

# Resurrecting the Value Factor from its Redundancy\*

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## Abstract

The value factor lacks incremental pricing power in the Fama-French five-factor model, being subsumed by the investment factor. The factors' relationship arises because book-to-market and investment both capture information about expected returns and cash flows. Using only stocks whose book-to-market and investment primarily reflect expected return information to construct the factors increases their means and Sharpe ratios by more than 50%. Importantly, the adjusted factors capture not only more but also complementary pricing information and improve the five-factor model's pricing power. Thus, a value factor built from stocks for which book-to-market is a good expected return indicator is not redundant.

**Keywords:** Fama-French five-factor model, value factor, investment factor, book-to-market, investment

**JEL Classification:** G12, G14

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# 1 Introduction

In this study, we resolve the recent controversy about the value factor, as raised in the studies of Fama and French (2015) and Hou et al. (2015). These studies conclude that the value factor has no added value beyond the investment factor. By contrast, we show that value and investment factors exhibit increased and incremental pricing power if their construction considers which stocks are likely to contain pricing information. Hence, factor models should still include a value factor in addition to an investment factor when determining risk-adjusted returns, capital costs, and investment performance. Fama and French’s (2015) value and investment factors are insufficient in this regard as they fail to reflect the incremental pricing information and need to be replaced by improved versions, such as the ones we propose.

Originally, Fama and French’s (1993; 1996) value factor has been viewed as the main source of their three-factor model’s explanatory power for the cross-section of stock returns. For this reason, Fama and French’s (2015) finding that the value factor has no incremental pricing power when profitability and investment factors are added came as a surprise. Fama and French (2015) motivate these additional factors as well as the value factor itself by manipulating the dividend discount model to show that book-to-market, profitability, and investment are indicators of expected returns. However, empirically, the value factor’s pricing power is subsumed by the other factors, particularly the investment factor.

The contrast between the value factor’s theoretical motivation and its empirical redundancy as well as Fama and French’s (2015) decision to keep it in their five-factor model has sparked controversy about the value factor. On the one hand, the value factor had been considered the most important factor for explaining the cross-section of stock returns for a long time. The value premium is an established empirical finding, and Fama and French (2015) provide a profound theoretical motivation for the value factor. Additionally, other recently proposed factor models also comprise value factors (e.g., Barillas and Shanken, 2018). On the other hand, Fama and French’s (2015) value factor has no incremental pricing power in the presence of their investment factor. Moreover, Hou et al. (2015) derive an economic model inspired by q-theory and production-based asset pricing that can motivate profitability and investment factors but not a value factor. Their four-factor model therefore does not include a value factor but performs, in general, better than the Fama-French (2015) model. Hence, the value factor’s theoretical motivation and empirical usefulness are called into question.

Resolving this controversy and recovering the value factor’s incremental pricing power relative to the investment factor is important for at least three reasons. First, the value factor is theoretically motivated based on such a fundamental principle as the dividend discount model. While the issue of an ever-expanding factor zoo (see, e.g., Cochrane, 2011; Harvey et al., 2016) suggests that getting rid of a factor is good news, losing a factor which, in theory, captures incremental information about expected returns is bad news. This is because losing a theoretically motivated factor implies that its incremental pricing information is not properly taken into account for the determination of risk-adjusted returns, capital costs, and investment per-

formance. Second, factor models are the workhorse approach in empirical asset pricing. It is critical to understand how to construct factors such that they reflect the intended pricing information. Given that the value and investment factors are jointly motivated by the dividend discount model and, therefore, theoretically complementary, the value factor’s empirical redundancy suggests that the factors’ construction is flawed. Third, the investment management industry widely employs investment strategies based on factors, and the value factor is one of the most targeted factors. Our study yields insights into how to construct value and investment strategies that effectively harvest the factor premia and complement each other.

To understand the reasons for the value and investment factors’ close connection, we consider their sorting variables—book-to-market and investment. The dividend discount model and the net present value rule suggest that both variables reflect variation in discount rates and expected cash flows: low expected cash flows and high discount rates lead investors to assign low valuations to firms, implying high book-to-market, and simultaneously prompt the firms to invest little.<sup>1</sup> This generates a negative relation between book-to-market and investment. Because the value factor is long in high book-to-market stocks and the investment factor is long in low investment stocks, the negative relation implies that the factors are likely to select similar stocks, in turn giving rise to their comovement.

Our empirical results support this mechanism. We confirm a negative relation between book-to-market and investment that leads to an overlap between the value and investment factors’ portfolios. The overlap is only due to stocks whose variation in book-to-market stems from variation in market equity rather than book equity. This is in line with the mechanism because variation in expected cash flows and discount rates should only be reflected in book-to-market’s market equity-driven variation. The factor portfolios’ overlap is, in turn, the primary reason for the factors’ strong comovement.

In theory, only differences in discount rates are associated with differences in expected returns. Thus, high book-to-market should only be associated with higher expected returns if it is high due to high discount rates rather than low expected cash flows. Analogously, low investment should only be associated with higher expected returns if it is low due to high discount rates rather than low expected cash flows. Hence, only those stocks whose variation in book-to-market and investment stems from variation in discount rates—and thus expected returns—should contain the value and investment factors’ pricing information. To determine whether firms’ book-to-market and investment likely reflect variation in expected returns, we orthogonalize market equity and investment changes to a proxy for cash flow shocks. Following Hou and van Dijk (2019), we use profitability shocks estimated from a cross-sectional profitability model as proxies for cash flow shocks. Since the orthogonalizations cancel variation in book-to-market’s market equity-driven part and investment that is informative about expected cash flows, their residuals should contain their expected return information.

Our approach successfully identifies the stocks that contain the value and investment factors’

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<sup>1</sup>The same reasoning applies analogously to high expected cash flows and low discount rates.

pricing information. In particular, only stocks whose book-to-market and investment are more strongly driven by the residuals than the profitability shocks earn the value and investment premia. The value and investment premia of the residual-driven stocks are around 6.0% and 3.7% p.a., respectively, representing increases of more than 50% relative to the usual premia. Moreover, unlike the usual premia, these value and investment premia are largely independent sources of excess returns.

The differences between the residual- and profitability shock-driven value and investment premia are arguably due to differences in expected returns. Nevertheless, the Fama-French (2015) five-factor model fails to explain why only residual-driven stocks earn value and investment premia. Thus, the model, and in particular its value and investment factors, cannot distinguish whether book-to-market is high and investment is low because of high expected returns or low expected cash flows.

For this reason, we construct adjusted versions of the value and investment factors that employ only those stocks whose book-to-market and investment are mainly driven by the residuals. These residual-driven value and investment factors strongly outperform their standard counterparts, generating Sharpe ratios that are more than 50% higher. Moreover, the correlation between the residual-driven value and investment factors is only 0.26, while the standard value and investment factors' correlation is 0.66. Thus, our residual-driven factors are more mean-variance efficient and independent than their standard counterparts. Importantly, the residual-driven value factor cannot be subsumed by the other factors, including the residual-driven investment factor. Unlike the standard value factor, our residual-driven value factor thus captures incremental pricing information and is not redundant.

We further show that a five-factor model that replaces the standard value and investment factors with our residual-driven factors achieves a significantly higher maximum Sharpe ratio than the standard Fama-French (2015) five-factor model. Based on Barillas and Shanken's (2017) conclusion that the factor model with the highest maximum Sharpe ratio exhibits the best pricing performance, this result implies that our residual-driven factors significantly improve the standard model's pricing performance. Thereby, our residual-driven value and investment factors capture the full pricing information of the standard factors.

Our study contributes to several strands of literature. First, it resolves the recent controversy about including a value factor in addition to an investment factor in factor models, as raised in Fama and French's (2015) and Hou et al.'s (2015) studies. Both studies concur that expected returns are related to investment and profitability. However, Hou et al. (2015) argue that there is no independent relation between book-to-market and expected returns and that the value effect is just a manifestation of the investment effect, suggesting that a value factor is not only empirically but also theoretically redundant. We agree with Hou et al. (2015) that book-to-market and investment capture similar effects—namely, variation in expected cash flows and discount rates. Nevertheless, our results reject the conclusion that a value factor is therefore necessarily redundant, showing that a value factor built only from stocks that are likely to

contain pricing information exhibits incremental pricing power.<sup>2</sup> Hence, we advocate including both value and investment factors in factor models.<sup>3</sup>

Second, this study contributes to the recent literature on improvements to factors' construction (e.g., Daniel et al., 2020; Fama and French, 2020; Ehsani and Linnainmaa, 2022). In line with these studies, our results suggest that better versions of existing factors are needed.<sup>4</sup> We complement them by proposing improvements to the factors motivated by economic rationale rather than statistical arguments. In particular, we show that factors' mean-variance efficiency and pricing power can be enhanced if their construction considers which stocks should contain their pricing information.

Third, our paper relates to the literature on the source of book-to-market's predictive power for returns. Daniel and Titman (2006), Fama and French (2008), and Gerakos and Linnainmaa (2018) split the change in book-to-market into different components to narrow down the source of book-to-market's predictive power. Daniel and Titman (2006) find that book-to-market's intangible return component, capturing news about firms' future performance, predicts returns. Fama and French (2008) argue that the per-share book equity change, the without-dividend return, and share issues all contain predictive information. Gerakos and Linnainmaa (2018) show that only book-to-market's market equity-driven component predicts returns. We expand on these studies by differentiating between book-to-market's information about expected returns and cash flows, thereby pinpointing the priced variation in book-to-market more accurately. In this regard, we show that value factors in the spirit of Daniel and Titman (2006) and Gerakos and Linnainmaa (2018) are—unlike our residual-driven value factor—redundant and capture significantly less pricing information.

Several recent studies (e.g., Arnott et al., 2021; Cong et al., 2023; Eisfeldt et al., 2022; Gonçalves and Leonard, 2023) show that book-to-market's predictive power and the value factor's pricing performance can be enhanced by adjusting book equity to better reflect fundamental value. This approach is conceptually different from Daniel and Titman (2006), Fama and French (2008), Gerakos and Linnainmaa (2018), and our study that focus on market equity rather than book equity. Taking Eisfeldt et al.'s (2022) approach of adjusting book equity for intangibles as an example, we show that our approach is complementary to adjusting book equity. Specifically, by applying our procedure to Eisfeldt et al.'s (2022) intangible value factor, we obtain a residual-driven intangible value factor that further enhances our usual residual-driven value factor regarding mean return, Sharpe ratio, and pricing power.

Finally, we contribute to the literature on the investment effect and its relation to the

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<sup>2</sup>In the Internet Appendix, we show that the value factor rather than the investment factor is empirically the redundant factor because it is more volatile and a worse hedge for the other factors. Out-of-sample evidence shows that these reasons may be specific to our sample period from 1963 to 2019, suggesting the value factor may not necessarily be the redundant factor going forward. On the one hand, this result is an additional argument in favor of including a value factor in factor models. On the other hand, it also corroborates the importance of adjusting the investment factor to prevent it from becoming redundant.

<sup>3</sup>Fama and French (2015) conclude that the value factor can be dropped when estimating risk-adjusted returns but should be retained when determining portfolios' factor tilts. Our recommendation contrasts with this conclusion: a value factor that captures incremental pricing information should always be included.

<sup>4</sup>Constructing better versions of existing factors counteracts the issue of an ever-expanding factor zoo.

value effect. Cooper et al. (2008) show that investment is negatively related to future returns. Xing (2008) finds that book-to-market and investment capture similar information about future returns. Thereby, the investment effect subsumes the value effect, but not vice versa. More recently, Cooper et al. (2024) document that the performance of the Fama-French (2015) five-factor model and Hou et al.’s (2015) four-factor model is highly sensitive to the construction of the investment factor. This finding corroborates the need for more prudent factor construction methodologies. We add to this literature by narrowing down the variation in investment related to future returns and suggesting a more carefully constructed investment factor. Importantly, our results reveal that book-to-market and investment capture incremental information about expected returns once their common information about expected cash flows is discarded.

## 2 Motivation

Our aim to disentangle the value and investment factors builds on Fama and French’s (2015) conclusion that firms’ book-to-market and investment are both related to their expected returns. This conclusion is based on the following manipulation of the dividend discount model:

$$\frac{ME_0}{BE_0} = \sum_{t=1}^{\infty} \frac{\frac{E_0(Y_t)}{BE_0} - \frac{E_0(dBE_t)}{BE_0}}{(1+r)^t} \quad (1)$$

where  $ME_0$  ( $BE_0$ ) is current market (book) equity,  $Y_t$  is total earnings,  $dBE_t$  is the change in book equity, and  $r$  is the long-term average expected stock return. This equation states that, all else being equal, a firm’s book-to-market ( $\frac{BE_0}{ME_0}$ ) is positively and its expected investment ( $\frac{E_0(dBE_t)}{BE_0}$ ) is negatively related to its expected stock return. Thus, book-to-market and investment are indicators of expected stock returns. Importantly, the equation suggests that they carry complementary information about expected returns.

Fama and French (2015) motivate their value and investment factors based on these insights. They go long stocks with high book-to-market and low investment and short stocks with low book-to-market and high investment, respectively. Thereby, they capture the differences in expected returns across stocks with different book-to-market and investment. Since differences in expected returns are, in equilibrium, associated with differences in systematic risk, the factors should reflect priced risks. The implicit assumption is that the variables capture sufficiently different information such that the factors reflect different priced risks.

However, this is empirically not the case: the value and investment factors comove strongly, and the former has no incremental pricing power beyond the latter. A natural explanation for the factors’ close connection is that book-to-market and investment are negatively related. Consider the following book-to-market decomposition:

$$BM_t = BM_{t-k} + \sum_{s=0}^{k-1} dBE_{t-s} - \sum_{s=0}^{k-1} dME_{t-s} \quad (2)$$

where  $BM_t$  is log book-to-market and  $dBE_t$  and  $dME_t$  are log changes in book and market

equity. In words, log book-to-market equals lagged log book-to-market plus log changes in book equity minus log changes in market equity. Given that  $dBE_t$  is book equity growth and investment is asset growth, they should correlate positively. Thus, a negative correlation between book-to-market and investment can only emanate from market equity changes.

To identify common drivers of market equity and investment, we consider how they are determined. First, firms' market values are determined by investors' valuations. Specifically, suppose a representative investor values firms' equity based on the dividend discount model:

$$ME_0 = \sum_{t=1}^{\infty} \frac{E_0(D_t)}{(1+r)^t} \quad (3)$$

where  $ME_0$  is market equity,  $D_t$  is total dividends, and  $r$  is the investor's required return.

Second, suppose that firms determine their investment based on the net present value rule:

$$NPV_0 = -I_0 + \sum_{t=1}^{\infty} \frac{E_0(CF_t)}{(1+r)^t} \geq 0 \quad \Longleftrightarrow \quad I_0 \leq \sum_{t=1}^{\infty} \frac{E_0(CF_t)}{(1+r)^t} \quad (4)$$

where  $NPV_0$  is the investment's net present value,  $I_0$  is the required investment amount,  $CF_t$  is the cash flow from the investment, and  $r$  is the investment's cost of capital, which is, in equilibrium, equal to the investor's required return from equation (3).<sup>5</sup>

Equations (3) and (4) show that firms' market equity and investment have common determinants. In particular, lower expected cash flows result in lower net present values for firms' investments, prompting them to invest less. Lower expected cash flows from investments also imply lower expected dividends, leading investors to decrease their firm valuations. Increases in investors' required returns also lead them to decrease their firm valuations. Higher required returns in turn imply higher cost of capital, leading to lower net present values for firms' investments and prompting them to invest less.<sup>6</sup> Thus, variation in required returns and expected cash flows should lead to a positive relation between market equity and investment and in turn to a negative relation between book-to-market and investment.

The value and investment factors are long in high book-to-market and low investment stocks (hf. value and conservative stocks) and short in low book-to-market and high investment stocks (hf. growth and aggressive stocks), respectively. Given the predicted negative relation between book-to-market and investment, value stocks should frequently also be conservative stocks, and growth stocks should frequently also be aggressive stocks. Hence, the factors are likely to select similar stocks in their portfolios, causing them to comove.

Variations in required returns and expected cash flows both contribute to the negative relation between book-to-market and investment. However, in equilibrium, only variation in

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<sup>5</sup>For simplicity, we assume that the firm's assets are homogeneous and that the firm is all-equity-financed. Thus, the cost of capital is the same for each investment and equal to the investor's required return.

<sup>6</sup>The same reasoning applies analogously to higher expected cash flows and lower required returns.

required returns is associated with variation in expected returns.<sup>7</sup> Hence, only value stocks whose book-to-market is high because of high required returns have high expected returns. Similarly, only conservative stocks whose investment is low because of high required returns have high expected returns. These stocks should contain the factors' pricing information. By contrast, variation in expected cash flows does not convey information about expected returns. Thus, value (conservative) stocks whose book-to-market (investment) is high (low) because of low expected cash flows should not have high expected returns. They should, therefore, not contain pricing information. In both cases, the analogous reasoning applies to growth and aggressive stocks. Given that equation (1) suggests that book-to-market and investment carry complementary information about expected returns, we suppose that stocks that contain the factors' pricing information should capture complementary pricing information.

### 3 Data and Methodology

#### 3.1 Data Sample

Our sample period spans from July 1963 to December 2019. We obtain stock data from CRSP and fundamentals data from Compustat. We supplement the Compustat data with Davis et al.'s (2000) hand-collected book equity data from Kenneth French's website.<sup>8</sup> Our sample includes all stocks traded on the NYSE, AMEX, or NASDAQ with a CRSP share code of 10 or 11. We adjust monthly returns for potential delisting returns. Following Shumway (1997) and Shumway and Warther (1999), we additionally set missing delisting returns for NYSE and AMEX stocks to -30% and for NASDAQ stocks to -55% in case the delisting was performance-related. Finally, we use the one-month T-bill rate from Kenneth French's website as risk-free rate. The construction of our key variables is described in Appendix A.

#### 3.2 Factor Portfolios

We construct the value and investment factors as described by Fama and French (2015). In detail, for the value factor's construction, we sort stocks at the end of each June into two groups according to their market equity at the end of June and into three groups according to their book-to-market from the last fiscal year ending in the prior year.<sup>9</sup> The breakpoints are the median market equity and the 30th and 70th book-to-market percentiles of all NYSE stocks. Taking the intersections of the two size groups and the three book-to-market groups yields six

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<sup>7</sup>Note that our theoretical arguments do not require the assumption of rationality. In particular, investors' required returns, and thus stocks' expected returns, may not only be determined by stocks' exposures to priced risks but also by investors' behavioral biases. Like rational variation in required returns, irrational variation in required returns should spill over to firms' cost of capital and therefore affect their investment. This conjecture is supported by the findings of, among others, Polk and Sapienza (2009) and Dessaint et al. (2019) that mispricing affects firms' investment decisions.

<sup>8</sup>[http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data\\_library.html](http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html)

<sup>9</sup>We measure book-to-market slightly differently than Fama and French (2015): We take the market equity at the fiscal year ending rather than at the calendar year ending. We make this adjustment to align market equity changes with the profitability shocks introduced in Section 3.3.

portfolios. The stocks in these portfolios are value-weighted. The return on the value factor (HML) is the average return on the two high book-to-market portfolios minus the average return on the two low book-to-market portfolios.

The investment factor is constructed analogously, only that the second sort is with respect to investment as measured by asset growth from the last fiscal year ending in the prior year. The return on the investment factor (CMA) is the average return on the two low investment portfolios minus the average return on the two high investment portfolios. The correlation between the value and investment factors is 0.66 (unreported).

For both factors, we define aggregate long (short) portfolios as the equal-weighted combinations of the small and big long (short) portfolios. Thereby, each stock receives the same weight in the aggregate portfolios as it has in calculating the factors' returns. We refer to the value factor's long (short) portfolio as value (growth) portfolio and to the investment factor's long (short) portfolio as conservative (aggressive) portfolio. The long-short combinations of the aggregate factor portfolios are denoted as HML and CMA portfolios, respectively.

### 3.3 Cash Flow Shock Proxy

In Section 2, we outline that stocks whose variation in book-to-market and investment is due to variation in expected cash flows should not contain the value and investment factors' pricing information. To identify these stocks, we estimate firms' profitability shocks following Hou and van Dijk (2019) and use them as proxies for the firms' cash flow shocks. For this purpose, we first implement Hou and van Dijk's (2019) cross-sectional profitability model, which yields estimates for firms' expected profitability. Specifically, we run the following cross-sectional regression at the end of each June from 1964 to 2019:<sup>10</sup>

$$\frac{OI_{i,t}}{AT_{i,t-1}} = b_{0,t} + b_{1,t} \frac{FV_{i,t-1}}{AT_{i,t-1}} + b_{2,t} DD_{i,t-1} + b_{3,t} \frac{D_{i,t-1}}{BE_{i,t-1}} + b_{4,t} \frac{OI_{i,t-1}}{AT_{i,t-2}} + \epsilon_{i,t} \quad (5)$$

where  $\frac{OI_{i,t}}{AT_{i,t-1}}$  is operating income after depreciation scaled by lagged total assets,  $\frac{FV_{i,t-1}}{AT_{i,t-1}}$  is assets' market-to-book value (assets' market value is calculated as their book value plus market equity (from Compustat) minus book equity (calculated as described in Appendix A)),  $\frac{D_{i,t-1}}{BE_{i,t-1}}$  is dividend payments-to-book equity, and  $DD_{i,t}$  is a dummy variable that equals one if the firm does not pay dividends.

Panel A of Table 1 presents the average coefficients. Their signs are identical, and their magnitudes are similar to those reported by Hou and van Dijk (2019). In line with intuition, the coefficients indicate that expected profitability is higher for firms with higher valuations, dividend payments, and past profitability. Despite its parsimony, the model exhibits an  $R^2$  of 61.3% and thus captures a large proportion of the variation in future profitability.

Like Hou and van Dijk (2019), we use the annual regression coefficients from the profitability model to calculate firms' profitability shocks. In particular, we forecast firms' profitability for

<sup>10</sup>Following Hou and van Dijk (2019), we exclude firms with total assets of less than \$10 million and book equity of less than \$5 million for the estimation of the model.

year  $t$  by multiplying the estimated coefficients from the regression in year  $t - 1$  with the firms' values for the predictor variables in year  $t - 1$ . Firms' profitability shocks in year  $t$  are then their realized minus forecasted profitability:

$$PS_{i,t} = \frac{OI_{i,t}}{AT_{i,t-1}} - E_{t-1} \left( \frac{OI_{i,t}}{AT_{i,t-1}} \right) = \frac{OI_{i,t}}{AT_{i,t-1}} - X_{i,t-1} \hat{b}'_{t-1} \quad (6)$$

where  $X_{i,t-1}$  is a vector containing firm  $i$ 's values for the predictors as of year  $t - 1$  and  $\hat{b}_{t-1}$  is the vector of coefficients estimated from regression (5) in year  $t - 1$ .

### 3.4 Residual Market Equity and Investment Changes

Next, we orthogonalize market equity and investment changes to the profitability shocks by running the following cross-sectional regressions at the end of each June from 1964 to 2019:<sup>11</sup>

$$dME_{i,t} = c_{0,t} + c_{1,t}PS_{i,t} + \epsilon_{i,t}^{dME} \quad (7)$$

$$dINV_{i,t} = d_{0,t} + d_{1,t}PS_{i,t} + \epsilon_{i,t}^{dINV} \quad (8)$$

where  $dME_{i,t}$  and  $dINV_{i,t}$  are log changes in market equity and investment, and  $PS_{i,t}$  is the estimated profitability shock, all of which are measured across the fiscal year ending in year  $t - 1$ . The regression residuals  $\epsilon_{i,t}^{dME}$  and  $\epsilon_{i,t}^{dINV}$  capture the parts of the market equity and investment changes unexplained by profitability shocks.

Panels B and C of Table 1 present the regression results. The profitability shock's average coefficients are positive and highly significant. In line with intuition, a positive profitability shock is associated with positive contemporaneous market equity and investment changes.

The regressions in (7) and (8) cancel variation in market equity and investment changes due to cash flow shocks, and thus due to variation in expected cash flows. In theory, this variation is uninformative about expected returns. The residual changes should therefore contain market equity and investment changes' expected return information. Hence, book-to-market and investment should only be informative about expected returns if they are mainly driven by the residual changes rather than profitability shocks. Stocks whose book-to-market and investment are mainly driven by the residual changes should therefore contain the factors' pricing information. The next section describes our procedure to identify these stocks.

Our approach extends those of Gerakos and Linnainmaa (2018), Daniel and Titman (2006), and Fama and French (2008). These studies argue that market equity changes, intangible returns, and without-dividend returns are the source of book-to-market's predictive power for future returns because they reflect information about expected returns. However, these studies neglect that market equity changes, intangible returns, and without-dividend returns also reflect information about expected cash flows. By contrast, we cancel information about expected cash flows from market equity changes to identify their expected return information more precisely.

<sup>11</sup>Note that this regression as well as the estimation of the profitability shocks require only data that are publicly available by the end of June of year  $t$ ; that is, there is no look-ahead bias.

### 3.5 Decomposition of Factor Portfolios

We use the estimated profitability shocks and residual changes to split the value and investment factors' portfolios into parts that are likely to contain pricing information and parts that are unlikely to contain pricing information. To this end, we classify value and growth stocks at the time they enter the value factor's portfolios according to whether their book-to-market changes are more strongly driven by book equity changes, profitability shocks, or residual market equity changes. Similarly, we classify conservative and aggressive stocks at the time they enter the investment factor's portfolios according to whether their investment changes are more strongly driven by profitability shocks or residual investment changes.

We conduct the classification based on stocks' book-to-market and investment changes at the time they enter the portfolios because these are the changes that make them high or low book-to-market and investment stocks. Identifying the reasons for stocks to become high or low book-to-market and investment stocks facilitates determining whether stocks are likely to reflect pricing information. Figure 1 lends support to this approach by showing (i) that the spreads in value and growth stocks' book-to-market and conservative and aggressive stocks' investment largely arise in the year of their entry and (ii) that they remain elevated for several years. Thus, the year in which stocks enter the factor portfolios is the year in which their potential pricing information emerges.

Our exact procedure to decompose the value and growth portfolios is as follows. First, we split the portfolios into market- and book-channel subsets based on the book-to-market decomposition in equation (2). Specifically, we classify value stocks in the year they enter the value portfolio as market-channel stocks if the negative of their cross-sectionally demeaned log market equity decrease is higher than their cross-sectionally demeaned log book equity increase.<sup>12,13</sup> Analogously, we classify growth stocks in the year they enter the growth portfolio as market-channel stocks if the negative of their cross-sectionally demeaned log market equity increase is lower than their cross-sectionally demeaned log book equity decrease. In the opposite cases, we classify value and growth stocks as book-channel stocks. Thus, market-channel value (growth) stocks are stocks whose book-to-market increases (decreases) that turn them into value (growth) stocks are relatively more strongly driven by market than book equity changes. On average, 81% (19%) of incoming value and growth stocks are classified as market-channel (book-channel) stocks, implying that stocks become value and growth stocks primarily because of market equity changes.

Next, we split the value and growth portfolios' market-channel subsets according to stocks'

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<sup>12</sup>We classify only stocks that could have but have not been in the previous year's portfolios. That is, we classify only stocks that were already in our sample and had valid data in the previous year.

<sup>13</sup>We cross-sectionally demean book and market equity changes to avoid that broad stock market movements affect the classification of stocks into market- and book-channel stocks. The reason is that, in line with our theoretical motivation outlined in Section 2, we aim to identify stocks that experienced firm-specific rather than market-wide discount rate and cash flow shocks. Moreover, cross-sectionally demeaning ensures that the relative proportion of market-channel to book-channel stocks remains stable over time. Nevertheless, we confirm in unreported results that our main findings are virtually unchanged when we do not cross-sectionally demean the book and market equity changes.

profitability shocks and residual market equity changes. For this purpose, we rank all market-channel value stocks in the year they enter the value portfolio according to their profitability shocks and residual market equity changes from low to high. We do the same for market-channel growth stocks. Market-channel value (growth) stocks are then classified as residual-driven if their residual market equity change ranks are lower (higher) than their profitability shock ranks.<sup>14</sup> In the opposite case, we classify them as profitability shock-driven stocks. Thus, residual-driven value (growth) stocks are stocks whose market equity decreases (increases) that turn them into value (growth) stocks are comparatively strongly driven by residual market equity decreases (increases). By contrast, profitability shock-driven value (growth) stocks are stocks whose market equity decreases (increases) that turn them into value (growth) stocks are comparatively strongly driven by negative (positive) profitability shocks. On average, 43% (57%) of market-channel incoming value and growth stocks that can be classified are classified as residual-driven (profitability shock-driven).

We analogously split the conservative and aggressive portfolios according to profitability shocks and residual investment changes. That is, we rank all conservative stocks in the year they enter the conservative portfolio according to their profitability shocks and residual investment changes from low to high. We do the same for aggressive stocks. Conservative (aggressive) stocks are classified as residual-driven if their residual investment change ranks are lower (higher) than their profitability shock ranks.<sup>15</sup> In the opposite case, we classify them as profitability shock-driven stocks. Thus, residual-driven conservative (aggressive) stocks are stocks whose investment decreases (increases) that turn them into conservative (aggressive) stocks are comparatively strongly driven by residual investment decreases (increases). By contrast, profitability shock-driven conservative (aggressive) stocks are stocks whose investment decreases (increases) that turn them into conservative (aggressive) stocks are comparatively strongly driven by negative (positive) profitability shocks. On average, 45% (55%) of incoming conservative and aggressive stocks that can be classified are classified as residual-driven (profitability shock-driven).

Stocks keep their classification as long as they remain uninterrupted in the respective factor portfolio. The stocks' weights in the factor portfolios' subsets are proportionally the same as in the respective factor portfolios.

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<sup>14</sup>Using this ranking approach to classify stocks into residual- versus profitability shock-driven stocks is motivated by two considerations. First, this approach is immune to market-wide cash flow and discount rate shocks. In line with our theoretical motivation outlined in Section 2, it thus ensures that the classification reflects cross-sectional (i.e., firm-specific) differences. Second, this ranking approach makes sure that the residual- and profitability shock-driven subsets of the factor portfolios are of similar size. Nevertheless, we confirm in unreported results that our main findings also hold for other classification procedures that rely on directly comparing profitability shocks and residual market equity changes rather than their ranks.

<sup>15</sup>Footnote 14 applies analogously.

## 4 Relation between Value and Investment Factors

### 4.1 Correlation between Book-to-Market and Investment

We begin our empirical analysis by evaluating why the value and investment factors are so closely connected. We first document that the average cross-sectional rank correlation between book-to-market and investment is, as expected, negative (-0.27). Since the value factor is long in high book-to-market stocks while the investment factor is long in low investment stocks, the negative correlation should induce an overlap between the factors' portfolios.

To shed light on the drivers of the negative correlation between book-to-market and investment, we decompose them as follows:

$$BM_{i,t} = BM_{i,t-k} + \sum_{s=0}^{k-1} dBE_{i,t-s} + \sum_{s=0}^{k-1} -dME_{i,t-s} \quad (9)$$

$$INV_{i,t} = INV_{i,t-k} + \sum_{s=0}^{k-1} dINV_{i,t-s} \quad (10)$$

where  $BM_{i,t}$  and  $INV_{i,t}$  are log book-to-market and investment and  $dBE_{i,t}$ ,  $dME_{i,t}$ , and  $dINV_{i,t}$  are log changes in book equity, market equity, and investment. The equations decompose book-to-market into lagged book-to-market, book equity changes, and market equity changes, and investment into lagged investment and investment changes.

In each year, we calculate the cross-sectional covariances between the terms of the book-to-market and investment decompositions and divide them by the total cross-sectional covariance between book-to-market and investment. Table 2 presents the average contributions of the terms to the total covariance for one- to ten-year decompositions. The table identifies two drivers of the negative relation between book-to-market and investment. First, the covariance between lagged book-to-market and lagged investment naturally contributes to the covariance between current book-to-market and current investment. Nevertheless, the most important driver is the covariance between market equity and investment changes. This result is in line with the discussion in Section 2 as it indicates that book-to-market and investment correlate negatively because market equity and investment changes have common determinants, namely changes in expected cash flows and required returns.

### 4.2 Association between Value and Investment Factors' Portfolios

The negative relation between book-to-market and investment implies that the value and investment factors should, to a considerable extent, comprise the same stocks. To verify this conjecture, we compute the average overlaps between the HML and CMA portfolios. The HML portfolio's overlap with the CMA portfolio is calculated as the difference between the value and growth portfolios' overlaps with the CMA portfolio, divided by 2. Thereby, the value and growth portfolios' overlaps with the CMA portfolio are calculated as the weighted percentages of value and growth stocks that are contemporaneously in the conservative portfolio minus the

weighted percentages of value and growth stocks that are contemporaneously in the aggressive portfolio. The CMA portfolio’s overlap with the HML portfolio is calculated analogously.

If the factors’ portfolios were independent, we would expect their overlaps to be zero, on average. Table 3 shows that this is not the case. The HML portfolio exhibits an overlap of 21.8% with the CMA portfolio, and the CMA portfolio an overlap of 23.6% with the HML portfolio. Thus, value stocks are more likely to be conservative stocks, and growth stocks are more likely to be aggressive stocks, and vice versa. The portfolios’ positive overlaps with each other naturally lead to a positive comovement between the factors. Specifically, their correlation is 0.66, and their betas on each other (1.04 and 0.40) are highly positive.<sup>16</sup>

The factors’ correlation of 0.66 seems large compared to their overlaps below 25%, suggesting that the comovement does not only stem from the overlap. To evaluate this, we split the HML portfolio according to whether the value (growth) stocks are contemporaneously also conservative (aggressive) stocks (hf. overlapping part) or not (hf. non-overlapping part). We analogously split the CMA portfolio according to whether the conservative (aggressive) stocks are contemporaneously also value (growth) stocks or not.

The results for the HML portfolio reveal that not only its overlapping part but also its non-overlapping part strongly comove with the investment factor. While the non-overlapping part’s correlation with the investment factor is naturally lower (0.442 vs. 0.829), it is still considerable, particularly given its negative overlap with the CMA portfolio of -27.6%. Thus, value and growth stocks behave like conservative and aggressive stocks, even if they are not conservative and aggressive stocks, respectively.

In contrast to the HML portfolio, the correlations of the CMA portfolio’s overlapping and non-overlapping parts with the value factor are in line with their overlaps. In particular, the CMA portfolio’s non-overlapping part exhibits a negative overlap with the HML portfolio (-35.1%) and negatively correlates with the value factor (-0.26). Thus, conservative and aggressive stocks only behave like value and growth stocks if they actually are value and growth stocks. The CMA portfolio’s non-overlapping part does therefore not contribute to the factors’ positive comovement.

We further examine whether the results differ for the HML and CMA portfolios’ market-channel, book-channel, profitability shock-driven, and residual-driven subsets. In line with the result that book-to-market’s negative relation with investment stems from the positive correlation between market equity and investment changes, the HML portfolio’s association with the CMA portfolio is largely due to its market-channel subset. Thereby, the HML portfolio’s profitability shock- and residual-driven subsets contribute to similar degrees to this association. By contrast, there is a pronounced difference between the CMA portfolio’s residual- and profitability shock-driven parts. Specifically, the CMA portfolio’s association with the HML portfolio is primarily due to its profitability shock-driven part, exhibiting a much higher overlap (30.6% vs.

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<sup>16</sup>The investment beta is obtained from a multivariate regression of the value factor on the market, size, profitability, and investment factors, and vice versa for the value beta. See Appendix B for the construction of the market, size, and profitability factors.

7.2%) and correlation (0.652 vs. 0.158) with the HML portfolio than the residual-driven part.

To conclude, we confirm a negative relation between book-to-market and investment that arises because market equity and investment changes have common determinants. The negative relation leads to an overlap between the factors' portfolios, which is in turn the main driver of the factors' strong comovement. Yet, the comovement is also due to value and growth stocks behaving like conservative and aggressive stocks, even if they are not.

## 5 The Sources of the Value and Investment Premia

### 5.1 Value and Investment Premia

In Section 3.4, we argue that stocks whose book-to-market (investment) is primarily driven by residual market equity (investment) changes should contain the value (investment) factor's pricing information. By contrast, stocks whose book-to-market and investment are primarily driven by profitability shocks should not contain pricing information. To verify this, we conduct portfolio sorts. First, we sort stocks at the end of each June into quintiles with respect to their size using NYSE breakpoints. Second, we intersect the size quintiles with the value, growth, conservative, and aggressive portfolios as well as their market-channel, book-channel, profitability shock-driven, and residual-driven subsets. The resulting portfolios are value-weighted. Panel A of Table 4 displays the average long-short returns and five-factor alphas of the different types of value and conservative stocks over the corresponding growth and aggressive stocks.

The table also presents results for strategies (i) that go long the market-channel and short the book-channel value premia, (ii) that go long the residual-driven and short the profitability shock-driven value premia, and (iii) that go long the residual-driven and short the profitability shock-driven investment premia. These strategies are close to book-to-market- respectively investment-neutral because value and growth stocks exhibit similar book-to-market ratios and conservative and aggressive stocks exhibit similar investment rates, irrespective of whether they are market equity-, book equity-, residual-, or profitability shock-driven. The standard value and investment effects thus suggest that these strategies' returns are, on average, zero.

Panel A of Table 4 documents a strong value premium of, on average, 0.32% per month across the size quintiles. The value premium is, however, only observable for market-channel stocks. In particular, the average monthly market-channel value premium across the size quintiles is 0.32%, whereas the average monthly book-channel value premium is only -0.01%. The Fama-French (2015) five-factor model cannot explain the highly significant difference between the two value premia.<sup>17</sup>

When further separating market-channel stocks into residual- and profitability shock-driven stocks, we find that the former contain almost the entire pricing information of the value factor. Specifically, residual-driven value stocks earn a substantial and highly significant premium of, on

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<sup>17</sup>The results for the differences between the market- and book-channel value premia do not add up perfectly with those for the individual market- and book-channel premia because a few of the book-channel size quintiles are empty in the first two years of the sample period (in total, five portfolio-year observations are missing).

average, 0.50% per month over residual-driven growth stocks. The five-factor model produces a significant alpha and therefore fails to capture this value premium. In contrast, the profitability shock-driven value premium of 0.12% per month is small and insignificant. The difference between the residual- and profitability shock-driven value premia cannot be explained by the five-factor model, leaving a significant alpha of 0.26%.<sup>18</sup>

Panel A also documents a significant investment premium of, on average, 0.19% per month. As for the value factor, the residual-driven stocks contain almost the entire pricing information of the investment factor, generating a significant investment premium of 0.31% per month which cannot be captured by the five-factor model. In contrast, the profitability shock-driven investment premium exhibits an insignificant mean return of only 0.11% per month. The difference between the residual- and profitability shock-driven investment premia is significant, and the five-factor model leaves a highly significant alpha of 0.20%.

These results give rise to two conclusions. First, our approach successfully identifies the variation in book-to-market and investment that is informative about future returns, respectively, those stocks that contain the factors' pricing information. Specifically, in line with our conjectures, only stocks whose book-to-market and investment are more strongly driven by residual market equity and investment changes than profitability shocks earn the value and investment premia. These stocks' value and investment premia are more than 50% higher than the standard value and investment premia. Second, the Fama-French (2015) five-factor model cannot sufficiently differentiate between stocks with pricing information and those without. It produces expected return estimates that are too similar for market- versus book-channel value and growth stocks as well as for residual- versus profitability shock-driven value, growth, conservative, and aggressive stocks. However, they have, predictably, very different expected returns.

## 5.2 Complementarity of Value and Investment Premia

Having identified the stocks that generate the factor premia, we examine whether they represent independent sources of returns. To this end, Panel B of Table 4 presents the value premia when we control for investment rather than size, and Panel C the investment premia when we control for book-to-market rather than size. The value and investment premia are somewhat attenuated compared to Panel A, indicating that the investment and value effects partially subsume each other. Nevertheless, the general patterns remain intact: the market-channel value, residual-driven value, and residual-driven investment premia (0.28%, 0.36%, and 0.29% per month, respectively) are significantly higher than the book-channel value, profitability shock-driven value, and profitability shock-driven investment premia (0.06%, 0.12%, and -0.02% per month, respectively). Moreover, the differences between the residual-driven value and investment premia and their profitability shock-driven counterparts can again not be explained by

<sup>18</sup>The results for the differences between the residual- and profitability shock-driven value premia do not add up perfectly with those for the individual residual- and profitability shock-driven premia because a few of the residual-driven and profitability shock-driven size quintiles are empty in the early years of the sample period (in total, five respectively nine portfolio-year observations are missing).

the standard five-factor model.

In Panel D, we further examine whether the residual-driven value and investment premia subsume each other. For this purpose, we exclude all residual-driven conservative (aggressive) stocks from the value (growth) portfolio’s residual-driven subset and vice versa. The resulting portfolios are then again intersected with the size quintiles. Panel D shows that the residual-driven value and investment premia cannot subsume each other: the average residual-driven value (investment) premium amounts to highly significant 0.45% (0.26%) per month when excluding the CMA (HML) portfolio’s residual-driven stocks. The premia decline only by 0.05% per month compared to Panel A. Thus, the residual-driven value and investment premia represent largely complementary sources of excess returns. Put differently, the variation in book-to-market that is informative about future returns is incremental to the variation in investment that is informative about future returns, and vice versa. This conclusion contrasts with the finding that the standard value and investment effects subsume each other to large extents, suggesting that this finding is due to book-to-market and investment reflecting similar information about profitability. Their common information about profitability overshadows their complementary information about future returns.

In the Internet Appendix, we show that this section’s conclusions also hold for equal-weighted portfolios. Moreover, we implement cross-sectional Fama-MacBeth (1973) regressions that predict stocks’ returns based on book-to-market, profitability shock-driven and residual market equity changes, book equity changes, investment, and profitability shock-driven and residual investment changes. The results support the same conclusions: book-to-market’s and investment’s predictive power emanates from the residual market equity and investment changes, and their predictive power complements each other.

## 6 Residual-driven Value and Investment Factors

### 6.1 Factor Construction and Summary Statistics

Amid the findings from the previous section, we construct value and investment factors that use only residual-driven stocks. Given that they use only stocks for which book-to-market and investment are likely good indicators of expected returns, these factors should capture more pricing information than the standard factors. We construct the residual-driven value and investment factors in the same way as the standard value and investment factors (see Section 3.2) but keep only residual-driven value, growth, conservative, and aggressive stocks in the factor portfolios. For comparison, we construct profitability shock-driven value and investment factors that keep only profitability shock-driven stocks. Finally, we also construct market- and book-channel value factors that keep only market- respectively book-channel stocks.

Table 5 presents summary statistics on the factors. Panel A shows that the residual-driven value and investment factors earn highly significant mean returns of 0.54% and 0.36% per month, respectively. These mean returns considerably exceed those of the standard factors (0.30% and

0.21% per month, respectively). Despite their smaller portfolios, the residual-driven factors' volatilities are very similar to those of the standard factors, implying that their higher mean returns are not achieved at the cost of sacrificing diversification benefits. Hence, the residual-driven factors' Sharpe ratios are around 50% higher than those of the standard factors. By contrast, the profitability shock-driven value and investment factors' mean returns and Sharpe ratios are considerably lower. Thus, our approach successfully decomposes the standard factors into parts that capture pricing information and parts that do not.<sup>19</sup>

Figure 2 compares the residual-driven and standard factors' performances. Panels A and C show that the residual-driven factors strongly outperform their standard counterparts over the full sample period. Panels B and D reveal that the residual-driven factors also quite consistently outperform their standard counterparts on a rolling basis.

Nevertheless, Panel B shows that our residual-driven value factor—like the standard factor—displays decreasing returns towards the end of our sample period. Hence, our residual-driven value factor is unable to prevent value's recent drawdown. Our approach differs in this regard from the approaches addressing book equity (e.g., Arnott et al., 2021; Cong et al., 2023; Eisfeldt et al., 2022; Gonçalves and Leonard, 2023). On the one hand, this result suggests that our residual-driven value factor's performance may be further enhanced if we replace book equity with an adjusted measure of fundamental value. We confirm this conjecture in Section 7.2. On the other hand, the finding that our residual-driven value factor's outperformance is not due to the standard value factor's recent weakness but is quite consistent across time indicates that our approach delivers robust improvements.

Panel B of Table 5 displays the factors' correlations. First, the residual-driven value and investment factors' correlations with their standard counterparts (0.74 and 0.57) are lower than the profitability shock-driven factors' (0.81 and 0.85), implying that the standard factors reflect more strongly the pricing-irrelevant covariation of profitability shock-driven stocks than the pricing-relevant covariation of residual-driven stocks. Second, the correlations between the residual- and profitability shock-driven value factors as well as between the residual- and profitability shock-driven investment factors are rather moderate (0.61 and 0.25, respectively), corroborating that they capture different effects. Third, the correlation between the residual-driven value and investment factors is substantially lower than between the standard factors (0.26 vs. 0.66). Thus, purging the factors of the stocks that do not contain pricing information yields factors that capture more independent pricing information.

To ensure that the differences between the residual- and profitability shock-driven factors are not due to implicitly sorting on other characteristics related to returns, Table 6 presents the factor portfolios' average characteristics. First, residual-driven stocks are somewhat smaller and more volatile than profitability shock-driven stocks. Yet, the differences are rather moderate and thus insufficient to explain the differences in the factors' mean returns. As can be expected,

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<sup>19</sup>In the Internet Appendix, we use the disconnects between the residual- and profitability shock-driven value and investment factors to evaluate Campbell et al.'s (2018) three-beta ICAPM as an explanation for the value and investment effects. We find that the model cannot explain the disconnects, implying that it cannot rationalize the value and investment effects.

the profitability shock-driven factors' profitability spreads (-0.222 and -0.160) are more negative than those of the residual-driven factors (-0.081 and 0.063). However, the differences are again too small to explain the different mean returns given that the profitability factor's profitability spread is 0.472 (unreported). The factors' momentum and long-term reversal characteristics are also unable to explain the differential mean returns. We therefore conclude that the differential mean returns of the residual- and profitability shock-driven value and investment factors are unlikely due to implicitly sorting on other characteristics that are related to returns.

## 6.2 Spanning Regressions

Our results so far reveal that the value and investment factors' residual-driven stocks represent largely independent sources of returns and that the residual-driven value and investment factors capture more pricing information and are much less correlated than the standard factors. Therefore, unlike the standard value factor, our residual-driven value factor may no longer be redundant and exhibit incremental pricing power. A factor's incremental pricing power in a given factor model can be assessed based on its alpha with respect to the models' other factors. In particular, Barillas and Shanken (2017) argue that a factor improves a model's pricing performance if its alpha with respect to the model is significant.

To evaluate the various value and investment factors' incremental pricing power, we conduct spanning regressions that regress the value factors on the investment factors as well as the market, size, and profitability factors, and vice versa. Table 7 presents the results. They reveal that the residual-driven value and investment factors always exhibit significant alphas, no matter whether we employ the standard, market-channel, profitability shock-driven, or residual-driven version of the respective other factor as an explanatory factor. In particular, when we use both residual-driven factors (specification (12)), the value factor's alpha is 0.47%, and the investment factor's alpha is 0.32%, both of which are highly significant. By contrast, the profitability shock-driven value and investment factors exhibit, in general, small and mostly insignificant alphas.

Given Barillas and Shanken's (2017) arguments, our residual-driven value factor's significant alphas imply that it would improve the pricing power of a four-factor model consisting of the market, size, profitability, and investment factors, irrespective of which version of the investment factor is used. Thus, a value factor built only from residual-driven stocks—that is, from stocks for which book-to-market is a good indicator of expected returns—would no longer be redundant. Our residual-driven investment factor's significant alphas imply it is not redundant as well. Hence, the residual-driven value and investment factors no longer subsume each other and exhibit incremental pricing power. The factors' incremental pricing information is only discernible when purging them of the profitability shock-driven stocks. They contain hardly any pricing information but strongly drive the factors' comovement.

### 6.3 Pricing Information

Next, we evaluate whether our residual-driven factors give rise to a better pricing performance than their standard counterparts. Barillas and Shanken (2017) argue that comparing factor models' maximum (squared) Sharpe ratios is sufficient to assess which model achieves the better pricing performance. Barillas et al. (2020) propose a test to evaluate whether two factor models' squared Sharpe ratios are significantly different.

Table 7 presents the squared Sharpe ratios of the various five-factor factor models obtained by combining the respective value and investment factors with the market, size, and profitability factors. Moreover, we test whether the factor models' squared Sharpe ratios are significantly different from the Fama-French (2015) model's. The results reveal that the five-factor model using our residual-driven value and investment factors achieves the highest maximum squared Sharpe ratio (0.118). It is significantly higher than the Fama-French (2015) model's maximum squared Sharpe ratio (0.088). Based on the arguments of Barillas and Shanken (2017) and Fama and French (2018), this result implies that our residual-driven value and investment factors give rise to a better pricing performance than the standard value and investment factors and that replacing the standard factors with our residual-driven factors would significantly improve the five-factor model's pricing performance.

To further verify that our residual-driven factors capture more pricing information, we regress them on the standard five-factor model and vice versa. Table 8 present the results. Panel A shows that the standard five-factor model cannot price our residual-driven value and investment factors as they exhibit highly significant alphas of 0.26% and 0.19%. By contrast, Panel B reveals that the adjusted five-factor model using our residual-driven factors can price the standard value and investment factors given their negligible alphas. Hence, our residual-driven factors capture the pricing information of the standard factors but not vice versa.

Panel C examines whether our residual-driven factors also capture pricing information beyond the four- and five-factor models of Hou et al. (2015, 2021), being the most well-known contenders of the Fama-French (2015) five-factor model.<sup>20</sup> First, both models can price the standard value and investment factors, generating insignificant alphas. In contrast, the four-factor model fails to price our residual-driven value and investment factors, leaving highly significant alphas of 0.37% and 0.22%. The four-factor model is thus unable to capture the actual source of the value effect. Moreover, its failure to price our residual-driven investment factor despite containing an investment factor itself corroborates our investment factor's superiority.

Hou et al.'s (2021) five-factor model, which extends Hou et al.'s (2015) four-factor model with an expected growth factor, performs better in pricing our residual-driven factors. Nevertheless, it still leaves a significant alpha of 0.13% for our residual-driven investment factor and a sizable, albeit statistically insignificant, alpha of 0.16% for our residual-driven value factor. Thus, it also fails to capture our residual-driven factors' pricing information fully.

In sum, this section's results indicate that value and investment factors that use only stocks

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<sup>20</sup>We obtain data on the factors from the authors' global-q website: <http://global-q.org/>.

for which book-to-market and investment are likely good indicators of expected returns improve upon the standard factors. In particular, they achieve higher mean returns and Sharpe ratios and are less correlated, implying that they capture more and more independent pricing information. Importantly, we show that our residual-driven factors’ pricing information is incremental relative to each other, implying that our residual-driven value factor is not redundant. Thus, the value factor can be resurrected from its redundancy if its construction is adjusted to consider which stocks’ variation in book-to-market is informative about expected returns. Moreover, our residual-driven factors enhance the Fama-French (2015) model’s pricing performance and fully subsume the standard factors’ pricing information. Our residual-driven factors should therefore replace the standard factors.

## 7 Comparison with Alternative Value Factors

### 7.1 Size and Intangible Return Value Factors

Various other approaches to narrowing down book-to-market’s information about future returns and constructing better value factors have been examined in the literature. Among the most influential studies in this regard are Gerakos and Linnainmaa (2018) and Daniel and Titman (2006). Similar to us, they reckon that market equity changes respectively returns reflect information about expected returns and argue that they give rise to book-to-market’s predictive power. To verify that our approach improves upon these studies, we implement their procedures and compare the resulting value factors to our residual-driven value factor.

Like us, Gerakos and Linnainmaa (2018) argue that book-to-market’s information about expected returns is in its market equity-driven component. They regress book-to-market on lagged market equity changes to extract its predictive information. Contrary to our approach, this approach neglects that market equity changes may not only reflect changes in expected returns but also changes in expected cash flows.

We repeat Gerakos and Linnainmaa’s (2018) approach by running the following cross-sectional regression at the end of each June from 1964 to 2019:

$$BM_{i,t} = b_{0,t} + \underbrace{\sum_{s=1}^5 b_{s,t} dME_{i,t-s+1}}_{BM_{i,t}^{SIZE}} + \underbrace{\epsilon_{i,t}}_{BM_{i,t}^{ORTH}} \quad (11)$$

where  $BM_{i,t}$  is log book-to-market and  $dME_{i,t}$  is the log market equity change. Gerakos and Linnainmaa (2018) denote the fitted values and residuals as book-to-market’s size and orthogonal components, respectively. They use the size component and Fama and French’s (2015) construction methodology (see Section 3.2) to construct their size value factor.

Daniel and Titman (2006) argue that book-to-market’s predictive power emanates from the part of the stock return orthogonal to accounting performance. They refer to this part as intangible return. It is obtained as the residual from regressing stock returns on lagged book-

to-market and book returns. However, the book return, which is roughly speaking book equity growth, is unlikely to be a good proxy for changes in expected cash flows. Hence, this approach also fails to explicitly consider that stock returns, like market equity changes, do not only reflect information about expected returns but also about expected cash flows.

We repeat Daniel and Titman’s (2006) approach by running the following cross-sectional regression at the end of each June from 1964 to 2019:

$$r_{i,t-5:t} = c_{0,t} + c_{1,t}BM_{i,t-5} + c_{2,t}r_{i,t-5:t}^B + \mu_{i,t} \quad (12)$$

where  $r_{i,t-5:t}$  is the log stock return from year  $t - 5$  to year  $t$ ,  $BM_{i,t}$  is log book-to-market, and  $r_{i,t-5:t}^B$  is the log book return from year  $t - 5$  to year  $t$ , calculated as the log book-to-market change plus the log stock return. While Daniel and Titman (2006) do not construct a value factor, we use the intangible return and Fama and French’s (2015) construction methodology to construct an intangible return value factor.

Panel A of Table 9 presents summary statistics and spanning regression results for the size and intangible return value factors. Their mean returns are significantly positive (0.29% and 0.20% per month, respectively) but considerably lower than our residual-driven value factor’s mean return (0.54% per month). Moreover, the size and intangible return value factors’ alphas with respect to the market, size, profitability, and investment factors are close to zero and insignificant (-0.01% and 0.02%, respectively). Contrary to our approach, Gerakos and Linnainmaa’s (2018) and Daniel and Titman’s (2006) approaches are therefore unable to resurrect the value factor from its redundancy.

Our residual-driven value factor relies on a refined construction methodology. To ensure that its outperformance relative to the size and intangible return value factors is not due to its refined construction methodology but the superior identification of book-to-market’s pricing information, we apply our refined construction methodology to the size and intangible return value factors. Specifically, to refine the size value factor, we rank all incoming value and growth stocks separately according to their size and orthogonal components from low to high. Value (growth) stocks are classified as size-driven if their size component ranks are higher (lower) than their orthogonal component ranks. To refine the intangible return value factor, we rank all incoming value and growth stocks separately according to their intangible returns from high to low and according to their book returns from low to high. Value (growth) stocks are classified as intangible return-driven if their intangible return ranks are higher (lower) than their book return ranks. In addition, we construct two further refined size and intangible return value factors by using only one rather than five lags in the estimation of book-to-market’s size component in (11) and the intangible return in (12).

The refined size and intangible return value factors’ mean returns increase relative to the usual size and intangible return value factors’ mean returns. Nevertheless, their spanning regression alphas are again insignificant. Value factors in the spirit of Gerakos and Linnainmaa (2018) and Daniel and Titman (2006) are therefore unable to resurrect the value factor from its

redundancy. Our attempt to cancel book-to-market’s information about expected cash flows is thus crucial to recover the value factor’s incremental pricing power.

Panel B examines whether our residual-driven value factor captures pricing information beyond the size and intangible return value factors. To this end, we regress our residual-driven value factor on five-factor models consisting of the market, size, profitability, and investment factors and one of the size and intangible return value factors. The results are unanimous: no matter which size or intangible return value factor is used, our residual-driven value factor’s alpha is significantly positive. Thus, it captures incremental pricing information relative to all size and intangible return value factors. This finding corroborates the superiority of our value factor and approach relative to Gerakos and Linnainmaa (2018) and Daniel and Titman (2006).

## 7.2 Intangibles-adjusted Value Factor

Another route to improving the standard value factor that has especially recently been explored in the literature is to adjust book equity to get a better measure of fundamental value. One of the most prominent examples in this regard is the study of Eisfeldt et al. (2022). They adjust book equity for intangibles amid their increasing importance for firm value in recent decades. Eisfeldt et al. (2022) find that a value factor based on their intangibles-adjusted book-to-market has a higher pricing power than the standard value factor, is not redundant, and exhibits a less pronounced drawdown since the mid-2000s.

Given that our approach focuses on market equity, adjusting book equity to improve the value factor should be complementary to our approach. To verify this conjecture, we reconstruct Eisfeldt et al.’s (2022) intangible value factor and apply our methodology as described in Section 3.5 to it.<sup>21</sup> We refer to this value factor as residual-driven intangible value factor. The reconstructed and residual-driven intangible value factors exhibit mean returns of 0.45% and 0.59% per month with t-statistics of 4.04 and 4.40, respectively, in the period from July 1977 to December 2019 (unreported). In line with Eisfeldt et al.’s (2022) findings, the intangible value factor outperforms the standard value factor by 0.22% per month (t-statistic: 2.54). Analogously, the residual-driven intangible value factor outperforms our usual residual-driven value factor by 0.19% per month (t-statistic: 1.63). Thus, using the intangibles-adjusted book equity enhances not only the standard value factor’s but also our residual-driven value factor’s mean return. Finally, the residual-driven intangible value factor outperforms the intangible value factor by 0.14% per month (t-statistic: 1.77).

To formally test the complementary of adjusting book equity and our approach, Table 10 presents results from spanning regressions of the residual-driven, intangible, and residual-driven intangible value factors. Panel A shows that five-factor models comprising the residual-driven intangible value factor in addition to market, size, profitability, and investment factors leave small and insignificant alphas for the residual-driven and intangible value factors. Thus, the

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<sup>21</sup>For the reconstruction, we employ the intangibles-adjusted book equity data provided by Edward Kim on Github: <https://github.com/edwardtkim/intangiblevalue>. The data is available from 1975 onwards.

residual-driven intangible value factor, combining Eisfeldt et al.’s (2022) and our approaches, subsumes their intangible and our residual-driven value factor.

In Panel B, we reverse the roles of the factors; that is, we use five-factor models comprising the residual-driven or intangible value factor to price the residual-driven intangible value factor. The factor exhibits a significant alpha of 0.21% when the factor model comprises the intangible value factor. Thus, the residual-driven intangible value factor captures significant pricing information relative to Eisfeldt et al.’s (2022) intangible value factor. If the model comprises our usual residual-driven value factor, the residual-driven intangible value factor exhibits considerable but insignificant alphas. While the alphas’ magnitudes suggest that the factor may capture more pricing information than our usual residual-driven value factor, the additional pricing information is insignificant. Nevertheless, the results in Table 10 overall indicate that the residual-driven intangible value factor improves upon Eisfeldt et al.’s (2022) intangible value factor as well as our usual residual-driven value factor.<sup>22</sup> Hence, our approach focusing on market equity is complementary to adjusting book equity.

## 8 Conclusion

Fama and French’s (2015) finding that the value factor has no incremental pricing power for the cross-section of stock returns in their five-factor model despite its theoretical motivation has sparked controversy about the value factor. In this work, we resolve this controversy.

The value factor’s pricing power is primarily subsumed by the investment factor. We argue that the factors’ close connection arises because book-to-market and investment both reflect variation in expected cash flows and returns. In line with this conjecture, we document a negative relation between the two variables that is driven by the positive association between market equity and investment changes. The negative relation causes an overlap between the value and investment factors’ portfolios which drives the factors’ comovement.

Book-to-market and investment are not informative about expected returns if their variation emanates from book equity changes or cash flow shocks. We suggest a procedure to identify the stocks for which book-to-market and investment are likely good indicators of expected returns. Portfolio sorts show that these stocks are in fact the source of the value and investment factors’ return premia and thus contain their pricing information.

Amid this finding, we construct adjusted value and investment factors that use only such stocks. The adjusted factors have substantially higher mean returns and Sharpe ratios than their standard counterparts. Moreover, they correlate much less with each other than their standard counterparts. Retaining only those stocks that contain the factors’ pricing information thus yields factors that capture more and more independent pricing information.

Importantly, our adjusted value factor is no longer redundant; that is, a value factor built

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<sup>22</sup>Unreported results reveal that the residual-driven intangible value factor exhibits a positive performance and outperforms the intangible value factor towards the end of our sample period as well. Thus, it prevents value’s recent drawdown and improves in this regard on Eisfeldt et al.’s (2022) intangible value factor.

only from stocks for which book-to-market is likely to be a good indicator of expected returns captures incremental pricing information, even beyond an investment factor. Factor models should therefore include such a value factor whose construction is adjusted to reflect its pricing information accurately. The standard value factor’s redundancy arises just because the value and investment factors’ construction does not account for book-to-market’s and investment’s common but pricing-irrelevant information about expected cash flows. Purging the factors’ unpriced parts uncovers their complementary pricing information.

We further show that a five-factor model that replaces the standard value and investment factors with our adjusted factors achieves a significantly higher maximum Sharpe ratio and subsumes the standard value and investment factors. Amid Barillas and Shanken’s (2017) arguments, our adjusted factors therefore give rise to a better pricing performance than the standard factors. Moreover, we verify that our adjusted value factor outperforms value factors in the spirit of Gerakos and Linnainmaa (2018) and Daniel and Titman (2006). Finally, we document that our procedure focusing on market equity is complementary to adjusting the book equity measure used in book-to-market.

Our results also deliver valuable insights for the investment management industry. While the value factor is frequently targeted by factor investing strategies, the investment factor is hardly targeted. One main reason may be that targeting the investment factor in addition to the value factor is not perceived to add value, given their close connection. Our findings challenge this perception, revealing that value and investment strategies that select only stocks for which book-to-market and investment are likely good indicators of expected returns represent largely independent sources of excess returns. Thus, it is beneficial for investors to include both—enhanced value and investment strategies—in a multifactor investing strategy.

## A Variable Definitions

**Market Equity (ME):** A stock’s market equity for the end of month  $t$  is calculated as its price times its shares outstanding at the end of month  $t$ . To reduce the skewness in ME, we take its natural logarithm. ME is considered missing if it is non-positive.

**Book-to-Market (BM):** A stock’s book-to-market for the end of June of year  $y$  is calculated as book equity from the firm’s last fiscal year ending in year  $y - 1$ , divided by market equity at the end of the month of the fiscal year ending.<sup>23</sup> Following Davis et al. (2000), book equity (BE) is the book value of stockholders’ equity, plus balance sheet deferred taxes and investment tax credit (if available), minus the book value of preferred stock (depending on availability, the redemption, liquidation, or par value of preferred stock is used, in that order); if the book value of stockholders’ equity is not directly available, it is measured as the book value of common equity plus the par value of preferred stock or as the difference between total assets and total liabilities (in that order). To reduce the skewness in BM, we take its natural logarithm. BM is considered missing if market equity or book equity is non-positive.

**Investment (INV):** A stock’s investment for the end of June of year  $y$  is calculated as total assets from the firm’s last fiscal year ending in year  $y - 1$ , divided by total assets from the firm’s last fiscal year ending in year  $y - 2$ , minus 1. To reduce the skewness in INV, we take its natural logarithm. INV is considered missing if total assets are non-positive.

**Operating Profitability (OP):** A stock’s operating profitability for the end of June of year  $y$  is calculated as revenues minus cost of goods sold, interest expense, and selling, general, and administrative expenses, divided by book equity, all from the firm’s last fiscal year ending in year  $y - 1$ . OP is considered missing if revenues are missing, if each of cost of goods sold, interest expense, and selling, general, and administrative expenses are missing, or if book equity is non-positive.

**Momentum (MOM):** A stock’s momentum for the end of month  $t$  is its return from the end of month  $t - 12$  to the end of month  $t - 1$ . MOM is considered missing if the stock does not have good price data for the end of month  $t - 12$  or good return data for month  $t - 1$ .

**Long-Term Reversal (LTR):** A stock’s long-term reversal for the end of month  $t$  is its return from the end of month  $t - 60$  to the end of month  $t - 12$ . LTR is considered missing if the stock does not have good price data for the end of month  $t - 60$  or good return data for month  $t - 12$ .

**Volatility (VOL):** A stock’s volatility for the end of June of year  $y$  is calculated as the annualized standard deviation of its daily returns across the fiscal year that ended in year  $y - 1$ .

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<sup>23</sup>This construction of book-to-market slightly differs from Fama and French (2015), who divide book equity by market equity from the end of December of year  $y - 1$ .

## B Market, Size, and Profitability Factors

We construct the market, size, and profitability factors as described in Fama and French (2015). First, the market portfolio in a given month contains all stocks traded on the NYSE, AMEX, or NASDAQ with a CRSP share code of 10 or 11 as well as good market equity data at the beginning of the month. The market portfolio is newly formed at the beginning of each month, and the stocks in the market portfolio are value-weighted. The return on the market factor (MP) is the return on the market portfolio in excess of the one-month T-bill rate.

The profitability factor is constructed in the same way as the value factor (see Section 3.2), only that the second sort is with respect to operating profitability from the last fiscal year ending in the prior year. The return on the profitability factor (RMW) is the average return on the two high profitability portfolios minus the average return on the two low profitability portfolios.

Finally, the return on the size factor (SMB) is the average return on the nine low market equity portfolios resulting from the bivariate sorts with respect to market equity and any of book-to-market, operating profitability, and investment, minus the average return on the nine high market equity portfolios.

## References

- Arnott, Robert D., Campbell R. Harvey, Vitali Kalesnik, and Juhani T. Linnainmaa, 2021, Reports of value's death may be greatly exaggerated, *Financial Analysts Journal* 77, 44–67.
- Barillas, Francisco, Raymond Kan, Cesare Robotti, and Jay Shanken, 2020, Model comparison with Sharpe ratios, *Journal of Financial and Quantitative Analysis* 55, 1840–1874.
- Barillas, Francisco, and Jay Shanken, 2017, Which alpha?, *Review of Financial Studies* 30, 1316–1338.
- Barillas, Francisco, and Jay Shanken, 2018, Comparing asset pricing models, *Journal of Finance* 73, 715–754.
- Campbell, John Y., Stefano Giglio, Christopher Polk, and Robert Turley, 2018, An intertemporal CAPM with stochastic volatility, *Journal of Financial Economics* 128, 207–233.
- Cochrane, John H., 2011, Presidential address: Discount rates, *Journal of Finance* 66, 1047–1108.
- Cong, Lin W., Nathan D. George, and Guojun Wang, 2023, RIM-based value premium and factor pricing using value-price divergence, *Journal of Banking and Finance* 149.
- Cooper, Michael, Huseyin Gulen, and Mihai Ion, 2024, The use of asset growth in empirical asset pricing models, *Journal of Financial Economics* 151.
- Cooper, Michael J., Huseyin Gulen, and Michael J. Schill, 2008, Asset growth and the cross-section of stock returns, *Journal of Finance* 63, 1609–1651.
- Daniel, Kent, Lira Mota, Simon Rottke, and Tano Santos, 2020, The cross-section of risk and returns, *Review of Financial Studies* 33, 1927–1979.
- Daniel, Kent, and Sheridan Titman, 2006, Market reactions to tangible and intangible information, *Journal of Finance* 61, 1605–1643.
- Davis, James L., Eugene F. Fama, and Kenneth R. French, 2000, Characteristics, covariances, and average returns: 1929 to 1997, *Journal of Finance* 55, 389–406.
- Dessaint, Olivier, Thierry Foucault, Laurent Frésard, and Adrien Matray, 2019, Noisy stock prices and corporate investment, *Review of Financial Studies* 32, 2625–2672.
- Ehsani, Sina, and Juhani T. Linnainmaa, 2022, Time-series efficient factors, Unpublished working paper.
- Eisfeldt, Andrea L., Edward T. Kim, and Dimitris Papanikolaou, 2022, Intangible value, *Critical Finance Review* 11, 299–332.

- Fama, Eugene F., and Kenneth R. French, 1993, Common risk factors in the returns on stocks and bonds, *Journal of Financial Economics* 33, 3–56.
- Fama, Eugene F., and Kenneth R. French, 1996, Multifactor explanations of asset pricing anomalies, *Journal of Finance* 51, 55–84.
- Fama, Eugene F., and Kenneth R. French, 2008, Average returns, B/M, and share issues, *Journal of Finance* 63, 2971–2995.
- Fama, Eugene F., and Kenneth R. French, 2015, A five-factor asset pricing model, *Journal of Financial Economics* 116, 1–22.
- Fama, Eugene F., and Kenneth R. French, 2018, Choosing factors, *Journal of Financial Economics* 128, 234–252.
- Fama, Eugene F., and Kenneth R. French, 2020, Comparing cross-section and time-series factor models, *Review of Financial Studies* 33, 1891–1926.
- Fama, Eugene F., and James D. MacBeth, 1973, Risk, return, and equilibrium: Empirical tests, *Journal of Political Economy* 81, 607–636.
- Gerakos, Joseph, and Juhani T. Linnainmaa, 2018, Decomposing value, *Review of Financial Studies* 31, 1825–1854.
- Gonçalves, Andrei S., and Gregory Leonard, 2023, The fundamental-to-market ratio and the value premium decline, *Journal of Financial Economics* 147, 382–405.
- Harvey, Campbell R., Yan Liu, and Heqing Zhu, 2016, ... and the cross-section of expected returns, *Review of Financial Studies* 29, 5–68.
- Hou, Kewei, Haitao Mo, Chen Xue, and Lu Zhang, 2021, An augmented q-factor model with expected growth, *Review of Finance* 25, 1–41.
- Hou, Kewei, and Mathijs A. van Dijk, 2019, Resurrecting the size effect: Firm size, profitability shocks, and expected stock returns, *Review of Financial Studies* 32, 2850–2889.
- Hou, Kewei, Chen Xue, and Lu Zhang, 2015, Digesting anomalies: An investment approach, *Review of Financial Studies* 28, 650–705.
- Newey, Whitney K., and Kenneth D. West, 1987, A simple, positive semi-definite, heteroskedasticity and autocorrelation consistent covariance matrix, *Econometrica* 55, 703–708.
- Polk, Christopher, and Paola Sapienza, 2009, The stock market and corporate investment: A test of catering theory, *Review of Financial Studies* 22, 187–217.
- Shumway, Tyler, 1997, The delisting bias in CRSP data, *Journal of Finance* 52, 327–340.

- Shumway, Tyler, and Vincent A. Warther, 1999, The delisting bias in CRSP's Nasdaq data and its implications for the size effect, *Journal of Finance* 54, 2361–2379.
- Xing, Yuhang, 2008, Interpreting the value effect through the q-theory: An empirical investigation, *Review of Financial Studies* 21, 1767–1795.

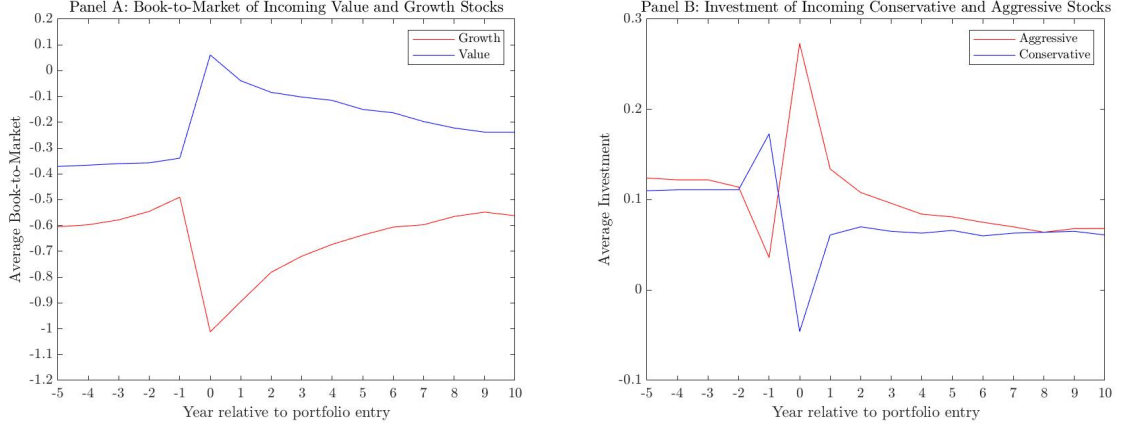


**Figure 1**  
**Evolution of Book-to-Market and Investment**

Panel A of this figure displays time-series averages of incoming value and growth stocks' weighted average past (up to five years), contemporaneous, and future (up to ten years) book-to-market. Panel B displays time-series averages of incoming conservative and aggressive stocks' weighted average past (up to five years), contemporaneous, and future (up to ten years) investment. Book-to-market and investment are calculated as described in Appendix A, are in log terms, are measured at the end of June, and are winsorized at the 0.5% and 99.5% levels. The weights used to calculate the averages correspond to the stocks' weights in the aggregate value, growth, conservative, and aggressive portfolios.



**Figure 2**  
**Factor Performance**

Panel A (C) of this figure displays the cumulative performances of the standard and residual-driven value (investment) factors. Panel B (D) displays the rolling ten-year cumulative performances of the standard and residual-driven value (investment) factors. The y-axes have a log scale. The sample period is from July 1964 to December 2019.

**Table 1**  
**Estimation of Profitability Shocks, Residual Market Equity Changes,**  
**and Residual Investment Changes**

Panel A of this table displays time-series averages of coefficients from the cross-sectional profitability model of Hou and van Dijk (2019). The regressions are estimated at the end of each June from 1964 to 2019 using common US stocks traded on the NYSE, AMEX, or NASDAQ with total assets above \$10 million and book equity above \$5 million. The dependent variable is operating income-to-total assets. The independent variables are the market-to-book value of assets (FV/AT), a dummy variable that equals one if the firm does not pay dividends (DD), the dividend-to-book ratio (D/BE), and operating income-to-total assets (OI/AT). The independent variables are lagged by one year relative to the dependent variable. The variables are measured at the end of June. Panel B (C) displays the time-series averages of the coefficients from annual cross-sectional regressions of firms' log market equity (investment) changes on their estimated profitability shocks. Firms' profitability shocks are calculated by subtracting their predicted profitability from their realized profitability.  $R^2$  is the average R-squared across all annual regressions. t-statistics are reported in parentheses. In Panel A, t-statistics are based on Newey-West (1987) heteroskedasticity-robust standard errors with five lags. \*, \*\*, and \*\*\* denote significance at the 10%, 5%, and 1% levels, respectively.

| Panel A: Estimation of Profitability Model |                     |                    |                       |                     |                      |       |
|--------------------------------------------|---------------------|--------------------|-----------------------|---------------------|----------------------|-------|
|                                            | Intercept           | FV/AT              | DD                    | D/BE                | OI/AT                | $R^2$ |
| Coefficient                                | 0.0155***<br>(7.37) | 0.0064**<br>(2.14) | -0.0128***<br>(-4.50) | 0.0675***<br>(3.65) | 0.7187***<br>(40.55) | 0.613 |

| Panel B: Estimation of Residual Market Equity Changes |                    |                      |       |
|-------------------------------------------------------|--------------------|----------------------|-------|
|                                                       | Intercept          | PS                   | $R^2$ |
| Coefficient                                           | 0.0510**<br>(2.06) | 1.8728***<br>(14.02) | 0.136 |

| Panel C: Estimation of Residual Investment Changes |                       |                     |       |
|----------------------------------------------------|-----------------------|---------------------|-------|
|                                                    | Intercept             | PS                  | $R^2$ |
| Coefficient                                        | -0.0178***<br>(-3.80) | 0.9183***<br>(8.99) | 0.112 |

**Table 2**  
**Decomposition of the Cross-Sectional Covariance**  
**between Book-to-Market and Investment**

This table displays the time-series averages of the percentage contributions of the covariances between the different book-to-market components and the different investment components to the total covariance between book-to-market and investment. At the end of each June from 1963 to 2019, book-to-market is decomposed into lagged book-to-market, book equity changes, and market equity changes; and investment is decomposed into lagged investment and investment changes. The percentage contributions are calculated by dividing the covariances between all terms of the decompositions by the total covariance between book-to-market and investment. The annual percentage contributions are averaged across the sample period. Book-to-market and investment are measured at the end of each June, are calculated as described in Appendix A, and are in log terms. The sample consists in each year of all common US stocks traded on the NYSE, AMEX, or NASDAQ.

| k  | $BM_{t-k}, INV_{t-k}$ | $BM_{t-k}, \sum dINV$ | $\sum dBE, INV_{t-k}$ | $\sum dBE, \sum dINV$ | $\sum -dME, INV_{t-k}$ | $\sum -dME, \sum dINV$ |
|----|-----------------------|-----------------------|-----------------------|-----------------------|------------------------|------------------------|
| 1  | 132.4                 | 25.1                  | -30.7                 | -168.0                | -22.3                  | 163.6                  |
| 2  | 131.7                 | -33.1                 | -47.4                 | -182.0                | -39.9                  | 270.6                  |
| 3  | 143.5                 | -74.0                 | -50.3                 | -183.1                | -53.9                  | 317.8                  |
| 4  | 152.8                 | -97.9                 | -54.5                 | -192.0                | -65.3                  | 356.9                  |
| 5  | 158.0                 | -115.9                | -58.6                 | -189.1                | -71.7                  | 377.4                  |
| 6  | 164.1                 | -130.9                | -59.1                 | -194.5                | -78.7                  | 399.1                  |
| 7  | 182.3                 | -155.8                | -70.3                 | -216.8                | -71.5                  | 432.1                  |
| 8  | 169.4                 | -141.9                | -75.2                 | -178.8                | -71.3                  | 397.8                  |
| 9  | 181.6                 | -156.6                | -85.8                 | -187.7                | -68.2                  | 416.6                  |
| 10 | 183.5                 | -156.6                | -95.5                 | -170.7                | -59.6                  | 398.9                  |

**Table 3**  
**Comovement of the Value and Investment Factors**

This table displays statistics on the association between the value and investment factors' portfolios over the period from July 1964 to December 2019. The HML and CMA portfolios are reformed annually at the end of each June and are constructed as described in Section 3.2. The HML portfolio's market-channel, book-channel, profitability shock-driven, and residual-driven subsets as well as the CMA portfolio's profitability shock-driven and residual-driven subsets are considered separately. They are constructed as described in Section 3.5. The HML portfolios are further split according to whether the stocks are contemporaneously in the corresponding leg of the CMA portfolio (i.e., in the conservative (aggressive) portfolio in the case of value (growth) stocks), denoted as "CMA-Overlap," or not, denoted as "Non-CMA-Overlap." The CMA portfolios are analogously split according to whether the stocks are contemporaneously in the corresponding leg of the HML portfolio. "%" is the subsets' average size as a percentage of the total portfolio's size. For HML (CMA) portfolios, "Overlap" is the average overlap with the CMA (HML) portfolio, calculated as the weighted fraction of stocks that are in the conservative (value) portfolio minus the weighted fraction of stocks that are in the aggressive (growth) portfolio, divided by two.  $\rho^{CMA}$  ( $\rho^{HML}$ ) is the correlation with the investment (value) factor.  $\beta^{CMA}$  ( $\beta^{HML}$ ) is the loading on the investment (value) factor from a multivariate regression on a four-factor model consisting of the market, size, profitability, and investment (value) factors. t-statistics are reported in parentheses. \*, \*\*, and \*\*\* denote significance at the 10%, 5%, and 1% levels, respectively.

|                    | All   |         |              |                    | Panel A: Value Factor Portfolio<br>CMA-Overlap |         |              |                    | Non-CMA-Overlap |         |              |                    |
|--------------------|-------|---------|--------------|--------------------|------------------------------------------------|---------|--------------|--------------------|-----------------|---------|--------------|--------------------|
|                    | %     | Overlap | $\rho^{CMA}$ | $\beta^{CMA}$      | %                                              | Overlap | $\rho^{CMA}$ | $\beta^{CMA}$      | %               | Overlap | $\rho^{CMA}$ | $\beta^{CMA}$      |
| HML                | 100.0 | 0.218   | 0.660        | 1.04***<br>(22.40) | 38.8                                           | 1.000   | 0.829        | 1.57***<br>(37.58) | 61.2            | -0.276  | 0.442        | 0.68***<br>(12.77) |
| HML <sup>ME</sup>  | 49.7  | 0.287   | 0.648        | 1.06***<br>(20.22) | 20.8                                           | 1.000   | 0.772        | 1.45***<br>(28.90) | 28.9            | -0.274  | 0.399        | 0.65***<br>(10.46) |
| HML <sup>BE</sup>  | 12.8  | -0.076  | 0.189        | 0.44***<br>(5.43)  | 3.1                                            | 1.000   | 0.424        | 1.23***<br>(11.26) | 9.7             | -0.467  | 0.031        | 0.15<br>(1.57)     |
| HML <sup>RES</sup> | 19.1  | 0.292   | 0.549        | 1.05***<br>(16.10) | 8.4                                            | 1.000   | 0.582        | 1.34***<br>(17.93) | 10.8            | -0.316  | 0.328        | 0.70***<br>(8.18)  |
| HML <sup>PS</sup>  | 27.0  | 0.303   | 0.607        | 1.07***<br>(18.12) | 11.0                                           | 1.000   | 0.698        | 1.51***<br>(22.91) | 16.0            | -0.249  | 0.331        | 0.58***<br>(8.49)  |

|                    | All   |         |              |                    | Panel B: Investment Factor Portfolio<br>HML-Overlap |         |              |                    | Non-HML-Overlap |         |              |                      |
|--------------------|-------|---------|--------------|--------------------|-----------------------------------------------------|---------|--------------|--------------------|-----------------|---------|--------------|----------------------|
|                    | %     | Overlap | $\rho^{HML}$ | $\beta^{HML}$      | %                                                   | Overlap | $\rho^{HML}$ | $\beta^{HML}$      | %               | Overlap | $\rho^{HML}$ | $\beta^{HML}$        |
| CMA                | 100.0 | 0.236   | 0.660        | 0.40***<br>(21.92) | 44.4                                                | 1.000   | 0.860        | 1.03***<br>(52.51) | 55.6            | -0.351  | -0.260       | -0.22***<br>(-10.16) |
| CMA <sup>RES</sup> | 34.0  | 0.072   | 0.158        | 0.08***<br>(2.97)  | 11.2                                                | 1.000   | 0.631        | 0.84***<br>(23.30) | 22.8            | -0.393  | -0.417       | -0.37***<br>(-13.41) |
| CMA <sup>PS</sup>  | 46.9  | 0.306   | 0.652        | 0.53***<br>(23.11) | 22.3                                                | 1.000   | 0.752        | 1.03***<br>(37.06) | 24.6            | -0.306  | -0.033       | -0.06**<br>(-2.08)   |

**Table 4**  
**Average Returns and Alphas on Subsets of the**  
**Value and Investment Factor Portfolios**

This table displays average monthly returns and monthly alphas (in percent) on long-short portfolios. The sample period is from July 1964 to December 2019. In Panel A, all common US stocks are first sorted into quintiles with respect to their market equity at the end of each June. The breakpoints for the sorts are based only on NYSE stocks. Second, the size quintiles are intersected with the aggregate value, growth, conservative, and aggressive portfolios, with the market-channel (ME) and book-channel (BE) subsets of the value and growth portfolios, and with the profitability shock-driven (PS) and residual-driven (RES) subsets of the value, growth, conservative, and aggressive portfolios. The construction of the aggregate value, growth, conservative, and aggressive portfolios is described in Section 3.2; the construction of their subsets is described in Section 3.5. The stocks in the resulting portfolios are value-weighted. The table displays the mean returns and alphas of strategies that go, within each size quintile, long in value stocks and short in growth stocks (HML), respectively, long in conservative stocks and short in aggressive stocks (CMA). The column “Avg” displays the averages across the size quintiles. Panel B (C) displays the same results when the first sort is with respect to investment (book-to-market) rather than market equity. In Panel D, the first sort is again with respect to market equity, but residual-driven conservative (aggressive) stocks are excluded from the value (growth) portfolios, and residual-driven value (growth) stocks are excluded from the conservative (aggressive) portfolios. The alphas are from regressions of the portfolios’ returns on the factors of the Fama-French (2015) five-factor model. t-statistics are reported in parentheses. \*, \*\*, and \*\*\* denote significance at the 10%, 5%, and 1% levels, respectively.

| Panel A: Controlling for Size |                   |                   |                   |                  |                   |                   |                    |                     |                    |                     |                     |                   |
|-------------------------------|-------------------|-------------------|-------------------|------------------|-------------------|-------------------|--------------------|---------------------|--------------------|---------------------|---------------------|-------------------|
|                               | Mean Returns      |                   |                   |                  |                   |                   | Five-Factor Alphas |                     |                    |                     |                     |                   |
|                               | Q1                | Q2                | Q3                | Q4               | Q5                | Avg               | Q1                 | Q2                  | Q3                 | Q4                  | Q5                  | Avg               |
| HML                           | 0.63***<br>(4.52) | 0.35***<br>(2.66) | 0.31**<br>(2.38)  | 0.18<br>(1.44)   | 0.12<br>(0.90)    | 0.32***<br>(2.84) | 0.32***<br>(4.22)  | 0.07<br>(0.99)      | −0.03<br>(−0.50)   | −0.14**<br>(−2.03)  | −0.16**<br>(−2.42)  | 0.01<br>(0.50)    |
| HML <sup>ME</sup>             | 0.44***<br>(3.32) | 0.42***<br>(3.13) | 0.26**<br>(1.96)  | 0.24*<br>(1.82)  | 0.24<br>(1.55)    | 0.32***<br>(2.96) | 0.15<br>(1.52)     | 0.18*<br>(1.88)     | 0.00<br>(−0.03)    | −0.03<br>(−0.28)    | −0.03<br>(−0.29)    | 0.06<br>(1.24)    |
| HML <sup>BE</sup>             | 0.38*<br>(1.65)   | −0.42*<br>(−1.71) | 0.25<br>(1.14)    | −0.24<br>(−1.25) | 0.00<br>(0.02)    | −0.01<br>(−0.06)  | 0.13<br>(0.62)     | −0.71***<br>(−3.09) | 0.04<br>(0.17)     | −0.19<br>(−1.00)    | −0.07<br>(−0.38)    | −0.16*<br>(−1.73) |
| HML <sup>ME-BE</sup>          | 0.06<br>(0.25)    | 0.84***<br>(3.40) | 0.00<br>(0.01)    | 0.50**<br>(2.44) | 0.22<br>(1.06)    | 0.33***<br>(3.02) | 0.02<br>(0.10)     | 0.89***<br>(3.58)   | −0.05<br>(−0.23)   | 0.18<br>(0.89)      | 0.00<br>(0.02)      | 0.22**<br>(2.15)  |
| HML <sup>RES</sup>            | 0.66***<br>(3.40) | 0.72***<br>(3.45) | 0.54***<br>(3.13) | 0.23<br>(1.31)   | 0.42**<br>(2.43)  | 0.50***<br>(3.89) | 0.31*<br>(1.80)    | 0.34*<br>(1.83)     | 0.24*<br>(1.67)    | −0.16<br>(−1.05)    | 0.22<br>(1.51)      | 0.17**<br>(2.17)  |
| HML <sup>PS</sup>             | 0.14<br>(0.77)    | 0.16<br>(1.01)    | 0.03<br>(0.19)    | 0.25*<br>(1.78)  | 0.05<br>(0.29)    | 0.12<br>(1.05)    | −0.12<br>(−0.71)   | −0.03<br>(−0.25)    | −0.15<br>(−1.27)   | 0.14<br>(1.23)      | −0.27**<br>(−2.19)  | −0.09<br>(−1.27)  |
| HML <sup>RES-PS</sup>         | 0.61***<br>(3.36) | 0.37*<br>(1.80)   | 0.51***<br>(2.84) | 0.00<br>(−0.01)  | 0.37**<br>(2.05)  | 0.38***<br>(3.78) | 0.49***<br>(2.66)  | 0.15<br>(0.72)      | 0.40**<br>(2.13)   | −0.28<br>(−1.58)    | 0.48***<br>(2.63)   | 0.26**<br>(2.55)  |
| CMA                           | 0.42***<br>(5.36) | 0.20**<br>(2.46)  | 0.13<br>(1.43)    | 0.05<br>(0.50)   | 0.17<br>(1.55)    | 0.19***<br>(2.92) | 0.42***<br>(6.28)  | 0.08<br>(1.34)      | −0.03<br>(−0.43)   | −0.23***<br>(−3.16) | −0.18***<br>(−3.12) | 0.01<br>(0.70)    |
| CMA <sup>RES</sup>            | 0.40***<br>(3.38) | 0.35***<br>(3.25) | 0.25**<br>(2.43)  | 0.17<br>(1.59)   | 0.38***<br>(3.13) | 0.31***<br>(4.99) | 0.26**<br>(2.14)   | 0.19*<br>(1.74)     | 0.07<br>(0.74)     | 0.00<br>(−0.03)     | 0.23**<br>(2.10)    | 0.15***<br>(2.99) |
| CMA <sup>PS</sup>             | 0.32**<br>(2.32)  | 0.20*<br>(1.73)   | −0.12<br>(−1.01)  | −0.01<br>(−0.06) | 0.13<br>(1.02)    | 0.11<br>(1.30)    | 0.29**<br>(2.22)   | 0.09<br>(0.88)      | −0.22**<br>(−2.17) | −0.22**<br>(−2.26)  | −0.20**<br>(−2.27)  | −0.05<br>(−1.10)  |
| CMA <sup>RES-PS</sup>         | 0.09<br>(0.47)    | 0.15<br>(0.98)    | 0.37***<br>(2.72) | 0.18<br>(1.26)   | 0.25<br>(1.49)    | 0.21**<br>(2.36)  | −0.03<br>(−0.16)   | 0.09<br>(0.60)      | 0.29**<br>(2.18)   | 0.22<br>(1.60)      | 0.43***<br>(2.78)   | 0.20***<br>(2.61) |

- Continued on next page -

| Panel B: Controlling for Investment |              |         |         |        |         |         |                    |         |         |         |          |         |
|-------------------------------------|--------------|---------|---------|--------|---------|---------|--------------------|---------|---------|---------|----------|---------|
|                                     | Mean Returns |         |         |        |         |         | Five-Factor Alphas |         |         |         |          |         |
|                                     | Q1           | Q2      | Q3      | Q4     | Q5      | Avg     | Q1                 | Q2      | Q3      | Q4      | Q5       | Avg     |
| HML                                 | 0.25*        | 0.21    | 0.20    | 0.28*  | 0.16    | 0.22**  | 0.13               | −0.02   | 0.01    | −0.01   | −0.32*** | −0.04   |
|                                     | (1.88)       | (1.58)  | (1.53)  | (1.85) | (0.96)  | (2.06)  | (1.13)             | (−0.23) | (0.06)  | (−0.08) | (−2.92)  | (−1.13) |
| HML <sup>ME</sup>                   | 0.25         | 0.17    | 0.24    | 0.27   | 0.46**  | 0.28**  | 0.10               | −0.05   | 0.03    | 0.05    | 0.05     | 0.04    |
|                                     | (1.49)       | (1.04)  | (1.52)  | (1.48) | (2.44)  | (2.32)  | (0.66)             | (−0.36) | (0.27)  | (0.37)  | (0.33)   | (0.55)  |
| HML <sup>BE</sup>                   | −0.08        | 0.18    | 0.07    | 0.13   | −0.02   | 0.06    | −0.01              | 0.05    | −0.07   | −0.08   | −0.21    | −0.08   |
|                                     | (−0.30)      | (0.73)  | (0.29)  | (0.51) | (−0.08) | (0.43)  | (−0.05)            | (0.21)  | (−0.27) | (−0.30) | (−0.84)  | (−0.71) |
| HML <sup>ME-BE</sup>                | 0.30         | −0.06   | 0.13    | 0.14   | 0.48*   | 0.22*   | 0.11               | −0.14   | 0.08    | 0.15    | 0.26     | 0.12    |
|                                     | (1.07)       | (−0.23) | (0.50)  | (0.52) | (1.65)  | (1.68)  | (0.39)             | (−0.50) | (0.28)  | (0.52)  | (0.88)   | (0.91)  |
| HML <sup>RES</sup>                  | 0.50**       | 0.31    | 0.08    | 0.34   | 0.61**  | 0.36*** | 0.40*              | 0.11    | −0.09   | 0.12    | 0.10     | 0.12    |
|                                     | (2.26)       | (1.44)  | (0.40)  | (1.58) | (2.56)  | (2.65)  | (1.82)             | (0.60)  | (−0.52) | (0.62)  | (0.51)   | (1.18)  |
| HML <sup>PS</sup>                   | −0.05        | 0.03    | 0.14    | 0.09   | 0.39*   | 0.12    | −0.28              | −0.23   | −0.04   | −0.15   | 0.01     | −0.14*  |
|                                     | (−0.25)      | (0.13)  | (0.76)  | (0.43) | (1.68)  | (0.92)  | (−1.42)            | (−1.22) | (−0.26) | (−0.88) | (0.05)   | (−1.70) |
| HML <sup>RES-PS</sup>               | 0.60**       | 0.28    | −0.06   | 0.25   | 0.22    | 0.25**  | 0.70**             | 0.34    | −0.05   | 0.27    | 0.11     | 0.26**  |
|                                     | (2.12)       | (1.07)  | (−0.29) | (1.06) | (0.81)  | (2.17)  | (2.38)             | (1.27)  | (−0.22) | (1.14)  | (0.40)   | (2.18)  |

| Panel C: Controlling for Book-to-Market |              |         |         |         |         |         |                    |         |         |         |        |         |
|-----------------------------------------|--------------|---------|---------|---------|---------|---------|--------------------|---------|---------|---------|--------|---------|
|                                         | Mean Returns |         |         |         |         |         | Five-Factor Alphas |         |         |         |        |         |
|                                         | Q1           | Q2      | Q3      | Q4      | Q5      | Avg     | Q1                 | Q2      | Q3      | Q4      | Q5     | Avg     |
| CMA                                     | −0.02        | 0.09    | 0.25**  | 0.07    | 0.14    | 0.11    | −0.41***           | −0.04   | 0.11    | −0.04   | 0.12   | −0.05   |
|                                         | (−0.13)      | (0.86)  | (2.27)  | (0.67)  | (1.08)  | (1.61)  | (−4.54)            | (−0.42) | (1.19)  | (−0.38) | (0.94) | (−1.31) |
| CMA <sup>RES</sup>                      | 0.35**       | 0.29*   | 0.48*** | 0.07    | 0.28    | 0.29*** | 0.10               | 0.13    | 0.34**  | −0.04   | 0.25   | 0.16**  |
|                                         | (2.22)       | (1.94)  | (3.06)  | (0.46)  | (1.58)  | (3.59)  | (0.67)             | (0.92)  | (2.28)  | (−0.29) | (1.40) | (2.25)  |
| CMA <sup>PS</sup>                       | −0.02        | −0.10   | −0.05   | 0.11    | −0.03   | −0.02   | −0.46***           | −0.25*  | −0.11   | 0.04    | 0.03   | −0.15** |
|                                         | (−0.14)      | (−0.68) | (−0.36) | (0.80)  | (−0.13) | (−0.21) | (−3.45)            | (−1.81) | (−0.77) | (0.29)  | (0.17) | (−2.23) |
| CMA <sup>RES-PS</sup>                   | 0.37*        | 0.38*   | 0.53**  | −0.05   | 0.31    | 0.31*** | 0.56***            | 0.38*   | 0.45**  | −0.08   | 0.22   | 0.30*** |
|                                         | (1.85)       | (1.80)  | (2.51)  | (−0.23) | (1.14)  | (2.80)  | (2.74)             | (1.74)  | (2.10)  | (−0.41) | (0.79) | (2.84)  |

| Panel D: Excluding each other's Residual-Driven Stocks |              |        |         |        |         |         |                    |        |        |         |        |         |
|--------------------------------------------------------|--------------|--------|---------|--------|---------|---------|--------------------|--------|--------|---------|--------|---------|
|                                                        | Mean Returns |        |         |        |         |         | Five-Factor Alphas |        |        |         |        |         |
|                                                        | Q1           | Q2     | Q3      | Q4     | Q5      | Avg     | Q1                 | Q2     | Q3     | Q4      | Q5     | Avg     |
| HML <sup>RES</sup>                                     | 0.70***      | 0.46** | 0.47*** | 0.26   | 0.35*   | 0.45*** | 0.35**             | 0.17   | 0.19   | −0.10   | 0.13   | 0.15*   |
|                                                        | (3.59)       | (2.11) | (2.58)  | (1.41) | (1.84)  | (3.43)  | (2.06)             | (0.87) | (1.20) | (−0.60) | (0.83) | (1.75)  |
| CMA <sup>RES</sup>                                     | 0.36***      | 0.28** | 0.17    | 0.14   | 0.35*** | 0.26*** | 0.25**             | 0.19*  | 0.01   | 0.02    | 0.20*  | 0.13*** |
|                                                        | (3.06)       | (2.45) | (1.62)  | (1.30) | (2.81)  | (4.29)  | (2.09)             | (1.70) | (0.08) | (0.19)  | (1.76) | (2.68)  |

**Table 5**  
**Factor Summary Statistics**

Panel A of this table displays the monthly mean returns (in percent), monthly standard deviations (in percent), and annualized Sharpe ratios of the market (MP), size (SMB), profitability (RMW), value (HML), market-channel value ( $HML^{ME}$ ), book-channel value ( $HML^{BE}$ ), residual-driven value ( $HML^{RES}$ ), profitability shock-driven value ( $HML^{PS}$ ), investment (CMA), residual-driven investment ( $CMA^{RES}$ ), and profitability shock-driven investment ( $CMA^{PS}$ ) factors. Panel B displays the factors' correlations. The sample period is from July 1964 to December 2019. t-statistics are reported in parentheses. \*, \*\*, and \*\*\* denote significance at the 10%, 5%, and 1% levels, respectively.

| Panel A: Summary Statistics |                   |                  |                   |                   |                   |                  |                |                   |                   |                 |                   |
|-----------------------------|-------------------|------------------|-------------------|-------------------|-------------------|------------------|----------------|-------------------|-------------------|-----------------|-------------------|
|                             | MP                | SMB              | RMW               | HML               | $HML^{ME}$        | $HML^{BE}$       | $HML^{PS}$     | $HML^{RES}$       | CMA               | $CMA^{PS}$      | $CMA^{RES}$       |
| Mean                        | 0.53***<br>(3.11) | 0.24**<br>(2.11) | 0.25***<br>(2.89) | 0.30***<br>(2.79) | 0.35***<br>(3.17) | −0.03<br>(−0.21) | 0.16<br>(1.34) | 0.54***<br>(4.16) | 0.21***<br>(2.93) | 0.15*<br>(1.74) | 0.36***<br>(5.13) |
| Std                         | 4.41              | 2.98             | 2.23              | 2.75              | 2.87              | 3.35             | 3.10           | 3.36              | 1.82              | 2.19            | 1.78              |
| SR                          | 0.42              | 0.28             | 0.39              | 0.37              | 0.43              | −0.03            | 0.18           | 0.56              | 0.39              | 0.23            | 0.69              |

| Panel B: Correlations |      |      |       |       |            |            |            |             |       |            |             |
|-----------------------|------|------|-------|-------|------------|------------|------------|-------------|-------|------------|-------------|
|                       | MP   | SMB  | RMW   | HML   | $HML^{ME}$ | $HML^{BE}$ | $HML^{PS}$ | $HML^{RES}$ | CMA   | $CMA^{PS}$ | $CMA^{RES}$ |
| MP                    | 1.00 | 0.27 | −0.24 | −0.26 | −0.23      | −0.07      | −0.21      | −0.21       | −0.38 | −0.23      | −0.23       |
| SMB                   |      | 1.00 | −0.35 | −0.08 | 0.00       | −0.14      | 0.02       | 0.01        | −0.09 | −0.05      | 0.06        |
| RMW                   |      |      | 1.00  | 0.12  | −0.01      | 0.15       | −0.08      | 0.01        | −0.07 | −0.19      | 0.03        |
| HML                   |      |      |       | 1.00  | 0.89       | 0.62       | 0.81       | 0.74        | 0.66  | 0.64       | 0.16        |
| $HML^{ME}$            |      |      |       |       | 1.00       | 0.49       | 0.89       | 0.84        | 0.65  | 0.66       | 0.18        |
| $HML^{BE}$            |      |      |       |       |            | 1.00       | 0.43       | 0.39        | 0.21  | 0.30       | −0.11       |
| $HML^{PS}$            |      |      |       |       |            |            | 1.00       | 0.61        | 0.61  | 0.63       | 0.14        |
| $HML^{RES}$           |      |      |       |       |            |            |            | 1.00        | 0.57  | 0.57       | 0.26        |
| CMA                   |      |      |       |       |            |            |            |             | 1.00  | 0.85       | 0.57        |
| $CMA^{PS}$            |      |      |       |       |            |            |            |             |       | 1.00       | 0.25        |
| $CMA^{RES}$           |      |      |       |       |            |            |            |             |       |            | 1.00        |

**Table 6**  
**Characteristics of Factor Portfolios**

This table displays average characteristics of the standard, residual-driven, and profitability shock-driven value and investment factors' portfolios. The portfolios' characteristics are measured at the portfolio formation date and are calculated as weighted averages of the characteristics of the portfolios' stocks. The characteristics are log market equity (ME), log book-to-market (BM), operating profitability (OP), log investment (INV), momentum (MOM), volatility (VOL), and long-term reversal (LTR). The variables are measured at the end of each June, are calculated as described in Appendix A, and are cross-sectionally winsorized at the 0.5% and 99.5% levels in each year.

|                             | ME     | BM     | OP     | INV    | MOM    | VOL    | LTR    |
|-----------------------------|--------|--------|--------|--------|--------|--------|--------|
| Growth                      | 7.156  | -1.396 | 0.350  | 0.170  | 0.225  | 0.384  | 1.408  |
| Value                       | 6.722  | 0.202  | 0.186  | 0.077  | 0.145  | 0.355  | 0.414  |
| HML                         | -0.434 | 1.598  | -0.164 | -0.093 | -0.080 | -0.029 | -0.994 |
| Growth <sup>RES</sup>       | 7.074  | -1.194 | 0.275  | 0.174  | 0.266  | 0.417  | 1.875  |
| Value <sup>RES</sup>        | 6.487  | 0.188  | 0.194  | 0.047  | 0.135  | 0.395  | 0.245  |
| HML <sup>RES</sup>          | -0.588 | 1.381  | -0.081 | -0.127 | -0.131 | -0.022 | -1.630 |
| Growth <sup>PS</sup>        | 7.336  | -1.159 | 0.405  | 0.167  | 0.260  | 0.357  | 1.744  |
| Value <sup>PS</sup>         | 6.915  | 0.131  | 0.183  | 0.055  | 0.125  | 0.332  | 0.342  |
| HML <sup>PS</sup>           | -0.420 | 1.289  | -0.222 | -0.111 | -0.135 | -0.025 | -1.402 |
| Aggressive                  | 7.043  | -0.960 | 0.313  | 0.297  | 0.212  | 0.385  | 1.548  |
| Conservative                | 6.879  | -0.494 | 0.238  | -0.055 | 0.173  | 0.381  | 0.456  |
| CMA                         | -0.164 | 0.466  | -0.075 | -0.352 | -0.038 | -0.004 | -1.092 |
| Aggressive <sup>RES</sup>   | 7.053  | -0.712 | 0.222  | 0.335  | 0.178  | 0.372  | 1.128  |
| Conservative <sup>RES</sup> | 6.873  | -0.582 | 0.285  | -0.066 | 0.185  | 0.381  | 0.575  |
| CMA <sup>RES</sup>          | -0.179 | 0.130  | 0.063  | -0.401 | 0.006  | 0.009  | -0.552 |
| Aggressive <sup>PS</sup>    | 7.464  | -1.006 | 0.373  | 0.242  | 0.215  | 0.352  | 1.602  |
| Conservative <sup>PS</sup>  | 7.183  | -0.414 | 0.213  | -0.039 | 0.145  | 0.358  | 0.376  |
| CMA <sup>PS</sup>           | -0.281 | 0.592  | -0.160 | -0.281 | -0.070 | 0.006  | -1.227 |

Table 7

## Spanning Regressions

This table displays results from spanning regressions that regress different versions of the value factor (VAL) on different versions of the investment factor (INV) as well as the market (MP), size (SMB), and profitability (RMW) factors, and vice versa. The sample period is from July 1964 to December 2019. The first two columns of each row depict which versions of the investment and value factors are used in the respective spanning regressions. “standard” refers to the standard factors. “ME” refers to the market-channel value factor. “PS” refers to the profitability shock-driven factors. “RES” refers to the residual-driven factors.  $\alpha$  is in percent. The column “max(SR<sup>2</sup>)” displays the maximum squared Sharpe ratio of a five-factor model that combines the respective value and investment factors with the market, size, and profitability factors and tests whether it is significantly different from the Fama-French (2015) model’s maximum squared Sharpe ratio using the test of Barillas et al. (2020). t-statistics are reported in parentheses. \*, \*\*, and \*\*\* denote significance at the 10%, 5%, and 1% levels, respectively.

|      |          |          |                       | Dependent Factor: Investment |                     |                     |                      |                    | Dependent Factor: Value |                   |                     |                   |                     |                    |                |
|------|----------|----------|-----------------------|------------------------------|---------------------|---------------------|----------------------|--------------------|-------------------------|-------------------|---------------------|-------------------|---------------------|--------------------|----------------|
|      | INV      | VAL      | max(SR <sup>2</sup> ) | $\alpha$                     | $\beta^{MP}$        | $\beta^{SMB}$       | $\beta^{RMW}$        | $\beta^{VAL}$      | R <sup>2</sup>          | $\alpha$          | $\beta^{MP}$        | $\beta^{SMB}$     | $\beta^{RMW}$       | $\beta^{INV}$      | R <sup>2</sup> |
| (1)  | standard | standard | 0.088                 | 0.20***<br>(3.92)            | -0.11***<br>(-9.11) | -0.03*<br>(-1.79)   | -0.18***<br>(-7.76)  | 0.41***<br>(22.25) | 0.525                   | 0.00<br>(-0.04)   | 0.03<br>(1.32)      | 0.04<br>(1.34)    | 0.24***<br>(6.22)   | 1.05***<br>(22.25) | 0.465          |
| (2)  | standard | ME       | 0.090                 | 0.17***<br>(5.00)            | -0.11***<br>(-8.69) | -0.05**<br>(-2.49)  | -0.12***<br>(-4.94)  | 0.37***<br>(20.65) | 0.495                   | 0.09<br>(1.05)    | 0.01<br>(0.42)      | 0.08**<br>(2.47)  | 0.08*<br>(1.90)     | 1.05***<br>(20.65) | 0.427          |
| (3)  | standard | PS       | 0.089                 | 0.25***<br>(4.67)            | -0.12***<br>(-8.98) | -0.04**<br>(-2.24)  | -0.09***<br>(-3.72)  | 0.32***<br>(18.45) | 0.452                   | -0.08<br>(-0.78)  | 0.01<br>(0.30)      | 0.08**<br>(2.16)  | -0.01<br>(-0.26)    | 1.06***<br>(18.45) | 0.377          |
| (4)  | standard | RES      | 0.097                 | 0.17***<br>(1.13)            | -0.12***<br>(-9.25) | -0.05***<br>(-2.42) | -0.14***<br>(-5.26)  | 0.28***<br>(16.83) | 0.419                   | 0.26**<br>(2.33)  | 0.01<br>(0.27)      | 0.10**<br>(2.57)  | 0.12**<br>(2.24)    | 1.08***<br>(16.83) | 0.331          |
| (5)  | PS       | standard | 0.070*                | 0.12**<br>(1.99)             | -0.06***<br>(-4.18) | -0.06***<br>(-2.61) | -0.32***<br>(-11.18) | 0.52***<br>(22.91) | 0.509                   | 0.09<br>(1.17)    | -0.03*<br>(-1.70)   | 0.05*<br>(1.90)   | 0.32***<br>(8.35)   | 0.86***<br>(22.91) | 0.479          |
| (6)  | PS       | ME       | 0.075                 | 0.09<br>(1.40)               | -0.06***<br>(-3.85) | -0.08***<br>(-3.38) | -0.24***<br>(-8.29)  | 0.48***<br>(22.18) | 0.494                   | 0.18**<br>(2.15)  | -0.05**<br>(-2.32)  | 0.09***<br>(3.09) | 0.17***<br>(4.12)   | 0.88***<br>(22.18) | 0.459          |
| (7)  | PS       | PS       | 0.068**               | 0.19***<br>(2.87)            | -0.07***<br>(-4.35) | -0.07***<br>(-3.07) | -0.21***<br>(-6.80)  | 0.41***<br>(19.65) | 0.443                   | 0.01<br>(0.14)    | -0.05**<br>(-2.15)  | 0.09***<br>(2.69) | 0.08*<br>(1.69)     | 0.89***<br>(19.65) | 0.404          |
| (8)  | PS       | RES      | 0.085                 | 0.08<br>(0.25)               | -0.08***<br>(-4.76) | -0.08***<br>(-3.19) | -0.27***<br>(-8.30)  | 0.35***<br>(17.54) | 0.398                   | 0.36***<br>(3.27) | -0.05**<br>(-2.00)  | 0.12***<br>(3.03) | 0.21***<br>(3.93)   | 0.90***<br>(17.54) | 0.347          |
| (9)  | RES      | standard | 0.109                 | 0.36***<br>(5.29)            | -0.09***<br>(-5.75) | 0.08***<br>(3.19)   | 0.00<br>(0.15)       | 0.07***<br>(2.85)  | 0.073                   | 0.29***<br>(2.70) | -0.13***<br>(-5.34) | 0.00<br>(-0.13)   | 0.08<br>(1.62)      | 0.17***<br>(2.85)  | 0.076          |
| (10) | RES      | ME       | 0.115*                | 0.35***<br>(5.11)            | -0.09***<br>(-5.55) | 0.07***<br>(3.06)   | 0.02<br>(0.54)       | 0.08***<br>(3.45)  | 0.078                   | 0.37***<br>(3.28) | -0.15***<br>(-5.62) | 0.03<br>(0.75)    | -0.08<br>(-1.56)    | 0.21***<br>(3.45)  | 0.073          |
| (11) | RES      | PS       | 0.102                 | 0.37***<br>(5.45)            | -0.10***<br>(-5.83) | 0.08***<br>(3.11)   | 0.02<br>(0.62)       | 0.05***<br>(2.45)  | 0.070                   | 0.22*<br>(1.81)   | -0.16***<br>(-5.45) | 0.03<br>(0.75)    | -0.17***<br>(-3.06) | 0.17**<br>(2.45)   | 0.064          |
| (12) | RES      | RES      | 0.118*                | 0.32***<br>(1.86)            | -0.08***<br>(-5.29) | 0.07***<br>(2.94)   | 0.02<br>(0.50)       | 0.11***<br>(5.68)  | 0.105                   | 0.47***<br>(3.62) | -0.13***<br>(-4.40) | 0.04<br>(0.82)    | -0.05<br>(-0.81)    | 0.41***<br>(5.68)  | 0.088          |

**Table 8**  
**Pricing Factors**

This table displays results from factor model regressions. In Panel A, the standard Fama-French (2015) five-factor model is used to explain the residual-driven value and investment factors ( $HML^{RES}$  and  $CMA^{RES}$ , respectively). In Panel B, the adjusted five-factor model with the residual-driven value and investment factors is used to explain the standard value and investment factors ( $HML$  and  $CMA$ , respectively). In Panel C, the q-factors of Hou et al. (2015, 2021) are used to explain the standard and residual-driven value and investment factors. MKT, ME, ROE, IA, and EG denote the market, size, profitability, investment, and expected growth factors. In Panels A and B, the sample period is from July 1964 to December 2019; in Panel C, the sample period is from January 1967 to December 2019.  $\alpha$  is in percent. t-statistics are reported in parentheses. \*, \*\*, and \*\*\* denote significance at the 10%, 5%, and 1% levels, respectively.

| Panel A: Fama-French (2015) Five-Factor Model |                   |                  |                   |                   |                    |                      |       |
|-----------------------------------------------|-------------------|------------------|-------------------|-------------------|--------------------|----------------------|-------|
|                                               | $\alpha$          | $\beta^{MP}$     | $\beta^{SMB}$     | $\beta^{RMW}$     | $\beta^{CMA}$      | $\beta^{HML}$        | $R^2$ |
| $HML^{RES}$                                   | 0.26***<br>(2.95) | -0.01<br>(-0.61) | 0.05<br>(1.48)    | -0.06<br>(-1.50)  | 0.24***<br>(3.57)  | 0.79***<br>(19.30)   | 0.571 |
| $CMA^{RES}$                                   | 0.19***<br>(3.55) | 0.00<br>(0.05)   | 0.11***<br>(5.95) | 0.16***<br>(6.08) | 0.86***<br>(21.03) | -0.27***<br>(-10.71) | 0.444 |

| Panel B: Adjusted Five-Factor Model |                |                     |                     |                     |                     |                     |       |
|-------------------------------------|----------------|---------------------|---------------------|---------------------|---------------------|---------------------|-------|
|                                     | $\alpha$       | $\beta^{MP}$        | $\beta^{SMB}$       | $\beta^{RMW}$       | $\beta^{CMA^{RES}}$ | $\beta^{HML^{RES}}$ | $R^2$ |
| $HML$                               | 0.01<br>(0.12) | -0.05***<br>(-3.07) | -0.03<br>(-1.05)    | 0.11***<br>(3.20)   | -0.08*<br>(-1.80)   | 0.60***<br>(27.03)  | 0.561 |
| $CMA$                               | 0.03<br>(0.59) | -0.08***<br>(-7.43) | -0.08***<br>(-4.67) | -0.14***<br>(-6.53) | 0.44***<br>(16.17)  | 0.23***<br>(15.91)  | 0.583 |

| Panel C: q-Factor Models |                   |                     |                   |                      |                    |                   |       |
|--------------------------|-------------------|---------------------|-------------------|----------------------|--------------------|-------------------|-------|
|                          | $\alpha$          | $\beta^{MKT}$       | $\beta^{ME}$      | $\beta^{ROE}$        | $\beta^{IA}$       | $\beta^{EG}$      | $R^2$ |
| $HML$                    | 0.03<br>(0.34)    | -0.02<br>(-1.24)    | 0.01<br>(0.37)    | -0.14***<br>(-4.13)  | 1.00***<br>(21.75) |                   | 0.480 |
| $HML^{RES}$              | 0.37***<br>(3.44) | -0.07***<br>(-2.79) | 0.05<br>(1.39)    | -0.31***<br>(-7.23)  | 0.94***<br>(16.45) |                   | 0.389 |
| $CMA$                    | 0.00<br>(0.11)    | -0.04***<br>(-6.14) | 0.01<br>(1.45)    | -0.13***<br>(-11.88) | 0.86***<br>(57.24) |                   | 0.870 |
| $CMA^{RES}$              | 0.22***<br>(3.33) | -0.04**<br>(-2.42)  | 0.07***<br>(3.22) | -0.01<br>(-0.40)     | 0.46***<br>(13.06) |                   | 0.263 |
| $HML$                    | 0.01<br>(0.06)    | -0.02<br>(-1.00)    | 0.01<br>(0.47)    | -0.15***<br>(-3.98)  | 1.00***<br>(20.93) | 0.04<br>(0.64)    | 0.479 |
| $HML^{RES}$              | 0.16<br>(1.40)    | -0.04<br>(-1.39)    | 0.08**<br>(2.20)  | -0.40***<br>(-8.63)  | 0.88***<br>(15.09) | 0.32***<br>(4.61) | 0.408 |
| $CMA$                    | -0.04<br>(-1.38)  | -0.03***<br>(-4.86) | 0.02**<br>(2.11)  | -0.15***<br>(-12.42) | 0.85***<br>(55.19) | 0.07***<br>(3.78) | 0.873 |
| $CMA^{RES}$              | 0.13*<br>(1.88)   | -0.02<br>(-1.45)    | 0.08***<br>(3.73) | -0.05*<br>(-1.73)    | 0.43***<br>(12.00) | 0.13***<br>(3.07) | 0.273 |

**Table 9**  
**Comparison with Size and Intangible Return Value Factors**

Panel A of this table displays summary statistics for different value factors and results from spanning regressions that regress the value factors on four-factor models consisting of the market (MP), size (SMB), profitability (RMW), and investment (CMA) factors.  $\mu$  and  $\sigma$  are monthly mean returns and volatilities.  $\mu$ ,  $\sigma$ , and  $\alpha$  are in percent. The sample period is from July 1964 to December 2019. The dependent value factors are Gerakos and Linnainmaa's (2018) size value factor ( $HML^{GL}$ ), an intangible return value factor ( $HML^{DT}$ ) in the spirit of Daniel and Titman (2006), two value factors constructed by splitting the incoming stocks of the standard value factor's portfolios based on book-to-market's five- and one-year size components obtained following Gerakos and Linnainmaa (2018) ( $HML^{GL,5}$  and  $HML^{GL,1}$ ), and two value factors constructed by splitting the incoming stocks of the standard value factor's portfolios based on five- and one-year intangible returns obtained following Daniel and Titman (2006) ( $HML^{DT,5}$  and  $HML^{DT,1}$ ). Panel B displays results from spanning regressions that regress the residual-driven value factor on five-factor models consisting of the market, size, and profitability factors, the standard or residual-driven investment factor (CMA respectively  $CMA^{RES}$ ), and one of the size and intangible return value ( $HML^{row}$ ) factors. t-statistics are reported in parentheses. \*, \*\*, and \*\*\* denote significance at the 10%, 5%, and 1% levels, respectively.

| Panel A: Redundancy of Value Factors               |                   |                     |                    |                   |                   |                     |                     |                |
|----------------------------------------------------|-------------------|---------------------|--------------------|-------------------|-------------------|---------------------|---------------------|----------------|
|                                                    | $\mu$             | $\sigma$            | $\alpha$           | $\beta^{MP}$      | $\beta^{SMB}$     | $\beta^{RMW}$       | $\beta^{CMA}$       | R <sup>2</sup> |
| HML <sup>GL</sup>                                  | 0.29***<br>(2.94) | 2.48                | -0.01<br>(-0.09)   | 0.02<br>(1.24)    | 0.14***<br>(5.23) | 0.10***<br>(2.86)   | 0.97***<br>(21.87)  | 0.474          |
| HML <sup>DT</sup>                                  | 0.20**<br>(2.25)  | 2.19                | 0.02<br>(0.21)     | 0.05***<br>(2.68) | 0.10***<br>(3.68) | -0.10***<br>(-2.81) | 0.67***<br>(15.00)  | 0.310          |
| HML <sup>GL,5</sup>                                | 0.39***<br>(2.88) | 3.33                | 0.07<br>(0.65)     | 0.01<br>(0.30)    | 0.08*<br>(1.96)   | 0.04<br>(0.85)      | 1.15***<br>(17.75)  | 0.373          |
| HML <sup>DT,5</sup>                                | 0.32**<br>(2.40)  | 3.27                | 0.06<br>(0.54)     | 0.03<br>(0.92)    | 0.11**<br>(2.57)  | -0.06<br>(-1.16)    | 0.96***<br>(14.04)  | 0.272          |
| HML <sup>GL,1</sup>                                | 0.33***<br>(2.58) | 3.31                | 0.08<br>(0.76)     | 0.02<br>(0.80)    | 0.05<br>(1.40)    | -0.06<br>(-1.16)    | 1.18***<br>(19.80)  | 0.409          |
| HML <sup>DT,1</sup>                                | 0.41***<br>(3.11) | 3.38                | 0.13<br>(1.24)     | 0.06**<br>(2.26)  | 0.19***<br>(5.08) | -0.16***<br>(-3.30) | 1.16***<br>(19.04)  | 0.408          |
|                                                    |                   |                     |                    |                   |                   |                     |                     |                |
| Panel B: Spanning the Residual-driven Value Factor |                   |                     |                    |                   |                   |                     |                     |                |
|                                                    | $\alpha$          | $\beta^{MP}$        | $\beta^{SMB}$      | $\beta^{RMW}$     | $\beta^{CMA}$     | $\beta^{CMA^{RES}}$ | $\beta^{HML^{row}}$ | R <sup>2</sup> |
| HML <sup>GL</sup>                                  | 0.19**<br>(2.22)  | -0.01<br>(-0.69)    | -0.03<br>(-0.85)   | 0.06<br>(1.53)    | 0.27***<br>(4.07) |                     | 0.83***<br>(18.25)  | 0.589          |
| HML <sup>DT</sup>                                  | 0.17**<br>(2.00)  | -0.04*<br>(-1.73)   | 0.01<br>(0.27)     | 0.23***<br>(5.67) | 0.53***<br>(8.99) |                     | 0.82***<br>(18.21)  | 0.588          |
| HML <sup>GL,5</sup>                                | 0.14*<br>(1.82)   | 0.00<br>(-0.04)     | 0.04<br>(1.43)     | 0.12***<br>(3.33) | 0.29***<br>(5.43) |                     | 0.69***<br>(25.30)  | 0.690          |
| HML <sup>DT,5</sup>                                | 0.15*<br>(1.90)   | -0.01<br>(-0.64)    | 0.02<br>(0.84)     | 0.19***<br>(5.21) | 0.47***<br>(9.18) |                     | 0.63***<br>(24.07)  | 0.674          |
| HML <sup>GL,1</sup>                                | 0.20**<br>(2.54)  | -0.01<br>(-0.41)    | 0.06**<br>(2.23)   | 0.16***<br>(4.31) | 0.18***<br>(3.18) |                     | 0.76***<br>(25.59)  | 0.663          |
| HML <sup>DT,1</sup>                                | 0.16**<br>(2.08)  | -0.04**<br>(-2.02)  | -0.04<br>(-1.63)   | 0.24***<br>(6.75) | 0.19***<br>(3.43) |                     | 0.77***<br>(27.47)  | 0.687          |
| HML <sup>GL</sup>                                  | 0.24***<br>(2.67) | -0.04**<br>(-1.97)  | -0.05<br>(-1.49)   | 0.03<br>(0.78)    |                   | 0.03<br>(0.63)      | 0.95***<br>(26.53)  | 0.578          |
| HML <sup>DT</sup>                                  | 0.26***<br>(2.86) | -0.10***<br>(-4.77) | -0.02<br>(-0.72)   | 0.20***<br>(4.72) |                   | 0.11**<br>(2.19)    | 1.02***<br>(24.26)  | 0.537          |
| HML <sup>GL,5</sup>                                | 0.13*<br>(1.65)   | -0.02<br>(-0.96)    | 0.01<br>(0.52)     | 0.08**<br>(2.44)  |                   | 0.18***<br>(4.15)   | 0.76***<br>(33.80)  | 0.683          |
| HML <sup>DT,5</sup>                                | 0.14*<br>(1.69)   | -0.04**<br>(-2.38)  | -0.02<br>(-0.70)   | 0.14***<br>(3.96) |                   | 0.30***<br>(6.82)   | 0.74***<br>(31.59)  | 0.655          |
| HML <sup>GL,1</sup>                                | 0.18**<br>(2.27)  | -0.01<br>(-0.79)    | 0.04<br>(1.56)     | 0.14***<br>(3.83) |                   | 0.16***<br>(3.60)   | 0.81***<br>(33.74)  | 0.665          |
| HML <sup>DT,1</sup>                                | 0.15**<br>(1.99)  | -0.05***<br>(-2.86) | -0.07**<br>(-2.43) | 0.23***<br>(6.35) |                   | 0.12***<br>(2.70)   | 0.82***<br>(35.41)  | 0.685          |

**Table 10**  
**Adjustment for Intangibles**

Panel A displays results from spanning regressions that regress the residual-driven ( $HML^{RES}$ ) and intangible ( $HML^{int}$ ) value factors on five-factor models consisting of the market, size, and profitability factors, the standard or residual-driven investment factor (CMA respectively  $CMA^{RES}$ ), and the residual-driven intangible value factor ( $HML^{RESint}$ ). Panel B displays results from spanning regressions that regress the residual-driven intangible value factor on five-factor models consisting of the market, size, and profitability factors, the standard or residual-driven investment factor, and the residual-driven or intangible value factor. The sample period is from July 1977 to December 2019.  $\alpha$  is in percent. t-statistics are reported in parentheses. \*, \*\*, and \*\*\* denote significance at the 10%, 5%, and 1% levels, respectively.

| Panel A: Residual-driven Intangible Value Factor as Independent Factor |                  |                     |                   |                    |                    |                     |                        |                |
|------------------------------------------------------------------------|------------------|---------------------|-------------------|--------------------|--------------------|---------------------|------------------------|----------------|
|                                                                        | $\alpha$         | $\beta^{MP}$        | $\beta^{SMB}$     | $\beta^{RMW}$      | $\beta^{CMA}$      | $\beta^{CMA}^{RES}$ | $\beta^{HML}^{RESint}$ | R <sup>2</sup> |
| HML <sup>RES</sup>                                                     | 0.03<br>(0.35)   | -0.02<br>(-0.93)    | 0.01<br>(0.41)    | -0.03<br>(-0.77)   | 0.72***<br>(11.48) |                     | 0.44***<br>(12.81)     | 0.537          |
| HML <sup>int</sup>                                                     | -0.09<br>(-1.44) | 0.07***<br>(4.66)   | 0.14***<br>(6.24) | 0.22***<br>(7.65)  | 0.44***<br>(10.95) |                     | 0.52***<br>(23.52)     | 0.726          |
| HML <sup>RES</sup>                                                     | 0.12<br>(1.10)   | -0.11***<br>(-4.42) | -0.01<br>(-0.19)  | -0.12**<br>(-2.34) |                    | 0.11*<br>(1.78)     | 0.60***<br>(16.91)     | 0.419          |
| HML <sup>int</sup>                                                     | 0.01<br>(0.21)   | 0.00<br>(0.12)      | 0.14***<br>(5.38) | 0.17***<br>(5.44)  |                    | -0.06<br>(-1.55)    | 0.63***<br>(27.97)     | 0.663          |

| Panel B: Residual-driven Intangible Value Factor as Dependent Factor |                  |                    |                     |                   |                  |                     |                     |                     |                |
|----------------------------------------------------------------------|------------------|--------------------|---------------------|-------------------|------------------|---------------------|---------------------|---------------------|----------------|
|                                                                      | $\alpha$         | $\beta^{MP}$       | $\beta^{SMB}$       | $\beta^{RMW}$     | $\beta^{CMA}$    | $\beta^{CMA}^{RES}$ | $\beta^{HML}^{RES}$ | $\beta^{HML}^{int}$ | R <sup>2</sup> |
| HML <sup>RESint</sup>                                                | 0.18<br>(1.64)   | 0.06**<br>(2.16)   | 0.08**<br>(2.07)    | 0.31***<br>(6.37) | 0.19**<br>(2.44) |                     | 0.56***<br>(12.81)  |                     | 0.434          |
| HML <sup>RESint</sup>                                                | 0.21**<br>(2.49) | -0.04**<br>(-1.99) | -0.09***<br>(-2.63) | -0.04<br>(-0.92)  | -0.07<br>(-1.12) |                     |                     | 1.00***<br>(23.52)  | 0.642          |
| HML <sup>RESint</sup>                                                | 0.14<br>(1.32)   | 0.05**<br>(1.99)   | 0.07*<br>(1.73)     | 0.29***<br>(6.02) |                  | 0.15**<br>(2.40)    | 0.60***<br>(16.91)  |                     | 0.434          |

# Resurrecting the Value Factor from its Redundancy: Internet Appendix

Manuel Ammann\*

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## Abstract

This Internet Appendix contains supplementary analyses and results for “Resurrecting the Value Factor from its Redundancy.”

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## C Additional Results

### C.1 Descriptive Statistics

Table IA1 provides summary statistics on our key variables and factor portfolios.

### C.2 The Sources of the Value and Investment Premia: Equal-Weighting

Table IA2 presents the results of the portfolio sorts from Section 5 when the portfolios are equal-weighted rather than value-weighted. They are qualitatively very similar to those for the value-weighted portfolios.

### C.3 The Sources of Book-to-Market's and Investment's Predictive Power

We run monthly cross-sectional Fama-MacBeth (1973) regressions that predict stocks' one-month ahead returns based on book-to-market, market equity changes, book equity changes, investment, and investment changes. We include size, operating profitability, momentum, and short-term reversal as additional controls. We estimate the regressions with weighted least squares with stocks' market capitalizations as weights.

Table IA3 presents the time-series averages of the monthly coefficient estimates. Regressions (1) and (7) show that book-to-market predicts returns significantly positively and that investment predicts returns significantly negatively when only one of the two variables is included. In line with the notion that the standard value and investment effects subsume each other to a considerable extent, regression (13) reveals that book-to-market's coefficient turns insignificant and investment's coefficient decreases notably when both variables are included simultaneously.

Regressions (2) to (6) extend regression (1) by adding book equity changes, residual market equity changes, and profitability shocks, one at a time, and lagging book-to-market accordingly such that the book equity changes, the market equity changes, and lagged book-to-market would sum up to current book-to-market. The results show that book-to-market's positive predictive power for returns emanates from the residual market equity changes. More specifically, residual market equity changes exhibit uniformly and mostly significantly negative coefficients. By contrast, the profitability shocks exhibit insignificantly positive coefficients. The coefficients on book equity changes are also mostly insignificant. Thus, our approach successfully narrows down the variation in book-to-market that is informative about future returns.

Regressions (8) to (12) analogously investigate the source of investment's predictive power. That is, they add residual investment changes and profitability shocks, one at a time, and lag investment accordingly such that the investment changes and lagged investment would sum up to current investment. The results show that investment's predictive power mainly emanates from the residual investment changes. In particular, residual investment changes exhibit uniformly significantly negative coefficients. Nevertheless, the profitability shocks also contain some of investment's predictive information. Their coefficients are, albeit mostly insignificant, often negative. Nevertheless, given that the predictive power of the residual investment changes

is much stronger, our approach also performs reasonably in narrowing down the variation in investment that is informative about future returns.

Finally, regressions (14) to (18) include residual market equity and investment changes, book equity changes, and profitability shocks. The results reveal that the residual market equity and investment changes largely retain their significant predictive power even when included simultaneously. Thus, the variation in book-to-market that is informative about future returns captures incremental information relative to the variation in investment that is informative about future returns, and vice versa. This conjecture contrasts with the finding that book-to-market and investment subsume each other’s predictive power to a considerable extent, suggesting that this finding arises because both variables also reflect information about expected cash flows. This common noise component overshadows their complementary information about future returns.

#### **C.4 Why is the Value Factor the Redundant Factor?**

Our findings so far indicate that the value and investment factors’ close connection arises because market equity and investment changes have common drivers. However, this raises the question of why their common drivers render the value factor rather than the investment factor redundant. We address this question by conducting spanning regressions with manipulated versions of the value and investment factors. Table IA4 presents the results. In specification (1), we regress the standard value and investment factors on the market, size, and profitability factors. Both factors exhibit significant alphas. Thus, neither of the two is redundant with respect to the market, size, and profitability factors. Specification (2) adds the investment factor as an explanatory factor to explain the value factor and vice versa. The usual result unfolds: the value factor is subsumed by the other factors, exhibiting an alpha of zero. By contrast, the investment factor exhibits a significant alpha and is therefore not subsumed.

Our discussion in Section 2 and our results in Section 5 indicate that the value factor’s book-channel part is a “noise” component that contaminates its pricing information. Thus, the book-channel part may be the reason why the investment factor trumps the value factor. The results from specification (3) confirm that the book-channel part is to some extent responsible for the value factor’s redundancy, given that its alpha increases notably when its market-channel rather than its standard version is employed. Nevertheless, amid its insignificant alpha, the market-channel value factor is still redundant.

Comparing the value and investment factors’ results in specifications (1) to (3) suggests three further potential reasons why the former is the redundant one. First, the value factor’s beta on the investment factor is much higher than vice versa (1.05 vs. 0.41). Second, the value factor’s volatility is higher than the investment factor’s (2.75% vs. 1.82%). Third, the value factor’s betas on the market, size, and profitability factors are higher than the investment factor’s.

The first and second reasons are related: a higher standard deviation of the dependent variable implies, all else being equal, a lower regression coefficient. In specification (4), we

rescale the value factor to have the same volatility as the investment factor while keeping its mean constant. The results show that the factors' betas on each other are similar in this case (0.69 vs. 0.62). Moreover, the value factor would exhibit a significant alpha, being therefore no longer redundant. Its higher volatility is thus a major reason for its redundancy.

To shed light on the reasons for the value factor's higher volatility, Figure IA1 displays three-year moving volatilities of the value and investment factors as well as their legs and three-year moving correlations between the factors' legs.<sup>1</sup> Panels C and D show that the short and long legs' volatilities are very similar. Panel B reveals, however, that the correlations between the factors' legs behave differently. The correlation between the investment factor's legs is quite stable and never drops below 0.85. By contrast, the correlation between the value factor's legs fluctuates strongly, occasionally falling even below 0.70. It drops especially during times of market-wide turbulences, such as the oil crises in the early 1970s and 1980s, the biotech and dotcom bubbles in the early 1990s and 2000s, and the global financial crisis in 2007/08. Panel A shows that the low correlation between the value factor's legs during such periods leads to surges in the factor's volatility and, importantly, to pronounced divergences from the investment factor's volatility. The reason for the value factor's noisiness during such market turbulences is arguably that book-to-market is more distorted than investment in such periods because it relies on a market variable.

A third reason for the value factor's redundancy is its less favorable exposure to the market, size, and profitability factors. Specifically, the value factor's mean return is partly explained by its positive exposures to these factors, deflating its alpha. By contrast, the investment factor's negative exposures to these factors inflate its alpha. To examine the importance of the factors' differential exposures to the other factors, we first orthogonalize both factors to the market, size, and profitability factors and then rescale them to their original means and volatilities. Specification (5) shows that the orthogonalized factors exhibit insignificant alphas. Thus, both factors are now redundant. However, the value factor's alpha increases by 0.09% relative to its original alpha, whereas the investment factor's alpha decreases by 0.12%. Thus, the factors' differential exposures are also an important reason why the value factor is redundant.

To evaluate whether the value factor's elevated volatility and worse hedge ability are typical features or just bad outcomes, we obtain out-of-sample data on the value factor for the period from 1926 to 1963 from Kenneth French's website and on the investment factor for the period from 1940 to 1963 from Sunil Wahal's website.<sup>2</sup> In unreported results, we find that the correlation between the value factor's legs was 0.930 from 1926 to 1963, suggesting that the correlation of 0.864 during our sample period was exceptionally low. Based on a correlation of 0.930, the value factor's volatility would have been 2.00% during our sample period and thus close to the investment factor's volatility. Moreover, we document that the value factor's profitability beta was much lower than the investment factor's during the period from 1940 to 1963 (-0.72 vs.

<sup>1</sup>A factor's volatility depends on its long and short legs' volatilities and the correlation between the legs. In particular, the factor's variance can be expressed as follows:  $\sigma_{Factor}^2 = \sigma_{Long}^2 + \sigma_{Short}^2 - 2 \cdot \rho_{Long, Short} \cdot \sigma_{Long} \cdot \sigma_{Short}$ .

<sup>2</sup><https://cie.wpcarey.asu.edu/>

-0.34). These findings suggest that the value factor’s elevated volatility and worse hedge ability may be specific to our sample period. Thus, the value factor may not necessarily continue to be the redundant factor going forward. On the one hand, this conjecture supports Fama and French’s (2015) decision to keep the value factor in their five-factor model. On the other hand, it highlights the importance of protecting the investment factor from becoming redundant by employing an improved version.

## C.5 Exposure to Cash Flow, Discount Rate, and Variance News

The literature has offered numerous explanations that aim to rationalize the value effect.<sup>3</sup> Our finding that only residual-driven stocks earn a value premium provides a fresh laboratory for testing these explanations. This is because any explanation aiming to rationalize the value effect must also explain why only residual-driven stocks generate the value premium. While an evaluation of all explanations is beyond the scope of this paper, we examine whether one particularly promising explanation passes this test: the three-beta ICAPM of Campbell et al. (2018). In this model, exposure to market cash flow news is positively priced, while exposures to market discount rate and volatility news are negatively priced. Campbell et al. (2018) show that value stocks have higher cash flow news betas and lower volatility news betas than growth stocks. Building on this finding, Gerakos and Linnainmaa (2018) investigate the exposures of their size and orthogonal value factors, only the former of which earns a value premium, to the news. The two factors have similar cash flow and discount rate news betas, but the size value factor has a significantly lower volatility news beta. Compensation for exposure to market volatility news represents therefore a potential explanation for the value effect.

If compensation for market volatility news exposure indeed rationalizes the value effect, our residual-driven value factor should have a lower volatility news beta than our profitability shock-driven value factor, given that only the former earns a value premium. To evaluate this conjecture, we obtain data on the quarterly estimated news terms for the period from July 1964 to December 2011 from Christopher Polk’s website.<sup>4</sup> Table IA5 presents the factors’ betas on the news terms. First, our market- and book-channel value factors’ cash flow and discount rate news betas are not significantly different, whereas the former’s volatility news beta is significantly lower than the latter’s. Since our market- and book-channel value factors are similar to Gerakos and Linnainmaa’s (2018) size and orthogonal value factors, respectively, this result is in line with Gerakos and Linnainmaa (2018). Nevertheless, our residual- and profitability shock-driven value factors have similar exposures to all news, in particular also to volatility news. Thus, exposure to volatility news is unable to explain the residual- and profitability shock-driven value factors’ return difference. Contrary to Campbell et al. (2018) and Gerakos and Linnainmaa (2018), we therefore conclude that compensation for volatility news exposure cannot rationalize the value effect.

We further examine whether compensation for exposure to any of the news types may explain

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<sup>3</sup>See Golubov and Konstantinidi (2019) for a comprehensive overview and evaluation of these explanations.

<sup>4</sup><https://personal.lse.ac.uk/polk/research/work.htm>

the investment effect. The standard investment factor exhibits significantly negative betas on discount rate and volatility news. Compensation for exposure to these news types can therefore potentially rationalize the investment effect. However, our residual-driven investment factor has significantly higher, and thus more advantageous, betas on both news than its profitability shock-driven counterpart. Hence, compensation for discount rate and volatility news exposure cannot explain the factors' differential returns and therefore the investment effect.

## D Additional Variable Definitions

**Short-Term Reversal (STR):** A stock's short-term reversal for the end of month  $t$  is its return from the end of month  $t - 1$  to the end of month  $t$ . STR is considered missing if the stock does not have good price data for the end of month  $t - 1$  or good return data for month  $t$ .

## References

- Campbell, John Y., Stefano Giglio, Christopher Polk, and Robert Turley, 2018, An intertemporal CAPM with stochastic volatility, *Journal of Financial Economics* 128, 207–233.
- Fama, Eugene F., and Kenneth R. French, 2015, A five-factor asset pricing model, *Journal of Financial Economics* 116, 1–22.
- Fama, Eugene F., and James D. MacBeth, 1973, Risk, return, and equilibrium: Empirical tests, *Journal of Political Economy* 81, 607–636.
- Gerakos, Joseph, and Juhani T. Linnainmaa, 2018, Decomposing value, *Review of Financial Studies* 31, 1825–1854.
- Golubov, Andrey, and Theodosia Konstantinidi, 2019, Where is the risk in value? Evidence from a market-to-book decomposition, *Journal of Finance* 74, 3135–3186.
- Shanken, Jay, 1992, On the estimation of beta-pricing models, *Review of Financial Studies* 5, 1–33.

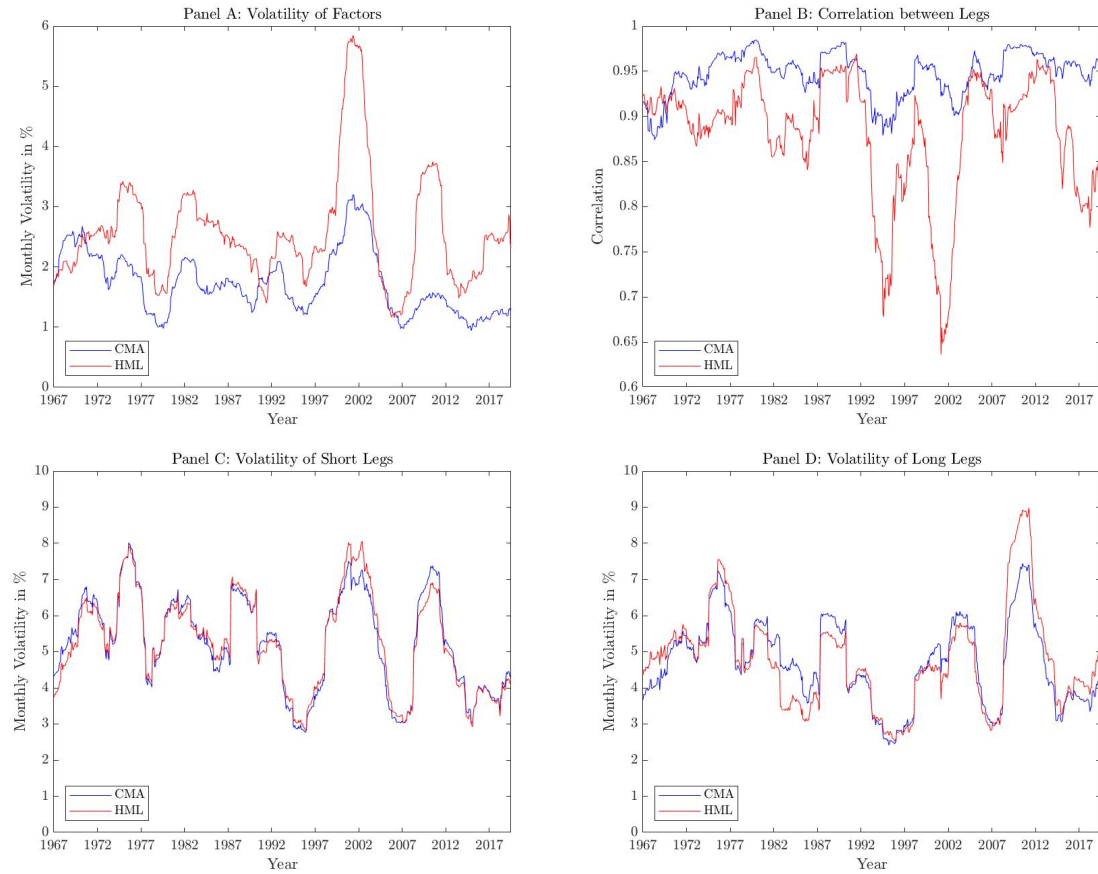


**Figure IA1**  
**Factor Volatilities**

Panel A of this figure displays the three-year rolling volatilities of the value and investment factors (HML and CMA, respectively). Panel B displays the three-year rolling correlations between the factors' long and short legs. Panel C (D) displays the three-year rolling volatilities of the factors' short (long) legs. The sample period is from July 1964 to December 2019.

**Table IA1**  
**Descriptive Statistics**

Panel A of this table displays descriptive statistics on stocks' log book-to-market (BM), annual log changes in book-to-market (dBM), annual log changes in book equity (dBE), annual log changes in market equity (dME), log investment (INV), annual log changes in INV (dINV), log market equity (ME), operating profitability (OP), momentum (MOM), volatility (VOL), and long-term reversal (LTR). The variables are measured at the end of each June and are calculated as described in Appendix A. dBE and dME are the annual log changes in the book equity and the market equity used in the calculation of book-to-market. The variables' descriptive statistics are calculated at the end of each June based on the cross-section of all common US stocks traded on the NYSE, AMEX, or NASDAQ and are then averaged across the sample period from 1963 and 2019. Panel B displays time-series averages of the value, growth, conservative, and aggressive portfolios' characteristics. "All" refers to the complete portfolios; "Incoming" refers to the portfolios' incoming stocks. The portfolios are reformed annually at the end of each June and are constructed as described in Section 3.2. The portfolios' characteristics are measured at the portfolio formation date and are calculated as weighted averages of the characteristics of the portfolios' stocks. N is the average number of stocks in the portfolio. Ret(P) (Ret(F)) is the weighted average cumulative return of the portfolios' stocks across the 12 months before (after) the portfolio formation.

| Panel A: Summary Statistics of Variables |        |        |        |          |        |        |        |       |       |
|------------------------------------------|--------|--------|--------|----------|--------|--------|--------|-------|-------|
|                                          | Mean   | Std    | Skew   | Kurt     | P1     | P10    | Med    | P90   | P99   |
| BM                                       | -0.511 | 0.847  | -0.863 | 6.133    | -3.021 | -1.568 | -0.412 | 0.419 | 1.231 |
| dBM                                      | 0.028  | 0.503  | -0.399 | 14.272   | -1.400 | -0.477 | 0.025  | 0.555 | 1.380 |
| dBE                                      | 0.074  | 0.405  | -1.007 | 45.253   | -1.198 | -0.206 | 0.075  | 0.361 | 1.292 |
| dME                                      | 0.045  | 0.484  | 0.068  | 5.987    | -1.266 | -0.512 | 0.050  | 0.586 | 1.355 |
| INV                                      | 0.095  | 0.281  | 1.127  | 25.912   | -0.613 | -0.130 | 0.070  | 0.351 | 1.055 |
| dINV                                     | -0.012 | 0.359  | 0.237  | 27.340   | -1.128 | -0.312 | -0.004 | 0.270 | 1.065 |
| ME                                       | 4.621  | 1.941  | 0.352  | 2.888    | 0.775  | 2.218  | 4.479  | 7.263 | 9.463 |
| OP                                       | 0.022  | 14.183 | -9.175 | 1910.739 | -2.042 | -0.156 | 0.215  | 0.449 | 1.291 |
| MOM                                      | 0.142  | 0.560  | 4.168  | 60.447   | -0.692 | -0.367 | 0.067  | 0.665 | 2.069 |
| VOL                                      | 0.511  | 0.305  | 2.967  | 34.858   | 0.147  | 0.232  | 0.441  | 0.866 | 1.545 |
| LTR                                      | 0.736  | 1.721  | 6.340  | 104.733  | -0.831 | -0.498 | 0.382  | 2.127 | 7.066 |

| Panel B: Characteristics of Factor Portfolios |      |        |        |        |        |        |        |        |        |
|-----------------------------------------------|------|--------|--------|--------|--------|--------|--------|--------|--------|
|                                               | N    | BM     | dBM    | dBE    | dME    | INV    | dINV   | Ret(P) | Ret(F) |
| Growth (All)                                  | 1292 | -1.396 | -0.070 | 0.152  | 0.220  | 0.170  | 0.007  | 0.241  | 0.104  |
| Growth (Incoming)                             | 214  | -1.012 | -0.506 | 0.028  | 0.525  | 0.125  | 0.015  | 0.406  | 0.110  |
| Value (All)                                   | 1198 | 0.202  | 0.108  | 0.073  | -0.033 | 0.077  | -0.014 | 0.153  | 0.142  |
| Value (Incoming)                              | 300  | 0.061  | 0.394  | 0.142  | -0.247 | 0.128  | -0.008 | 0.067  | 0.130  |
| Aggressive (All)                              | 1187 | -0.960 | 0.022  | 0.252  | 0.230  | 0.297  | 0.110  | 0.227  | 0.111  |
| Aggressive (Incoming)                         | 492  | -0.803 | -0.032 | 0.207  | 0.240  | 0.273  | 0.236  | 0.229  | 0.118  |
| Conservative (All)                            | 1100 | -0.494 | -0.035 | -0.042 | -0.007 | -0.055 | -0.130 | 0.185  | 0.133  |
| Conservative (Incoming)                       | 518  | -0.535 | 0.006  | -0.027 | -0.033 | -0.046 | -0.220 | 0.158  | 0.129  |

**Table IA2**  
**Average Returns and Alphas on Subsets of the Value and Investment**  
**Factor Portfolios: Equal-Weighting**

This table displays average monthly returns and monthly alphas (in percent) on long-short portfolios. The sample period is from July 1964 to December 2019. In Panel A, all common US stocks are first sorted into quintiles with respect to their market equity at the end of each June. The breakpoints for the sorts are based only on NYSE stocks. Second, the size quintiles are intersected with the aggregate value, growth, conservative, and aggressive portfolios, with the market-channel (ME) and book-channel (BE) subsets of the value and growth portfolios, and with the profitability shock-driven (PS) and residual-driven (RES) subsets of the value, growth, conservative, and aggressive portfolios. The construction of the aggregate value, growth, conservative, and aggressive portfolios is described in Section 3.2; the construction of their subsets is described in Section 3.5. The stocks in the resulting portfolios are equal-weighted. The table displays the mean returns and alphas of strategies that go, within each size quintile, long in value stocks and short in growth stocks (HML), respectively, long in conservative stocks and short in aggressive stocks (CMA). The column “Avg” displays the averages across the size quintiles. Panel B (C) displays the same results when the first sort is with respect to investment (book-to-market) rather than market equity. In Panel D, the first sort is again with respect to market equity, but residual-driven conservative (aggressive) stocks are excluded from the value (growth) portfolios, and residual-driven value (growth) stocks are excluded from the conservative (aggressive) portfolios. The alphas are from regressions of the portfolios’ returns on the factors of the Fama-French (2015) five-factor model. t-statistics are reported in parentheses. \*, \*\*, and \*\*\* denote significance at the 10%, 5%, and 1% levels, respectively.

|                       | Panel A: Controlling for Size |                   |                   |                    |                   |                   |                    |                     |                  |                   |                    |                     |
|-----------------------|-------------------------------|-------------------|-------------------|--------------------|-------------------|-------------------|--------------------|---------------------|------------------|-------------------|--------------------|---------------------|
|                       | Mean Returns                  |                   |                   |                    |                   |                   | Five-Factor Alphas |                     |                  |                   |                    |                     |
|                       | Q1                            | Q2                | Q3                | Q4                 | Q5                | Avg               | Q1                 | Q2                  | Q3               | Q4                | Q5                 | Avg                 |
| HML                   | 0.71***<br>(5.02)             | 0.35**<br>(2.54)  | 0.33**<br>(2.53)  | 0.23*<br>(1.88)    | 0.11<br>(0.91)    | 0.35***<br>(3.10) | 0.46***<br>(4.96)  | 0.03<br>(0.41)      | −0.02<br>(−0.29) | −0.08<br>(−1.07)  | −0.15**<br>(−2.47) | 0.05<br>(1.26)      |
| HML <sup>ME</sup>     | 0.53***<br>(4.03)             | 0.48***<br>(3.44) | 0.23*<br>(1.80)   | 0.33**<br>(2.52)   | 0.17<br>(1.32)    | 0.35***<br>(3.29) | 0.25**<br>(2.41)   | 0.20**<br>(1.97)    | −0.03<br>(−0.28) | 0.07<br>(0.76)    | −0.04<br>(−0.52)   | 0.09*<br>(1.76)     |
| HML <sup>BE</sup>     | 0.17<br>(0.75)                | −0.27<br>(−1.18)  | 0.02<br>(0.09)    | −0.55**<br>(−2.32) | −0.32<br>(−1.52)  | −0.22*<br>(−1.70) | 0.05<br>(0.25)     | −0.56***<br>(−2.64) | −0.12<br>(−0.47) | −0.43*<br>(−1.80) | −0.27<br>(−1.34)   | −0.28***<br>(−2.60) |
| HML <sup>ME-BE</sup>  | 0.36<br>(1.55)                | 0.75***<br>(3.20) | 0.21<br>(0.80)    | 0.94***<br>(3.81)  | 0.45**<br>(2.21)  | 0.57***<br>(4.66) | 0.20<br>(0.89)     | 0.76***<br>(3.20)   | 0.09<br>(0.34)   | 0.55**<br>(2.19)  | 0.26<br>(1.25)     | 0.37***<br>(3.21)   |
| HML <sup>RES</sup>    | 0.64***<br>(3.28)             | 0.73***<br>(3.54) | 0.45**<br>(2.48)  | 0.30*<br>(1.75)    | 0.26<br>(1.56)    | 0.46***<br>(3.54) | 0.29<br>(1.63)     | 0.30*<br>(1.71)     | 0.09<br>(0.62)   | −0.03<br>(−0.18)  | −0.03<br>(−0.23)   | 0.11<br>(1.34)      |
| HML <sup>PS</sup>     | 0.13<br>(0.79)                | 0.19<br>(1.27)    | 0.06<br>(0.45)    | 0.41***<br>(2.83)  | 0.06<br>(0.41)    | 0.17<br>(1.52)    | −0.11<br>(−0.69)   | −0.02<br>(−0.15)    | −0.09<br>(−0.76) | 0.25**<br>(2.16)  | −0.13<br>(−1.26)   | −0.02<br>(−0.24)    |
| HML <sup>RES-PS</sup> | 0.59***<br>(3.48)             | 0.34*<br>(1.85)   | 0.38**<br>(2.08)  | −0.08<br>(−0.47)   | 0.20<br>(1.30)    | 0.29***<br>(2.98) | 0.47***<br>(2.75)  | 0.10<br>(0.53)      | 0.18<br>(0.98)   | −0.26<br>(−1.49)  | 0.09<br>(0.59)     | 0.13<br>(1.31)      |
| CMA                   | 0.65***<br>(8.57)             | 0.21***<br>(2.60) | 0.25***<br>(2.74) | 0.13<br>(1.33)     | 0.25***<br>(2.66) | 0.30***<br>(4.54) | 0.64***<br>(9.24)  | 0.08<br>(1.27)      | 0.10<br>(1.61)   | −0.12*<br>(−1.86) | −0.04<br>(−0.74)   | 0.13***<br>(4.44)   |
| CMA <sup>RES</sup>    | 0.58***<br>(5.06)             | 0.33***<br>(2.91) | 0.32***<br>(3.00) | 0.22**<br>(2.09)   | 0.42***<br>(4.31) | 0.38***<br>(6.11) | 0.45***<br>(3.85)  | 0.13<br>(1.14)      | 0.16<br>(1.62)   | 0.04<br>(0.34)    | 0.31***<br>(3.37)  | 0.22***<br>(4.26)   |
| CMA <sup>PS</sup>     | 0.43***<br>(3.34)             | 0.16<br>(1.44)    | −0.03<br>(−0.26)  | 0.02<br>(0.14)     | 0.12<br>(1.06)    | 0.14*<br>(1.77)   | 0.37***<br>(3.01)  | 0.03<br>(0.31)      | −0.13<br>(−1.25) | −0.15<br>(−1.60)  | −0.18**<br>(−2.39) | −0.01<br>(−0.24)    |
| CMA <sup>RES-PS</sup> | 0.15<br>(0.93)                | 0.17<br>(1.17)    | 0.35**<br>(2.48)  | 0.21<br>(1.52)     | 0.30**<br>(2.22)  | 0.24***<br>(2.95) | 0.08<br>(0.45)     | 0.10<br>(0.66)      | 0.29**<br>(2.12) | 0.18<br>(1.36)    | 0.49***<br>(3.91)  | 0.23***<br>(3.19)   |

- Continued on next page -

| Panel B: Controlling for Investment |                   |                   |                   |                   |                   |                   |                    |                   |                  |                  |                  |                   |
|-------------------------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|--------------------|-------------------|------------------|------------------|------------------|-------------------|
|                                     | Mean Returns      |                   |                   |                   |                   |                   | Five-Factor Alphas |                   |                  |                  |                  |                   |
|                                     | Q1                | Q2                | Q3                | Q4                | Q5                | Avg               | Q1                 | Q2                | Q3               | Q4               | Q5               | Avg               |
| HML                                 | 0.46***<br>(3.69) | 0.42***<br>(3.89) | 0.31***<br>(2.85) | 0.31***<br>(2.90) | 0.48***<br>(3.64) | 0.40***<br>(4.20) | 0.25**<br>(2.40)   | 0.24***<br>(2.91) | 0.16*<br>(1.89)  | 0.11<br>(1.42)   | 0.21**<br>(2.45) | 0.20***<br>(3.52) |
| HML <sup>ME</sup>                   | 0.54***<br>(3.64) | 0.38***<br>(2.93) | 0.27**<br>(2.30)  | 0.27**<br>(2.29)  | 0.52***<br>(3.57) | 0.39***<br>(3.84) | 0.25*<br>(1.82)    | 0.19*<br>(1.72)   | 0.12<br>(1.24)   | 0.10<br>(1.07)   | 0.31**<br>(2.55) | 0.19***<br>(2.67) |
| HML <sup>BE</sup>                   | −0.09<br>(−0.44)  | 0.00<br>(−0.02)   | 0.49*<br>(1.96)   | −0.18<br>(−0.65)  | 0.12<br>(0.38)    | 0.03<br>(0.18)    | −0.19<br>(−0.91)   | −0.01<br>(−0.06)  | 0.42<br>(1.64)   | −0.27<br>(−0.96) | −0.15<br>(−0.46) | −0.08<br>(−0.63)  |
| HML <sup>ME-BE</sup>                | 0.63***<br>(2.68) | 0.35<br>(1.41)    | −0.26<br>(−1.03)  | 0.51*<br>(1.83)   | 0.40<br>(1.22)    | 0.37***<br>(2.58) | 0.44*<br>(1.86)    | 0.19<br>(0.75)    | −0.32<br>(−1.20) | 0.44<br>(1.55)   | 0.45<br>(1.34)   | 0.27*<br>(1.95)   |
| HML <sup>RES</sup>                  | 0.66***<br>(3.34) | 0.71***<br>(3.82) | 0.36**<br>(2.25)  | 0.53***<br>(3.30) | 0.68***<br>(3.54) | 0.58***<br>(4.64) | 0.31*<br>(1.65)    | 0.48***<br>(2.84) | 0.12<br>(0.85)   | 0.34**<br>(2.35) | 0.32*<br>(1.95)  | 0.30***<br>(3.18) |
| HML <sup>PS</sup>                   | 0.26<br>(1.48)    | 0.14<br>(0.97)    | 0.17<br>(1.14)    | 0.12<br>(0.83)    | 0.40**<br>(2.25)  | 0.21*<br>(1.95)   | 0.05<br>(0.29)     | −0.02<br>(−0.16)  | 0.07<br>(0.53)   | 0.01<br>(0.08)   | 0.27*<br>(1.68)  | 0.06<br>(0.77)    |
| HML <sup>RES-PS</sup>               | 0.48***<br>(1.98) | 0.58***<br>(2.97) | 0.19<br>(1.12)    | 0.42**<br>(2.34)  | 0.28<br>(1.33)    | 0.37***<br>(3.74) | 0.32<br>(1.29)     | 0.51**<br>(2.52)  | 0.05<br>(0.29)   | 0.33*<br>(1.80)  | 0.07<br>(0.30)   | 0.23**<br>(2.36)  |

| Panel C: Controlling for Book-to-Market |                   |                   |                   |                   |                   |                   |                    |                   |                   |                   |                   |                   |
|-----------------------------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|--------------------|-------------------|-------------------|-------------------|-------------------|-------------------|
|                                         | Mean Returns      |                   |                   |                   |                   |                   | Five-Factor Alphas |                   |                   |                   |                   |                   |
|                                         | Q1                | Q2                | Q3                | Q4                | Q5                | Avg               | Q1                 | Q2                | Q3                | Q4                | Q5                | Avg               |
| CMA                                     | 0.42***<br>(3.42) | 0.28***<br>(3.11) | 0.24***<br>(3.03) | 0.30***<br>(3.53) | 0.44***<br>(5.19) | 0.34***<br>(5.23) | 0.26**<br>(2.45)   | 0.32***<br>(4.06) | 0.26***<br>(3.75) | 0.29***<br>(3.67) | 0.37***<br>(4.55) | 0.30***<br>(6.08) |
| CMA <sup>RES</sup>                      | 0.74***<br>(5.27) | 0.56***<br>(4.97) | 0.37***<br>(3.42) | 0.29***<br>(2.64) | 0.32***<br>(2.82) | 0.46***<br>(6.86) | 0.46***<br>(3.39)  | 0.51***<br>(4.63) | 0.30***<br>(2.86) | 0.23**<br>(2.07)  | 0.18<br>(1.57)    | 0.34***<br>(5.61) |
| CMA <sup>PS</sup>                       | 0.06<br>(0.34)    | −0.07<br>(−0.61)  | 0.00<br>(−0.03)   | 0.26**<br>(2.53)  | 0.40***<br>(3.27) | 0.13<br>(1.63)    | −0.08<br>(−0.52)   | −0.10<br>(−0.88)  | 0.05<br>(0.50)    | 0.29***<br>(2.83) | 0.35***<br>(2.92) | 0.10<br>(1.58)    |
| CMA <sup>RES-PS</sup>                   | 0.69***<br>(3.76) | 0.63***<br>(4.31) | 0.37***<br>(2.68) | 0.04<br>(0.27)    | −0.08<br>(−0.55)  | 0.33***<br>(4.26) | 0.54***<br>(3.02)  | 0.61***<br>(4.03) | 0.26*<br>(1.85)   | −0.06<br>(−0.42)  | −0.17<br>(−1.15)  | 0.24***<br>(3.11) |

| Panel D: Excluding each other's Residual-Driven Stocks |                   |                  |                  |                  |                   |                   |                    |                |                |                |                   |                   |
|--------------------------------------------------------|-------------------|------------------|------------------|------------------|-------------------|-------------------|--------------------|----------------|----------------|----------------|-------------------|-------------------|
|                                                        | Mean Returns      |                  |                  |                  |                   |                   | Five-Factor Alphas |                |                |                |                   |                   |
|                                                        | Q1                | Q2               | Q3               | Q4               | Q5                | Avg               | Q1                 | Q2             | Q3             | Q4             | Q5                | Avg               |
| HML <sup>RES</sup>                                     | 0.61***<br>(3.19) | 0.45**<br>(2.06) | 0.33*<br>(1.80)  | 0.36**<br>(1.97) | 0.19<br>(1.04)    | 0.39***<br>(2.98) | 0.26<br>(1.53)     | 0.08<br>(0.43) | 0.01<br>(0.03) | 0.08<br>(0.48) | −0.12<br>(−0.80)  | 0.07<br>(0.78)    |
| CMA <sup>RES</sup>                                     | 0.52***<br>(4.51) | 0.24**<br>(2.20) | 0.23**<br>(2.09) | 0.22**<br>(2.02) | 0.38***<br>(3.75) | 0.32***<br>(5.40) | 0.42***<br>(3.64)  | 0.11<br>(0.99) | 0.10<br>(0.92) | 0.09<br>(0.82) | 0.26***<br>(2.73) | 0.20***<br>(3.87) |

Table IA3

## Return Prediction with Decomposed Book-to-Market and Investment

This table displays time-series averages of regression coefficients from monthly Fama-MacBeth (1973) regressions. The regressions are estimated at the end of each month from June 1963 to November 2019 using all common US stocks traded on the NYSE, AMEX, or NASDAQ. The dependent variable is the return in excess of the one-month T-bill rate across the next month. The independent variables are log book-to-market (BM), lagged log book-to-market (Lagged BM), the log change in book equity (dBE), the residual change in market equity (dME<sup>RES</sup>), log investment (INV), lagged log investment (Lagged INV), the residual change in investment (dINV<sup>RES</sup>), the profitability shock (PS), log market equity (ME), operating profitability (OP), momentum (MOM), and short-term reversal (STR). The independent variables are constructed as described in Appendix A and Internet Appendix D, are measured at the end of the most recent June (except ME, MOM, and STR, which are measured at the end of each month), and are winsorized at the 0.5% and 99.5% levels. A subscript  $t-l$  indicates that the respective variable is lagged by  $l$  years. Lagged BM (INV) is BM (INV) lagged by one (two, three, four, five) years if the previous one (two, three, four, five) annual dBE and dME<sup>RES</sup> (dINV<sup>RES</sup>) are included. The regressions are estimated with weighted least squares with stocks' market capitalizations as weights. R<sup>2</sup> is the average adjusted R-squared across all monthly regressions. T is the number of monthly Fama-MacBeth (1973) regressions. t-statistics are reported in parentheses. Boldface indicates significance at the 10% level.

|                                   | (1)                    | (2)                    | (3)                    | (4)                    | (5)                    | (6)                    | (7)                    | (8)                    | (9)                    | (10)                   | (11)                   | (12)                   | (13)                   | (14)                   | (15)                   | (16)                   | (17)                   | (18)                   |
|-----------------------------------|------------------------|------------------------|------------------------|------------------------|------------------------|------------------------|------------------------|------------------------|------------------------|------------------------|------------------------|------------------------|------------------------|------------------------|------------------------|------------------------|------------------------|------------------------|
| Intercept                         | <b>0.007</b><br>(2.17) | <b>0.008</b><br>(2.48) | <b>0.009</b><br>(2.76) | <b>0.009</b><br>(2.68) | <b>0.010</b><br>(2.87) | <b>0.010</b><br>(2.93) | <b>0.010</b><br>(3.01) | <b>0.011</b><br>(3.21) | <b>0.011</b><br>(3.38) | <b>0.012</b><br>(3.44) | <b>0.012</b><br>(3.56) | <b>0.013</b><br>(3.67) | <b>0.008</b><br>(2.60) | <b>0.008</b><br>(2.60) | <b>0.009</b><br>(2.88) | <b>0.009</b><br>(2.73) | <b>0.010</b><br>(2.86) | <b>0.010</b><br>(3.04) |
| BM                                | <b>0.001</b><br>(1.81) |                        |                        |                        |                        |                        |                        |                        |                        |                        |                        |                        |                        |                        |                        |                        |                        |                        |
| Lagged BM                         |                        | 0.001<br>(0.96)        | 0.000<br>(0.64)        | 0.001<br>(0.83)        | 0.000<br>(0.49)        | 0.000<br>(0.43)        |                        |                        |                        |                        |                        |                        | 0.001<br>(0.89)        | 0.001<br>(0.73)        | 0.001<br>(0.73)        | 0.001<br>(1.09)        | 0.001<br>(0.77)        | 0.001<br>(0.77)        |
| dBE                               |                        | -0.002<br>(-1.36)      | -0.003<br>(-2.20)      | -0.002<br>(-1.76)      | -0.002<br>(-1.47)      | -0.001<br>(-0.73)      |                        |                        |                        |                        |                        |                        | -0.002<br>(-1.13)      | -0.002<br>(-1.16)      | -0.001<br>(-1.03)      | -0.001<br>(-1.03)      | -0.001<br>(-0.59)      | -0.001<br>(-0.38)      |
| dBE <sub>t-1</sub>                |                        |                        | 0.001<br>(0.87)        | 0.000<br>(-0.01)       | 0.000<br>(0.28)        | 0.000<br>(0.29)        |                        |                        |                        |                        |                        |                        | 0.001<br>(1.31)        | 0.002<br>(1.31)        | 0.000<br>(0.26)        | 0.000<br>(0.26)        | 0.001<br>(0.89)        | 0.001<br>(0.70)        |
| dBE <sub>t-2</sub>                |                        |                        |                        | 0.001<br>(1.07)        | -0.001<br>(-0.69)      | 0.000<br>(0.31)        |                        |                        |                        |                        |                        |                        |                        |                        | 0.000<br>(0.14)        | 0.000<br>(0.14)        | -0.002<br>(-1.02)      | 0.000<br>(0.28)        |
| dBE <sub>t-3</sub>                |                        |                        |                        |                        | 0.001<br>(0.41)        | 0.000<br>(-0.10)       |                        |                        |                        |                        |                        |                        |                        |                        |                        |                        | 0.000<br>(-0.33)       | -0.001<br>(-0.49)      |
| dBE <sub>t-4</sub>                |                        |                        |                        |                        |                        | 0.000<br>(0.07)        |                        |                        |                        |                        |                        |                        |                        |                        |                        |                        |                        | -0.002<br>(-1.01)      |
| dME <sup>RES</sup>                |                        | -0.003<br>(-1.98)      | -0.003<br>(-2.06)      | -0.003<br>(-2.05)      | -0.003<br>(-2.15)      | -0.003<br>(-2.03)      |                        |                        |                        |                        |                        |                        | -0.003<br>(-2.22)      | -0.003<br>(-2.22)      | -0.003<br>(-2.16)      | -0.003<br>(-2.08)      | -0.003<br>(-2.06)      | -0.003<br>(-2.06)      |
| dME <sup>RES</sup> <sub>t-1</sub> |                        |                        | -0.001<br>(-0.82)      | -0.001<br>(-1.17)      | -0.001<br>(-1.14)      | -0.002<br>(-1.66)      |                        |                        |                        |                        |                        |                        |                        |                        | -0.001<br>(-0.98)      | -0.002<br>(-1.42)      | -0.001<br>(-1.16)      | -0.002<br>(-1.56)      |
| dME <sup>RES</sup> <sub>t-2</sub> |                        |                        |                        | -0.002<br>(-2.05)      | -0.002<br>(-1.83)      | -0.002<br>(-1.91)      |                        |                        |                        |                        |                        |                        |                        |                        | -0.003<br>(-2.26)      | -0.003<br>(-2.26)      | -0.002<br>(-1.82)      | -0.002<br>(-1.83)      |
| dME <sup>RES</sup> <sub>t-3</sub> |                        |                        |                        |                        | -0.001<br>(-1.07)      | -0.002<br>(-1.31)      |                        |                        |                        |                        |                        |                        |                        |                        |                        |                        | -0.001<br>(-1.10)      | -0.002<br>(-1.25)      |
| dME <sup>RES</sup> <sub>t-4</sub> |                        |                        |                        |                        |                        | -0.002<br>(-1.83)      |                        |                        |                        |                        |                        |                        |                        |                        |                        |                        |                        | -0.003<br>(-2.25)      |

- Continued on next page -

|                                    | (1)               | (2)               | (3)               | (4)               | (5)               | (6)               | (7)               | (8)               | (9)               | (10)              | (11)              | (12)              | (13)              | (14)              | (15)              | (16)              | (17)              | (18)              |
|------------------------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|
| INV                                |                   |                   |                   |                   |                   |                   | -0.006<br>(-3.40) |                   |                   |                   |                   |                   | -0.004<br>(-2.46) |                   |                   |                   |                   |                   |
| Lagged INV                         |                   |                   |                   |                   |                   |                   |                   | -0.007<br>(-2.93) | -0.010<br>(-3.18) | -0.010<br>(-2.93) | -0.010<br>(-2.75) | -0.011<br>(-2.94) | -0.001<br>(-0.58) | -0.003<br>(-1.21) | 0.001<br>(0.18)   | 0.002<br>(0.43)   | 0.003<br>(0.81)   |                   |
| dINV <sup>RES</sup>                |                   |                   |                   |                   |                   |                   |                   | -0.005<br>(-3.21) | -0.007<br>(-3.90) | -0.007<br>(-4.05) | -0.006<br>(-3.63) | -0.005<br>(-2.86) | -0.001<br>(-0.89) | -0.003<br>(-2.11) | -0.003<br>(-1.85) | -0.003<br>(-1.77) | -0.002<br>(-1.04) |                   |
| dINV <sup>RES</sup> <sub>t-1</sub> |                   |                   |                   |                   |                   |                   |                   |                   | -0.010<br>(-4.03) | -0.011<br>(-4.69) | -0.011<br>(-4.83) | -0.011<br>(-4.79) | -0.005<br>(-2.41) | -0.005<br>(-2.30) | -0.005<br>(-2.35) | -0.005<br>(-2.53) | -0.005<br>(-2.35) |                   |
| dINV <sup>RES</sup> <sub>t-2</sub> |                   |                   |                   |                   |                   |                   |                   |                   |                   | -0.011<br>(-3.56) | -0.012<br>(-4.39) | -0.012<br>(-4.36) | -0.002<br>(-0.73) | -0.002<br>(-1.56) | -0.002<br>(-1.56) | -0.004<br>(-1.56) | -0.004<br>(-1.50) |                   |
| dINV <sup>RES</sup> <sub>t-3</sub> |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   | -0.013<br>(-3.98) | -0.014<br>(-4.65) | -0.003<br>(-0.99) | -0.003<br>(-0.99) | -0.003<br>(-0.99) | -0.002<br>(-0.75) | -0.003<br>(-0.99) |                   |
| dINV <sup>RES</sup> <sub>t-4</sub> |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   | -0.012<br>(-3.49) | 0.001<br>(0.31)   | 0.001<br>(0.31)   | 0.001<br>(0.31)   | 0.001<br>(0.31)   | 0.001<br>(0.31)   |                   |
| PS                                 |                   | 0.002<br>(0.30)   | 0.007<br>(1.16)   | 0.003<br>(0.55)   | 0.005<br>(0.75)   | 0.008<br>(1.22)   |                   | 0.004<br>(0.59)   | 0.004<br>(0.67)   | 0.001<br>(0.13)   | 0.002<br>(0.29)   | 0.004<br>(0.58)   | 0.001<br>(0.17)   | 0.004<br>(0.69)   | 0.001<br>(0.09)   | 0.001<br>(0.16)   | 0.005<br>(0.77)   |                   |
| PS <sub>t-1</sub>                  |                   |                   | 0.004<br>(0.84)   | 0.007<br>(1.30)   | 0.001<br>(0.25)   | 0.004<br>(0.79)   |                   | -0.004<br>(-0.72) | -0.004<br>(-0.72) | -0.001<br>(-0.13) | -0.007<br>(-1.08) | -0.003<br>(-0.54) | -0.003<br>(-0.45) | -0.003<br>(-0.45) | 0.002<br>(0.30)   | -0.006<br>(-0.94) | -0.001<br>(-0.16) |                   |
| PS <sub>t-2</sub>                  |                   |                   |                   | 0.001<br>(0.30)   | 0.006<br>(1.25)   | 0.004<br>(0.73)   |                   |                   | -0.015<br>(-2.43) | -0.014<br>(-2.36) | -0.014<br>(-2.36) | -0.014<br>(-2.22) | -0.001<br>(-0.10) | -0.001<br>(-0.81) | -0.001<br>(-0.81) | -0.003<br>(-0.48) | -0.005<br>(-0.77) |                   |
| PS <sub>t-3</sub>                  |                   |                   |                   |                   | 0.005<br>(0.91)   | 0.004<br>(0.72)   |                   |                   |                   |                   | -0.012<br>(-1.70) | -0.010<br>(-1.46) | -0.001<br>(-0.04) | -0.001<br>(-0.04) | -0.001<br>(-0.04) | -0.003<br>(-0.03) | -0.000<br>(0.00)  |                   |
| PS <sub>t-4</sub>                  |                   |                   |                   |                   |                   | 0.004<br>(0.77)   |                   |                   |                   |                   |                   | -0.012<br>(-1.65) | -0.001<br>(-1.65) | -0.001<br>(-1.65) | -0.001<br>(-1.65) | -0.001<br>(-1.65) | -0.001<br>(-1.65) |                   |
| ME                                 | -0.001<br>(-1.69) | -0.001<br>(-2.00) | -0.001<br>(-2.12) | -0.001<br>(-1.86) | -0.001<br>(-1.73) | -0.001<br>(-1.66) | -0.001<br>(-2.40) | -0.001<br>(-2.48) | -0.001<br>(-2.44) | -0.001<br>(-2.35) | -0.001<br>(-2.26) | -0.001<br>(-2.18) | -0.001<br>(-1.99) | -0.001<br>(-2.00) | -0.001<br>(-1.75) | 0.000<br>(-1.64)  | 0.000<br>(-1.69)  |                   |
| OP                                 | 0.005<br>(3.37)   | 0.004<br>(2.56)   | 0.003<br>(1.78)   | 0.003<br>(2.19)   | 0.002<br>(1.20)   | 0.001<br>(0.71)   | 0.003<br>(2.33)   | 0.003<br>(1.91)   | 0.002<br>(1.21)   | 0.002<br>(1.40)   | 0.001<br>(0.73)   | 0.000<br>(-0.14)  | 0.004<br>(2.96)   | 0.004<br>(2.43)   | 0.003<br>(2.12)   | 0.002<br>(1.27)   | 0.001<br>(0.67)   |                   |
| MOM                                | 0.007<br>(3.56)   | 0.006<br>(3.33)   | 0.006<br>(3.03)   | 0.005<br>(2.39)   | 0.004<br>(2.23)   | 0.004<br>(2.02)   | 0.007<br>(3.52)   | 0.006<br>(3.26)   | 0.006<br>(3.14)   | 0.005<br>(2.41)   | 0.005<br>(2.28)   | 0.004<br>(2.01)   | 0.006<br>(3.39)   | 0.006<br>(3.21)   | 0.004<br>(2.20)   | 0.004<br>(2.06)   | 0.004<br>(1.89)   |                   |
| STR                                | -0.029<br>(-6.15) | -0.034<br>(-7.08) | -0.037<br>(-7.82) | -0.039<br>(-8.10) | -0.040<br>(-8.19) | -0.043<br>(-8.85) | -0.028<br>(-5.73) | -0.029<br>(-6.00) | -0.032<br>(-6.46) | -0.032<br>(-6.53) | -0.033<br>(-6.52) | -0.035<br>(-6.76) | -0.031<br>(-6.59) | -0.035<br>(-7.31) | -0.039<br>(-8.28) | -0.041<br>(-8.41) | -0.041<br>(-9.10) | -0.044<br>(-9.10) |
| R <sup>2</sup>                     | 0.178             | 0.196             | 0.209             | 0.220             | 0.233             | 0.247             | 0.170             | 0.179             | 0.187             | 0.195             | 0.203             | 0.213             | 0.184             | 0.202             | 0.217             | 0.230             | 0.245             | 0.261             |
| T                                  | 678               | 666               | 654               | 642               | 630               | 618               | 678               | 666               | 654               | 642               | 630               | 618               | 678               | 666               | 654               | 642               | 630               | 618               |

**Table IA4**  
**Spanning Regressions: Sensitivity Analysis**

This table displays results from spanning regressions that regress different versions of the value factor (VAL) on different versions of the investment factor (INV) as well as the market (MP), size (SMB), and profitability (RMW) factors, and vice versa. The sample period is from July 1964 to December 2019. The first two columns of each row depict which versions of the investment and value factors are used in the respective spanning regressions. “standard” refers to the standard factors. “ME” refers to the market-channel value factor. “sc,M” indicates that the factor is first orthogonalized to the market, size, and profitability factors and then rescaled to have the same mean and standard deviation as originally.  $\mu$  and  $\sigma$  are the factors’ monthly mean returns and volatilities.  $\mu$ ,  $\sigma$ , and  $\alpha$  are in percent. t-statistics are reported in parentheses. \*, \*\*, and \*\*\* denote significance at the 10%, 5%, and 1% levels, respectively.

|     |                      | Dependent Factor: Investment |                   |          |                   |                      |                     |                     |                    |       |                   | Dependent Factor: Value |                   |                     |                  |                   |                    |       |
|-----|----------------------|------------------------------|-------------------|----------|-------------------|----------------------|---------------------|---------------------|--------------------|-------|-------------------|-------------------------|-------------------|---------------------|------------------|-------------------|--------------------|-------|
|     | INV                  | VAL                          | $\mu$             | $\sigma$ | $\alpha$          | $\beta^{MP}$         | $\beta^{SMB}$       | $\beta^{RMW}$       | $\beta^{VAL}$      | $R^2$ | $\mu$             | $\sigma$                | $\alpha$          | $\beta^{MP}$        | $\beta^{SMB}$    | $\beta^{RMW}$     | $\beta^{INV}$      | $R^2$ |
| (1) | standard             | standard                     | 0.21***<br>(2.93) | 1.82     | 0.34***<br>(5.20) | -0.17***<br>(-11.15) | -0.03<br>(-1.21)    | -0.15***<br>(-4.81) |                    | 0.171 | 0.30***<br>(2.79) | 2.75                    | 0.36***<br>(3.38) | -0.15***<br>(-6.20) | 0.01<br>(0.22)   | 0.08*             |                    | 0.066 |
| (2) | standard             | standard                     | 0.21***<br>(2.93) | 1.82     | 0.20***<br>(3.92) | -0.11***<br>(-9.11)  | -0.03*<br>(-1.79)   | -0.18***<br>(-7.76) | 0.41***<br>(22.25) | 0.525 | 0.30***<br>(2.79) | 2.75                    | 0.00<br>(-0.04)   | 0.03<br>(1.32)      | 0.04<br>(1.34)   | 0.24***<br>(6.22) | 1.05***<br>(22.25) | 0.465 |
| (3) | standard             | ME                           | 0.21***<br>(2.93) | 1.82     | 0.17***<br>(3.34) | -0.11***<br>(-8.69)  | -0.05***<br>(-2.49) | -0.12***<br>(-4.94) | 0.37***<br>(20.65) | 0.495 | 0.35***<br>(3.17) | 2.87                    | 0.09<br>(1.05)    | 0.01<br>(0.42)      | 0.08**<br>(2.47) | 0.08*             | 1.05***<br>(20.65) | 0.427 |
| (4) | standard             | (sc,M)                       | 0.21***<br>(2.93) | 1.82     | 0.14***<br>(2.67) | -0.11***<br>(-9.11)  | -0.03*<br>(-1.79)   | -0.18***<br>(-7.76) | 0.62***<br>(22.25) | 0.525 | 0.30***<br>(4.21) | 1.82                    | 0.10*<br>(1.82)   | 0.02<br>(1.32)      | 0.03<br>(1.34)   | 0.16***<br>(6.22) | 0.69***<br>(22.25) | 0.465 |
| (5) | standard<br>(t,orth) | standard<br>(t,orth)         | 0.21***<br>(2.93) | 1.82     | 0.08<br>(1.41)    |                      |                     |                     | 0.43***<br>(22.25) | 0.425 | 0.30***<br>(2.79) | 2.75                    | 0.09<br>(1.12)    |                     |                  |                   | 0.99***<br>(22.25) | 0.425 |

**Table IA5**  
**Cash Flow, Discount Rate, and Volatility News Betas**

This table displays market cash flow, discount rate, and volatility news betas of the standard (HML), market-channel (HML<sup>ME</sup>), book-channel (HML<sup>BE</sup>), residual-driven (HML<sup>RES</sup>), and profitability shock-driven (HML<sup>PS</sup>) value factors as well as the standard (CMA), residual-driven (CMA<sup>RES</sup>), and profitability shock-driven (CMA<sup>PS</sup>) investment factors. The betas are estimated from multivariate regressions that regress the factors' quarterly returns on the quarterly news terms estimated by Campbell et al. (2018). The sample period is from July 1964 to December 2011. t-statistics are reported in parentheses and are calculated based on the approach of Shanken (1992). \*, \*\*, and \*\*\* denote significance at the 10%, 5%, and 1% levels, respectively.

|                       | Constant          | $\beta^{CF}$        | $\beta^{DR}$        | $\beta^V$           | R <sup>2</sup> |
|-----------------------|-------------------|---------------------|---------------------|---------------------|----------------|
| HML                   | 1.14***<br>(3.38) | 0.27***<br>(3.18)   | -0.24***<br>(-5.30) | -0.78***<br>(-5.79) | 0.351          |
| HML <sup>ME</sup>     | 1.31***<br>(3.52) | 0.29***<br>(3.15)   | -0.17***<br>(-3.38) | -0.87***<br>(-5.86) | 0.288          |
| HML <sup>BE</sup>     | -0.07<br>(-0.17)  | 0.44***<br>(4.43)   | -0.15***<br>(-2.76) | -0.41**<br>(-2.53)  | 0.178          |
| HML <sup>ME-BE</sup>  | 1.37***<br>(3.60) | -0.15<br>(-1.60)    | -0.02<br>(-0.38)    | -0.46***<br>(-3.03) | 0.068          |
| HML <sup>RES</sup>    | 2.05***<br>(4.46) | 0.21*<br>(1.80)     | -0.20***<br>(-3.19) | -0.76***<br>(-4.13) | 0.188          |
| HML <sup>PS</sup>     | 0.56<br>(1.48)    | 0.33***<br>(3.58)   | -0.19***<br>(-3.66) | -0.83***<br>(-5.53) | 0.292          |
| HML <sup>RES-PS</sup> | 1.49***<br>(3.99) | -0.13<br>(-1.37)    | -0.01<br>(-0.24)    | 0.07<br>(0.48)      | 0.012          |
| CMA                   | 0.83***<br>(3.49) | 0.06<br>(1.07)      | -0.21***<br>(-6.47) | -0.29***<br>(-3.09) | 0.280          |
| CMA <sup>RES</sup>    | 1.25***<br>(5.06) | -0.11*<br>(-1.80)   | -0.10***<br>(-3.08) | -0.03<br>(-0.32)    | 0.074          |
| CMA <sup>PS</sup>     | 0.60**<br>(2.02)  | 0.22***<br>(2.95)   | -0.18***<br>(-4.51) | -0.40***<br>(-3.37) | 0.227          |
| CMA <sup>RES-PS</sup> | 0.65**<br>(1.98)  | -0.33***<br>(-4.02) | 0.08*<br>(1.76)     | 0.37***<br>(2.81)   | 0.147          |