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WHICH FACTORS?

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ABSTRACT

Many recently proposed, seemingly different factor models are closely related. In spanning tests, the q-factor model largely subsumes the Fama-French (2015, 2018) 5-and 6-factor models, and the q^5 model captures the Stambaugh-Yuan (2017) model. The Stambaugh-Yuan factors are sensitive to their construction, and once replicated via the standard approach, are close to the q-factors, with correlations of 0.8 and 0.84. Finally, it seems difficult to motivate the Fama-French 5-factor model from valuation theory, which predicts a positive relation between the expected investment and the expected return.

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1 Introduction

A new generation of factor pricing models has emerged in the cross section of expected returns, including the Hou-Xue-Zhang (2015) q-factor model and the Hou-Mo-Xue-Zhang (2018) q^5 model, the Fama-French (2015, 2018) 5- and 6-factor models, the Stambaugh-Yuan (2017) 4-factor model, the Barillas-Shanken (2018) 6-factor model, as well as the Daniel-Hirshleifer-Sun (2018) 3-factor model. In this paper, we compare the new factor models on both empirical and conceptual grounds.

We show that the seemingly different factor models are in fact closely related. In factor spanning tests, the q-factor and q^5 models largely subsume the Fama-French 5- and 6-factor premiums. From January 1967 to December 2016, the average premiums of the value, investment, profitability, and momentum factors (HML, CMA, RMW, and UMD) are 0.37%, 0.33%, 0.26%, and 0.65% per month ($t = 2.71, 3.51, 2.5,$ and 3.61), respectively. However, their q-factor alphas are tiny, 0.07%, -0.00%, 0.01%, and 0.12% ($t = 0.62, -0.02, 0.08,$ and 0.5), and the q^5 alphas 0.05%, -0.04%, -0.01%, and -0.16% ($t = 0.48, -0.96, -0.16,$ and -0.78), respectively. The cash profitability factor, RMWc, earns on average 0.33% ($t = 4.16$), with a q-factor alpha of 0.25% ($t = 3.83$) and a q^5 alpha of 0.14% ($t = 2.18$). More important, the Gibbons, Ross, and Shanken (1989) test cannot reject the q-factor or the q^5 model based on the null that the alphas of HML, CMA, RMW, and UMD are jointly zero. Although the test rejects the q-factor model based on the null that the alphas of HML, CMA, RMWc, and UMD are joint zero. it fails to reject the q^5 model (p-value $= 0.13$).

Conversely, the Fama-French 5- and 6-factor models cannot explain the q- and q^5-factor premiums. The investment, return on equity, and expected growth factors in the q-factor and q^5 models are on average 0.41%, 0.55%, and 0.82% per month ($t = 4.92, 5.25,$ and 9.81), their 5-factor alphas 0.12%, 0.47%, and 0.78% ($t = 3.44, 5.94,$ and 11.34), the 6-factor alphas 0.11%, 0.3%, and 0.7% ($t = 3.11, 4.51,$ and 11.1), and the alphas from the alternative 6-factor model with RMWc 0.11%, 0.23%, and 0.61% ($t = 2.78, 2.8,$ and 9.33), respectively. The Gibbons-Ross-Shanken test strongly rejects the Fama-French 5- and 6-factor models based on the null that the alphas of the investment

and return on equity factors (with and without the expected growth factor) are jointly zero.

Deviating from the standard factor construction per Fama and French (1993), Stambaugh and Yuan (2017) use the NYSE, Amex, and NASDAQ breakpoints of the 20th and 80th percentiles when forming their factors, as opposed to the more standard NYSE breakpoints of the 30th and 70th percentiles. We reproduce their factors following their exact procedure, and also replicate their factors via the standard approach. The performance of their model is sensitive to the factor construction. While their original factors survive the q-factor model (but not the q^5 model), only the replicated management factor survives the q-factor model. Neither the original nor the replicated Stambaugh-Yuan model can explain the q and q^5 factors in the Gibbons-Ross-Shanken test, but the q^5 model can explain both their original and replicated models. More important, their replicated factors are close to the q-factors, with correlations of 0.8 and 0.84. As such, their statistical cluster analysis essentially rediscovers the q-factors, which are in turn motivated from economic theory.

Daniel, Hirshleifer, and Sun (2018) also deviate from the standard approach when constructing their financing and post-earnings-announcement-draft factors. We reproduce their factors following their exact procedure, and also replicate their factors via the standard approach. Their model's performance is also sensitive to the construction. In particular, their financing factor premium is more than halved with the standard approach, and is explained by the q and q^5 models. However, their earnings factor (reproduced or replicated) cannot be explained by our models. The Daniel et al. 3-factor model explains the return on equity premium, but not the investment or expected growth premium. Without a size factor, their model also fails to explain the size premium. More important, their replicated factors are also close to the q-factors, with correlations of 0.69.

Barillas and Shanken (2018) form a 6-factor model by combining the market factor, SMB, the investment and return on equity factors from the q-factor model, the Asness-Frazzini (2013) monthly formed HML factor, and UMD. We show that the Brillas-Shanken model cannot explain the expected growth premium, with a large alpha of 0.6% per month ($t = 8.78$). However, neither

the q or q^5 model can explain the monthly formed HML factor, with alphas of 0.37% ($t = 2.36$) and 0.41% ($t = 2.99$), respectively. Reconstructing the q-factors with all monthly sorts on size, investment-to-assets, and return on equity, we show that the monthly formed q and q^5 models deliver insignificant alphas of 0.18% ($t = 0.97$) and 0.26% ($t = 1.64$), respectively.

While the Stambaugh-Yuan, Daniel-Hirshleifer-Sun, and Fama-French 6-factor models are largely statistical in nature, Fama and French (2015) attempt to motivate their 5-factor model from valuation theory. We raise a few concerns on their motivation. The relations between book-to-market, investment, and profitability with the internal rate of return do not necessarily carry over to the 1-period-ahead expected return. Empirically, the estimates of the internal rate of returns for RMW differ greatly from their 1-period-ahead average returns. In addition, CMA is motivated from the negative relation between the expected investment and the internal rate of return. Reformulating the valuation equation with the 1-period-ahead expected return, we show that the theoretical relation between the expected investment and the expected return tends to be positive. Finally, Fama and French use past investment as a proxy for the expected investment. We document that past investment does not forecast future investment at the firm level.

The rest of the paper is organized as follows. Section 2 describes the construction of all the factors. Section 3 reports the spanning regressions. Section 4 raises some concerns on the motivation of the Fama-French (2015) 5-factor model from valuation theory. Finally, Section 5 concludes.

2　Factors

Monthly returns are from Center for Research in Security Prices (CRSP, with share codes 10 or 11) and accounting variables from Compustat Annual and Quarterly Fundamental Files.

2.1　The q-factor and the q^5 Models

Hou, Xue, and Zhang (2015) construct the size, investment, and return on equity (Roe) factors from a triple $2 \times 3 \times 3$ sort on size, investment-to-assets (I/A), and Roe. Size is the market equity, which

is stock price per share times shares outstanding from CRSP. I/A is the annual change in total assets (Compustat annual item AT) divided by 1-year-lagged total assets. Roe is income before extraordinary items (Compustat quarterly item IBQ) divided by 1-quarter-lagged book equity.[1] We exclude financial firms and firms with negative book equity.

At the end of June of each year t, we use the NYSE median to split stocks into two groups, small and big. Independently, at the end of June of year t, we break stocks into three I/A groups using the NYSE breakpoints for the low 30%, middle 40%, and high 30% of the ranked values of I/A for the fiscal year ending in calendar year $t-1$. Also, independently, at the beginning of each month, we sort all stocks into three groups based on the NYSE breakpoints for the low 30%, middle 40%, and high 30% of Roe. Earnings data in Compustat quarterly files are used in the months immediately after the most recent public quarterly earnings announcement dates (Compustat quarterly item RDQ). For a firm to enter the factor construction, we require the end of the fiscal quarter that corresponds to its announced earnings to be within six months prior to the portfolio formation month.

Taking the intersection of the two size, three I/A, and three Roe groups, we form 18 portfolios. Monthly value-weighted portfolio returns are calculated for the current month, and the portfolios are rebalanced monthly. The size factor, denoted R_{Me}, is the difference (small-minus-big), each month, between the simple average of the returns on the nine small size portfolios and the simple average of the returns on the nine big size portfolios. The investment factor, $R_{\text{I/A}}$, is the difference (low-minus-high), each month, between the simple average of the returns on the six low I/A portfolios and the simple average of the returns on the six high I/A portfolios. Finally, the Roe factor, R_{Roe}, is the difference (high-minus-low), each month, between the simple average of the returns on the six high Roe portfolios and the simple average of the returns on the six low Roe portfolios.

Hou, Xue, and Zhang (2015) start their sample in January 1972, which is restricted by the

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[1]Book equity is shareholders' equity, plus balance sheet deferred taxes and investment tax credit (Compustat quarterly item TXDITCQ) if available, minus the book value of preferred stock (item PSTKQ). Depending on availability, we use stockholders' equity (item SEQQ), or common equity (item CEQQ) plus the carrying value of preferred stock (item PSTKQ), or total assets (item ATQ) minus total liabilities (item LTQ) in that order as shareholders' equity.

limited coverage of earnings announcement dates and book equity in Compustat quarterly files. We follow their procedure from January 1972 onward, but extend the starting point of the sample backward to January 1967. To overcome the lack of coverage for quarterly earnings announcement dates, we use the most recent quarterly earnings from fiscal quarters ending at least four months prior to the portfolio formation month. To expand the coverage for quarterly book equity, we use book equity from Compustat annual files, and impute quarterly book equity with clean surplus accounting. Whenever available we first use quarterly book equity from Compustat quarterly files. We then supplement the coverage for fiscal quarter four with book equity from Compustat annual files.[2]

If both approaches are unavailable, we apply the clean surplus relation to impute the book equity. If available, we backward impute the beginning-of-quarter book equity as the end-of-quarter book equity minus quarterly earnings plus quarterly dividends.[3] Because we impose a 4-month lag between earnings and the holding period month (and the book equity in the denominator of Roe is 1-quarter-lagged relative to earnings), all the Compustat data in the backward imputation are at least 4-month lagged relative to the portfolio formation month.

If data are unavailable for the backward imputation, we impute the book equity for quarter t forward based on book equity from prior quarters. Let $\text{BEQ}_{t-j}, 1 \leq j \leq 4$, denote the latest available quarterly book equity as of quarter t, and $\text{IBQ}_{t-j+1,t}$ and $\text{DVQ}_{t-j+1,t}$ be the sum of quarterly earnings and the sum of quarterly dividends from quarter $t-j+1$ to t, respectively. BEQ_t can be imputed as $\text{BEQ}_{t-j} + \text{IBQ}_{t-j+1,t} - \text{DVQ}_{t-j+1,t}$. We do not use prior book equity from more than four quarters ago ($1 \leq j \leq 4$) to reduce imputation errors. We start the sample in January 1967 to ensure

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[2]We measure annual book equity per Davis, Fama, and French (2000) as stockholders' book equity, plus balance sheet deferred taxes and investment tax credit (Compustat annual item TXDITC) if available, minus the book value of preferred stock. Stockholders' equity is the value reported by Compustat (item SEQ), if available. Otherwise, we use the book value of common equity (item CEQ) plus the par value of preferred stock (item PSTK), or the book value of assets (item AT) minus total liabilities (item LT). Depending on availability, we use redemption value (item PSTKRV), liquidating (item PSTKL), or par value (item PSTK) for the book value of preferred stock.

[3]Quarterly earnings are income before extraordinary items (Compustat quarterly item IBQ). Quarterly dividends are zero if dividends per share (item DVPSXQ) are zero. Otherwise, total dividends are dividends per share times beginning-of-quarter shares outstanding adjusted for stock splits during the quarter. Shares outstanding are from Compustat (quarterly item CSHOQ supplemented with annual item CSHO for fiscal quarter four) or CRSP (item SHROUT), and the share adjustment factor is from Compustat (quarterly item AJEXQ supplemented with annual item AJEX for fiscal quarter four) or CRSP (item CFACSHR).

that all the 18 benchmark portfolios from the triple sort on size, I/A, and Roe have at least ten firms.

Hou, Mo, Xue, and Zhang (2018) augment the q-factor model with an expected growth factor, denoted R_{Eg}, to form the q^5 model. The expected growth factor is constructed from an independent 2×3 sort on size and the expected 1-year-ahead investment-to-assets change, $E_t[\mathrm{d}^1\mathrm{I}/\mathrm{A}]$. Tobin's q, operating cash flow-to-assets, and the change in Roe are used to form $E_t[\mathrm{d}^1\mathrm{I}/\mathrm{A}]$.

At the beginning of each month t, Tobin's q is the market equity (price per share times the number of shares outstanding from CRSP) plus long-term debt (Compustat annual item DLTT) and short-term debt (item DLC) scaled by total assets (item AT), all from the fiscal year ending at least four months ago. For firms with multiple share classes, we merge the market equity for all classes. Following Ball, Gerakos, Linnainmaa, and Nikolaev (2016), we measure operating cash flow-to-assets, denoted Cop, as total revenue (item REVT) minus cost of goods sold (item COGS), minus selling, general, and administrative expenses (item XSGA), plus research and development expenditures (item XRD, zero if missing), minus change in accounts receivable (item RECT), minus change in inventory (item INVT), minus change in prepaid expenses (item XPP), plus change in deferred revenue (item DRC plus item DRLT), plus change in trade accounts payable (item AP), and plus change in accrued expenses (item XACC), scaled by book assets, all from the fiscal year ending at least four months ago. All changes are annual changes, and the missing changes are set to zero.

Finally, we measure the change in Roe, denoted dRoe, as Roe minus its value from four quarters ago (Hou, Xue, and Zhang 2018). Before 1972, we use the most recent dRoe with quarterly earnings from fiscal quarters ending at least four months ago. Starting from 1972, we use dRoe with quarterly earnings from the most recent earnings announcement dates. We require the end of the fiscal quarter corresponding to its most recent dRoe to be within six months prior to the portfolio formation to exclude stale information. Missing dRoe values are set to zero in cross-sectional regressions in estimating the expected 1-year-ahead investment-to-assets change, $E_t[\mathrm{d}^1\mathrm{I}/\mathrm{A}]$.

At the beginning of each month t, we compute $E_t[\mathrm{d}^1\mathrm{I}/\mathrm{A}]$ by combining the latest known $\log(q)$,

Cop, and dRoe values winsorized at the 1–99% level and the average cross-sectional regression slopes estimated from the prior 120-month rolling window (30 months minimum). In the prior predictive regressions, the dependent variables, d^1I/A, are from the fiscal year ending at least four months ago as of month t, and the regressors are further lagged accordingly. In particular, the regressors used in the latest monthly cross-sectional regression are further lagged by 12 months relative to the latest known $\log(q)$, Cop, and dRoe values used in calculating $E_t[d^1I/A]$. We winsorize both the left- and right-hand side variables in the cross-sectional regressions each month at the 1–99% level. To control for microcaps, we use weighted least squares with the market equity as weights.

At the beginning of each month t, we use the beginning-of-month median NYSE market equity to split stocks into two groups, small and big. Independently, we split all stocks into three groups, low, median, and high, based on the NYSE breakpoints for the low 30%, middle 40%, and high 30% of the ranked values of $E_t[d^1I/A]$ calculated at the beginning of the month. Taking the intersection of the two size and three $E_t[d^1I/A]$ groups, we form six benchmark portfolios. Monthly value-weighted portfolio returns are calculated for the current month t, and the portfolios are rebalanced at the beginning of month $t+1$. The expected growth factor, R_{Eg}, is the difference (high-minus-low), each month, between the simple average of the returns on the two high $E_t[d^1I/A]$ portfolios and the simple average of the returns on the two low $E_t[d^1I/A]$ portfolios.

2.2 The Fama-French (2015, 2018) 5- and 6-factor Models

Subsequent to Hou, Xue, and Zhang (2015), Fama and French (2015) incorporate two factors that resemble the q-factors into their 3-factor model to form a 5-factor model. RMW is the difference between the returns on portfolios of stocks with robust and weak profitability, and CMA the difference between the returns on portfolios of low and high investment stocks.

Fama and French (2015) measure operating profitability to equity as total revenue (Compustat annual item REVT) minus cost of goods sold (item COGS, zero if missing), minus selling, general, and administrative expenses (item XSGA, zero if missing), and minus interest expense (item XINT,

zero if missing), scaled by book equity (the denominator is current, not lagged, book equity). At least one of the three expense items (COGS, XSGA, and XINT) must be nonmissing. Investment is measured as I/A, the annual change in total assets divided by 1-year-lagged total assets.

Fama and French (2015) construct RMW and CMA from independent 2×3 sorts by interacting size with operating profitability, and separately, with investment-to-assets. At the end of June of year t, stocks are split into two groups, small and big, based on the NYSE median size, and independently into three groups, low, median, and high, based on the 30th and 70th NYSE percentiles of operating profitability, and separately, of investment-to-assets. Taking intersections yields six size-profitability portfolios and six size-I/A portfolios. Monthly value-weighted portfolio returns are calculated from July of year t to June of $t + 1$, and the portfolios are rebalanced at the June-end of year $t + 1$. RMW is the average of the two high profitability portfolio returns minus the average of the two low profitability portfolio returns. Similarly, CMA is the average of the two low I/A portfolio returns minus the average of the two high I/A portfolio returns.

Fama and French (2018) incorporate the momentum factor, UMD, from Jegadeesh and Titman (1993), into their 5-factor model to form a 6-factor model. At the beginning of each month t, stocks are split into two groups, small and big, based on the NYSE median size, and independently into three groups, low, median, and high, based on the 30th and 70th NYSE percentiles of prior 11-month returns from month $t - 12$ to $t - 2$, skipping month $t - 1$. Taking intersections yields six size-momentum portfolios. Monthly value-weighted portfolio returns are calculated for the current month, and the portfolios are rebalanced at the beginning of month $t + 1$. UMD is the average of the two winner portfolio returns minus the average of the two loser portfolio returns.

Fama and French (2018) also introduce a cash-based profitability factor, denoted RMWc. At the June end of year t, cash-based operating profitability is revenues (Compustat annual item REVT) minus cost of goods sold (item COGS, zero if missing), minus selling, general, and administrative expenses (item XSGA, zero if missing), minus interest expense (item XINT, zero if missing) minus

change in accounts receivable (item RECT), minus change in inventory (item INVT), minus change in prepaid expenses (item XPP), plus change in deferred revenue (item DRC plus item DRLT), plus change in trade accounts payable (item AP), and plus change in accrued expenses (item XACC), scaled by book equity, all from the fiscal year ending in calendar year $t-1$. At least one of the three expense items (COGS, XSGA, and XINT) must be nonmissing. The numerator of this variable is a variant of that in Ball, Gerakos, Linnainmaa, and Nikolaev (2016), without adding back research and development expenses. The construction of RMWc is analogous to that of RMW.[4]

2.3 The Stambaugh-Yuan (2017) 4-factor Model

Stambaugh and Yuan (2017) start with 11 anomalies, which are grouped into two clusters based on pairwise cross-sectional correlations. The first cluster, labeled MGMT (management), includes net stock issues, composite issues, accruals, net operating assets, asset growth (from Cooper, Gulen, and Schill 2008, investment-to-assets in Hou, Xue, and Zhang 2015), and the annual change in gross property, plant, and equipment plus the annual change in inventories scaled by lagged book assets. The second cluster, labeled PERF (performance), includes failure probability (Campbell, Hilscher, and Szilagyi 2008), O-score, momentum, gross profitability, and return on assets. Appendix A details the variable definitions. Conceptually, MGMT contains different investment measures, and PERF different profitability measures. The individual variables in each cluster are realigned to yield positive average low-minus-high returns. The composite measures, MGMT and PERF, are formed by equal-weighting a stock's rankings across the anomaly variables within a given cluster.

Stambaugh and Yuan (2017) form the MGMT and PERF factors from independent 2×3 sorts on size and MGMT, and on size and PERF. At the beginning of each month t, stocks (excluding those with prices per share less than \$5) are split by the NYSE median size into two groups, small and big. Independently, stocks are split based on MGMT, and separately, on PERF, into three groups, low, median, and high, with breakpoints of the 20th and 80th percentiles of the NYSE,

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[4]The sample in Fama and French (2015, 2018) includes financial firms and firms with negative book equity, except that positive book equity is required for constructing HML, RMW, and RMWc.

Amex, and NASDAQ universe. Taking intersections yields six size-MGMT portfolios and six size-PERF portfolios. Monthly value-weighted portfolio returns are calculated for the current month t, and the portfolios are rebalanced at the beginning of month $t+1$. The MGMT factor is the average of the returns on the two low MGMT portfolios minus the average of the returns on the two high MGMT portfolios. The PERF factor is the average of the returns on the two low PERF portfolios minus the average of the returns on the two high PERF portfolios. The size factor is the returns of the value-weighted portfolio of stocks in the intersection of the small-cap middle portfolios from the double sorts of size with MGMT and with PERF minus the returns of the value-weighted portfolio of stocks in the intersection of both big-cap middle portfolios from the two double sorts.

Most important, the Stambaugh-Yuan (2017) factor construction deviates from the standard approach in Fama and French (1993, 2015) and Hou, Xue, and Zhang (2015) in several important aspects. First, when sorting on MGMT and PERF, the breakpoints of the 20th and 80th percentiles are adopted, as opposed to the standard 30th and 70th percentiles. Second, the NYSE, Amex, and NASDAQ breakpoints are used, instead of the NYSE breakpoints. Finally, the size factor contains stocks only in the middle portfolios of the MGMT and PERF sorts, as opposed to stocks from all three portfolios. To evaluate the sensitivity of the Stambaugh-Yuan (2017) model's performance to its factor construction, we present two sets of results. In the first, we use their original factors series from Yu Yuan's Web site.[5] In the second set, we replicate their factors via the standard approach.

2.4 The Daniel-Hirshleifer-Sun (2018) 3-factor Model

The Daniel-Hirshleifer-Sun (2018) 3-factor model contains the market factor, a financing factor (FIN), and a post-earnings-announcement-draft factor (PEAD). FIN is based on two financing measures, the 1-year net share issuance from Pontiff and Woodgate (2008) and the 5-year composite share issuance from Daniel and Titman (2006). PEAD is based on the 4-day cumulative abnormal return, denoted Abr, around the most recent quarterly earnings announcement dates from Chan,

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[5]We have reproduced their factors, following their factor construction, and obtained quantitatively close results.

Jegadeesh, and Lakonishok (1996). Abr is a stock's daily return minus the value-weighted market's daily return cumulated from two days prior to and one day after the earnings announcements.

At the end of June of each year t, net share issuance is the natural log of the ratio of split-adjusted shares outstanding for fiscal year ending in calendar year $t-1$ (the common share outstanding, Compustat annual item CSHO, times the adjustment factor, item AJEX) to the split-adjusted shares outstanding for fiscal year ending in $t-2$. The composite share issuance is the log growth rate of the market equity not attributable to stock return, $\log\left(\mathrm{Me}_t/\mathrm{Me}_{t-5}\right) - r(t-5, t)$, in which $r(t-5, t)$ is the cumulative log stock return from the last trading day of June in year $t-5$ to the last trading day of June in year t, and Me_t is the market equity from CRSP on the last trading day of June in year t.

Daniel, Hirshleifer, and Sun (2018) construct FIN from annual independent 2×3 sorts on size and the financing variables. The size sort is based on the NYSE median. The composite issuance sort is based on the NYSE breakpoints of the 20th and 80th percentiles. The net share issuance sort is more involved. First, all negative net issuance (repurchasing) firms are split into two groups based on the NYSE median. Second, all positive net issuance (equity issuing) firms are split into three groups based on the NYSE breakpoints of the 30th and 70th percentiles. Finally, firm with the most negative issuance are assigned to the low issuance portfolio, firms with the most positive issuance to the high issuance portfolio, and all the other firms to the middle issuance portfolio.

To combine the net and the composite issuance groups, Daniel, Hirshleifer, and Sun (2018) adopt the following algorithm. If a firm belongs to the high portfolio per both financing measures, or to the high net issuance portfolio, but missing the composite issuance data, the firm is assigned to the high financing portfolio. If a firm belongs to the low portfolio per both measures, or to the low portfolio per one measure but missing the data for the other, the firm is assigned to the low financing portfolio. In all other cases, the firm is assigned to the middle financing portfolio. The FIN factor is then the simple average of the monthly returns on the two low financing portfolios minus the simple average of the returns on the two high financing portfolios.

Daniel, Hirshleifer, and Sun (2018) construct the PEAD factor from monthly independent 2×3 sorts on size and Abr. The size sort is based on the NYSE median. The Abr sort is based on the NYSE breakpoints of the 20th and 80th percentiles. Value-weighted monthly returns are calculated for the current month, and the portfolios are rebalanced at the beginning of next month. The PEAD factor is then the simple average of the monthly returns on the two high Abr portfolios minus the simple average of the returns on the two low Abr portfolios.

We raise three concerns with the factor construction in Daniel, Hirshleifer, and Sun (2018). First, only Abr is picked to form the PEAD factor, even though Chan, Jegadeesh, and Lakonishok (1996) examine simultaneously three PEAD measures that also include standard unexpected earnings (Sue) and revisions in analysts' earnings forecasts (Re). In particular, Sue seems to be more widely used than Abr in the existing literature. Second, the NYSE breakpoints of the 20th and 80th percentiles are used, as opposed to the standard 30th and 70th percentiles. Finally, the net issuance and composite issuance sorts are nonstandard, and also differing from each other. These concerns suggest that the Daniel et al. factors might not be directly comparable to the more standard factors.

To ensure that we compare apples with apples, in addition to reproduce the Daniel-Hirshleifer-Sun) factors per their exact procedure, we also replicate their factors via the standard approach.[6] In particular, we form the PEAD factor by combining Sue, Abr, and Re.[7] At each portfolio formation date, we calculate a stock's NYSE percentiles on each of the three PEAD variables, and then take their simple average as the stock's ranked PEAD value. When taking the simple average, we use the

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[6]In our reproduction, we have obtained results that are quantitatively close to those reported in their paper. Because their factors are not available online, we use our reproduced factors in subsequent tests.

[7]Sue is calculated as the change in split-adjusted quarterly earnings per share (Compustat quarterly item EPSPXQ divided by item AJEXQ) from its value four quarters ago divided by the standard deviation of this change in quarterly earnings over the prior eight quarters (six quarters minimum). Before 1972, we use the most recent Sue with earnings from fiscal quarters ending at least four months prior to the portfolio formation. Starting from 1972, we use Sue with quarterly earnings from the most recent quarterly earnings announcement dates (Compustat quarterly item RDQ). For a firm to enter our portfolio formation, we require the end of the fiscal quarter that corresponds to its most recent Sue to be within six months prior to the portfolio formation. Because analysts' earnings forecasts from the Institutional Brokers' Estimate System (IBES) are not necessarily revised each month, we construct a 6-month moving average of past revisions, $\sum_{\tau=1}^{6}(f_{it-\tau} - f_{it-\tau-1})/p_{it-\tau-1}$, in which $f_{it-\tau}$ is the consensus mean forecast (IBES unadjusted file, item MEANEST) issued in month $t-\tau$ for firm i's current fiscal year earnings (fiscal period indicator = 1), and $p_{it-\tau-1}$ is the prior month's share price (unadjusted file, item PRICE). We require both earnings forecasts and share prices to be denominated in US dollars (currency code = USD). We also adjust for any stock splits and require a minimum of four monthly forecast changes when constructing Re.

available NYSE percentiles. Doing so allows us to extend the sample backward to January 1967. This composite score approach follows Stambaugh and Yuan (2017). We use the same approach to combine the net issuance with the composite issuance in annual sorts. Doing so avoids the Daniel et al. nonstandard, separate sorts on the two financing measures. Finally, with the composite FIN and PEAD scores, we split stocks based on their NYSE breakpoints of the 30th and 70th percentiles.

2.5 The Barillas-Shanken (2018) 6-factor Model

Barillas and Shanken (2018) propose a 6-factor model that contains the market factor, the Fama-French (2015) SMB, the Hou-Xue-Zhang (2015) investment and Roe factors, the Asness-Frazzini (2013) monthly sorted HML factor, denoted HML^{m}, and UMD. Asness and Frazzini form HML^{m} from monthly sequential sorts on, first, size, than then book-to-market, in which the book equity is from the fiscal year ending at least six months ago, but the market equity is updated monthly. We obtain the HML^{m} data from the AQR Web site. We have reproduced this factor per the AQR procedure. We have also replicated the factor per the standard independent sorts, and obtained quantitatively similar results. As such, we only report the results with the AQR HML^{m} factor to save space.

3 Spanning Regressions

In this section, we detail the results from factor spanning regressions.

3.1 The q-factor and q^5 Models versus the Fama-French 5- and 6-factor Models

The upshot is that the q-factor and q^5 models largely explain the Fama-French 5- and 6-factor premiums, but the 5- and 6-factor models cannot explain the q- and q^5-factor premiums.

In Panel A of Table 1, we regress the q- and q^5-factor returns on the Fama-French 5- and 6-factor models, as well as their alternative 6-factor model with RMW replaced by RMWc. From January 1967 to December 2016, the size factor, R_{Me}, in the q-factor model earns an average return of 0.31% per month ($t = 2.43$). All three Fama-French specifications account for this size premium, with alphas at most 0.05%, due to the presence of SMB.

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The investment factor, $R_{\text{I/A}}$, in the q-factor model earns an average return of 0.41% per month ($t = 4.92$). Despite the presence of CMA, the Fama-French 5-factor model reduces the $R_{\text{I/A}}$ premium to an alpha of 0.12%, but significant ($t = 3.44$). The two specifications of the 6-factor model yield largely similar results. $R_{\text{I/A}}$ is stronger than CMA, because $R_{\text{I/A}}$ is based on a joint sort with Roe, whereas the CMA construction does not control for return on equity.

The Roe factor, R_{Roe}, earns an average return of 0.55% per month ($t = 5.25$). The Fama-French 5-factor model only reduces the Roe premium to an alpha of 0.47% ($t = 5.94$), despite a large RMW loading of 0.7 ($t = 12.76$). Intuitively, the Roe factor is constructed from monthly sorts on the latest known quarterly earnings data, whereas RMW is from annual sorts on the more stale operating profitability from the last fiscal year end. As such, the Roe factor is more powerful than RMW. The 6-factor model reduces the Roe premium further to an alpha of 0.3% ($t = 4.51$), with the help of an UMD loading of 0.24 ($t = 9.94$). Replacing RMW with RMWc in the 6-factor model yields a smaller alpha of 0.23%, due to a higher premium of RMWc than RMW, 0.33% versus 0.26%. However, the alternative 6-factor alpha for the Roe factor is still significant ($t = 2.8$).

The expected growth factor, R_{Eg}, in the q^5 model earns an average return of 0.82% per month ($t = 9.81$). The Fama-French 5-factor model reduces the R_{Eg} premium only slightly, with an alpha of 0.78% ($t = 11.34$). Their 6-factor model reduces the R_{Eg} premium further to an alpha of 0.7% ($t = 11.1$), with the help of a small UMD loading of 0.12 ($t = 6.42$). Finally, replacing RMW with RMWc in the 6-factor model shrinks the R_{Eg} premium to an alpha of 0.61%, which remains highly significant ($t = 9.32$), helped by a large RMWc loading of 0.39 ($t = 5.77$).

We also perform the Gibbons, Ross, and Shanken (1989, GRS) test on the null hypothesis that the alphas of the key q and q^5 factors in the Fama-French 5- and 6-factor regressions are jointly zero (Panel C). For the null that the alphas of the investment and Roe factors are jointly zero, the GRS statistic is 22.72 ($p = 0.00$) in the 5-factor model, 14.6 ($p = 0.00$) in the 6-factor model with RMW, and 8.2 ($p = 0.00$) in the 6-factor model with RMWc. For the null that the alphas of the investment,

Roe, and expected growth factors are jointly zero, the GRS statistic is 55.14 ($p = 0.00$) in the 5-factor model, 48.85 ($p = 0.00$) in the 6-factor model with RMW, and 36.59 ($p = 0.00$) with RMWc. As such, the Fama-French 5- and 6-factor models cannot explain the q and q^5 factor premiums.

From Panel B, the q-factor and q^5 models largely subsume the Fama-French 5- and 6-factor premiums in spanning regressions, with economically small and mostly insignificant alphas. HML has an average return of 0.37% per month ($t = 2.71$), and its q- and q^5-alphas are 0.07% ($t = 0.62$) and 0.05% ($t = 0.48$), respectively. The investment factor, $R_{I/A}$, delivers the explanatory power. The factor loadings are economically large (about one), and also highly significant (t-values above 11).

The momentum factor, UMD, is on average 0.65% per month ($t = 3.61$). The q-factor alpha is only 0.12% ($t = 0.5$), with the help of a large Roe factor loading of 0.91 ($t = 5.9$). The q^5-alpha is weakly negative, -0.16% ($t = -0.78$). In addition to a large Roe factor loading of 0.78 ($t = 4.4$), the expected growth factor loading of 0.44 ($t = 2.62$) also helps. Intuitively, momentum winners have both higher Roe and higher expected growth than momentum losers.

CMA has an average return of 0.33% per month ($t = 3.51$). The q-factor alpha is virtually zero ($t = -0.02$), helped by a large investment factor loading of 0.96 ($t = 33.56$). The q^5-alpha is also tiny, -0.04% ($t = -0.96$), with a similar investment factor loading. RMW has an average return of 0.26% ($t = 2.5$). The q-factor alpha is only 0.01% ($t = 0.08$), with a large Roe factor loading of 0.54 ($t = 8.5$). Similarly, the q^5-alpha is also tiny, -0.01% ($t = -0.16$), with a large Roe factor loading of 0.53 ($t = 7.85$). Finally, RMWc has an average return of 0.33% ($t = 4.16$). RMWc survives the control of the q-factors, with an alpha of 0.25% ($t = 3.83$). Although the Roe factor loading is significant ($t = 9.88$), its magnitude is only 0.29. The q^5 model reduces the alpha of RMWc further to 0.14%, albeit still significant ($t = 2.18$), helped by both the Roe and expected growth factors.

Panel C reports the GRS tests on the null hypothesis that the alphas of the key Fama-French 5- and 6-factors are jointly zero in the q-factor and q^5 models. For the null that the alphas of HML, CMA, and RMW are jointly zero, the GRS statistic is 0.2 ($p = 0.9$) in the q-factor model, and 0.62

($p = 0.6$) in the q^5 model. For the null that the alphas of HML, CMA, RMW, and UMD are jointly zero, the GRS statistic is 0.36 ($p = 0.84$) in the q-factor model, and 0.65 ($p = 0.62$) in the q^5 model. Finally, for the null that the alphas of HML, CMA, RMWc, and UMD are jointly zero, the GRS statistic is 6.14 ($p = 0.00$) in the q-factor model, and 1.81 ($p = 0.13$) in the q^5 model. As such, the q-factor model largely subsumes the Fama-French 5- and 6-factor models. Although the alternative 6-factor model with RMWc survives the q-factor model, it is largely explained by the q^5 model.

3.2   The q-factor and q^5 Models versus the Stambaugh-Yuan Model

Table 2 reports the factor spanning tests of the q-factor and q^5 models versus the Stambaugh-Yuan model. As noted, their factor construction deviates from the standard approach in several important aspects. As such, we report two sets of results, with both their original factors and our replicated factors reconstructed via the standard approach. The upshot is that their model's performance is sensitive to the factor construction. While the original Stambaugh-Yuan factors survive the q-factor and q^5 models, the replicated factors are largely absorbed by the q^5 model. In addition, neither their original nor the replicated model can explain the q and q^5 factors.

In Panel A, we use the Stambaugh-Yuan model to explain the q and q^5 factor premiums. Consistent with Stambaugh and Yuan (2017), their original model explains the size and investment factors, but not the Roe factor. The alphas of the size and investment factors are -0.04% and 0.08% per month ($t = -0.65$ and 1.26), respectively. However, the alpha of the Roe factor is 0.33% ($t = 3.55$), despite a large PERF factor loading of 0.42 ($t = 11.65$). The expected growth factor also survives the Stambaugh-Yuan model, with an alpha of 0.55% ($t = 9.04$).

The replicated Stambaugh-Yuan factors yield largely similar results. The alphas of the size and investment factors are 0.01% ($t = 0.18$) and 0.07% ($t = 1.41$), but the alphas of the Roe and expected growth factors are 0.32% ($t = 4.71$) and 0.58% ($t = 10.25$), respectively. For the null hypothesis that the investment and Roe factor alphas are jointly zero, the GRS statistic is 8.16 ($p = 0.00$) in the original Stambaugh-Yuan model, and 12.12 ($p = 0.00$) in the replicated model. For

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the null that the alphas of the investment, Roe, and expected growth factors are jointly zero, the GRS statistic is 30.24 ($p = 0.00$) in the original model, and 41.27 ($p = 0.00$) in the replicated model.

In Panel B, we use the q-factor and q^5 models to explain the Stambaugh-Yuan factors. Their size factor earns on average 0.44% per month ($t = 3.6$), and the replicated version 0.31% ($t = 2.13$). The q-factor and q^5 alphas of the original size factor are significant, about 0.15%. For the replicated size factor, the q-factor alpha is 0.06% ($t = 1.13$), and the q^5 alpha 0.09% ($t = 1.72$).

The original MGMT factor earns on average 0.61% per month ($t = 4.72$), with a q-factor alpha of 0.36% ($t = 4.73$) and a q^5 alpha of 0.12% ($t = 1.64$). The replicated MGMT factor earns on average 0.47% ($t = 4.68$). The q-factor model yields an alpha of 0.2%, albeit significant ($t = 3.59$), despite a large investment factor loading of 0.92 ($t = 22.65$). The q^5 model shrinks the alpha further to -0.02% ($t = -0.38$), helped by an expected growth factor loading of 0.36 ($t = 9.79$).

The original PERF factor earns on average 0.68% per month ($t = 4.2$). The q-factor model yields an alpha of 0.34% ($t = 2$), with the help of a large Roe factor loading of 0.95 ($t = 10.42$). The q^5 model yields a tiny alpha of 0.01% ($t = 0.05$), helped by both the Roe and expected growth factor loadings, 0.79 ($t = 8.4$) and 0.53 ($t = 4.8$), respectively. The replicated PERF factor earns on average 0.49% ($t = 3.67$). The q-factor and q^5 alphas are both insignificant, 0.03% ($t = 0.28$) and -0.19% ($t = -1.87$), respectively. The Roe and expected growth factors again pull the weight.

For the GRS tests, the null hypothesis that the alphas of the original MGMT and PERF factors are jointly zero has a statistic of 17.16 ($p = 0.00$) in the q-factor model, and 1.46 ($p = 0.23$) in the q^5 model. For comparison, the null that the alphas of the replicated MGMT and PERF factors are jointly zero has a statistic of 7.96 ($p = 0.00$) in the q-factor model, and 2.38 ($p = 0.09$) in the q^5 model. As such, the q^5 model subsumes both the original and replicated Stambaugh-Yuan factors.

Stambaugh and Yuan (2017) include financial firms and firms with negative book equity, but impose a \$5 price screen in their sample selection. For comparison, we exclude financial firms and firms with negative book equity, without imposing the price screen. Without going through the

details, we can report that the sample difference has little impact. Panel A of Table A1, which replicates their factors based on their sample criterion, yields largely similar results as Table 2.

3.3 The q-factor and q^5 Models versus the Daniel-Hirshleifer-Sun Model

Table 3 reports the factor spanning tests of the q-factor and q^5 models versus the Daniel-Hirshleifer-Sun model. As noted, their factor construction also deviates from the standard approach in several important aspects. As such, we report two sets of results, with both the reproduced factors (following exactly their procedure) and the replicated factors (following the standard approach). The upshot is that their model's performance is sensitive to the factor construction. Their FIN factor premium is more than halved with the standard construction, and is explained by both the q and q^5 models. However, their PEAD factor (reproduced or replicated) cannot be explained by the q and q^5 models. Their 3-factor model explains the Roe premium, but not the investment or expected growth premium. Finally, without a size factor, their model fails to explain the size premium.

In Panel A, we use the Daniel-Hirshleifer-Sun model to explain the q and q^5 factors. Without a size factor, their model cannot explain the size premium, with an alpha of 0.46% per month ($t = 3.11$) with the reproduced factors and 0.63% ($t = 4.25$) with the replicated factors. Their model also fails to explain the investment factor, with an alpha of 0.18% ($t = 2.56$) with the reproduced factors and 0.32% ($t = 4.34$) with the replicated factors, as well as the expected growth factor, with an alphas of 0.56% ($t = 7.42$) and 0.54% ($t = 7.45$), respectively. However, the Daniel et al. model does subsume the Roe premium, with an alpha of 0.1% ($t = 0.83$) with the reproduced factors and -0.14% ($t = -1.91$) with the replicated factors. However, the GRS tests all reject the null that their model can explain the key q and q^5 factor premiums jointly.

In Panel B, we use the q and q^5 models to explain the FIN and PEAD factors in the Daniel-Hirshleifer-Sun model. The reproduced FIN factor earns an average return of 0.83% per month ($t = 4.55$), a q-factor alpha of 0.33% ($t = 2.67$), but an insignificant q^5-alpha of 0.14% ($t = 1.12$). In contrast, the replicated FIN factor premium is only 0.32% ($t = 2.53$), and its q-factor and q^5 alphas

are both close to zero. The investment factor is the main source behind the models' explanatory power for FIN. The reproduced PEAD factor earns an average return of 0.62% ($t = 7.73$). Both the q and q^5 models fail to explain this premium, with alphas of 0.56% ($t = 5.66$) and 0.47% ($t = 5.32$), respectively. The replicated PEAD factor earns an even higher average return of 0.72% ($t = 7.78$), although its q and q^5 alphas are smaller, 0.43% ($t = 5.13$) and 0.31% ($t = 4.07$), respectively. Finally, the GRS tests indicate that the q and q^5 models cannot explain FIN and PEAD jointly.

Daniel, Hirshleifer, and Sun (2018) exclude financial firms, but include firms with negative book equity in their sample selection. For comparison, we exclude financial firms and firms with negative book equity. This sample difference has little impact on our results. Panel B of Table A1, which replicates their factors based on their sample criterion, yields largely similar results as Table 3.

3.4   The q-factor and q^5 Models versus the Barillas-Shanken Model

Table 4 reports the spanning tests of the q-factor and q^5 models versus the Barillas-Shanken model. Because their model includes the investment and Roe factors in the q-factor model, we only study whether their model can explain the expected growth factor in the q^5 model. From Panel A, the answer is no. The Barillas-Shanken alpha of the expected growth factor is 0.6% per month ($t = 8.78$).

Panel B shows that the monthly formed HML factor, HML$^{\mathrm{m}}$, earns an average premium of 0.34% per month ($t = 2.13$). Neither the q-factor nor the q^5 model can explain the HML$^{\mathrm{m}}$ premium, leaving alphas of 0.37% ($t = 2.36$) and 0.41% ($t = 2.99$), respectively. The investment factor loadings are economically large, 0.93 and 0.95, going in the right direction in explaining the HML$^{\mathrm{m}}$ premium. However, their impact is mostly offset by the large but negative Roe factor loadings, -0.69 and -0.67, respectively, which go in the wrong direction in explaining the HML$^{\mathrm{m}}$ premium.

3.5   Correlation Matrix

To shed further light on the relations between the myriad of factors, Table 5 reports their correlation matrix. The size factor in the q-factor model and SMB in the Fama-French models are largely

equivalent, with a correlation of 0.97. The investment factor, $R_{I/A}$, in the q-factor model has high correlations of 0.67 with HML, 0.91 with CMA, 0.84 with the replicated MGMT factor, 0.69 with the replicated FIN factor, and 0.49 with the monthly formed HML. As such, HML contains similar pricing information as the investment factor, and MGMT and FIN are also closely related factors.

The Roe factor, R_{Roe}, in the q-factor model has high correlations of 0.67 with RMW and 0.57 with RMWc. Intuitively, R_{Roe}, RMW, and RMWc are all based on profitability, measured differently. The Roe factor also has a high correlation of 0.5 with UMD, suggesting that momentum contains some pricing information of Roe. More important, the Roe factor has a high correlation of 0.8 with the replicated PERF factor and 0.69 with the replicated PEAD factor. As such, PERF and PEAD are closely related factors as the Roe factor.

The expected growth factor, R_{Eg}, has a high correlation of 0.59 with RMWc. Intuitively, firms with more cash available for investments tend to have high expected investment growth than firms with less cash. Cash- and earnings-based profitability measures are related, giving rise to correlations of R_{Eg} with the Roe factor, 0.52, with RMW, 0.43, with the replicated PERF factor, 0.51, and with the replicated PEAD factor, 0.4. Cash flows are also related to investment, giving rise to correlations of R_{Eg} with $R_{I/A}$, 0.38, with CMA, 0.33, with the replicated MGMT factor, 0.54, and with the replicated FIN factor, 0.54. In all, the seemingly different factors are closely related.

3.6 Monthly Formed q-factors

When constructing the q-factors, we adopt annual sorts on size and investment-to-assets (I/A) at the end of each June, but monthly sorts on Roe computed with the latest known quarterly earnings at the beginning of each month. Using up-to-date quarterly earnings data in monthly sorts is critical in yielding the Roe factor's stronger explanatory power than the Fama-French RMW, which is based on more stale operating profitability from last fiscal year end in annual sorts. We should point out that if we use annual sorts on (annual) return on equity from the last fiscal year end (income before extraordinary item [Compustat annual item IB] scaled by 1-year-lagged book equity [foot-

note 2]) in the trip $2 \times 3 \times 3$ sorts on size, investment-to-assets, and Roe, the average Roe premium would be only 0.16% ($t = 1.66$). The size and investment premiums would also be weaker, 0.23% ($t = 1.82$) and 0.32% ($t = 3.64$), respectively. However, we emphasize that using updated quarterly earnings data in monthly sorts is standard, as in the construction of price and earnings momentum.

The remaining question is then how the different sorting frequencies in constructing the q-factors affect our results. To this end, we reconstruct the q-factors using monthly sorts on all the three underlying characteristics. Specifically, at the beginning of month t, we use the beginning-of-the-month NYSE median to split stocks into two groups, small and big. Independently, we split stocks into three I/A groups based on the NYSE breakpoints for the low 30%, middle 40%, and high 30% of the ranked I/A values for the fiscal year ending at least four months ago. Also independently, we sort stocks into three groups based on the NYSE breakpoints for the low 30%, middle 40%, and high 30% of Roe, calculated with the latest announced quarterly earnings (if not available, quarterly earnings from the fiscal quarter ending at least four months ago). Taking the intersection of the two size, three I/A, and three Roe portfolios yields 18 portfolios. Monthly value-weighted returns are computed for the current month, and the portfolios are rebalanced at the beginning of month $t+1$.

The monthly size factor, $R_{\mathrm{Me}}^{\mathrm{m}}$, is the difference (small-minus-big) between the average of the returns on the nine small portfolios and the average of the returns on the nine big portfolios. The monthly investment factor, $R_{\mathrm{I/A}}^{\mathrm{m}}$, is the difference (low-minus-high) between the average of the returns on the six low I/A portfolios and the average of the returns on the six high I/A portfolios. Finally, the monthly Roe factor, $R_{\mathrm{Roe}}^{\mathrm{m}}$, is the difference (high-minus-low) between the average of the returns on the six high Roe portfolios and the average of the returns on the six low Roe portfolios. The monthly size, I/A, and Roe factor premiums are on average 0.33%, 0.5%, and 0.57% per month ($t = 2.49, 5.73$, and 5.23), which are somewhat higher than 0.31%, 0.41%, and 0.55% ($t = 2.43, 4.92$, and 5.25), respectively, for the original q-factors. The correlations between the monthly formed and original q-factors are 0.96, 0.92, and 0.98 for the size, I/A, and Roe factors (untabulated).

In Table 6, we redo the spanning tests with the Fama-French 5- and 6-factor models using the monthly formed q and q^5 models. The original expected growth factor, R_{Eg}, is monthly formed. We call the monthly formed q-factor model (q_{m}) augmented with R_{Eg} the monthly formed q^5 model (q_{m}^5). Panel A shows that the three Fama-French models continue to have difficulty in explaining the q-factors. From Panel B, the monthly formed q and q^5 models reduce the key factors in the Fama-French 5- and 6-factor models to insignificance, mostly with economically small alphas. For RMWc, the q_m-factor alpha is 0.25% per month ($t = 3.33$), but the q_{m}^5 alpha is 0.13 ($t = 1.93$). Finally, the GRS tests indicate that the q_{m} and q_{m}^5 models largely subsume the Fama-French models.

In Table 7, we redo the spanning tests with the replicated Stambaugh-Yuan and Daniel-Hirshleifer-Sun models using the monthly formed q and q^5 models. Without going through the details, we can report that the results are quantitatively close to those in Tables 2 and 3. Finally, in Panel C of Table 7, we redo the spanning tests with the Barillas-Shanken model. Unlike the original q and q^5 models, their monthly counterparts do a better job in explaining the monthly formed HML factor premium. The q_{m} alpha is 0.18% per month ($t = 0.97$), and the q_{m}^5 alpha 0.26% ($t = 1.64$). As such, overall, using the monthly formed q-factors strengthens the spanning test results.

4   Can the Fama-French (2015) 5-factor Model Be Motivated from Valuation Theory?

In this section, we turn to the conceptual foundation of factor models. The q and q^5 models stand out in that the investment, Roe, and expected growth factors are motivated from the first principles of real investment (Hou, Xue, and Zhang 2015; Hou, Mo, Xue, and Zhang 2018). For comparison, the Stambaugh-Yuan (2017) model and the Fama-French (2018) 6-factor model are largely statistical in nature.[8] Although Daniel, Hirshleifer, and Sun (2018) attempt to motivate their FIN factor

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[8]In particular, Fama and French (2018) acknowledge: "We include momentum factors (somewhat reluctantly) now to satisfy insistent popular demand. We worry, however, that opening the game to factors that seem empirically robust but lack theoretical motivation has a destructive downside: the end of discipline that produces parsimonious models and the beginning of a dark age of data dredging that produces a long list of factors with little hope of sifting through them in a statistically reliable way (p. 237)."

from long-term overreaction and the PEAD factor from short-term underreaction, the conceptual

linkage between specifical behavioral biases and the anomaly variables in question seems tenuous.[9]

Fama and French (2015) attempt to provide a conceptual foundation for their 5-factor model

based on the residual income model (Preinreich 1938, Miller and Modigliani 1961, Ohlson 1995).

In the dividend discounting model, a firm's market equity is the present value of its dividends:

$$P_{it} = \sum_{\tau=1}^{\infty} \frac{E[D_{it+\tau}]}{(1+r_i)^\tau}, \tag{1}$$

in which P_{it} is the market equity, D_{it} dividends, and r_i the long-term average expected return, or

the internal rate of return (Williams 1938). The clean surplus relation says that dividends equal

earnings minus the change in book equity, $D_{it+\tau} = Y_{it+\tau} - \triangle Be_{it+\tau}$, in which $Y_{it+\tau}$ is earnings, and

$\triangle Be_{it+\tau} \equiv Be_{it+\tau} - Be_{it+\tau-1}$ the change in book equity. The dividend discounting model becomes:

$$\frac{P_{it}}{Be_{it}} = \frac{\sum_{\tau=1}^{\infty} E[Y_{it+\tau} - \triangle Be_{it+\tau}]/(1+r_i)^\tau}{Be_{it}}. \tag{2}$$

Fama and French (2015) make three predictions based on equation (2). First, fixing every-

thing except the current market value, P_{it}, and the expected stock return, r_i, a low P_{it}, or a high

book-to-market equity, Be_{it}/P_{it}, implies a high expected return. Second, fixing everything except

the expected profitability and the expected stock return, high expected profitability implies a high

expected return. Finally, fixing everything except the expected book equity growth (expected in-

vestment) and the expected return, high expected book equity growth implies a low expected return.

We emphasize that equation (2) connects book-to-market, investment, and profitability to the

internal rate of return. However, Fama and French (2015) argue that the difference between the 1-

period-ahead expected return and the internal rate of return is unimportant.[10] Empirically, Fama

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[9]For example, in a recent survey from the behavioral perspective, Lee and So (2015) acknowledge: "Be forewarned: none of these [behavioral] studies will provide a clean one-to-one mapping between the investor psychology literature and specific market anomalies. Rather, their goal is to simply set out the experimental evidence from psychology, sociology, and anthropology. The hope is that, thus armed, financial economists would be more attuned to, and more readily recognize, certain market phenomena as manifestations of these enduring human foibles (p. 69)."

[10]In particular, Fama and French (2015) argue: "Most asset pricing research focuses on short-horizon returns—we use a one-month horizon in our tests. If each stock's short-horizon expected return is positively related to its internal

and French use profitability as a proxy for the expected profitability to form RMW, and asset growth as a proxy for the expected investment to form CMA.

We raise four concerns on the Fama-French (2015) motivation. First, the internal rate of return can differ drastically from, and can even correlate negatively with the 1-period-ahead expected return (Section 4.1). Second, HML is a separate factor from CMA in the Fama-French setup, but is redundant in explaining average returns in the data (Section 4.2). Third, CMA can only arise from the market-to-book term, P_{it}/Be_{it}, in equation (2). In particular, the expected book equity growth is positively correlated with the 1-period-ahead expected return (Section 4.3). Finally, past investment is a poor proxy for the expected investment (Section 4.4).

4.1 The Internal Rate of Return Is Not the 1-period-ahead Expected Return

The Fama-French (2015) assumption that the expected return is the same for all horizons contradicts the notion of time-varying expected returns. The internal rate of return (IRR) can differ greatly from the 1-period ahead expected return. The difference is most striking in the context of price and earnings momentum. Chan, Jegadeesh, and Lakonishok (1996) show that momentum profits are short-lived, large, and positive for up to 12 months, but negative afterward. In contrast, Tang, Wu, and Zhang (2014) estimate price and earnings momentum to be significantly negative, once measured as the internal rate of return per Gebhardt, Lee, and Swaminathan (2001).

To quantify how the IRRs deviate from 1-period-ahead average returns, we estimate the IRRs for the Fama-French (2015) SMB, HML, RMW, and CMA per Claus and Thomas (2001), Gebhardt, Lee, and Swaminathan (2001), Easton (2004), and Ohlson and Juettner-Nauroth (2005). Although differing in implementation details, these methods all share the basic idea of backing out the IRRs from different versions of the valuation equation (2). Appendix B details the estimation procedures.

The baseline versions of these accounting methods all use analysts' earnings forecasts to predict

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rate of return—if, for example, the expected return is the same for all horizons—the valuation equation implies that the cross-section of expected returns is determined by the combination of current prices and expectations of future dividends. The decomposition of cash flows then implies that each stock's relevant expected return is determined by its price-to-book ratio and expectations of its future profitability and investment (p. 2)."

future profitability. Because analysts' forecasts are limited to a relatively small sample and are likely even biased, we also implement two modified procedures. The Hou-van Dijk-Zhang (2012) modification uses pooled cross-sectional regressions to forecast future earnings, and the Tang-Wu-Zhang (2014) modification uses annual cross-sectional regressions to forecast future profitability.

Empirically, we measure one period as one year, and compare the average factor IRRs at the June end of each year t with the annual average factor returns from the July of year t to the June of year $t+1$. Panel A of Table 8 reports that the IRRs estimated with analysts' earnings forecasts for RMW differ significantly from their 1-period-ahead average returns. The differences for RMW are significant in 12 out of the 12 experiments from intersecting the three expected Roe estimation procedures with the four accounting models. The IRRs of RMW are even significantly negative in eight experiments, in contrast to the average returns that are significantly positive in all 12.

Averaging across the four IRR models implemented with analysts' earnings forecasts, the IRR for the RMW is -1.58% per annum ($t = -9.66$), whereas its 1-period-ahead average return is 4.52% ($t = 2.88$). The contrast from implementing the accounting models with cross-sectional earnings forecasts is largely similar, -1.84% ($t = -9.41$) versus 3.61% ($t = 2.66$). With cross-sectional Roe forecasts, the contrast is between -2.47% ($t = -21.47$) versus 3.14% ($t = 2.54$).

Table 8 also reports important IRR-average-return differences for CMA, although not as drastic as the differences for RMW. The differences for CMA are significant for six out of 12 experiments. Finally, without going through the details, we can report that, consistent with Tang, Wu, and Zhang (2014), the IRR-average-return differences for SMB and HML are mostly insignificant.

4.2 The Relation between Investment and Book-to-market Equity

Fama and French (2015) argue that market-to-book, expected profitability, and expected investment give rise to three separate factors in equation (2). However, empirically, once RMW and CMA are added to their three-factor model, Fama and French report that HML becomes redundant in describing average returns in the data. This evidence contradicts their conceptual argument.

However, the evidence accords well with the investment CAPM underlying the q-factor model. Intuitively, the marginal cost of investment (which increases with investment-to-assets) equals marginal q (the value of an extra unit of capital). With constant returns to scale, marginal q equals average q (Hayashi 1982), which is in turn highly correlated with market-to-book equity. This tight economic linkage between investment and value implies that HML should be highly correlated with the investment factor. From January 1967 to December 2016, the correlation between HML and CMA is 0.69, and the correlation between HML and the investment factor in the q-factor model is 0.67 (Table 5). The conceptual linkage between investment and value also means that CMA can be motivated from the market-to-book term in the valuation equation (2), barring the difference between the internal rate of return and the 1-period-ahead expected return (Section 4.1).

4.3   The Relations between Past Investment, the Expected Investment, and the Expected Return

Fama and French (2015) argue that equation (2) predicts a negative relation between the expected investment and the internal rate of return. However, this negative relation does not apply to the 1-period-ahead expected return, $E_t[r_{it+1}]$. From the definition of return, $P_{it} = (E_t[D_{it+1}] + E_t[P_{it+1}])/(1 + E_t[r_{it+1}])$, and the clean surplus relation, we can reformulate the valuation equation (2) in terms of the 1-period-ahead expected return as:

$$P_{it} = \frac{E_t[Y_{it+1} - \triangle Be_{it+1}] + E_t[P_{it+1}]}{1 + E_t[r_{it+1}]}. \tag{3}$$

Dividing both sides of equation (3) by Be_{it} and rearranging, we obtain:

$$\frac{P_{it}}{Be_{it}} = \frac{E_t\left[\frac{Y_{it+1}}{Be_{it}}\right] - E_t\left[\frac{\triangle Be_{it+1}}{Be_{it}}\right] + E_t\left[\frac{P_{it+1}}{Be_{it+1}}\left(1 + \frac{\triangle Be_{it+1}}{Be_{it}}\right)\right]}{1 + E_t[r_{it+1}]}, \tag{4}$$

$$\frac{P_{it}}{Be_{it}} = \frac{E_t\left[\frac{Y_{it+1}}{Be_{it}}\right] + E_t\left[\frac{\triangle Be_{it+1}}{Be_{it}}\left(\frac{P_{it+1}}{Be_{it+1}} - 1\right)\right] + E_t\left[\frac{P_{it+1}}{Be_{it+1}}\right]}{1 + E_t[r_{it+1}]}. \tag{5}$$

Fixing everything except $E_t[\triangle Be_{it+1}/Be_{it}]$ and $E_t[r_{it+1}]$, high $E_t[\triangle Be_{it+1}/Be_{it}]$ implies *high* $E_t[r_{it+1}]$, because $P_{it+1}/Be_{it+1} - 1$ tends to be positive in the data. This prediction is consistent with

the weakly positive $E_t\left[\triangle Be_{it+1}/Be_{it}\right]$-$E_t[r_{it+1}]$ relation documented in Fama and French (2006).

The relation between the expected investment and the expected return is also positive in the investment CAPM, forming the conceptual foundation behind the expected growth factor (Hou, Mo, Xue, and Zhang 2018). As such, the prediction from the valuation equation (2), once reformulated in terms of the 1-period-ahead expected return, is consistent with the investment CAPM.

4.4 Past Investment Is a Poor Proxy for the Expected Investment

After motivating CMA from the expected investment effect, Fama and French (2015) use past investment as a proxy for the expected investment. This procedure seems problematic. Whereas past profitability is a good proxy for the expected profitability, past investment is a poor proxy for the expected investment. A large economics literature on lumpy investment emphasizes the lack of persistence of micro-level investment data (Dixit and Pindyck 1994; Doms and Dunne 1998; Whited 1998).

To show the poor quality of past investment as a proxy for the expected investment, we adopt the Fama-French (2006) setup, and perform annual cross-sectional regressions of future book equity growth rates, $\triangle Be_{it+\tau}/Be_{it+\tau-1} \equiv (Be_{it+\tau} - Be_{it+\tau-1})/Be_{it+\tau-1}$, for $\tau = 1, 2, \ldots, 10$, on the current asset growth, $\triangle A_{it}/A_{it-1} = (A_{it} - A_{it-1})/A_{it-1}$, and, separately, on book equity growth, $\triangle Be_{it}/Be_{it-1}$. For comparison, we also report annual cross-sectional regressions of future operating profitability, $Op_{it+\tau}$, on operating profitability, Op_{it}. Following Fama and French, we include all common stocks traded on NYSE, Amex, and NASDAQ from 1963 to 2016, including financial firms. We measure book equity per Davis, Fama, and French (2000) (footnote 2) and operating profitability per Fama and French (2015). Variables dated t are from the fiscal year ending in calendar year t. Firms with total assets below \$5 million or book equity below \$2.5 million in year t are excluded in Panel A of Table 9. The cutoffs are \$25 million and \$12.5 million, respectively, in Panel B. The right- and left-hand side variables in the regressions are winsorized each year at the 1–99% level.

Asset growth does not predict future book equity growth. In Panel A in Table 9, the slope starts at 0.22 at the 1-year horizon, drops to 0.06 in year three and to 0.04 in year five. The average

R^2 of the cross-sectional regressions starts at 5% in year one, drops to zero in year four, and stays at zero for the remaining years. Book equity growth does not predict future book equity growth either. The slope starts at 0.2 at the one-year horizon, drops to 0.06 in year three and to 0.02 in year five. The average R^2 of the cross-sectional regressions starts at 6% in year one, drops to zero in year four, and stays at zero for the remaining years. The results with the more stringent sample criterion in Panel B are largely similar. The evidence casts doubt on the motivation of CMA from the expected investment effect, but lends support to our reinterpretation of CMA as the substitute for the value effect via the market-to-book term in the valuation equation (2).

The last five columns in Table 9 show that operating profitability forecasts future operating profitability. In Panel A, the slope in the annual cross-sectional regressions starts with 0.8 in year one, drops to 0.59 in year three and 0.49 in year five, and remains at 0.38 even in year ten. The average R^2 starts at 54% in year one, drops to 27% in year three and 19% in year five, and remains above 10% in year ten. The evidence with the more stringent sample criterion in Panel B is largely similar. As such, using past profitability as a proxy for the expected profitability is sensible, but using past investment as a proxy for the expected investment is not.

5   Conclusion

Many recently proposed, seemingly different factor modes are closely related. In factor spanning tests, the q-factor model largely subsumes the Fama-French (2015, 2018) 5- and 6-factor models. The Stambaugh-Yuan (2017) factors are sensitive to their construction, and once replicated via the standard approach, are close to the q-factors, with correlations of 0.8 and 0.84. Neither the original nor the replicated Stambaugh-Yuan model can explain the q and q^5 factors in the Gibbons-Ross-Shanken (1989) test, but the q^5 model can explain both their original and replicated factors. The Daniel-Hirshleifer-Sun (2018) factors are also sensitive to their construction, and once replicated via the standard approach, are close to the q-factors, with correlations of 0.69. Their 3-factor model cannot explain the size, investment, and expected growth factors, but the q and q^5 models

cannot explain their earnings factor. Finally, the Barillas-Shanken (2018) model, which embeds the investment and Roe factors from the q-factor model, cannot explain the expected growth factor in the q^5 model. Although the q-factor model cannot explain the Asness-Frazzini (2013) monthly formed HML factor in the Barillas-Shanken specification, the monthly formed q-factor model can.

Conceptually, the Stambaugh-Yuan (2017), Daniel-Hirshleifer-Sun (2018), and Fama-French (2018) 6-factor models are mostly empirical in nature. We show that the Fama-French 5-factor model cannot be motivated from valuation theory as originally advertised. In particular, once reformulated with the 1-period-ahead expected return, valuation theory implies a positive relation between the expected investment and the expected return, consistent with the investment CAPM.

References

Asness, Clifford, and Andrea Frazzini, 2013, The devil in HML's details, *Journal of Portfolio Management* 39, 49–68.

Ball, Ray, Joseph Gerakos, Juhani Linnainmaa, and Valeri Nikolaev, 2016, Accruals, cash flows, and operating profitability in the cross section of stock returns, *Journal of Financial Economics* 121, 28–45.

Barillas, Francisco, and Jay Shanken, 2018, Comparing asset pricing models, *Journal of Finance* 73, 715–754.

Campbell, John Y., Jens Hilscher, and Jan Szilagyi, 2008, In search of distress risk, *Journal of Finance* 63, 2899–2939.

Chan, Louis K. C., Narasimhan Jegadeesh, and Josef Lakonishok, 1996, Momentum strategies, *Journal of Finance* 51, 1681–1713.

Claus, James, and Jacob Thomas, 2001, Equity premia as low as three percent? Evidence from analysts' earnings forecasts for domestic and international stock markets, *Journal of Finance* 56, 1629–1666.

Cooper, Michael J., Huseyin Gulen, and Michael J. Schill, 2008, Asset growth and the cross-section of stock returns, *Journal of Finance* 63, 1609–1652.

Daniel, Kent D., David Hirshleifer, and Lin Sun, 2018, Short- and long-horizon behavioral factors, working paper, Columbia University, University of California at Irvine, and Florida State University.

Daniel, Kent D. 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.

Dixit, Avinash K., and Robert S. Pindyck, 1994, *Investment Under Uncertainty*, Princeton University Press: Princeton, New Jersey.

Doms, Mark, and Timothy Dunne, 1998, Capital adjustment patterns in manufacturing plants, *Review of Economic Dynamics* 1, 409–429.

Easton, Peter D., 2004, PE ratios, PEG ratios, and estimating the implied expected rate of return on equity capital, *The Accounting Review* 79, 73–95.

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, 2006, Profitability, investment, and average returns, *Journal of Financial Economics* 82, 491–518.

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.

Gebhardt, William R., Charles M. C. Lee, and Bhaskaram Swaminathan, 2001, Toward an implied cost of capital, *Journal of Accounting Research* 39, 135–176.

Gibbons, Michael R., Stephen A. Ross, and Jay Shanken, 1989, A test of the efficiency of a given portfolio, *Econometrica* 57, 1121–1152.

Hayashi, Fumio, 1982, Tobin's marginal q and average q: A neoclassical interpretation, *Econometrica* 50, 213–224.

Hou, Kewei, Haitao Mo, Chen Xue, and Lu Zhang, 2018, q^5, working paper, The Ohio State University.

Hou, Kewei, Chen Xue, and Lu Zhang, 2015, Digesting anomalies: An investment approach, *Review of Financial Studies* 28, 650–705.

Hou, Kewei, Chen Xue, and Lu Zhang, 2018, Replicating anomalies, working paper, The Ohio State University.

Hou, Kewei, Mathijs A. van Dijk, and Yinglei Zhang, 2012, The implied cost of capital: A new approach, *Journal of Accounting and Economics* 53, 504–526.

Jegadeesh, Narasimhan and Sheridan Titman, 1993, Returns to buying winners and selling losers: Implications for stock market efficiency, *Journal of Finance* 48, 65–91.

Lee, Charles M. C., and Eric C. So, 2015, Alphanomics: The informational underpinnings of market efficiency, *Foundations and Trends in Accounting* 9, 59–258.

Miller, Merton H., and Franco Modigliani, 1961, Dividend policy, growth, and the valuation of shares, *Journal of Business* 34, 411–433.

Ohlson, James A., 1995, Earnings, book values, and dividends in security valuation, *Contemporary Accounting Research* 18, 109–131.

Ohlson, James A., and Beate E. Juettner-Nauroth, 2005, Expected EPS and EPS growth as determinants of value, *Review of Accounting Studies* 10, 349–365.

Pontiff, Jeffrey, and Artemiza Woodgate, 2008, Share issuance and cross-sectional returns, *Journal of Finance* 63, 921–945.

Preinreich, Gabriel A. D., 1938, Annual survey of economic theory: The theory of depreciation, *Econometrica* 6, 219–241.

Stambaugh, Robert F., and Yu Yuan, 2017, Mispricing factors, *Review of Financial Studies* 30, 1270–1315.

Tang, Yue, Jin (Ginger) Wu, and Lu Zhang, 2013, Do anomalies exist ex ante? *Review of Finance* 18, 843–875.

Whited, Toni M., 1998, Why do investment Euler equations fail? *Journal of Business and Economic Statistics* 16, 479–488.

Williams, John B., 1938, *The Theory of Investment Value*, Harvard University Press.

Table 1 : Factor Spanning Tests, the q-factor and q^5 Models versus the Fama-French 5- and 6-factor Models, January 1967 to December 2016, 600 Months

$\overline{R}$ is a factor's average return, α the intercept from a spanning regression, and R^2 its goodness-of-fit coefficient. $R_{\text{Mkt}}, R_{\text{Me}}, R_{\text{I/A}}$, and R_{Roe} are the market, size, investment, and Roe factors in the q-factor model (q), respectively, and R_{Eg} the expected growth factor in the q^5 model (q^5). MKT, SMB, HML, RMW, and CMA are the market, size, value, profitability, and investment factors in the Fama-French 5-factor model (FF5), and UMD the momentum factor in the 6-factor model (FF6). Finally, RMWc is the cash-based profitability factor in the alternative specification of the 6-factor model (FF6c), in which RMW is replaced by RMWc. The t-values (reported in the rows beneath the corresponding estimates) are adjusted for heteroscedasticity and autocorrelations.

Panel A: Explaining the q and q^5 factors

	$\overline{R}$	α	MKT	SMB	HML	RMW	CMA	UMD	RMWc	R^2
R_{Me}	0.31	0.05	0.01	0.97	0.04	−0.03	0.02			95%
	2.43	1.53	0.88	68.35	1.85	−0.91	0.66			
		0.03	0.01	0.97	0.06	−0.03	0.01	0.03		95%
		0.85	1.35	71.18	3.01	−1.28	0.29	2.54		
		0.05	0.01	0.96	0.05		0.01	0.03	−0.07	95%
		1.37	0.62	74.88	2.92		0.51	2.75	−2.28	
$R_{\text{I/A}}$	0.41	0.12	0.01	−0.05	0.04	0.07	0.80			85%
	4.92	3.44	0.91	−3.19	1.63	2.48	29.30			
		0.11	0.01	−0.05	0.05	0.06	0.80	0.01		85%
		3.11	1.09	−3.17	2.12	2.22	30.79	0.82		
		0.11	0.01	−0.05	0.05		0.78	0.01	0.06	84%
		2.78	1.10	−3.13	2.22		27.89	0.81	1.49	
R_{Roe}	0.55	0.47	−0.03	−0.12	−0.24	0.70	0.10			51%
	5.25	5.94	−1.20	−2.92	−3.75	12.76	1.01			
		0.30	−0.00	−0.12	−0.10	0.65	−0.02	0.24		66%
		4.51	−0.01	−3.66	−2.04	14.69	−0.24	9.94		
		0.23	0.03	−0.10	−0.03		−0.18	0.24	0.72	54%
		2.80	1.41	−2.49	−0.49		−2.05	7.12	8.49	
R_{Eg}	0.82	0.78	−0.10	−0.14	−0.08	0.25	0.28			41%
	9.81	11.34	−5.62	−5.36	−2.62	5.19	5.43			
		0.70	−0.09	−0.14	−0.02	0.22	0.22	0.12		48%
		11.10	−5.43	−6.43	−0.54	5.43	5.12	6.42		
		0.61	−0.06	−0.10	−0.00		0.18	0.11	0.39	50%
		9.33	−3.41	−4.01	−0.01		3.87	5.77	6.73	

Panel B: Explaining the Fama-French factors

	$\overline{R}$	α	R_{Mkt}	R_{Me}	$R_{\text{I/A}}$	R_{Roe}	R_{Eg}	R^2
SMB	0.25	0.04	−0.01	0.95	−0.08	−0.09		95%
	1.93	1.42	−0.82	60.67	−4.48	−6.00		
		0.07	−0.01	0.94	−0.07	−0.08	−0.04	96%
		2.29	−1.32	61.42	−3.86	−4.44	−1.95	
HML	0.37	0.07	−0.04	0.02	1.02	−0.19		48%
	2.71	0.62	−0.96	0.24	12.11	−2.61		
		0.05	−0.03	0.02	1.01	−0.20	0.03	48%
		0.48	−0.90	0.26	11.50	−2.42	0.36	
UMD	0.65	0.12	−0.08	0.23	−0.00	0.91		28%
	3.61	0.50	−1.25	1.73	−0.02	5.90		
		−0.16	−0.03	0.27	−0.11	0.78	0.44	30%
		−0.78	−0.51	2.00	−0.60	4.40	2.62	
CMA	0.33	−0.00	−0.05	0.04	0.96	−0.10		85%
	3.51	−0.02	−3.77	1.91	33.56	−3.57		
		−0.04	−0.04	0.05	0.94	−0.12	0.06	85%
		−0.96	−3.14	2.12	35.60	−3.89	2.07	
RMW	0.26	0.01	−0.03	−0.12	0.03	0.54		48%
	2.50	0.08	−1.17	−1.71	0.38	8.50		
		−0.01	−0.03	−0.12	0.02	0.53	0.03	48%
		−0.16	−0.13	−1.59	0.28	7.85	0.42	
RMWc	0.33	0.25	−0.10	−0.18	0.09	0.29		56%
	4.16	3.83	−6.00	−5.25	2.02	9.88		
		0.14	−0.09	−0.17	0.05	0.23	0.18	58%
		2.18	−5.15	−4.45	0.93	6.55	4.27	

Panel C: GRS statistics and their p-values testing that the alphas of a key set of factors are jointly zero

	$\alpha_{\text{I/A}}, \alpha_{\text{Roe}}$			$\alpha_{\text{I/A}}, \alpha_{\text{Roe}}, \alpha_{\text{Eg}}$			$\alpha_{\text{HML}}, \alpha_{\text{CMA}}, \alpha_{\text{RMW}}$		$\alpha_{\text{HML}}, \alpha_{\text{CMA}}, \alpha_{\text{RMW}}, \alpha_{\text{UMD}}$		$\alpha_{\text{HML}}, \alpha_{\text{CMA}}, \alpha_{\text{RMWc}}, \alpha_{\text{UMD}}$	
	FF5	FF6	FF6c	FF5	FF6	FF6c	q	q^5	q	q^5	q	q^5
GRS	22.72	14.60	8.20	55.14	48.85	36.59	0.20	0.62	0.36	0.65	6.14	1.81
p	0.00	0.00	0.00	0.00	0.00	0.00	0.90	0.60	0.84	0.62	0.00	0.13

Table 2 : Factor Spanning Tests, the q-factor and q^5 Models versus the Stambaugh-Yuan Model, January 1967 to December 2016, 600 Months

$\overline{R}$ is the average return, α the intercept, and R^2 its goodness-of-fit coefficient. $R_{\text{Mkt}}, R_{\text{Me}}, R_{\text{I/A}}$, and R_{Roe} are the market, size, investment, and Roe factors in the q-factor and q^5 models, respectively, and R_{Eg} the expected growth factor in the q^5 model. MKT, SMB, MGMT, and PERF are the market, size, management, and performance factors in the Stambaugh-Yuan model. The t-values (reported in the rows beneath the corresponding estimates) are adjusted for heteroscedasticity and autocorrelations.

Panel A: Explaining the q and q^5 factors

	$\overline{R}$	α	MKT	SMB	MGMT	PERF	R^2
				Original Stambaugh-Yuan factors			
R_{Me}	0.31	−0.04	−0.01	0.97	−0.06	−0.06	87%
	2.43	−0.65	−0.67	25.97	−1.71	−2.98	
$R_{\text{I/A}}$	0.41	0.08	0.01	0.05	0.53	−0.02	61%
	4.92	1.26	0.52	2.35	15.99	−1.06	
R_{Roe}	0.55	0.33	0.02	−0.20	0.02	0.42	46%
	5.25	3.55	0.73	−3.44	0.42	11.65	
R_{Eg}	0.82	0.55	−0.03	−0.10	0.29	0.21	53%
	9.81	9.04	−1.76	−3.92	12.19	10.72	

	$\alpha_{\text{I/A}}, \alpha_{\text{Roe}} = 0$	$\alpha_{\text{I/A}}, \alpha_{\text{Roe}}, \alpha_{\text{Eg}} = 0$
GRS	8.16	30.24
p	0.00	0.00

	$\overline{R}$	α	MKT	SMB	MGMT	PERF	R^2
				Replicated Stambaugh-Yuan factors			
R_{Me}	0.31	0.01	−0.04	0.95	−0.03	0.10	92%
	2.43	0.18	−2.51	29.43	−1.00	4.23	
$R_{\text{I/A}}$	0.41	0.07	0.00	0.05	0.70	−0.02	71%
	4.92	1.41	−0.08	2.77	26.78	−0.85	
R_{Roe}	0.55	0.32	0.01	−0.16	−0.04	0.59	67%
	5.25	4.71	0.50	−4.54	−0.82	20.03	
R_{Eg}	0.82	0.58	−0.05	−0.09	0.35	0.25	57%
	9.81	10.25	−3.29	−4.48	13.57	9.03	

	$\alpha_{\text{I/A}}, \alpha_{\text{Roe}} = 0$	$\alpha_{\text{I/A}}, \alpha_{\text{Roe}}, \alpha_{\text{Eg}} = 0$
GRS	12.12	41.27
p	0.00	0.00

Panel B: Explaining the Stambaugh-Yuan factors

	$\overline{R}$	α	R_{Mkt}	R_{Me}	$R_{\text{I/A}}$	R_{Roe}	R_{Eg}	R^2
				Original Stambaugh-Yuan factors				
SMB	0.44	0.16	0.01	0.86	−0.01	0.01		86%
	3.60	3.37	0.57	31.16	−0.23	0.45		
		0.14	0.01	0.87	−0.02	−0.00	0.04	86%
		2.43	0.81	30.92	−0.50	−0.03	0.97	
MGMT	0.61	0.36	−0.17	−0.15	1.00	−0.06		69%
	4.72	4.73	−7.95	−5.02	18.59	−1.33		
		0.12	−0.13	−0.11	0.90	−0.18	0.38	73%
		1.64	−6.70	−4.15	18.76	−3.91	7.61	
PERF	0.68	0.34	−0.18	0.11	−0.30	0.95		45%
	4.20	2.00	−4.22	1.35	−2.02	10.42		
		0.01	−0.12	0.15	−0.44	0.79	0.53	49%
		0.05	−3.17	1.95	−3.06	8.40	4.80	

	$\alpha_{\text{MGMT}}, \alpha_{\text{PERF}} = 0$ in q	$\alpha_{\text{MGMT}}, \alpha_{\text{PERF}} = 0$ in q^5
GRS	17.16	1.46
p	0.00	0.23

	$\overline{R}$	α	R_{Mkt}	R_{Me}	$R_{\text{I/A}}$	R_{Roe}	R_{Eg}	R^2
				Replicated Stambaugh-Yuan factors				
SMB	0.31	0.06	0.06	0.94	0.04	−0.16		93%
	2.13	1.13	3.37	18.96	0.86	−4.94		
		0.09	0.06	0.93	0.05	−0.15	−0.05	93%
		1.72	3.28	18.52	1.08	−3.94	−1.54	
MGMT	0.47	0.20	−0.09	−0.10	0.92	−0.06		75%
	4.68	3.59	−5.82	−4.10	22.65	−1.68		
		−0.02	−0.05	−0.07	0.83	−0.17	0.36	79%
		−0.38	−4.21	−3.30	23.50	−5.28	9.79	
PERF	0.49	0.03	−0.08	0.08	−0.15	1.00		65%
	3.67	0.28	−2.87	1.85	−1.72	13.97		
		−0.19	−0.05	0.11	−0.24	0.89	0.35	68%
		−1.87	−1.62	2.63	−2.91	11.57	4.85	

	$\alpha_{\text{MGMT}}, \alpha_{\text{PERF}} = 0$ in q	$\alpha_{\text{MGMT}}, \alpha_{\text{PERF}} = 0$ in q^5
GRS	7.96	2.38
p	0.00	0.09

Table 3 : Factor Spanning Tests, the q-factor and q^5 Models versus the Daniel-Hirshleifer-Sun (2018) Model, January 1967 to December 2016

$\overline{R}$ is the average return, α the intercept, and R^2 its goodness-of-fit coefficient. $R_{\text{Mkt}}, R_{\text{Me}}, R_{\text{I/A}}$, and R_{Roe} are the market, size, investment, and Roe factors in the q-factor and q^5 models, respectively, and R_{Eg} the expected growth factor in the q^5 model. MKT, FIN, and PEAD are the market, financing, and post-earnings-announcement-draft factors in the Daniel-Hirshleifer-Sun model. The t-values (reported in the rows beneath the corresponding estimates) are adjusted for heteroscedasticity and autocorrelations.

	Panel A: Explaining the q and q^5 factors							Panel B: Explaining the Daniel-Hirshleifer-Sun factors							
	$\overline{R}$	α	MKT	FIN	PEAD	R^2		$\overline{R}$	α	MKT	R_{Me}	$R_{\text{I/A}}$	R_{Roe}	R_{Eg}	R^2
							Reproduced Daniel-Hirshleifer-Sun factors (July 1972–December 2016)								
R_{Me}	0.27	0.46	0.06	−0.24	−0.04	13%	FIN	0.83	0.33	−0.17	−0.21	1.15	0.33		59%
	2.03	3.11	1.10	−2.23	−0.28			4.55	2.67	−4.11	−2.36	11.45	3.89		
$R_{\text{I/A}}$	0.41	0.18	−0.03	0.29	−0.01	43%			0.14	−0.14	−0.19	1.08	0.24	0.30	60%
	4.69	2.56	−1.33	10.21	−0.21				1.12	−3.47	−2.02	10.77	2.57	3.50	
R_{Roe}	0.54	0.10	0.01	0.24	0.38	20%	PEAD	0.62	0.56	−0.04	0.05	−0.08	0.19		8%
	4.80	0.83	0.17	4.15	3.66			7.73	5.66	−1.64	0.84	−1.06	3.53		
R_{Eg}	0.83	0.56	−0.08	0.22	0.21	37%			0.47	−0.03	0.06	−0.11	0.15	0.15	9%
	9.44	7.42	−4.49	8.36	5.20				5.32	−1.17	1.02	−1.42	2.15	1.95	
	$\alpha_{\text{I/A}}, \alpha_{\text{Roe}} = 0$			$\alpha_{\text{I/A}}, \alpha_{\text{Roe}}, \alpha_{\text{Eg}} = 0$				$\alpha_{\text{FIN}}, \alpha_{\text{PEAD}} = 0$ in q				$\alpha_{\text{FIN}}, \alpha_{\text{PEAD}} = 0$ in q^5			
GRS		4.89			23.90					29.67					14.99
p		0.01			0.00					0.00					0.00
							Replicated Daniel-Hirshleifer-Sun factors (January 1967–December 2016)								
R_{Me}	0.31	0.63	0.00	−0.46	−0.24	23%	FIN	0.32	0.00	−0.16	−0.22	0.86	0.22		69%
	2.43	4.25	0.07	−3.76	−3.20			2.53	0.01	−6.90	−3.94	14.01	4.23		
$R_{\text{I/A}}$	0.41	0.32	0.00	0.44	−0.07	48%			−0.05	−0.15	−0.22	0.84	0.19	0.09	69%
	4.92	4.34	−0.14	8.97	−1.99				−0.65	−6.97	−3.61	12.37	3.26	1.45	
R_{Roe}	0.55	−0.14	0.04	0.32	0.78	58%	PEAD	0.72	0.43	0.00	0.02	−0.11	0.61		48%
	5.25	−1.91	1.65	5.98	18.90			7.78	5.13	0.00	0.52	−1.71	11.76		
R_{Eg}	0.82	0.54	−0.08	0.28	0.31	47%			0.31	0.02	0.03	−0.15	0.55	0.18	49%
	9.81	7.45	−4.64	8.26	8.59				4.07	0.96	0.98	−2.36	8.98	2.89	
	$\alpha_{\text{I/A}}, \alpha_{\text{Roe}} = 0$			$\alpha_{\text{I/A}}, \alpha_{\text{Roe}}, \alpha_{\text{Eg}} = 0$				$\alpha_{\text{FIN}}, \alpha_{\text{PEAD}} = 0$ in q				$\alpha_{\text{FIN}}, \alpha_{\text{PEAD}} = 0$ in q^5			
GRS		14.27			35.37					20.44					8.67
p		0.00			0.00					0.00					0.00

Table 4 : Factor Spanning Tests, the q-factor and q^5 Models versus the Barillas-Shanken (2018) 6-factor Models, January 1967 to December 2016

$\overline{R}$ is a factor's average return, α the intercept from a spanning regression, and R^2 its goodness-of-fit coefficient. $R_{\mathrm{Mkt}}, R_{\mathrm{Me}}, R_{\mathrm{I/A}}$, and R_{Roe} are the market, size, investment, and Roe factors in the q-factor and q^5 models, respectively, and R_{Eg} the expected growth factor in the q^5 model. MKT, SMB, UMD, and $\mathrm{HML^m}$ are the market, size, momentum, and the Asness-Frazzini monthly formed HML factor in the Barillas-Shanken model. The t-values (reported in the rows beneath the corresponding estimates) are adjusted for heteroscedasticity and autocorrelations.

Panel A: Regressing the q^5 factors on the Barillas-Shanken factors

	$\overline{R}$	α	MKT	SMB	$R_{\mathrm{I/A}}$	R_{Roe}	UMD	$\mathrm{HML^m}$	R^2
R_{Me}	0.31	−0.04	0.02	1.00	0.03	0.09	0.02	0.05	95%
	2.43	−1.08	1.79	60.21	1.11	2.98	1.85	2.01	
R_{Eg}	0.82	0.60	−0.10	−0.11	0.18	0.25	0.09	0.06	50%
	9.81	8.78	−5.80	−4.77	4.50	5.90	3.54	2.00	

Panel B: Regressing the Asness-Frazzini HML factor on the q-factor and q^5 models

	$\overline{R}$	α	R_{Mkt}	R_{Me}	$R_{\mathrm{I/A}}$	R_{Roe}	R_{Eg}	R^2
$\mathrm{HML^m}$	0.34	0.37	−0.01	−0.10	0.93	−0.69		48%
	2.13	2.36	−0.12	−0.95	8.18	−6.78		
		0.41	−0.01	−0.10	0.95	−0.67	−0.08	48%
		2.99	−0.30	−0.98	7.72	−5.61	−0.72	

Table 5 : Correlation Matrix, January 1967 to December 2016

$R_{\text{Mkt}}, R_{\text{Me}}, R_{\text{I/A}},$ and R_{Roe} are the market, size, investment, and Roe factors in the q-factor and q^5 models, respectively, and R_{Eg} the expected growth factor in the q^5 model. SMB, HML, RMW, and CMA are the size, value, profitability, and investment factors in the Fama-French 5- and 6-factor models, respectively, and UMD the momentum factor in the 6-factor model. RMWc is the cash-based profitability factor in the alternative specification of the 6-factor model, in which RMW is replaced by RMWc. MGMT and PERF are the management and performance factors in the replicated Stambaugh-Yuan model in our sample, and FIN and PEAD the financing and post-earnings-announcement drift factors in the replicated Daniel-Hirshleifer-Sun model, respectively. The p-values testing that a given correlation equals zero are reported in the rows beneath the correlations.

	R_{Me}	$R_{\text{I/A}}$	R_{Roe}	R_{Eg}	SMB	HML	RMW	CMA	UMD	RMWc	MGMT	PERF	FIN	PEAD	HML$^{\text{m}}$
R_{Mkt}	0.27	−0.38	−0.21	−0.47	0.28	−0.27	−0.24	−0.40	−0.15	−0.48	−0.49	−0.23	−0.57	−0.11	−0.12
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00
R_{Me}		−0.15	−0.31	−0.37	0.97	−0.04	−0.37	−0.05	−0.02	−0.53	−0.28	−0.20	−0.44	−0.18	0.00
		0.00	0.00	0.00	0.00	0.30	0.00	0.21	0.59	0.00	0.00	0.00	0.00	0.00	0.94
$R_{\text{I/A}}$			0.04	0.38	−0.19	0.67	0.10	0.91	0.03	0.26	0.84	−0.02	0.69	−0.07	0.49
			0.34	0.00	0.00	0.00	0.02	0.00	0.53	0.00	0.00	0.55	0.00	0.10	0.00
R_{Roe}				0.52	−0.37	−0.14	0.67	−0.09	0.50	0.57	0.05	0.80	0.34	0.69	−0.45
				0.00	0.00	0.00	0.00	0.03	0.00	0.00	0.25	0.00	0.00	0.00	0.00
R_{Eg}					−0.42	0.19	0.43	0.33	0.35	0.59	0.54	0.51	0.54	0.40	−0.06
					0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.18
SMB						−0.09	−0.37	−0.09	−0.05	−0.53	−0.31	−0.22	−0.47	−0.22	−0.01
						0.04	0.00	0.03	0.21	0.00	0.00	0.00	0.00	0.00	0.77
HML							0.10	0.69	−0.19	0.17	0.66	−0.23	0.64	−0.29	0.78
							0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RMW								−0.02	0.11	0.76	0.17	0.54	0.53	0.25	−0.05
								0.70	0.01	0.00	0.00	0.00	0.00	0.00	0.21
CMA									0.00	0.18	0.83	−0.08	0.63	−0.14	0.51
									0.97	0.00	0.00	0.04	0.00	0.00	0.00
UMD										0.17	0.03	0.71	0.03	0.70	−0.65
										0.00	0.46	0.00	0.46	0.00	0.00
RMWc											0.37	0.46	0.63	0.27	0.00
											0.00	0.00	0.00	0.00	0.96
MGMT												0.04	0.80	−0.05	0.49
												0.36	0.00	0.18	0.00
PERF													0.22	0.70	−0.63
													0.00	0.00	0.00
FIN														0.02	0.43
														0.59	0.00
PEAD															−0.61
															0.00

Table 6 : Factor Spanning Tests, the Monthly Formed q-factor and q^5 Models versus the Fama-French 5- and 6-factor Models, January 1967 to December 2016, 600 Months

$\overline{R}$ is a factor's average return, α the intercept from a spanning regression, and R^2 its goodness-of-fit coefficient. R_{Mkt}, R^{m}_{Me}, $R^{\text{m}}_{\text{I/A}}$, and $R^{\text{m}}_{\text{Roe}}$ are the market, size, investment, and Roe factors in the monthly formed q-factor model (q_{m}), respectively, and R_{Eg} the (monthly formed) expected growth factor in the q^5 model (q^5_{m}). MKT, SMB, HML, RMW, and CMA are the market, size, value, profitability, and investment factors in the Fama-French 5-factor model (FF5), and UMD the momentum factor in the 6-factor model (FF6). Finally, RMWc is the cash-based profitability factor in the alternative 6-factor model (FF6c), in which RMW is replaced by RMWc. The t-values (in the rows beneath the corresponding estimates) are adjusted for heteroscedasticity and autocorrelations.

Panel A: Explaining the monthly formed q factors

	$\overline{R}$	α	MKT	SMB	HML	RMW	CMA	UMD	RMWc	R^2
R^{m}_{Me}	0.33	0.05	0.05	0.93	0.16	0.02	−0.11			90%
	2.49	1.13	3.05	33.58	4.36	0.35	−2.45			
		0.11	0.04	0.94	0.11	0.04	−0.07	−0.09		92%
		2.76	2.83	40.11	3.97	1.10	−1.99	−5.13		
		0.12	0.03	0.93	0.12		−0.08	−0.09	0.01	92%
		2.92	2.44	36.95	3.70		−2.07	−5.02	0.17	
$R^{\text{m}}_{\text{I/A}}$	0.50	0.21	−0.00	−0.04	0.11	0.07	0.76			78%
	5.73	4.56	−0.44	−1.81	4.82	2.00	15.56			
		0.20	−0.00	−0.04	0.11	0.07	0.75	0.01		78%
		3.98	−0.35	−1.83	4.60	2.09	17.01	0.32		
		0.22	−0.01	−0.05	0.12		0.73	0.01	0.01	78%
		4.27	−0.75	−2.37	4.74		18.98	0.44	0.33	
$R^{\text{m}}_{\text{Roe}}$	0.57	0.46	−0.03	−0.11	−0.22	0.74	0.12			52%
	5.23	5.84	−1.15	−2.72	−3.38	13.34	1.28			
		0.30	−0.00	−0.12	−0.09	0.68	0.02	0.23		66%
		4.30	−0.06	−3.43	−1.69	14.74	0.24	8.33		
		0.24	0.03	−0.10	−0.01		−0.16	0.24	0.73	52%
		2.70	1.21	−2.31	−0.16		−1.70	6.26	7.57	

Panel B: Explaining the Fama-French factors

	$\overline{R}$	α	R_{Mkt}	R^{m}_{Me}	$R^{\text{m}}_{\text{I/A}}$	$R^{\text{m}}_{\text{Roe}}$	R_{Eg}	R^2
SMB	0.25	0.03	−0.03	0.93	−0.09	−0.05		89%
	1.93	0.49	−1.78	38.76	−1.61	−1.16		
		0.03	−0.03	0.93	−0.08	−0.05	−0.01	89%
		0.57	−1.75	36.25	−1.59	−1.00	−0.20	
HML	0.37	−0.05	−0.03	0.07	0.97	−0.13		50%
	2.71	−0.45	−0.95	1.54	15.15	−1.66		
		−0.01	−0.04	0.06	0.99	−0.11	−0.07	50%
		−0.12	−1.14	1.35	14.26	−1.25	−0.90	
UMD	0.65	0.30	−0.05	−0.04	−0.11	0.77		24%
	3.61	1.12	−0.79	−0.37	−0.50	4.35		
		0.04	−0.01	0.01	−0.22	0.64	0.43	25%
		0.18	−0.20	0.07	−1.01	3.15	2.50	
CMA	0.33	−0.02	−0.05	0.02	0.83	−0.09		77%
	3.51	−0.51	−3.79	0.94	28.25	−2.62		
		−0.03	−0.05	0.02	0.83	−0.09	0.00	77%
		−0.52	−3.48	0.93	29.65	−2.37	0.10	
RMW	0.26	−0.05	−0.03	−0.06	0.05	0.57		48%
	2.50	−0.53	−1.15	−1.32	0.62	8.13		
		−0.06	−0.03	−0.06	0.04	0.56	0.02	49%
		−0.69	−1.13	−1.17	0.56	7.31	0.28	
RMWc	0.33	0.25	−0.11	−0.16	0.06	0.28		53%
	4.16	3.33	−5.74	−6.05	1.28	7.29		
		0.13	−0.09	−0.14	0.00	0.22	0.20	55%
		1.93	−5.10	−5.02	0.09	4.88	4.48	

Panel C: GRS statistics and their p-values testing that the alphas of a key set of factors are jointly zero

	$\alpha^{\text{m}}_{\text{I/A}}, \alpha^{\text{m}}_{\text{Roe}}$			$\alpha^{\text{m}}_{\text{I/A}}, \alpha^{\text{m}}_{\text{Roe}}, \alpha_{\text{Eg}}$			$\alpha_{\text{HML}}, \alpha_{\text{CMA}}, \alpha_{\text{RMW}}$		$\alpha_{\text{HML}}, \alpha_{\text{CMA}}, \alpha_{\text{RMW}}, \alpha_{\text{UMD}}$		$\alpha_{\text{HML}}, \alpha_{\text{CMA}}, \alpha_{\text{RMWc}}, \alpha_{\text{UMD}}$	
	FF5	FF6	FF6c	FF5	FF6	FF6c	q_{m}	q^5_{m}	q_{m}	q^5_{m}	q_{m}	q^5_{m}
GRS	28.26	20.15	15.16	55.07	48.67	36.92	0.32	0.36	0.90	0.27	7.61	1.67
p	0.00	0.00	0.00	0.00	0.00	0.00	0.81	0.78	0.46	0.90	0.00	0.16

Table 7 : Factor Spanning Tests, the Monthly Formed q-factor and q^5 Models versus the Stambaugh-Yuan Model, the Daniel-Hirshleifer-Sun Model, and the Barillas-Shanken Model, January 1967 to December 2016, 600 Months

$\overline{R}$ is the average return, α the intercept, and R^2 its goodness-of-fit coefficient. $R_{\text{Mkt}}, R^m_{\text{Me}}, R^m_{\text{I/A}}$, and R^m_{Roe} are the market, size, investment, and Roe factors in the monthly formed q-factor model (q_m), respectively, and R_{Eg} the expected growth factor in the monthly formed q^5 model (q^5_m). In Panel A, MKT, SMB, MGMT, and PERF are the market, size, management, and performance factors in the Stambaugh-Yuan model, respectively. In Panel B, MKT, FIN, and PEAD are the market, financing, and post-earnings-announcement-draft factors in the Daniel-Hirshleifer-Sun model, respectively. In Panel C, MKT, SMB, UMD, and HML^m are the market, size, momentum, and the Asness-Frazzini monthly formed HML factor in the Barillas-Shanken model, respectively. The t-values (reported in the rows beneath the corresponding estimates) are adjusted for heteroscedasticity and autocorrelations.

Panel A: Replicated Stambaugh-Yuan factors

	$\overline{R}$	α	MKT	SMB	MGMT	PERF	R^2
R^m_{Me}	0.33	0.09	−0.03	0.94	−0.04	−0.01	96%
	2.49	3.47	−2.80	89.45	−2.14	−0.93	
$R^m_{\text{I/A}}$	0.50	0.10	0.00	0.08	0.81	−0.01	78%
	5.73	1.89	0.23	4.57	18.88	−0.52	
R^m_{Roe}	0.57	0.30	0.01	−0.15	0.02	0.60	67%
	5.23	4.32	0.51	−3.84	0.43	19.83	

	$\overline{R}$	α	R_{Mkt}	R^m_{Me}	$R^m_{\text{I/A}}$	R^m_{Roe}	R_{Eg}	R^2
SMB	0.31	−0.01	0.03	0.99	0.04	−0.09		97%
	2.13	−0.33	2.95	87.56	1.63	−4.52		
		−0.01	0.03	0.99	0.04	−0.09	−0.00	97%
		−0.27	2.81	84.35	1.68	−4.17	−0.06	
MGMT	0.47	0.11	−0.07	−0.11	0.90	−0.03		80%
	4.68	2.40	−5.21	−5.63	35.96	−1.18		
		−0.04	−0.05	−0.09	0.83	−0.11	0.25	83%
		−0.77	−3.94	−4.70	32.20	−3.52	8.36	
PERF	0.49	0.08	−0.06	−0.02	−0.17	0.95		65%
	3.67	0.64	−2.25	−0.60	−1.69	12.83		
		−0.12	−0.03	0.01	−0.26	0.86	0.33	67%
		−1.07	−1.22	0.34	−2.61	10.43	4.63	

	$\alpha^m_{\text{I/A}}, \alpha^m_{\text{Roe}} = 0$	$\alpha^m_{\text{I/A}}, \alpha^m_{\text{Roe}}, \alpha_{\text{Eg}} = 0$	$\alpha_{\text{MGMT}}, \alpha_{\text{PERF}} = 0$ in q_m	$\alpha_{\text{MGMT}}, \alpha_{\text{PERF}} = 0$ in q^5_m
GRS	11.65	41.49	3.45	1.27
p	0.00	0.00	0.03	0.28

				Panel B: Replicated Daniel-Hirshleifer-Sun factors										
	$\overline{R}$	α	MKT	FIN	PEAD	R^2			$\overline{R}$	α	MKT	R_{Me}^{m}	$R_{\text{I/A}}^{\text{m}}$	$R_{\text{Roe}}^{\text{m}}$	R_{Eg}	R^2
R_{Me}^{m}	0.33	0.71	0.05	−0.39	−0.38	26%		FIN	0.32	−0.08	−0.16	−0.17	0.78	0.27		67%
	2.49	5.14	1.31	−6.10	−5.21				2.53	−0.72	−6.35	−4.04	12.19	3.94		
$R_{\text{I/A}}^{\text{m}}$	0.50	0.42	−0.01	0.46	−0.09	46%				−0.09	−0.16	−0.17	0.77	0.26	0.01	67%
	5.73	5.00	−0.53	6.72	−2.13					−0.90	−6.71	−3.72	10.69	3.34	0.22	
$R_{\text{Roe}}^{\text{m}}$	0.57	−0.13	0.05	0.37	0.77	58%		PEAD	0.72	0.49	0.01	−0.06	−0.13	0.55		46%
	5.23	−1.69	1.83	6.40	17.64				7.78	5.55	0.56	−1.89	−2.29	9.99		
										0.38	0.03	−0.04	−0.18	0.50	0.19	47%
										4.65	1.41	−1.25	−3.01	7.58	2.91	

	$\alpha_{\text{I/A}}^{\text{m}}, \alpha_{\text{Roe}}^{\text{m}} = 0$	$\alpha_{\text{I/A}}^{\text{m}}, \alpha_{\text{Roe}}^{\text{m}}, \alpha_{\text{Eg}} = 0$	$\alpha_{\text{FIN}}, \alpha_{\text{PEAD}} = 0$ in q_{m}	$\alpha_{\text{FIN}}, \alpha_{\text{PEAD}} = 0$ in q_{m}^5
GRS	20.57	36.20	23.48	11.73
p	0.00	0.00	0.00	0.00

					Panel C: The Barillas-Shanken model											
	$\overline{R}$	α	MKT	SMB	$R_{\text{I/A}}$	R_{Roe}	UMD	HML^{m}	R^2			$\overline{R}$	α	R_{Mkt}	R_{Me}^{m}	$R_{\text{I/A}}^{\text{m}}$	$R_{\text{Roe}}^{\text{m}}$	R_{Eg}	R^2
R_{Me}^{m}	0.33	−0.00	0.05	0.96	−0.05	0.16	−0.07	0.14	93%		HML^{m}	0.34	0.18	−0.02	0.08	0.94	−0.58		47%
	2.49	−0.02	3.88	42.87	−1.72	5.97	−3.82	6.44				2.13	0.97	−0.37	1.09	8.11	−4.76		
													0.26	−0.03	0.06	0.98	−0.53	−0.14	48%
													1.64	−0.66	0.82	7.83	−3.82	−1.34	

Table 8 : Estimates of the Internal Rates of Returns for the Fama-French (2015) Factors

AR, IRR, and Diff (all in annual percent) are the average return, the internal rate of return, and AR minus IRR, respectively. SMB, HML, RMW, and CMA are the Fama-French (2015) size, value, profitability, and investment factors, respectively. IRR is measured at the June of of each year t, and AR from the July of year t to June of $t+1$. Panel A uses the analysts' earnings forecasts, Panel B the Hou-van Dijk-Zhang (2012) cross-sectional earnings forecasts, and Panel C the Tang-Wu-Zhang (2014) cross-sectional Roe forecasts in estimating the IRRs. GLS denotes the Gebhardt-Lee-Swaminathan model, Easton the Easton model, CT the Claus-Thomas model, OJ the Ohlson-Juettner-Nauroth model, and Average the averages across the models. Appendix B details the estimation methods.

	Panel A: IBES earnings forecasts (1979–2016)						Panel B: Cross-sectional earnings forecasts (1967–2016)						Panel C: Cross-sectional Roe forecasts (1967–2016)					
	AR	IRR	Diff	AR	IRR	Diff	AR	IRR	Diff	AR	IRR	Diff	AR	IRR	Diff	AR	IRR	Diff
	GLS			Easton			GLS			Easton			GLS			Easton		
SMB	1.51	0.88	0.64	1.57	2.51	−0.94	2.57	1.52	1.04	2.38	5.11	−2.72	2.91	0.06	2.84	2.71	1.14	1.58
[t]	0.76	4.62	0.33	0.82	14.85	−0.50	1.25	4.02	0.53	1.18	6.96	−1.44	1.49	0.26	1.49	1.38	4.82	0.80
HML	2.98	3.50	−0.52	2.90	3.26	−0.36	3.36	5.57	−2.20	3.27	7.23	−3.96	3.64	5.21	−1.57	3.87	7.60	−3.73
[t]	1.39	18.91	−0.25	1.29	7.45	−0.17	1.83	27.23	−1.24	1.77	15.32	−2.08	1.98	32.87	−0.89	2.04	16.10	−2.08
RMW	3.72	−1.19	4.91	4.48	−3.27	7.75	3.46	−1.43	4.89	4.06	−3.66	7.72	3.13	−1.35	4.47	3.35	−6.41	9.76
[t]	2.64	−8.27	3.58	2.82	−9.44	4.75	2.72	−6.54	4.00	2.77	−10.22	5.00	2.54	−7.81	3.77	2.65	−19.72	7.19
CMA	3.46	0.64	2.82	3.58	2.45	1.13	3.72	1.59	2.13	4.46	4.06	0.40	3.50	1.09	2.41	3.63	4.52	−0.88
[t]	2.87	4.69	2.42	3.14	7.91	1.08	3.17	9.09	1.87	4.34	11.56	0.37	3.19	5.75	2.24	3.10	9.97	−0.78
	CT			OJ			CT			OJ			CT			OJ		
SMB	1.55	1.11	0.43	1.70	0.68	1.02	2.65	2.71	−0.06	3.73	3.21	0.52	3.23	−1.17	4.41	3.21	−1.40	4.62
[t]	0.78	6.84	0.22	0.86	4.57	0.53	1.29	4.23	−0.03	1.91	5.39	0.28	1.65	−3.65	2.29	1.59	−3.86	2.26
HML	3.12	0.14	2.98	2.05	0.73	1.32	3.14	3.68	−0.54	2.85	4.74	−1.89	2.95	2.64	0.31	3.02	4.23	−1.22
[t]	1.42	0.42	1.33	0.98	3.77	0.63	1.71	16.21	−0.29	1.69	17.64	−1.10	1.74	5.90	0.18	1.58	9.36	−0.63
RMW	3.66	0.29	3.38	4.07	−0.05	4.12	3.18	−0.01	3.19	3.16	−1.57	4.72	2.57	−0.04	2.61	2.07	−2.11	4.17
[t]	2.68	1.94	2.48	3.41	−0.27	3.41	3.01	−0.03	3.04	3.14	−5.50	4.45	2.56	−0.20	2.59	2.04	−9.38	3.85
CMA	3.41	0.11	3.30	3.15	0.08	3.07	3.32	1.52	1.81	3.89	2.12	1.77	2.91	0.62	2.29	3.26	0.66	2.60
[t]	2.88	0.79	2.78	2.79	0.48	2.70	2.92	11.29	1.54	3.35	11.11	1.54	2.68	4.32	2.06	2.67	3.06	2.04
	Average						Average						Average					
SMB	1.44	1.72	−0.28				2.53	3.22	−0.69				2.90	−0.25	3.15			
[t]	0.76	10.74	−0.15				1.23	5.60	−0.35				1.49	−0.93	1.64			
HML	2.90	2.04	0.86				3.52	5.31	−1.79				3.60	5.14	−1.54			
[t]	1.28	9.07	0.39				1.88	25.28	−0.97				1.96	17.72	−0.85			
RMW	4.52	−1.58	6.10				3.61	−1.84	5.45				3.14	−2.47	5.61			
[t]	2.88	−9.66	3.90				2.66	−9.41	4.07				2.54	−21.47	4.52			
CMA	3.40	1.16	2.24				3.81	2.64	1.17				3.44	2.02	1.43			
[t]	2.92	7.09	2.02				3.34	19.06	1.04				3.17	13.47	1.34			

Table 9 : Annual Cross-sectional Regressions of Future Book Equity Growth Rates and Operating Profitability, 1963–2016

The sample contains all common stocks on NYSE, Amex, and Nasdaq. We do not exclude financial firms, because these stocks are included in the construction of the Fama-French (2015) five factors. All the regressions are annual cross-sectional regressions. A_{it} is total assets for firm i at year t, $\triangle A_{it} \equiv A_{it} - A_{it-1}$, Be_{it} is book equity for firm i at year t, $\triangle Be_{it} \equiv Be_{it} - Be_{it-1}$, and Op_{it} is operating profitability for firm i at year t. Book equity is measured as in Davis, Fama, and French (2000), and operating profitability is measured as in Fama and French (2015). Variables dated t are measured at the end of the fiscal year ending in calendar year t. To avoid the excess influence of small firms, we follow Fama and French (2006) and exclude those with total assets below \$5 million or book equity below \$2.5 million in year t in Panel A. The cutoffs are \$25 million and \$12.5 million in Panel B. We winsorize all regression variables at the 1st and 99th percentiles of the cross-sectional distribution each year.

τ	#firms	$\frac{\triangle Be_{it+\tau}}{Be_{it+\tau-1}} = \gamma_0 + \gamma_1 \frac{\triangle A_{it}}{A_{it-1}} + \epsilon_{t+\tau}$					$\frac{\triangle Be_{it+\tau}}{Be_{it+\tau-1}} = \gamma_0 + \gamma_1 \frac{\triangle Be_{it}}{Be_{it-1}} + \epsilon_{t+\tau}$					$Op_{it+\tau} = \gamma_0 + \gamma_1 Op_{it} + \epsilon_{t+\tau}$				
		γ_0	$t(\gamma_0)$	γ_1	$t(\gamma_1)$	R^2	γ_0	$t(\gamma_0)$	γ_1	$t(\gamma_1)$	R^2	γ_0	$t(\gamma_0)$	γ_1	$t(\gamma_1)$	R^2
		Panel A: Firms with assets $\geq$ \$5 million and book equity $\geq$ \$2.5 million														
1	3,105	0.09	14.46	0.22	13.94	0.05	0.09	13.10	0.20	8.47	0.06	0.03	4.73	0.80	43.30	0.54
2	2,843	0.10	14.32	0.10	7.60	0.01	0.10	14.43	0.10	5.21	0.02	0.05	6.24	0.67	27.12	0.36
3	2,624	0.10	14.71	0.06	6.31	0.01	0.10	14.70	0.06	4.05	0.01	0.07	7.84	0.59	24.18	0.27
4	2,431	0.10	15.78	0.05	5.53	0.00	0.10	15.88	0.05	3.69	0.00	0.09	9.32	0.53	22.64	0.22
5	2,259	0.10	14.76	0.04	3.44	0.00	0.10	15.71	0.02	1.92	0.00	0.10	11.18	0.49	22.78	0.19
6	2,103	0.10	14.99	0.05	4.57	0.00	0.10	14.71	0.03	2.27	0.00	0.11	13.03	0.45	23.22	0.16
7	1,961	0.09	15.15	0.04	4.43	0.00	0.10	15.26	0.03	2.68	0.00	0.11	14.62	0.43	21.87	0.15
8	1,828	0.09	15.07	0.03	4.14	0.00	0.10	15.35	0.01	1.71	0.00	0.12	15.86	0.40	19.23	0.13
9	1,706	0.09	15.09	0.03	3.37	0.00	0.10	15.16	0.01	1.19	0.00	0.12	15.08	0.39	17.63	0.12
10	1,593	0.09	14.47	0.04	4.32	0.00	0.09	14.61	0.02	2.13	0.00	0.12	14.14	0.38	16.68	0.11
		Panel B: Firms with assets $\geq$ \$25 million and book equity $\geq$ \$12.5 million														
1	2,492	0.08	15.77	0.23	16.94	0.05	0.08	14.11	0.24	10.36	0.07	0.03	7.15	0.82	58.34	0.61
2	2,284	0.09	15.41	0.13	10.30	0.02	0.09	15.84	0.12	7.08	0.02	0.06	8.95	0.70	34.86	0.42
3	2,109	0.09	16.25	0.08	7.65	0.01	0.09	16.18	0.08	5.75	0.01	0.08	10.74	0.62	30.44	0.32
4	1,956	0.09	16.71	0.07	6.75	0.01	0.09	16.69	0.07	4.41	0.01	0.09	13.11	0.56	29.61	0.26
5	1,821	0.09	16.35	0.05	3.94	0.01	0.09	16.97	0.04	2.85	0.01	0.10	15.92	0.52	30.60	0.22
6	1,699	0.09	16.24	0.05	5.50	0.00	0.09	16.04	0.04	3.37	0.00	0.11	17.80	0.48	31.61	0.19
7	1,588	0.09	16.48	0.05	4.96	0.00	0.09	16.58	0.04	3.12	0.00	0.12	19.76	0.45	31.23	0.17
8	1,485	0.09	15.84	0.03	3.99	0.00	0.09	15.83	0.02	2.62	0.00	0.13	20.33	0.43	27.16	0.15
9	1,388	0.09	15.68	0.03	3.84	0.00	0.09	15.80	0.02	2.10	0.00	0.13	18.98	0.42	22.62	0.14
10	1,298	0.09	14.50	0.05	5.23	0.00	0.09	14.71	0.03	2.98	0.00	0.13	17.77	0.41	21.77	0.13

A Variable Definitions

We describe the 11 anomaly variables used to replicate the Stambaugh-Yuan (2017) factors. At the beginning of each month, we rank stocks into percentiles (1 to 100) based on each anomaly. The rankings are created such that high rankings are associated with lower future average returns. The first composite measure, MGMT (management), is the average of the six percentile rankings in net stock issues, composite equity issuance, accruals, net operating assets, asset growth, and investment-to-assets. The second composite measure, PERF (performance), is the average of the five percentile rankings in failure probability, O-score, momentum, gross profitability, and return on assets. In any given month, an anomaly variable needs at least 30 stocks with non-missing values in order to be included in the composite measure. In addition, we compute a composite measure for a stock only if it has non-missing values for at least three of the (six or five) component anomalies.

Net stock issues. Net stock issues is the annual change in the log of the split-adjusted shares outstanding. The split-adjusted shares outstanding is shares outstanding (Compustat annual item CSHO) times the adjustment factor (item AJEX). At the beginning of each month, we use the latest net stock issues from fiscal year ending at least four months ago.

Composite equity issuance. Following Stambaugh and Yuan (2017), at the beginning of month t, we measure composite equity issuance as the growth rate in market equity minus the cumulative stock return from month $t - 16$ to $t - 5$ (skipping month $t - 4$ to $t - 1$).

Accruals. We measure accruals as changes in noncash working capital minus depreciation, in which the noncash working capital is changes in noncash current assets minus changes in current liabilities less short-term debt and taxes payable. In particular, accruals equals (dCA − dCASH) − (dCL − dSTD − dTP) − DP, in which dCA is the change in current assets (Compustat annual item ACT), dCASH is the change in cash or cash equivalents (item CHE), dCL is the change in current liabilities (item LCT), dSTD is the change in debt included in current liabilities (item DLC), dTP is the change in income taxes payable (item TXP), and DP is depreciation and amortization (item DP). Missing changes in income taxes payable are set to zero. We scale accruals by average total assets from the previous and current years. At the beginning of each month, we use the latest accruals from fiscal year ending at least four months ago.

Net operating assets. We measure net operating assets as operating assets minus operating liabilities. Operating assets are total assets (Compustat annual item AT) minus cash and short-term investment (item CHE). Operating liabilities are total assets minus debt included in current liabilities (item DLC, zero if missing), minus long-term debt (item DLTT, zero if missing), minus minority interests (item MIB, zero if missing), minus preferred stocks (item PSTK, zero if missing), and minus common equity (item CEQ). We scale net operating assets by one-year-lagged total assets. At the beginning of each month, we use the latest net operating assets from fiscal year ending at least four months ago.

Asset growth. Asset growth is the annual change in total assets (Compustat annual item AT) scaled by 1-year-lagged total assets. At the beginning of each month, we use the latest asset growth from fiscal year ending at least four months ago.

Changes in PPE and Inventory-to-assets are measured as the annual change in gross property, plant, and equipment (Compustat annual item PPEGT) plus the annual change in inventory (item INVT) scaled by 1-year-lagged total assets (item AT). At the beginning of each month, we use the latest investment-to-assets from fiscal year ending at least four months ago.

Failure Probability. At the beginning of month t, we follow Campbell, Hilscher, and Szilagyi (2008, Table IV, Column 3) to construct failure probability:

$$\text{Fp}_t \equiv -9.164 - 20.264\text{NIMTAAVG}_t + 1.416\text{TLMTA}_t - 7.129\text{EXRETAVG}_t$$
$$+ 1.411\text{SIGMA}_t - 0.045\text{RSIZE}_t - 2.132\text{CASHMTA}_t + 0.075\text{MB}_t - 0.058\text{PRICE}_t \qquad (A1)$$

in which

$$\text{NIMTAAVG}_{t-1,t-12} \equiv \frac{1-\phi^3}{1-\phi^{12}}\left(\text{NIMTA}_{t-1,t-3} + \cdots + \phi^9\text{NIMTA}_{t-10,t-12}\right) \qquad (A2)$$

$$\text{EXRETAVG}_{t-1,t-12} \equiv \frac{1-\phi}{1-\phi^{12}}\left(\text{EXRET}_{t-1} + \cdots + \phi^{11}\text{EXRET}_{t-12}\right), \qquad (A3)$$

and $\phi = 2^{-1/3}$. NIMTA is net income (Compustat quarterly item NIQ) divided by the sum of market equity (share price times the number of shares outstanding from CRSP) and total liabilities (item LTQ). The moving average NIMTAAVG captures the idea that a long history of losses is a better predictor of bankruptcy than one large quarterly loss in a single month. EXRET $\equiv \log(1+R_{it}) - \log(1+R_{\text{S\&P500},t})$ is the monthly log excess return on each firm's equity relative to the S&P 500 index. The moving average EXRETAVG captures the idea that a sustained decline in stock market value is a better predictor of bankruptcy than a sudden stock price decline in a single month.

TLMTA is total liabilities divided by the sum of market equity and total liabilities. SIGMA is the annualized three-month rolling sample standard deviation: $\sqrt{\frac{252}{N-1}\sum_{k\in\{t-1,t-2,t-3\}} r_k^2}$, in which k is the index of trading days in months $t-1, t-2$, and $t-3$, r_k is the firm-level daily return, and N is the total number of trading days in the three-month period. SIGMA is treated as missing if there are less than five nonzero observations over the three months in the rolling window. RSIZE is the relative size of each firm measured as the log ratio of its market equity to that of the S&P 500 index. CASHMTA, aimed to capture the liquidity position of the firm, is cash and short-term investments (Compustat quarterly item CHEQ) divided by the sum of market equity and total liabilities (item LTQ). MB is the market-to-book equity, in which we add 10% of the difference between the market equity and the book equity to the book equity to alleviate measurement issues for extremely small book equity values (Campbell, Hilscher, and Szilagyi 2008). For firm-month observations that still have negative book equity after this adjustment, we replace these negative values with $1 to ensure that the market-to-book ratios for these firms are in the right tail of the distribution. PRICE is each firm's log price per share, truncated above at $15. We further eliminate stocks with prices less than $1 at the portfolio formation date. Variables requiring quarterly accounting data are from fiscal quarter ending at least four months ago to ensure the availability of balance sheet items. We winsorize the variables on the right-hand side of equation (A1) at the 1th and 99th percentiles of their distributions each month.

Ohlson's O-score. The O-score is defined as:

$$O \equiv -1.32 - 0.407\log(\text{TA}) + 6.03\text{TLTA} - 1.43\text{WCTA} + 0.076\text{CLCA}$$
$$- 1.72\text{OENEG} - 2.37\text{NITA} - 1.83\text{FUTL} + 0.285\text{INTWO} - 0.521\text{CHIN}, \qquad (A4)$$

in which TA is total assets (Compustat annual item AT). TLTA is the leverage ratio defined as total debt (item DLC plus item DLTT) divided by total assets. WCTA is working capital (item ACT minus item LCT) divided by total assets. CLCA is current liability (item LCT) divided by

current assets (item ACT). OENEG is one if total liabilities (item LT) exceeds total assets and zero otherwise. NITA is net income (item NI) divided by total assets. FUTL is the fund provided by operations (item PI plus item DP) divided by total liabilities. INTWO is equal to one if net income is negative for the last two years and zero otherwise. CHIN is $(\text{NI}_s - \text{NI}_{s-1})/(|\text{NI}_s| + |\text{NI}_{s-1}|)$, in which NI_s and NI_{s-1} are the net income for the current and prior years. We winsorize all non-dummy variables on the right-hand side of equation (A4) at the 1th and 99th percentiles of their distributions each year. At the beginning of each month, we use the latest O-score from fiscal year ending at least four months ago.

Momentum. At the beginning of each month t, we measure momentum as the 11-month cumulative return from month $t - 12$ to $t - 2$ (skipping month $t - 1$).

Gross Profitability is total revenue (Compustat annual item REVT) minus cost of goods sold (item COGS) divided by total assets (item AT). At the beginning of each month, we use the latest gross profitability from fiscal year ending at least four months ago.

Return on Assets is income before extraordinary items (Compustat quarterly item IBQ) divided by 1-quarter-lagged total assets (item ATQ). At the beginning of each month, we use return on assets computed with quarterly earnings from the most recent earnings announcement dates (item RDQ). For a firm to enter our sample, we require the end of the fiscal quarter that corresponds to its most recent return on assets to be within six months prior to the portfolio formation. This restriction is imposed to exclude stale earnings information. To avoid potentially erroneous records, we also require the earnings announcement date to be after the corresponding fiscal quarter end.

B   Estimating the Internal Rate of Return

The Gebhardt, Lee, and Swaminathan (2001, GLS) Procedure. At the end of June in each year t, we estimate the IRR from the following nonlinear equation:

$$P_t = Be_t + \sum_{\tau=1}^{11} \frac{(E_t[\text{Roe}_{t+\tau}] - \text{IRR}) \times Be_{t+\tau-1}}{(1 + \text{IRR})^\tau} + \frac{(E_t[\text{Roe}_{t+12}] - \text{IRR}) \times Be_{t+11}}{\text{IRR} \times (1 + \text{IRR})^{11}}, \qquad \text{(B1)}$$

in which P_t is the market equity in year t, $Be_{t+\tau}$ is the book equity, and $E_t[\text{Roe}_{t+\tau}]$ is the expected return on equity for year $t + \tau$ based on information available in year t.

We measure current book equity, Be_t, using the latest accounting data from the fiscal year ending between March of year $t - 1$ to February of t. This practice implies that for the IRR estimates at the end of June in t, we impose at least a four-month lag to ensure that the accounting information is released to the public. The definition of book equity follows Davis, Fama, and French (2000). We apply clean surplus accounting to construct future book equity as $Be_{t+\tau} = Be_{t+\tau-1} + Be_{t+\tau-1}E_t[\text{Roe}_{t+\tau}](1 - k), 1 \leq \tau \leq 11$, in which k is the dividend payout ratio in year t. Dividend payout ratio is dividends (Compustat annual item DVC) divided by earnings (item IB) for profitable firms, or dividends divided by 6% of total assets (item AT) for firms with zero or negative earnings. We drop a firm if its book equity is zero or negative in any year.

We construct the expected Roe for the first three years ahead, using analyst earnings forecasts from the Institutional Brokers' Estimated System (IBES) or forecasts from cross-sectional regressions. After year $t + 3$, we assume that the expected firm-level Roe mean-reverts linearly to the historical industry median Roe by year $t + 12$, and becomes a perpetuity afterwards. We use the

Fama-French (1997) 48 industry classification. We use at least five and up to ten years of past Roe data from non-loss firms to compute the industry median Roe.

Following GLS (2001), we implement the GLS model on a per share basis with analysts' earnings forecasts. P_t is the June-end share price from CRSP. Be_t is book equity per share calculated as book equity divided by the number of shares outstanding reported in June from IBES (unadjusted file, item SHOUT). When IBES shares are not available, we use shares from CRSP (daily item SHROUT) on the IBES pricing date (item PRDAYS) that corresponds to the IBES report.

At the end of June in each year t, we construct the expected Roe for year $t+1$ to $t+3$ as $E_t[\text{Roe}_{t+\tau}] = \text{FEPS}_{t+\tau}/Be_{t+\tau-1}$, in which $\text{FEPS}_{t+\tau}$ is the consensus mean forecast of earnings per share from IBES (unadjusted file, item MEANEST) for year $t+\tau$ (fiscal period indicator $=\tau$) reported in June of t. We require the availability of earnings forecast for years $t+1$ and $t+2$. When the forecast for year $t+3$ is not available, we use the long-term growth rate (item LTG) to compute a three-year-ahead forecast: $\text{FEPS}_{t+3} = \text{FEPS}_{t+2} \times (1 + \text{LTG})$. If the long-term growth rate is missing, we replace it with the growth rate implied by the first two forecasts: $\text{FEPS}_{t+3} = \text{FEPS}_{t+2} \times (\text{FEPS}_{t+2}/\text{FEPS}_{t+1})$, when FEPS_{t+1} and FEPS_{t+2} are both positive.

As noted, we measure current book equity Be_t based on the latest accounting data from the fiscal year ending between March of year $t-1$ and February of t. However, firms with fiscal years ending between March of t and May of t can announce their latest earnings before the IBES report in June of t. In response to earnings announcement for the current fiscal year, the analyst forecasts would "roll forward" to the next year. As such, we also need to roll forward book equity by one year for these firms to match with the updated analyst forecasts. In particular, we roll forward their book equity using clean surplus accounting as: $Be_{t-1} + Y_t - D_t$, in which Be_{t-1} is the lagged book equity (relative to the announced earnings), Y_t is the earnings announced after February of t but before the IBES report in June of t, and D_t is dividends.

In the first modified procedure, we follow Hou, van Dijk, and Zhang (2012) to estimate the IRRs at the firm level (not the per share basis), whenever regression-based earnings forecasts (not analysts' earnings forecasts) are used. We use pooled cross-sectional regressions to forecast future earnings for up to three years ahead:

$$Y_{is+\tau} = a + b_1 A_{is} + b_2 D_{is} + b_3 DD_{is} + b_4 Y_{is} + b_5 Y_{is}^- + b_6 AC_{is} + \epsilon_{is+\tau}, \qquad \text{(B2)}$$

for $1 \leq \tau \leq 3$, in which Y_{is} is earnings (Compustat annual item IB) of firm i for fiscal year s, A_{is} is total assets (item AT), D_{is} is dividends (item DVC), and DD_{is} is a dummy variable that equals one for dividend payers, and zero otherwise. Y_{is}^- is a dummy variable that equals one for negative earnings, and zero otherwise, and AC_{is} is operating accruals.

Prior to 1988, we use the balance-sheet approach of Sloan (1996) to measure operating accruals as changes in noncash working capital minus depreciation, in which the noncash working capital is changes in noncash current assets minus changes in current liabilities less short-term debt and taxes payable. In particular, $AC = (\triangle CA - \triangle CASH) - (\triangle CL - \triangle STD - \triangle TP) - DP$, in which $\triangle CA$ is the change in current assets (Compustat annual item ACT), $\triangle CASH$ is the change in cash or cash equivalents (item CHE), $\triangle CL$ is the change in current liabilities (item LCT), $\triangle STD$ is the change in debt included in current liabilities (item DLC, zero if missing), $\triangle TP$ is the change in income taxes payable (item TXP, zero if missing), and DP is depreciation and amortization (item DP, zero if missing). Starting from 1988, we follow Hribar and Collins (2002) to measure AC using the statement of cash flows as net income (item NI) minus net cash flow from operations (item OANCF).

In equation (B2), regressors with time subscript s are from the fiscal year ending between March of year s and February of $s+1$. Following Hou, van Dijk, and Zhang (2012), we winsorize all the level variables in equation (B2) at the 1st and 99th percentiles of their cross-sectional distributions each year. In June of each year t, we estimate the regressions using the pooled panel data from the previous ten years. With a minimum four-month lag, the accounting data are from fiscal years ending between March of $t-10$ and February of t. Differing from the baseline GLS procedure, we forecast the expected earnings as the estimated regression coefficients times the latest values of the (unwinsorized) predictors from the fiscal year ending between March of $t-1$ and February of t.

In the second modified procedure, we use annual cross-sectional regressions per Tang, Wu, and Zhang (2014) to forecast the future ROE for up to three years, $\text{Roe}_{is+\tau} \equiv Y_{is+\tau}/Be_{is+\tau-1}$:

$$\text{Roe}_{is+\tau} = a + b_1 \log\left(\frac{Be_{is}}{P_{is}}\right) + b_2 \log(P_{is}) + b_3 Y_{is}^- + b_4 \text{Roe}_{is} + b_5 \frac{A_{is} - A_{is-1}}{A_{is-1}} + \epsilon_{is+\tau}, \qquad \text{(B3)}$$

for $1 \leq \tau \leq 3$, in which Roe_{is} is return on equity of firm i for fiscal year s, Y_{is} is earnings (Compustat annual item IB), Be_{is} is the book equity, P_{is} is the market equity at the fiscal year end from Compustat or CRSP, Y_{is}^- is a dummy variable that equals one for negative earnings and zero otherwise, and A_{is} is total assets (item AT). Regression variables with time subscript s are from the fiscal year ending between March of year s and February of $s+1$. Extremely small firms tend to have extreme regression variables which can affect the Roe regression estimates significantly. To alleviate this problem, we exclude firm-years with total assets less than \$5 million or book equity less than \$2.5 million. Fama and French (2006, p. 496) require firms to have at least \$25 million total assets and \$12.5 million book equity, but state that their results are robust to using the \$5 million total assets and \$2.5 million book equity cutoff. We choose the less restrictive cutoff to enlarge the sample coverage. We also winsorize each variable (except for Y_{it}^-) at the 1st and 99th percentiles of its cross-sectional distribution each year to further alleviate the impact of outliers.

In June of each year t, we run the regression (B3) using the previous ten years of data. With a minimum four-month information lag, the accounting data are from fiscal years ending between March of $t-10$ and February of t. Differing from the baseline GLS procedure, we directly forecast the expected Roe, $E_t[\text{Roe}_{t+\tau}]$, as the average cross-sectional regression coefficients times the latest values of the predictors from fiscal years ending between March of $t-1$ and February of t. We implement this modified GLS procedure at the firm level.

The Easton (2004) Procedure. At the end of June in each year t, we estimate the IRR from:

$$P_t = \frac{E_t[Y_{t+2}] + \text{IRR} \times E_t[D_{t+1}] - E_t[Y_{t+1}]}{\text{IRR}^2}, \qquad \text{(B4)}$$

in which P_t is the market equity in year t, $E_t[Y_{t+\tau}]$ is the expected earnings for year $t+\tau$ based on information available in year t, and $E_t[D_{t+1}]$ is the expected dividends for year $t+1$.

Expected earnings are based on analyst forecasts from IBES or forecasts from regression models. Expected dividends are expected earnings times the current dividend payout ratio, which is computed as dividends (Compustat annual item DVC) divided by earnings (item IB) for profitable firms, or dividends divided by 6% of total assets (item AT) for firms with zero or negative earnings. When equation (B4) has two positive roots (in very few cases), we use the average as the IRR estimate.

Following Easton (2004), we implement the model on the per share basis with analysts' earnings forecasts. We measure P_t as the June-end share price from CRSP. At the end of June in year t, the

expected earnings per share for year $t + \tau$ is the consensus mean forecast from IBES (unadjusted file, item MEANEST) for year $t + \tau$ (fiscal period indicator $= \tau$) reported in June of t.

Instead of analysts' earnings forecasts, we also use pooled cross-sectional regressions in equation (B2) to forecast future earnings for up to two years ahead. In June of each year t, we estimate the regression using the pooled panel data from the previous ten years. With a four-month information lag, the accounting data are from fiscal years ending between March of $t - 10$ and February of t. We construct the expected earnings as the estimated regression coefficients times the latest values of the (unwinsorized) predictors from the fiscal year ending between March of $t - 1$ and February of t. We implement the modified procedure at the firm level.

Finally, we also use annual cross-sectional regressions in equation (B3) to forecast future ROE for up to two years ahead. In June of each year t, we estimate the regression using the previous ten years of data. With a four-month information lag, the accounting data are from fiscal years ending between March of $t - 10$ and February of t. We forecast the expected Roe, $E_t[\text{Roe}_{t+\tau}]$, as the average regression coefficients times the latest values of the predictors from fiscal years ending between March of $t - 1$ and February of t. Expected earnings are then constructed as: $E_t[Y_{t+\tau}] = E_t[\text{Roe}_{t+\tau}] \times Be_{t+\tau-1}$, in which $Be_{t+\tau-1}$ is the book equity in year $t + \tau - 1$. We measure current book equity Be_t based on the latest accounting data from the fiscal year ending in March of $t-1$ to February of t, and impute future book equity by applying clean surplus accounting recursively. We implement the modified procedure at the firm level.

The Claus and Thomas (2001, CT) Procedure. At the end of June in each year t, we estimate the IRR from:

$$P_t = Be_t + \sum_{\tau=1}^{5} \frac{(E_t[\text{Roe}_{t+\tau}] - \text{IRR}) \times Be_{t+\tau-1}}{(1 + \text{IRR})^\tau} + \frac{(E_t[\text{Roe}_{t+5}] - \text{IRR}) \times Be_{t+4} \times (1 + g)}{(\text{IRR} - g) \times (1 + \text{IRR})^5}, \quad \text{(B5)}$$

in which P_t is the market equity in year t, $Be_{t+\tau}$ is the book equity, $E_t[\text{Roe}_{t+\tau}]$ is the expected Roe for year $t + \tau$ based on information available in year t, and g is the long-term growth rate of abnormal earnings. Abnormal earnings are defined as $(E_t[\text{Roe}_{t+\tau}] - \text{IRR}) \times Be_{t+\tau-1}$.

We measure book equity using the latest accounting data from the fiscal year ending between March of year $t - 1$ and February of t. The definition follows Davis, Fama, and French (2000). We apply clean surplus accounting to construct future book equity as $Be_{t+\tau} = Be_{t+\tau-1} + Be_{t+\tau-1} E_t[\text{Roe}_{t+\tau}](1 - k), 1 \leq \tau \leq 4$, in which k is the dividend payout ratio in year t. Dividend payout ratio is dividends (Compustat annual item DVC) divided by earnings (item IB) for profitable firms, or dividends divided by 6% of total assets (item AT) for firms with zero or negative earnings. We drop a firm if its book equity is zero or negative in any year. We construct the expected Roe, $E_t[\text{Roe}_{t+\tau}]$, for up to five years ahead, using analysts' earnings forecasts from IBES or regression-based forecasts. Following CT (2001), we set g to the ten-year Treasury bond rate minus 3%.

Following CT (2001), we implement the CT model on the per share basis when using analysts' earnings forecasts. We measure P_t as the June-end share price from CRSP. Book equity per share, B_t, is book equity divided by the number of shares outstanding reported in June from IBES (unadjusted file, item SHOUT). When IBES shares are not available, we use shares from CRSP (daily item SHROUT) on the IBES pricing date (item PRDAYS) that corresponds to the IBES report. As noted, current book equity B_t is based on the latest accounting data from the fiscal year ending between March of $t - 1$ and February of t. However, firms with fiscal year ending in March of t to May of t can announce their latest earnings before the IBES report in June of t. To match

the updated analyst forecasts, we roll forward their book equity using clean surplus accounting as: $B_{t-1}+Y_t-D_t$, in which B_{t-1} is the lagged book equity (relative to the announced earnings), Y_t is the earnings announced after February of t but before the IBES report in June of t, and D_t is dividends.

At the end of June in each year t, we construct the expected Roe for year $t+1$ to $t+5$ as $E_t[\text{Roe}_{t+\tau}] = \text{FEPS}_{t+\tau}/Be_{t+\tau-1}$, in which $\text{FEPS}_{t+\tau}$ is the consensus mean forecast of earnings per share from IBES (unadjusted file, item MEANEST) for year $t+\tau$ (fiscal period indicator $= \tau$) reported in June of t. We require the availability of earnings forecast for years $t+1$ and $t+2$. When the forecast after year $t+2$ is not available, we use the long-term growth rate (item LTG) to construct it as $\text{FEPS}_{t+\tau} = \text{FEPS}_{t+\tau-1} \times (1 + \text{LTG})$. If the long-term growth rate is missing, we replace it with the growth rate implied by the forecasts for the previous two years: $\text{FEPS}_{t+\tau} = \text{FEPS}_{t+\tau-1} \times (\text{FEPS}_{t+\tau-1}/\text{FEPS}_{t+\tau-2})$, when $\text{FEPS}_{t+\tau-2}$ and $\text{FEPS}_{t+\tau-1}$ are both positive.

Instead of analysts' earnings forecasts, we also use pooled cross-sectional regressions in equation (B2) to forecast future earnings for up to five years ahead. In June of each year t, we estimate the regression using the pooled panel data from the previous ten years. With a four-month information lag, the accounting data are from fiscal years ending between March of $t-10$ and February of t. We forecast the expected earnings as the estimated regression coefficients times the latest values of the (unwinsorized) predictors from the fiscal year ending between March of $t-1$ and February of t. We implement this modified CT procedure at the firm level. Finally, we also use annual cross-sectional regressions in equation (B3) to forecast future Roe for up to five years ahead. In June of each year t, we estimate the regression using the previous ten years of data. With a four-month information lag, the accounting data are from fiscal years ending between March of $t-10$ and February of t. We directly forecast the expected Roe, $E_t[\text{Roe}_{t+\tau}]$, as the average cross-sectional regression coefficients times the latest values of the predictors from fiscal years ending between March of $t-1$ and February of t. We implement the modified CT procedure at the firm level.

The Ohlson and Juettner-Nauroth (2005, OJ) Procedure. At the end of June in each year t, we construct the IRR as:

$$\text{IRR} = A + \sqrt{A^2 + \frac{E_t[Y_{t+1}]}{P_t} \times (g - (\gamma - 1))}, \tag{B6}$$

in which

$$A \equiv \frac{1}{2}\left((\gamma - 1) + \frac{E_t[D_{t+1}]}{P_t}\right), \tag{B7}$$

$$g \equiv \frac{1}{2}\left(\frac{E_t[Y_{t+3}] - E_t[Y_{t+2}]}{E_t[Y_{t+2}]} + \frac{E_t[Y_{t+5}] - E_t[Y_{t+4}]}{E_t[Y_{t+4}]}\right). \tag{B8}$$

P_t is the market equity in year t, $E_t[Y_{t+\tau}]$ is the expected earnings for year $t+\tau$ based on information available in t, and $E_t[D_{t+1}]$ is the expected dividends for year $t+1$.

Expected earnings are based on analyst forecasts from IBES or forecasts from regression models. Expected dividends are expected earnings times the current dividend payout ratio, which is computed as dividends (Compustat annual item DVC) divided by earnings (item IB) for profitable firms, or dividends divided by 6% of total assets (item AT) for firms with zero or negative earnings. We follow Gode and Mohanram (2003) and use the average of forecasted near-term growth rate and five-year growth rate as an estimate of g. We require $E_t[Y_{t+2}]$ and $E_t[Y_{t+4}]$ to be positive so that g is well defined. Following Gode and Mohanram (2003), we implement the OJ model on the per share basis with analysts' earnings forecasts. We measure P_t as the June-end share price from

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CRSP. At the end of June in year t, the expected earnings per share for year $t + \tau$ is the consensus mean forecast from IBES (unadjusted file, item MEANEST) for year $t + \tau$ (fiscal period indicator $= \tau$) reported in June of t. We require the availability of earnings forecast for years $t+1$ and $t+2$. When the forecast after year $t + 2$ is not available, we use the long-term growth rate (item LTG) to construct it as: $\text{FEPS}_{t+\tau} = \text{FEPS}_{t+\tau-1} \times (1 + \text{LTG})$. If the long-term growth rate is missing, we replace it with the growth rate implied by the forecasts for the previous two years: $\text{FEPS}_{t+\tau} = \text{FEPS}_{t+\tau-1} \times (\text{FEPS}_{t+\tau-1}/\text{FEPS}_{t+\tau-2})$, when $\text{FEPS}_{t+\tau-2}$ and $\text{FEPS}_{t+\tau-1}$ are both positive.

Instead of analysts' earnings forecasts, we also use pooled cross-sectional regressions in equation (B2) to forecast future earnings for up to five years ahead. In June of each year t, we estimate the regression using the pooled panel data from the previous ten years. With a four-month information lag, the accounting data are from fiscal years ending between March of $t - 10$ and February of t. We construct the expected earnings as the estimated regression coefficients times the latest values of the (unwinsorized) predictors from the fiscal year ending between March of $t - 1$ and February of t. We implement the modified OJ procedure at the firm level.

We also use annual cross-sectional regressions in equation (B3) to forecast future Roe for up to five years ahead. In June of each year t, we estimate the regression using the previous ten years of data. With a four-month information lag, the accounting data are from fiscal years ending between March of $t - 10$ and February of t. We forecast the expected Roe, $E_t[\text{Roe}_{t+\tau}]$, as the average cross-sectional regression coefficients times the latest values of the predictors from fiscal years ending between March of $t - 1$ and February of t. Expected earnings are then constructed as: $E_t[Y_{t+\tau}] = E_t[\text{Roe}_{t+\tau}] \times Be_{t+\tau-1}$, in which $Be_{t+\tau-1}$ is the book equity in year $t + \tau - 1$. We measure current book equity Be_t based on the latest accounting data from the fiscal year ending in March of $t-1$ to February of t, and impute future book equity by applying clean surplus accounting recursively. We implement the modified OJ procedure at the firm level.

Table A1 : Factor Spanning Tests, Supplementary Results, January 1967 to December 2016, 600 Months

$\overline{R}$ is the average return, α the intercept, and R^2 its goodness-of-fit coefficient. $R_{\text{Mkt}}, R_{\text{Me}}, R_{\text{I/A}}$, and R_{Roe} are the market, size, investment, and Roe factors in the q-factor and q^5 models, respectively, and R_{Eg} the expected growth factor in the q^5 model. In Panel A, MKT, SMB, MGMT, and PERF are the market, size, management, and performance factors in the Stambaugh-Yuan model. In Panel B, MKT, PIN, and PEAD are the market, financing, and post-earnings-announcement-drift factors in the Daniel-Hirshleifer-Sun model. The t-values (reported in the rows beneath the corresponding estimates) are adjusted for heteroscedasticity and autocorrelations.

Panel A: Replicated Stambaugh-Yuan factors with their sample criterion

	$\overline{R}$	α	MKT	SMB	MGMT	PERF	R^2
R_{Me}	0.31	−0.00	0.01	1.03	−0.01	0.01	91%
	2.43	−0.11	0.40	26.50	−0.47	0.29	
$R_{\text{I/A}}$	0.41	0.09	0.02	0.06	0.69	−0.02	67%
	4.92	1.59	1.19	2.82	18.38	−0.68	
R_{Roe}	0.55	0.31	0.01	−0.22	0.15	0.54	44%
	5.25	3.51	0.49	−3.90	1.91	10.01	
R_{Eg}	0.82	0.56	−0.03	−0.12	0.43	0.29	55%
	9.81	9.66	−2.26	−5.35	13.88	11.58	

	$\overline{R}$	α	R_{Mkt}	R_{Me}	$R_{\text{I/A}}$	R_{Roe}	R_{Eg}	R^2
SMB	0.31	0.06	0.01	0.87	0.00	−0.05		92%
	2.51	1.42	0.38	22.52	0.07	−2.16		
		0.11	−0.00	0.86	0.02	−0.03	−0.07	92%
		2.56	−0.15	22.12	0.66	−0.94	−2.56	
MGMT	0.44	0.19	−0.12	−0.10	0.86	−0.02		73%
	4.26	3.26	−7.00	−4.33	23.19	−0.61		
		−0.01	−0.09	−0.07	0.79	−0.11	0.31	76%
		−0.17	−6.20	−3.57	22.49	−3.49	8.18	
PERF	0.44	0.24	−0.09	0.09	−0.37	0.66		41%
	3.70	1.92	−2.78	1.72	−4.00	10.78		
		0.02	−0.05	0.12	−0.46	0.55	0.35	44%
		0.20	−1.75	2.30	−4.92	8.08	4.36	

	$\alpha_{\text{I/A}}, \alpha_{\text{Roe}} = 0$	$\alpha_{\text{I/A}}, \alpha_{\text{Roe}}, \alpha_{\text{Eg}} = 0$	$\alpha_{\text{MGMT}}, \alpha_{\text{PERF}} = 0$ in q	$\alpha_{\text{MGMT}}, \alpha_{\text{PERF}} = 0$ in q^5
GRS	7.91	34.93	11.09	0.03
p	0.00	0.00	0.00	0.97

Panel B: Replicated Daniel-Hirshleifer-Sun factors with their sample criterion

	$\overline{R}$	α	MKT	FIN	PEAD	R^2
R_{Me}	0.31	0.63	0.00	−0.46	−0.23	23%
	2.43	4.25	0.07	−3.74	−3.16	
$R_{\text{I/A}}$	0.41	0.32	−0.01	0.43	−0.07	47%
	4.92	4.31	−0.26	8.65	−1.98	
R_{Roe}	0.55	−0.16	0.04	0.32	0.79	59%
	5.25	−2.21	1.91	6.43	19.47	
R_{Eg}	0.82	0.54	−0.08	0.28	0.31	47%
	9.81	7.35	−4.54	8.24	8.68	

	$\overline{R}$	α	MKT	R_{Me}	$R_{\text{I/A}}$	R_{Roe}	R_{Eg}	R^2
FIN	0.33	0.00	−0.16	−0.22	0.86	0.23		69%
	2.55	0.04	−6.77	−3.79	13.46	4.32		
		−0.06	−0.15	−0.22	0.83	0.20	0.09	69%
		−0.65	−6.83	−3.46	11.92	3.32	1.54	
PEAD	0.74	0.44	0.00	0.02	−0.10	0.61		49%
	8.00	5.34	−0.17	0.54	−1.64	11.96		
		0.33	0.02	0.03	−0.15	0.56	0.18	50%
		4.25	0.78	1.01	−2.31	9.10	2.92	

	$\alpha_{\text{I/A}}, \alpha_{\text{Roe}} = 0$	$\alpha_{\text{I/A}}, \alpha_{\text{Roe}}, \alpha_{\text{Eg}} = 0$	$\alpha_{\text{FIN}}, \alpha_{\text{PEAD}} = 0$ in q	$\alpha_{\text{FIN}}, \alpha_{\text{PEAD}} = 0$ in q^5
GRS	14.39	34.82	22.31	9.57
p	0.00	0.00	0.00	0.00