau=t-4}^{t}(M_{i,\tau} - B_{i,\tau})$. Organizational and knowledge capital are estimated using the perpetual inventory model applied to a firm's past research and development spending (R&D) and a fraction of past selling, general and administrative spending (SG&A), as in Peters and Taylor (2017). Book equity and market equity are defined as in Davis, Fama, and French (2000). *t*-statistics are shown in parenthesis.

	(1)	(2)	(3)	(4)	(5)	(6)
ln(B/M)	0.10			0.08	-0.22	
	(1.33)			(1.03)	(-2.02)	
ln((B+I+G)/M)		0.10		0.04		-0.11
		(0.68)		(0.25)		(-0.71)
ln((B+O+K)/M)			0.19		0.38	0.20
			(2.52)		(3.48)	(2.79)
ln(M)	-0.06	-0.06	-0.05	-0.06	-0.05	-0.05
	(-1.58)	(-1.53)	(-1.28)	(-1.52)	(-1.36)	(-1.30)
Constant	1.66	1.57	1.55	1.61	1.61	1.52
	(3.76)	(3.57)	(3.52)	(3.65)	(3.65)	(3.45)

Table V

Return Reversal and Momentum Effects, 1976–2019

This table reports Fama and MacBeth (1973) regressions of one-month ahead returns on a constant, on the natural logarithm of book equity plus intangible assets and growth opportunities to market equity, short-term reversal, momentum, and long-term reversal from July 1976 to December 2019. Intangible assets and growth opportunities are estimated as the average difference of market equity minus book equity averaged over a firm's previous five years. Formally, $(I_{i,t} + G_{i,t}) = \frac{1}{5} \cdot \sum_{\tau=t-4}^{t}(M_{i,\tau} - B_{i,\tau})$. Organizational and knowledge capital are estimated using the perpetual inventory model applied to a firm's past research and development spending (R&D) and a fraction of past selling, general and administrative spending (SG&A), as in Peters and Taylor (2017). Book equity and market equity are defined as in Davis, Fama, and French (2000). Short-term reversal is the one-month return in the previous month, as in Jegadeesh (1990); momentum is the cumulative monthly return from t-12 to t-2, as in Jegadeesh and Titman (1993); and long-term reversal is the cumulative monthly return from t-59 to t-13, as in DeBondt and Thaler (1985). t-statistics are shown in parenthesis.

	(1)	(2)	(3)	(4)	(5)
ln((B+I+G)/M)	0.21	0.20	0.28	0.10	0.20
	(1.67)	(1.66)	(2.36)	(0.75)	(1.63)
Short-term Reversal		-3.90			-4.84
		(-8.62)			(-11.76)
Momentum			0.22		0.60
			(1.18)		(3.34)
Long-term Reversal				-0.06	-0.05
				(-1.99)	(-1.98)
ln(M)	-0.05	-0.04	-0.05	-0.05	-0.06
	(-1.42)	(-1.22)	(-1.61)	(-1.44)	(-1.72)
Constant	1.48	1.45	1.37	1.52	1.41
	(4.12)	(4.12)	(4.09)	(4.31)	(4.30)

Table VI
Share Issuance Effects, 1976–2019

This table reports Fama and MacBeth (1973) regressions of one-month ahead returns on a constant, on the natural logarithm of book equity plus intangible assets and growth opportunities to market equity, short-term reversal, momentum, and long-term reversal from July 1976 to December 2019. Intangible assets and growth opportunities are estimated as the average difference of market equity minus book equity averaged over a firm's previous five years. Formally, $(I_{i,t} + G_{i,t}) = \frac{1}{5} \cdot \sum_{\tau=t-4}^{t}(M_{i,\tau} - B_{i,\tau})$. Organizational and knowledge capital are estimated using the perpetual inventory model applied to a firm's past research and development spending (R&D) and a fraction of past selling, general and administrative spending (SG&A), as in Peters and Taylor (2017). Book equity and market equity are defined as in Davis, Fama, and French (2000). Share issuance variables are defined from *t*-17 to *t*-6 and from *t*-65 to *t*-6, as in Pontiff and Woodgate (2008). *t*-statistics are in parenthesis.

	(1)	(2)	(3)	(4)
Ln((B+I+G)/M)	0.20	0.16	0.17	0.16
	(1.60)	(1.25)	(1.36)	(1.27)
Share Issuance$_{t-17,\,t-6}$		-1.38		-0.53
		(-4.26)		(-1.98)
Share Issuance$_{t-65,\,t-6}$			-0.57	-0.50
			(-4.45)	(-3.87)
Ln(M)	-0.05	-0.06	-0.06	-0.07
	(-1.40)	(-1.74)	(-1.97)	(-2.01)
Constant	1.47	1.57	1.66	1.67
	(4.12)	(4.51)	(4.96)	(4.98)

Table VII

Correction of Mispricing? 1976–2019

This table reports monthly returns of portfolios sorted on the difference between the natural logarithm of book equity plus intangible assets and growth opportunities to market equity minus the natural logarithm of book equity plus organizational and knowledge capital to market equity from July 1976 to December 2019. Portfolios are value-weighted and based on NYSE breakpoints.

$$Difference = \ln\left(\frac{B+I}{M}\right) - \ln\left(\frac{B+O+K}{M}\right)$$

Intangible assets and growth opportunities are estimated as the average difference of market equity minus book equity averaged over a firm's previous five years. Formally, $(I_{i,t} + G_{i,t}) = \frac{1}{5} \cdot \sum_{\tau=t-4}^{t}(M_{i,\tau} - B_{i,\tau})$. Organizational and knowledge capital are estimated using the perpetual inventory model applied to a firm's past research and development spending (R&D) and a fraction of past selling, general and administrative spending (SG&A), as in Peters and Taylor (2017). Book equity and market equity are defined as in Davis, Fama, and French (2000). The monthly factor returns for Mkt-Rf, SMB, and HML are from Kenneth French's webpage. *t*-statistics are shown in parenthesis.

Panel A: Unconditional Portfolio Returns

	(1)	(2)	(3)	(4)	(5)	(5)-(1)
Constant	1.24	1.08	1.00	1.09	0.97	-0.26
	(5.22)	(5.04)	(4.75)	(5.37)	(4.81)	(-1.91)

Panel B: Fama and French (1993) Three-Factor Alpha

	(1)	(2)	(3)	(4)	(5)	(5)-(1)
Alpha	0.38	0.41	0.40	0.54	0.39	0.01
	(3.97)	(5.26)	(5.68)	(8.60)	(4.64)	(0.10)
Mkt-RF	1.12	1.03	1.00	0.98	0.97	-0.15
	(49.39)	(56.05)	(60.22)	(66.28)	(48.20)	(-5.30)
SMB	0.27	0.08	-0.02	-0.14	-0.16	-0.42
	(8.10)	(2.83)	(-0.85)	(-6.32)	(-5.32)	(-10.08)
HML	0.35	-0.01	-0.16	-0.21	-0.05	-0.41
	(10.07)	(-0.21)	(-6.35)	(-9.19)	(-1.76)	(-9.16)

Chapter 3: What is the Dominant Value Explanation?

1. Introduction

What explains the higher returns of stocks with high book-to-market equity over stocks with low book-to-market equity (Fama and French, 1992)? The literature puts forward nine explanations: Fama and French (1993) argue that value stocks are more exposed to the systematic value factor. Lakonishok, Shleifer, and Vishny (1994) argue that investors wrongly extrapolate the past growth of growth stocks and that its correction gives rise to the value effect. Bhandari (1988) argues that value stocks have higher financial leverage. Carlson, Fisher and Giammarino (2004), Zhang (2005), and Novy-Marx (2011) argue that value stocks have higher operating leverage. Campbell and Vuolteenaho (2004) and Da and Warachka (2009) argue that value stocks have higher cashflow risk. Parker and Julliard (2005) and Bansal, Dittmar, and Lundblad (2005) argue that value stocks have higher consumption risk. Dechow, Sloan, and Soliman (2004) and Da (2009) argue that value stocks have higher durations. Daniel and Titman (2006) argue that the value effect is a result of investor's reaction to intangible information. Kogan and Papanikolaou (2014) argue that value stocks are less exposed to investment-specific technology shocks.

In this paper, I simultaneously study these nine explanations to better understand what the dominant explanation of the value effect is. The empirical strategy is a Fama and MacBeth (1973) regression in which the expected returns of the value effect are regressed on proxies for the nine explanations. If the value effect is the result of one dominant explanation, I expect to find one significant slope estimate. If the value effect, however, is the result of multiple explanations (Ball, 1978; Berk, 1995), I expect to find multiple significant slope estimates.

The expected returns of the value effect, which is the left-hand side variable in the main regression analysis, have to be estimated in a prior step. I estimate them using monthly cross-sectional regressions in which monthly stock returns are regressed on the natural logarithm of book-to-market equity and on the natural logarithm of market equity. The expected returns of the value effect are then defined as the natural logarithm of book-to-market equity times its monthly slope estimates. I include the natural logarithm of market equity as a right-hand side variable to account for the higher returns of smaller stocks (Banz, 1981; Fama and French, 1992).

The empirical evidence suggests that duration is the dominant explanation of the value effect. I find that a one standard deviation in a stock's duration is associated with expected value returns of 0.09% per month. This is more than half of the value effect in my sample. Duration explains nearly the entire value effect in the original value study's sample period, and about half of the value effect out-of-sample. The slope estimates of the other proxies are statistically significant, but economically negligible relative to the effect of duration.

Are these value explanations the result of investor's rational or irrational expectations? I estimate the main regression specification using data from the original study's sample period and using post-publication data. If the value expectations are the result of rational expectations, I expect to find similar slope estimate in sample and out of sample. If the value explanations are the result of irrational expectations, however, I expect to find slope estimates that are significantly smaller out of sample.

The empirical evidence suggests that the part of the value effect that is explained by duration may be the result of rational or irrational expectations. The in- versus out-of-sample difference is large but not statistically significant. The findings are, on one hand, consistent with Fama and French's (2020) argument that the smaller out-of-sample value effect is a result of noise in monthly stock returns. The findings are, on the other hand, consistent with McLean and Pontiff's (2020) argument that sophisticated investors learn about mispricing and trade on it.

2. Explanations for the Value Effect

This section describes the nine explanations of the value effect that are put forward in the literature, it defines their proxy variables, and it reports the correlations between the variables. Table I provides an overview.

[Table I]

Exposure to the Systematic Value Factor: Fama and French (1993, 1996) argue that value stocks have higher returns than growth stocks because value stocks are more exposed to the systematic value factor of their three-factor asset pricing model. I measure a stock's exposure to the systematic value factor as the beta of a stock's monthly returns with the returns of the HML portfolio over the previous five years.

Overreaction to Past Growth: Lakonishok, Shleifer, and Vishny (1994) and La Porta (1996) argue that investors wrongly extrapolate the past growth of growth stocks and that its correction gives rise to the value effect. I measure sales growth as the average annual growth in sales over a firm's previous five years using the weights 5, 4, 3, 2, and 1 as in Lakonishok, Shleifer, and Vishny (1994).

Financial Leverage: Value stocks may have higher returns than growth stocks because value stocks have higher financial leverage. Fama and French (1992) report that book-to-market equity and size absorb the stock return predictability of debt to market equity (Bhandari, 1988), earnings to price (Basu, 1977, 1983), and other variables. This suggests therefore that the higher returns of value stocks may be the result of financial leverage. Penman, Richardson, and Tuna (2007) decompose book-to-market equity into a financial leverage component and an enterprise component. They find, however, that financial leverage is negatively related to returns. I measure financial leverage as total debt to total assets.

Operating Leverage: Carlson, Fisher, and Giammarino (2004), Zhang (2005), and Novy-Marx (2011) argue that value stocks have higher returns than growth stocks because value firms have higher fixed costs of production that are costlier to adjust in economic downturns. I measure operating leverage as cost of goods sold plus selling, general and administrative costs to total assets as in Novy-Marx (2011).

Reaction to Intangible Information: Daniel and Titman (2006) argue that value stocks have higher returns than growth stocks because of investors' reaction to intangible information that is orthogonal to investors' reaction to tangible information. I measure the reaction to intangible information as the residuals of annual cross-sectional regressions in which a stock's total return over the previous five years is regressed on the stock's book return over the previous five years and on share issuance as in Daniel and Titman (2006).

Cashflow Risk: Campbell and Vuolteenaho (2004) and Da and Warachka (2009) argue that value stocks have higher returns than growth stocks because value stocks have higher cashflow risk. I measure cashflow risk as the beta of a stock's return with cashflow news using the VAR decomposition of returns in Campbell and Vuolteenaho (2004). Specifically, I sort stocks on book-to-market equity into ten portfolios, calculate the beta of each portfolio's return with cashflow news from the VAR system, and then use the beta of each portfolio for the betas of the stocks in that portfolio.

Consumption Risk: Parker and Julliard (2005) and Bansal, Dittmar, and Lundblad (2005) argue that value stocks have higher returns than growth stocks because value stocks have higher consumption risk. I measure consumption risk as the beta of a stock's return with consumption growth over the subsequent three years as in Parker and Julliard (2005). Specifically, I sort stocks on book-to-market equity into ten portfolios, calculate the beta of each portfolio's return with consumption growth, and then use the beta of each portfolio for the betas of the stocks in that portfolio.

Duration Risk: Dechow, Sloan, and Soliman (2004), Lettau and Wachter (2007), and Da (2009) argue that value stocks have higher returns than growth stocks because the cashflows of growth stocks occur in the more distant future than those of growth stocks, and that long-horizon equity is less risky. I measure duration as in Dechow, Sloan, and Soliman (2004).

Investment-Specific Technology Shocks: Kogan and Papanikolaou (2014) argue that value stocks have higher returns than growth stocks because value stocks are more exposed to investment-specific technology stocks that come with a negative risk premium. I measure a firm's exposure to investment-specific technology shocks as the beta of a stock's returns with the returns of the IMC portfolio (a portfolio that goes long investment goods producers and short consumer goods producers) as in Kogan and Papanikolaou (2014). Specifically, I sort stocks on book-to-market equity into ten portfolios, calculate the beta of each portfolio's return with the IMC portfolio's returns, and then use the beta of each portfolio for the betas of the stocks in that portfolio.

My empirical analysis is based on data from the intersection of CRSP and Compustat. The sample is restricted to common ordinary US stocks (share code 10 or 11) that are trading on the NYSE, the NASDAQ, and the Amex (exchange code 1, 2, or 3) with non-missing and non-negative book equity, non-missing market equity at the end of December of year t-1 and at the end of June of year t, and with at least two years of available Compustat data. The final sample requires non-missing observations for the nine proxies. All proxies are winsorized at 0.5% and 99.5% in each month to mitigate the impact of extreme observations.

Table II reports the correlations between the proxies of the value explanations from 1968 to 2019. The correlations between some variables are low, for example sales growth and financial leverage with a correlation of 0.05, and suggest that the value effect may be the result of multiple explanations. The correlations of other variables are high, for example cashflow risk and consumption risk with a correlation of 0.91, and suggests that the empirical evidence for one explanation may be the result of another explanation.

[Table II]

3. The Expected Returns of the Value Effect

The expected returns of the value effect, which is the left-hand side variable in the main regression analysis, are estimated in a prior step. I estimate them using monthly cross-sectional regressions in which monthly stock returns, Ret_{it+1}, are regressed on the natural logarithm of book-to-market equity, $\ln\left(\frac{B_{it}}{M_{it}}\right)$, and on the natural logarithm of market equity, $\ln(M_{it})$, as in Fama and French (1992). The expected returns of the value effect are then defined as the natural logarithm of book-to-market equity times their monthly slope estimates from these regressions. Equation (1) shows the regression specification and indicates the term that is used as the estimate for the expected return of the value effect in each month t.

$$Ret_{it+1} = \hat{\alpha}_t + \underbrace{\hat{\beta}_t \cdot \ln\left(\frac{B_{it}}{M_{it}}\right)}_{\substack{Expected\ Returns \\ of\ the\ Value\ Effect}} + \hat{\gamma}_t \cdot \ln(M_{it}) \tag{1}$$

I include the natural logarithm of market equity as a right-hand side variable to account for the higher returns of smaller stocks (Banz, 1981; Fama and French, 1992). Also, I require non-missing observations for the nine proxies of the value explanations. The natural logarithm of book-to-market equity and the natural logarithm of market equity are winsorized at 0.5% and 99.5% in each month to mitigate the influence of extreme observations.

[Table III]

Table III reports the estimation results of the Fama and MacBeth (1973) regressions using data from the full sample period from July 1968 to December 2019. The sample starts in 1968 because the first five years are needed for the estimation of the proxy variables (e.g. sales growth is measured over five years).

Column (1) estimates a value effect of 0.29 (t-statistic 4.13) unconditionally and column (2) estimates a value effect of 0.20 (t-statistic 3.12) conditional on size. These estimates are somewhat smaller than the ones reported in the literature (Fama and French, 1992) because the requirement of non-missing observations for the nine proxies of the value explanations excludes many small and young stocks for which the value effect is somewhat stronger (Fama and French, 2008). Column (3) reports a value effect of 0.31 (t-statistic 3.67) for the in-sample period and column (4) reports a value effect of 0.10 (t-statistic 1.05) for the out-of-sample period. These findings are consistent with Fama and French (2020).

4. What is the Dominant Value Explanation?

Table IV reports estimation results of Fama and MacBeth (1973) regressions in which expected returns of the value effect are regressed on the proxies for the nine explanations of the value effect over the full sample period from July 1968 to December 2019.

[Table IV]

Columns (1) to (9) report the slope estimates of univariate regressions. The nine slope estimates have the correct sign and they are statistically significant, which is consistent with the findings in the original studies. Column (10) reports the slope estimates of the multivariate regression. Duration accounts for the largest part of the value effect. A one-standard deviation in duration is associated with expected value returns of -0.09% per month (*t*-statistic -2.78) and accounts for about half of the value effect (0.09 out of 0.16 is 0.55%). The second largest part of the value effect is explained by investors' reaction to intangible information. A one-standard deviation in the reaction to intangible information is associated with expected value returns of -0.03% per month (*t*-statistic -3.15) which is only about a fifth of the value effect (0.03 out of 0.16 is 0.18). The other explanations each account for a tenth of the value effect at most.

The empirical findings suggest therefore that duration (Dechow, Sloan and Soliman, 2007; Da, 2009) is the dominant explanation of the value effect. They also suggest that the book-to-market equity is not a catch-all proxy for multiple omitted factors (Ball, 1978; Berk, 1995).

5. In- Versus Out-Of-Sample Findings

Is the part of the value effect that is explained by duration the result of rational or irrational expectations? Dechow, Sloan and Soliman (2007) argue that duration reflects risk similar to duration in fixed income securities.

I compare the slope estimates from the main regression specification using in-sample and out-of-sample data to better understand whether duration explains the value effect because of rational or irrational expectations. If duration explains the value effect because of rational expectations, I expect to find the same slope estimates in- and out-of-sample. If duration explains the value effect because of irrational expectations, however, I expect to find slope estimates that are smaller out-of-sample.

Table V reports estimation results of Fama and MacBeth (1973) regressions of the expected value returns on proxies for value explanations. Column (1) reports the in-sample estimates using data from July 1968 to June 1963. I find that duration is the dominant explanation of the value effect in-sample. A one-standard deviation in duration is associated with expected value returns of -0.21% per month (*t*-statistic of -3.73) which accounts for almost the entire value effect. (0.21 out of 0.24 is 88%). The in-sample slope estimates are similar to the full-sample slope estimate.

Column (2) reports the out-of-sample estimates using data from July 1963 to December 2019. I also find that duration is the dominant explanation of the value effect out-of-sample. A one-standard deviation in duration is associated with expected value returns of -0.05% per month (*t*-statistic of -1.02) which accounts for about half of the value effect (0.05 out of 0.09 is 55%). The estimate is not statistically significant however.

Column (3) reports the difference between the in- and the out-of-sample slope estimates along with *t*-statistics for the null hypothesis that the difference is zero. I find that duration has a slope estimate that is 0.08% per month (*t*-statistic 1.02) smaller out-of-sample and that the difference is not statistically significant. It is not clear what economic inference one should draw from this test. On one hand, the large difference suggest that duration may be a result of irrational expectations. This is related to McLean and Pontiff's (2016) finding that the average anomaly portfolio return is 59% smaller post-publication consistent with sophisticated investors learning about mispricing. On the other hand, however, the difference is not statistically significant and may suggests that duration is a result of rational expectations. This is related to Fama and French's (2020) finding that the value effect is smaller out-of-sample but that the effect is not statistically significant consistent with rational expectations.

6. Conclusion

What explains the higher returns of stocks with high book-to-market equity over stocks with low book-to-market equity (Fama and French, 1992)? The literature puts forward nine explanations: Exposure to the systematic value factor (Fama and French, 1993), investors' over-reaction to past growth (Lakonishok, Shleifer, and Vishny, 1994), financial leverage (Bhandari, 1988), operating leverage (Carlson, Fisher and Giammarino, 2004; Zhang, 2005; Novy-Marx, 2011), cashflow risk (Campbell and Vuolteenaho, 2004; Da and Warachka, 2009), consumption risk (Parker and Julliard, 2005; Bansal, Dittmar, and Lundblad, 2005), duration risk (Dechow, Sloan, and Soliman, 2004; Da, 2009), investor's reaction to intangible information (Daniel and Titman, 2006), and exposure to investment-specific technology shocks (Kogan and Papanikolaou, 2014).

In this paper, I simultaneously study these nine explanations to better understand what the dominant explanation of the value effect is. Specifically, I estimate Fama and MacBeth (1973) regressions in which the expected returns of the value effect are regressed on proxies for the explanations of the value effect. If the value effect is the result of one dominant explanation, I expect to find one significant slope estimate. If the value effect is the result of multiple explanations because book-to-market equity is a catch-all variable for multiple factors (Ball, 1978; Berk, 1995), then I expect to find multiple significant slope estimates.

My empirical findings suggest that duration is the dominant explanation of the value effect. Duration accounts for about half of the value effect in the full sample from July 1968 to December 2019. Also, duration accounts for almost the entire value effect in the original value study's sample period and for more than half of the value effect out-of-sample. The other eight explanations account for a statistically significant amount of the value effect, but the effects are economically negligible.

Dechow, Sloan, and Soliman (2004) and Da (2009) argue that duration explains the value effect because of risk. I estimate the above Fama and MacBeth (1973) regression using in-sample and out-of-sample data, and then study the difference in the estimates to better understand whether duration explains the value effect because of rational or irrational expectations. I find a large difference between the in- and the out-of-sample estimates that suggests that duration may explain the value effect because of irrational expectations. I also find, however, that the difference is not statistically significant. This suggests that the duration may explain the value effect because of rational expectations.

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Table I

Explanations of the Value Effect

This table provides an overview of the explanations of the value effect that are put forward in the literature.

Variable	**Study**	**Definition**
Beta HML	Fama and French (1993)	Beta of returns with the HML portfolio of the Fama and French (1993) three-factor model estimated using the previous five years
Sales Growth	Lakonishok, Shleifer and Vishny (1994)	Average annual growth in sales over the previous five years using the weights 5, 4, 3, 2, and 1
Operating Leverage	Carlson, Fisher and Giammarino (2004), Zhang (2005), Novy-Marx (2011)	Cost of goods sold plus selling, general, and administrative expenses divided by total assets, (COGS+XSGA)/AT
Financial Leverage	Bhandari (1988), Fama and French (1993), Penman, Richardson, Tuna (2007)	Current liabilities and long-term liabilities to total assets, (DLC+DLTT)/AT
Cashflow Risk	Campbell and Vuolteenaho (2004), Da and Warachka (2009)	Beta of returns with news about cashflow of 10 book-to-market equity sorted portfolios as in Campbell and Vuolteenaho (2004)
Consumption Risk	Parker and Julliard (2005), Bansal, Dittmar, and Lundblad (2005)	Beta of returns with consumption growth of 10 book-to-market equity sorted portfolios as in Parker and Julliard (2005)
Beta IMC	Kogan and Papanikolaou (2014)	Beta of returns with the IMC portfolio of 10 book-to-market equity sorted portfolios as in Kogan and Papanikolaou (2014)
Duration	Dechow, Sloan, and Soliman (2004), Da (2009)	Infinite sum of discounted dividend growth rates of 10 book-to-market equity sorted portfolios as in Dechow, Sloan, and Soliman (2004)
Reaction to Int. Information	Daniel and Titman (2006)	The residual from monthly cross-sectional regression of returns over five years on the change in book equity over five years conditional on share issuance as in Daniel and Titman (2006)

Table II
Correlations between Value Explanations, 1968-2019

This table reports the correlations between the proxies of the value explanations from 1968 to 2019. All variables are defined in Table I. I require non-missing observations for the nine proxies of the value explanation. The proxies are winsorized at 0.5% and 99.5% in each month, and then standardized in each month.

		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Beta HML	(1)	1.00								
Sales Growth	(2)	-0.11	1.00							
Financial Leverage	(3)	0.11	0.05	1.00						
Operating Leverage	(4)	0.04	-0.07	-0.12	1.00					
Reaction to Int. Information	(5)	-0.13	0.12	-0.03	0.00	1.00				
Cashflow Risk	(6)	0.16	-0.17	0.09	0.05	-0.70	1.00			
Consumption Risk	(7)	0.19	-0.21	0.09	0.05	-0.80	0.91	1.00		
Duration	(8)	-0.19	0.21	-0.07	-0.04	0.77	-0.66	-0.90	1.00	
Beta IMC	(9)	-0.15	0.17	-0.03	-0.03	0.57	-0.29	-0.63	0.90	1.00

Table III
Value Effect, 1968-2019

This table reports estimation results of Fama and MacBeth (1973) regressions in which one-month ahead returns, $Return_{it}$, are regressed on the natural logarithm of book-to-market equity, $\ln\left(\frac{B_{it}}{M_{it}}\right)$, and on the natural logarithm of market equity, $\ln(M_{it})$.

$$Return_{it} = \hat{\alpha}_t + \underbrace{\hat{\beta}_t \cdot \ln\left(\frac{B_{it}}{M_{it}}\right)}_{\substack{Expected\ Returns \\ of\ the\ Value\ Effect}} + \hat{\gamma}_t \cdot \ln(M_{it})$$

The variables are defined as in Fama and French (1992). I require non-missing observations for the nine proxies of the value explanation. The right-hand side variables are winsorized at 0.5% and 99.5% in each month. t-statistics are in reported parenthesis.

	(1)	(2)	(3)	(4)
Sample	1968-2019	1968-2019	1968-1992	1993-2019
ln(B/M)	0.29	0.20	0.31	0.10
	(4.13)	(3.12)	(3.67)	(1.05)
ln(M)		-0.06	-0.07	-0.06
		(-1.70)	(-1.21)	(-1.19)
Constant	1.30	1.58	1.58	1.57
	(5.59)	(4.70)	(3.24)	(3.40)

Table IV

Value Explanations in the Full Sample, 1968-2019

This Table reports the estimation results of Fama and MacBeth (1973) regressions in which the expected returns of the value effect are regressed on nine proxies of the explanations of the value effect from July 1968 to December 2019. All variables are defined in Table I. The right-hand side variables are winsorized at 0.5% and 99.5% in each month, and standardized in each month. I require non-missing observations for the nine proxies of the value explanation. *t*-statistics are in parenthesis.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Beta HML	0.03									0.00
	(1.85)									(2.11)
Sales Growth		-0.04								0.00
		(-3.98)								(3.31)
Financial Leverage			0.02							0.00
			(3.80)							(4.52)
Operating Leverage				0.02						0.00
				(3.00)						(4.57)
Reaction to Int. Information					-0.13					-0.03
					(-2.85)					(-3.15)
Cashflow Risk						0.13				0.02
						(2.76)				(2.28)
Consumption Risk							0.15			0.02
							(2.78)			(2.21)
Duration								-0.14		-0.09
								(-2.80)		(-2.78)
Beta IMC									-0.11	0.01
									(-2.75)	(2.47)
Constant	-0.04	-0.04	-0.04	-0.04	-0.04	-0.04	-0.04	-0.04	-0.04	-0.04
	(-1.13)	(-1.13)	(-1.13)	(-1.13)	(-1.13)	(-1.13)	(-1.13)	(-1.13)	(-1.13)	(-1.13)

Table V

In-Sample Versus Out-Of-Sample Comparison

This table compares the in-sample and the out-of-sample estimation results of Fama and MacBeth (1973) regressions in which the expected returns of the value effect are regressed on nine proxies of the explanations of the value effect. The third column reports the difference between the in-sample and the out-of-sample estimates with a hypothesis test for their difference. The in-sample period is July 1968 to June 1993, and the out-of-sample period is July 1993 to December 2019. All variables are defined in Table I. The right-hand side variables are winsorized at 0.5% and 99.5% in each month, and standardized in each month. I require non-missing observations for the nine proxies of the value explanation. *t*-statistics are in parenthesis.

	IS	OOS	Difference
Beta HML	0.00	0.00	0.00
	(2.68)	(1.07)	(0.23)
Sales Growth	-0.01	0.00	0.00
	(-3.53)	(0.91)	(2.28)
Financial Leverage	0.00	0.00	0.00
	(2.07)	(4.33)	(1.47)
Operating Leverage	0.00	0.00	0.00
	(3.64)	(2.96)	(0.01)
Reaction to Int. Information	-0.04	-0.03	0.01
	(-3.61)	(-1.55)	(0.56)
Cashflow Risk	0.04	0.01	-0.04
	(3.79)	(0.32)	(-1.82)
Consumption Risk	0.03	0.02	-0.01
	(2.71)	(1.14)	(-0.23)
Duration	-0.13	-0.05	0.08
	(-3.43)	(-1.02)	(1.19)
Beta IMC	0.01	0.02	0.01
	(1.67)	(1.93)	(0.93)

Table VI
Value Explanations In-Sample, 1968-1992

This Table reports the estimation results of Fama and MacBeth (1973) regressions in which the expected returns of the value effect are regressed on nine proxies of the explanations of the value effect from July 1968 to June 1993. All variables are defined in Table I. The right-hand side variables are winsorized at 0.5% and 99.5% in each month, and standardized in each month. I require non-missing observations for the nine proxies of the value explanation. *t*-statistics are in parenthesis.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Beta HML	0.06									0.00
	(3.75)									(2.68)
Sales Growth		-0.07								-0.01
		(-3.71)								(-3.53)
Financial Leverage			0.02							0.00
			(3.03)							(2.07)
Operating Leverage				0.02						0.00
				(1.85)						(3.64)
Reaction to Int. Information					-0.19					-0.04
					(-3.84)					(-3.61)
Cashflow Risk						0.18				0.04
						(3.71)				(3.79)
Consumption Risk							0.21			0.03
							(3.72)			(2.71)
Duration								-0.21		-0.13
								(-3.73)		(-3.43)
Beta IMC									(-0.16)	0.01
									(-3.68)	(1.67)
Constant	-0.06	-0.06	-0.06	-0.06	-0.06	-0.06	-0.06	-0.06	-0.06	-0.06
	(-1.91)	(-1.91)	(-1.91)	(-1.91)	(-1.91)	(-1.91)	(-1.91)	(-1.91)	(-1.91)	(-1.91)

Table VII

Value Explanations Out-Of-Sample, 1993-2019

This Table reports the estimation results of Fama and MacBeth (1973) regressions in which the expected returns of the value effect are regressed on nine proxies of the explanations of the value effect from July 1993 to December 2019. All variables are defined in Table I. The right-hand side variables are winsorized at 0.5% and 99.5% in each month, and standardized in each month. I require non-missing observations for the nine proxies of the value explanation. *t*-statistics are in parenthesis.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Beta HML	0.00									0.00
	(0.04)									(1.07)
Sales Growth		-0.02								0.00
		(-1.68)								(0.91)
Financial Leverage			0.02							0.00
			(2.42)							(4.33)
Operating Leverage				0.02						0.00
				(2.50)						(2.96)
Reaction to Int. Information					-0.08					-0.03
					(-1.05)					(-1.55)
Cashflow Risk						0.08				0.01
						(0.99)				(0.32)
Consumption Risk							0.08			0.02
							(0.97)			(1.14)
Duration								-0.08		-0.05
								(-0.96)		(-1.02)
Beta IMC									-0.06	0.02
									(-0.92)	(1.93)
Constant	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02
	(-0.34)	(-0.34)	(-0.34)	(-0.34)	(-0.34)	(-0.34)	(-0.34)	(-0.34)	(-0.34)	(-0.34)