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Replicating Anomalies

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Abstract

The anomalies literature is infested with widespread p-hacking. We replicate this literature by compiling a large data library with 447 anomalies. With microcaps alleviated via NYSE breakpoints and value-weighted returns, 286 anomalies (64%) including 95 out of 102 liquidity variables (93%) are insignificant at the 5% level. Imposing the t-cutoff of three raises the number of insignificance to 380 (85%). Even for the 161 significant anomalies, their magnitudes are often much lower than originally reported. Among the 161, the q-factor model leaves 115 alphas insignificant (150 with $t < 3$). In all, capital markets are more efficient than previously recognized.

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1 Introduction

This paper conducts a gigantic replication of the bulk of the published anomalies literature in finance and accounting by compiling a largest-to-date data library with 447 anomaly variables. The list includes 57, 68, 38, 79, 103, and 102 variables from the momentum, value-versus-growth, investment, profitability, intangibles, and trading frictions categories, respectively. We use a consistent set of replication procedures throughout. To control for microcaps (stocks that are smaller than the 20th percentile of market equity for New York Stock Exchange, or NYSE, stocks), we form testing deciles with NYSE breakpoints and value-weighted returns. We treat an anomaly as a replication success if the average return of its high-minus-low decile is significant at the 5% level ($t \geq 1.96$).

Our results indicate widespread p-hacking in the anomalies literature. Out of 447 anomalies, 286 (64%) are insignificant at the 5% level. Imposing the cutoff t-value of three proposed by Harvey, Liu, and Zhu (2016) raises the number of insignificant anomalies further to 380 (85%).

The biggest casualty is the liquidity literature. In the trading frictions category that contains mostly liquidity variables, 95 out of 102 variables (93%) are insignificant. Prominent variables that do not survive our replication include the Jegadeesh (1990) short-term reversal; the Datar-Naik-Radcliffe (1998) share turnover; the Chordia-Subrahmanyam-Anshuman (2001) coefficient of variation for dollar trading volume; the Amihud (2002) absolute return-to-volume; the Acharya-Pedersen (2005) liquidity betas; the Ang-Hodrick-Xing-Zhang (2006) idiosyncratic volatility, total volatility, and systematic volatility; the Liu (2006) number of zero daily trading volume; and the Corwin-Schultz (2012) high-low bid-ask spread. Several recently proposed friction variables are also insignificant, including the Bali-Cakici-Whitelaw (2011) maximum daily return; the Adrian-Etula-Muir (2014) financial intermediary leverage beta; and the Kelly-Jiang (2014) tail risk.

The distress anomaly is virtually nonexistent in our replication. The Campbell-Hilscher-Szilagyi (2008) failure probability, the O-score and Z-score studied in Dichev (1998), and the Avramov-Chordia-Jostova-Philipov (2009) credit rating produce mostly insignificant average return spreads.

Other influential and widely cited variables that are insignificant in our replication include the Bhandari (1988) debt-to-market; the Lakonishok-Shleifer-Vishny (1994) five-year sales growth; several of the Abarbanell-Bushee (1998) fundamental signals; the Diether-Malloy-Scherbina (2002) dispersion in analysts' forecast; the Gompers-Ishii-Metrick (2003) corporate governance index; the Francis-LaFond-Olsson-Schipper (2004) earnings attributes, including persistence, smoothness, value relevance, and conservatism; the Francis et al. (2005) accruals quality; the Richardson-Sloan-Soliman-Tuna (2005) total accruals; and the Fama-French (2015) operating profits-to-book equity.

Even for significant anomalies, their magnitudes are often much lower than originally reported. Famous examples include the Jegadeesh-Titman (1993) price momentum; the Lakonishok-Shleifer-Vishny (1994) cash flow-to-price; the Sloan (1996) operating accruals; the Chan-Jegadeesh-Lakonishok (1996) earnings momentum formed on standardized unexpected earnings, abnormal returns around earnings announcements, and revisions in analysts' earnings forecasts; the Cohen-Frazzini (2008) customer momentum; and the Cooper-Gulen-Schill (2008) asset growth.

Why does our replication differ so much from original studies? The key word is microcaps. Fama and French (2008) show that microcaps represent only 3% of the total market capitalization of the NYSE-Amex-NASDAQ universe, but account for 60% of the number of stocks. Microcaps not only have the highest equal-weighted returns, but also the largest cross-sectional standard deviations in returns and anomaly variables among microcaps, small stocks, and big stocks. Many studies overweight microcaps with equal-weighted returns, and often together with NYSE-Amex-NASDAQ breakpoints, in portfolio sorts. Hundreds of studies also use Fama-MacBeth (1973) cross-sectional regressions of returns on anomaly variables, assigning even higher weights to microcaps than equal-weights in sorts. The reason is that regressions impose a linear functional form, making them more susceptible to outliers, which most likely are microcaps. Alas, due to high costs in trading these stocks, anomalies in microcaps are more apparent than real. More important, with only 3% of the total market equity, the economic importance of microcaps is small, if not trivial.

Our low replication rate of only 36% is not due to our extended sample relative to the original studies. Repeating our replication in the original, shorter samples, we find that 293 (66%) anomalies are insignificant at the 5% level, including 24, 44, 13, 38, 81, and 93 across the momentum, value-versus-growth, investment, profitability, intangibles, and trading frictions categories, respectively. Imposing the t-cutoff of three raises the number of insignificance further to 387 (86.6%). The total number of insignificance at the 5% level, 293, is even higher than 286 in our extended sample.

We then use the q-factor model to explain the 161 significant anomalies. The q-factor model explains the bulk of the anomalies, but still leaves 46 alphas significant (11 with $t \geq 3$). Examples include abnormal returns around earnings announcements, operating and discretionary accruals, cash-based operating profits-to-assets, R&D-to-market, and the Heston-Sadka (2008) seasonality anomalies. These anomalies tend to be relatively diffused, and do not comove strongly together.

Our contribution is to provide the largest-to-date replication in finance. Using a multiple testing framework, Harvey, Liu, and Zhu (2016) cast doubt on the credibility of the anomalies literature, and conclude that "most claimed research findings in financial economics are likely false (p. 5)." Harvey et al. do not attempt to replicate the anomalies. In contrast, we replicate the bulk of the published anomalies literature with a common set of procedures. We also present extensive evidence on the relative successes and weaknesses of the q-factor model in explaining the significant anomalies.

The rest of the paper is organized as follows. Section 2 reviews the related literature on replication, and motivates our massive effort. Section 3 constructs the 447 anomalies, and details our replication results. Section 4 uses the q-factor model to explain the significant anomalies. Finally, Section 5 summarizes our results, and discusses their implications for future work.

2 Motivating Replication

Because replication is relatively new in finance, we briefly review the related literature.

2.1 Finance

Finance academics have long warned against data mining. Lo and MacKinlay (1990) argue that future research is often motivated by the successes and failures of past investigations. As a result, few empirical studies are free of data mining, which becomes more severe as the number of published studies performed on a single data set increases. Fama (1998) shows that many anomalies tend to weaken and even disappear when measured with value-weights. Conrad, Cooper, and Kaul (2003) argue that data mining can account for up to one half of the in-sample relations between firm characteristics and average returns in one-way sorts. Schwert (2003) shows that after anomalies are documented in the academic literature, the patterns often seem to disappear, reverse, or weaken. McLean and Pontiff (2016) find that the average return spreads of 97 anomalies decline out of sample and post publication, but the tests are based on NYSE-Amex-NASDAQ breakpoints and equal-weights.

As hundreds of anomalies have been documented in recent decades, the concern over data mining has become especially acute. In a pioneering meta-study in finance, Harvey, Liu, and Zhu (2016) present a new multiple testing framework to derive threshold statistical significant levels to account for data mining in the anomalies literature. The threshold cutoff increases over time as more anomalies have been data-mined. A newly discovered factor today should have a t-statistic exceeding three. Reevaluating 296 significant anomalies in past published studies, Harvey et al. report that 80–158 (27%–53%) are false discoveries, depending on the specific methods of adjusting for multiple testing. The estimates are likely conservative because many factors have been tried by empiricists, failed, and never been reported (and consequently unobservable).

Harvey, Liu, and Zhu (2016) suggest that two publication biases are likely responsible for the high percentage of false discoveries. The first bias is that it is difficult to publish a negative result in top academic journals. The second, more subtle bias is that it is difficult to publish replication studies in finance and economics, while in many other scientific fields, replications routinely appear in top journals. As a result, financial economists tend to focus on publishing new factors rather than rigorously verifying the validity of published factors.

Harvey (2017) elaborates the complex agency problem behind the publication biases. Journal editors compete for citation-based impact factors, and prefer to publish papers with the most significant results. In response to this incentive, authors often file away papers with results that are weak or negative, instead of submitting them for publication. More disconcertingly, authors often engage in p-hacking, i.e., selecting sample criteria and test procedures until insignificant results become significant. The likely outcome is an embarrassingly large number of false positives that cannot be replicated in the future. Harvey provides a Bayesian p-value as a remedy that incorporates the economic plausibility of the testable hypothesis as part of statistical inference.

Yan and Zheng (2017) form about 18,000 fundamental signals, use bootstrapping to quantify data mining, and find that top signals exhibit superior forecasting power of returns above and beyond sampling variation. By permutating 240 accounting variables with 15 base variables and five different ways of scaling, Yan and Zheng include both published variables and those that have likely been tried but not reported. However, Yan and Zheng construct high-minus-low deciles with NYSE-Amex-NASDAQ, as opposed to NYSE breakpoints, allowing microcaps to populate extreme deciles. This practice exaggerates anomaly profits, especially in equal-weighted returns.

The anomalies literature is the scientific foundation for quantitative asset management (Ang 2014). Since the mid-1990s, factors-based exchange traded funds (ETFs) have experienced spectacular growth. ETFGI, an independent research and consultancy firm, reports that total assets under management of ETFs and other exchanged traded products (ETPs) reach over four trillion dollars worldwide and over 1.5 trillion dollars in the U.S. as of May 2017. As factor investing becomes increasingly important, the financial press has rightfully called into question the reliability of the underlying academic research. For example, a Bloomberg article by Coy (2017) writes: "Most investors have a vague sense they're being ripped off. Here's how it happens." "[R]esearchers have more knobs to twist in search of a prized 'anomaly'—a subtle pattern in the data that looks like it could be a moneymaker. They can vary the period, the set of securities under consideration, or even the statistical method. Negative findings go in a file drawer; positive ones get submitted to a journal (tenure!) or made into an ETF whose performance we rely on for retirement."

2.2 Economics

Finance is only the latest field that starts to take replication of published results seriously. In economics, Leamer (1983) exposes the fragility of empirical results to small specification changes, and proposes to "take the con out of econometrics" by reporting extensive sensitivity analysis to show how key results vary with perturbations in regression specification and in functional form. In an influential study, Dewald, Thursby, and Anderson (1986) attempt to replicate empirical results published at *Journal of Money, Credit, and Banking*, and find that inadvertent errors are so commonplace that the original results often cannot be reproduced.[1] McCullough and Vinod (2003) report that nonlinear maximization routines from different software packages often produce very different estimates, and many articles published at *American Economic Review* fail to test their solutions across different software packages. Chang and Li (2015) report a success rate of less than 50% from replicating 67 published papers from 13 economics journals, and Camerer et al. (2016) show a success rate of 61% from replicating 18 studies in experimental economics.

Collecting more than 50,000 tests published in *American Economic Review*, *Journal of Political Economy*, and *Quarterly Journal of Economics*, Brodeur, Lé, Sangnier, and Zylberberg (2016) document a troubling two-humped pattern of test statistics. The pattern features a first hump with high p-values, a sizeable under-representation of p-values just above 5%, and a second hump with p-values slightly below 5%. The evidence indicates p-hacking that authors search for specifications that deliver just-significant results and ignore those that give just-insignificant results to make their work more publishable. The two-humped shape is less visible in articles with theoretical models,

[1]Dewald, Thursby, and Anderson (1986) write: "The replication of research is an essential component of scientific methodology. Only through replication of the results of others can scientists unify the disparate findings of various researchers in a discipline into a defensible, consistent, coherent body of knowledge (p. 600)."

with randomized control trials, and with tenured or older authors.[2]

2.3 Meta-science

A highly influential article by Ioannidis (2005) develops a theoretical model to show that most (more than 50%) research findings are false for most designs and for most fields. Results are more likely to be false when the studies in a field use smaller samples, when the effect magnitudes are smaller, when there exist many but fewer theoretically predicted relations, when researchers have more degrees of freedom in designs, variable definitions, and analytical methods, when there exist greater financial and other interest and bias, and when more independent teams are involved in a field.

We briefly review Ioannidis's (2005) theoretical arguments in two simplest cases. Let PPV_i be field i's positive predictive value, or the fraction that its published empirical relations are true. Let R_i be the ratio of true relations to false relations tested in the field, meaning that the ex ante probability of a relation being true is $R_i/(1+R_i)$. Let $1-\beta_i$ be the statistical power of the tests, and α be the significance level. Ioannidis shows that the probability of a true finding in field i equals:

$$\text{PPV}_i = \frac{(1-\beta_i)R_i}{(1-\beta_i)R_i + \alpha}. \tag{1}$$

In addition, in the presence of bias, u_i, defined as the likelihood that an author reports a false relation as true above and beyond sampling variation, the probability of a true finding becomes:

$$\text{PPV}_i = \frac{(1-\beta_i)R_i + u_i\beta R_i}{(1-\beta_i)R_i + \alpha + u_i\beta R_i + u_i(1-\alpha)}. \tag{2}$$

For a numerical illustration, we set the significance level, α, to be 0.05 by convention. Ioannidis, Stanley, and Doucouliagos (2015) report that the median statistical power is only 18% or less from 64,076 estimates in more than 6,700 empirical studies in economics. The bulk of the anomalies literature uses monthly returns from the Center for Research in Security Prices (CRSP) and account-

[2] Reviewing the replication literature in economics, Christensen and Miguel (2016) write: "[A]n overall increase in replication research will serve a critical role in establishing the credibility of empirical findings in economics, and in equilibrium, will create stronger incentives for scholars to generate more reliable results (p. 24)."

ing information from Compustat. The sample size is larger than most empirical economic studies. However, our estimation target is the elusive expected stock return, and its common proxy as the average realized return is notoriously noisy (Fama and French 1997, Elton 1999). To get the ball rolling, we set the power to be 0.4, or $\beta_i = 0.6$, which more than doubles Ioannidis et al.'s estimate.

We set $R_i = 0.5$, which implies that, a priori, the number of true relations is one half of the number of false relations tested in the anomalies literature. This R_i value is likely optimistic. For decades, the anomalies literature is largely statistical in nature. Fama and French (1992) reject the classic Capital Asset Pricing Model (CAPM, Sharpe 1964, Lintner 1965). Despite its theoretical elegance, the Breeden (1979) consumption CAPM performs even worse than the CAPM, and is rarely used in the anomalies literature. The Merton (1973) intertemporal CAPM gives rise to multifactor models, but is silent on the state variables that predict future movements in investment opportunities. Finally, the Ross (1976) arbitrage pricing theory is also silent about the factors that describe the cross section of average returns. In this theoretical vacuum, empiricists are free to explore hundreds of accounting, price, volume, and other variables, often with little or no a priori hypothesizing as for why a given anomaly variable should predict future returns.

For the bias parameter, u_i, we experiment with three values, 0.25, 0.5, and 0.75. Our sense is that u_i must be high in the anomalies literature. First, publication biases are well documented elsewhere in economics and social sciences (De Long and Lang 1992, Card and Krueger 1995, Franco, Malhotra, and Simonovits 2014). Second, empiricists have many degrees of freedom in exploiting ambiguities in sample criteria, variable definitions, and empirical specifications, which are all tools of chasing statistical significance (Section 3.1.1). Third, more significant results make a bigger splash, and are more likely to lead to publications, as well as promotion, tenure, and prestige in academia. Fourth, with trillions of dollars invested in factors-based ETFs (and quantitative hedge funds) worldwide, the financial interest is overwhelming. Finally, armies of academics and practitioners engage in searching for significant anomalies, each eager to beat competitors in claiming the first in a discovery. The anomalies literature is most likely one of the biggest areas in finance and accounting.

With these parameters, $\beta_i = 0.6$, $R_i = 0.5$, and $\alpha = 0.05$, equation (1) implies a positive predictive value of 80%, without bias. However, more problematically, with the low, median, and high bias parameter values of 0.25, 0.5, and 0.75, equation (2) implies positive predictive values of only 49%, 40%, and 36%, respectively. Most anomalies are false. As such, although perhaps surprising at first glance, our evidence that only 36% of anomalies can be replicated accords well with the theoretical arguments of Ioannidis (2005) and the multiple testing results of Harvey, Liu, and Zhu (2016).

More broadly, replication failures have been widely documented across scientific disciplines in the past decade. Fanelli (2010) reports that "positive" results increase down the hierarchy of sciences, with hard sciences such as space science and physics at the top and soft sciences such as psychology, economics, and business at the bottom. In oncology, Prinz, Schlange, and Asadullah (2011) report that scientists at Bayer fail to reproduce two thirds of 67 published studies. Begley and Ellis (2012) report that scientists at Amgen attempt to replicate 53 landmark studies in cancer research, but reproduce the original results in only six. Freedman, Cockburn, and Simcoe (2015) estimate the economic costs of irreproducible preclinical studies amount to about 28 billion dollars in the U.S. alone.

In psychology, Open Science Collaboration (2015), which consists of about 270 researchers, conducts replications of 100 studies published in top three academic journals, and reports a success rate of only 36%. Baker (2016) reports that 80% of the respondents in a survey of 1,576 scientists conducted by *Nature* believe that there exists a reproducibility crisis in the published scientific literature. The surveyed scientists cover diverse fields such as chemistry, biology, physics and engineering, medicine, earth sciences, and others. More than 70% of researchers have tried and failed to reproduce another scientist's experiments, and more than 50% have failed to reproduce their own experiments. Selective reporting, pressure to publish, and poor use of statistics are three leading causes.

On replication, Ioannidis (2012) writes: "The ability to self-correct is considered a hallmark of science. However, self-correction does not always happen to scientific evidence by default. The trajectory of scientific credibility can fluctuate over time, both for defined scientific fields and for science at-large. History suggests that major catastrophes in scientific credibility are unfortunately possible and the argument that 'it is obvious that progress is made' is weak. Careful evaluation of the current status of credibility of various scientific fields is important in order to understand any credibility deficits and how one could obtain and establish more trustworthy results. Efficient and unbiased replication mechanisms are essential for maintaining high levels of scientific credibility (p. 645)."

3 Replication

We report our replication results in this section. Table 1 shows the list of 447 anomalies, including 57, 68, 38, 79, 103, and 102 variables from the momentum, value-versus-growth, investment, profitability, intangibles, and trading frictions categories, respectively.[3] Appendix A details variable definitions and portfolio construction. Monthly returns are from CRSP and accounting information from the Compustat Annual and Quarterly Fundamental Files. The sample is from January 1967 to December 2014. Financial firms and firms with negative book equity are excluded.

Section 3.1 describes our replication procedures. Section 3.2 details the anomalies that cannot be replicated. Section 3.3 shows that even for significant anomalies, their magnitudes are often much lower than originally reported. Section 3.4 reports supplementary replication results.

3.1 A Common Set of Replicating Procedures

To test whether an anomaly variable can forecast returns reliably, we form testing deciles with NYSE breakpoints and value-weighted returns. For annually sorted testing deciles, we split all stocks at the end of June of each year t into deciles based on, for instance, book-to-market at the fiscal year ending in calendar year $t-1$, and calculate decile returns from July of year t to June of $t+1$. For monthly sorted portfolios involving latest earnings data, we use earnings data in

[3] Our data library with 447 anomalies is among the largest in the existing literature. Green, Hand, and Zhang (2013) reference 330 anomaly papers, but code up only 39 variables. Green, Hand, and Zhang (2016) and McLean and Pontiff (2016) program about 100 anomaly variables. Harvey, Liu, and Zhu (2016) compile a list of 316 papers, but many variables are macroeconomic in nature, such as aggregate consumption growth. Also, Harvey et al. do not attempt replication. As noted, Yan and Zheng (2017) form about 18,000 fundamental signals, but these are from permutating 240 accounting variables with 15 base variables and five different ways of scaling.

Compustat quarterly files in the months immediately after the quarterly earnings announcement dates. For monthly sorted portfolios involving quarterly accounting data other than earnings, we impose a four-month lag between the fiscal quarter end and subsequent returns. Unlike earnings, other quarterly items are typically not available upon earnings announcement dates. Many firms announce their earnings for a given quarter through a press release, and then file SEC reports several weeks later. In particular, Easton and Zmijewski (1993) document a median reporting lag of 46 days for NYSE/Amex firms and 52 days for NASDAQ firms. Chen, DeFond, and Park (2002) also report that only 37% of quarterly earnings announcements include balance sheet information.

For monthly sorted anomalies, we include three different holding periods (1-, 6-, and 12-month). Chan, Jegadeesh, and Lakonishok (1996), for example, emphasize the short-lived nature of momentum, by examining how momentum profits vary with the holding horizon. As such, it is economically interesting to study how monthly sorted anomalies vary across different holding periods.

Following Beaver, McNichols, and Price (2007), we adjust monthly stock returns for delisting returns by compounding returns in the month before delisting with delisting returns from CRSP. When a delisting return is missing, we replace it with the mean of available delisting returns of the same delisting type and stock exchange in the prior 60 months. Appendix B details our delisting adjustment procedure. Adjusting for delisting returns has little impact on our empirical results.

3.1.1 Why Portfolio Sorts with NYSE Breakpoints and Value-weighted Returns

Empiricists in the anomalies literature have much flexibility in test designs. Some studies exclude stocks with prices per share lower than $1 or $5. We do not impose such a sample screen because low price stocks have little impact on the results from our robust portfolio construction procedures.

Many studies also equal-weight portfolio returns. We instead use value-weights, for several reasons. First, value-weights accurately reflect the wealth effect experienced by investors (Fama 1998). Second, microcaps are influential in equal-weighted returns. Microcaps are on average only 3% of the market value of the NYSE-Amex-NASDAQ universe, but account for about 60% of the total number of stocks (Fama and French 2008). Due to high transaction costs, anomalies in microcaps are difficult to exploit in practice. Also, with only 3% of the total market value, the economic significance of microcaps is trivial. Finally, building on Blume and Stambaugh (1983), Asparouhova, Bessembinder, and Kalcheva (2013) show that microstructure frictions, such as bid-ask spreads, nonsynchronous trading, discrete prices, and order imbalances, can bias upward cross-sectional monthly mean equal-weighted returns. In contrast, the bias in value-weighted returns is minimal.

When forming portfolios, many studies use NYSE-Amex-NASDAQ breakpoints, as opposed to NYSE breakpoints. We use NYSE breakpoints because the cross-sectional dispersion of anomaly variables is the largest among microcaps. Fama and French (2008) show that microcaps have the highest cross-sectional standard deviations of returns and many anomaly variables among micro, small, and big stocks. With NYSE-Amex-NASDAQ breakpoints, microcaps typically account for more than 60% of the stocks in extreme deciles. These microcaps can greatly inflate the anomalies, especially when combined with equal-weights. In contrast, using NYSE breakpoints assigns a fair number of small and big stocks into extreme deciles, alleviating the impact of microcaps.

Hundreds of anomaly studies use Fama-MacBeth (1973) cross-sectional regressions of returns on anomaly variables. We opt to use portfolio sorts, for several reasons. First, cross-sectional regressions, most often performed with ordinary least squares, can be dominated by microcaps because of their plentifulness. The slopes in these regressions are returns to zero-investment portfolios (Fama 1976). In this sense, cross-sectional regressions are analogous to sorts with NYSE-Amex-NASDAQ breakpoints and equal-weights. Second, cross-sectional regressions in effect assign even more weights to microcaps than equal-weights. Because regressions impose a linear functional form between average returns and anomaly variables, regressions are more susceptible to outliers, volatile returns and values of anomaly variables, which most likely belong to microcaps. In contrast, the largely nonparametric sorts do not impose such a linear functional form. Using weighted least squares with the market equity as weights alleviates the concern on equal-weights, but not NYSE-Amex-NASDAQ breakpoints or the linear functional form. Third, the zero-investment portfolios constructed from cross-sectional regressions often involve high turnover and extreme leverage, especially with many regressors, making the portfolios hard to interpret in economic terms.

Finally, most important, cross-sectional regressions with many anomaly variables provide an excess amount of flexibility. Leamer and Leonard (1983) show that inferences from slopes estimated in linear regressions are very sensitive to the underlying specification.[4] For example, two individually insignificant variables that are highly correlated can appear significant when used together. Because the set of regressors included in a regression specification is ambiguous, it is common and perhaps even acceptable to explore various specifications, to search for, and then report a combination that yields "statistical significance" (Simmons, Nelson, and Simonsohn 2011). The likelihood that at least one specification out of many that can produce a false positive at the 5% level can be substantially greater then 5%. Based on survey evidence, John, Loewenstein, and Prelec (2012) suggest that such questionable research practices seem to be the prevailing norm in psychology. Bruns and Ioannidis (2016) also emphasize that the choice of control variables can be a major source of p-hacking in observational research.[5] We avoid this trap altogether by using univariate sorts.

3.1.2 The Economic (In)significance of Microcaps

To further justify our replication procedures, we provide updated evidence on microcaps. Table 2 replicates Fama and French's (2008) Table I in our 1967–2014 sample. Panel A shows that on average, there are 2,406 microcaps, which account for 61% of the total number of firms, 3,938. However, microcaps represent only 3.28% of the total market capitalization, small stocks 6.77%, and

[4]Leamer and Leonard (1983) write: "Empirical results reported in economics journals are selected from a large set of estimated models. Journals, through their editorial policies, engage in some selection, which in turn stimulates extensive model searching and prescreening by prospective authors. Since this process is well known to professional readers, the reported results are widely regarded to overstate the precision of the estimates, and probably to distort them as well. As a consequence, statistical analyses are either greatly discounted or completely ignored (p. 306)."

[5]The American Statistical Association (2016) also states: "P-values and related analyses should not be reported selectively. Conducting multiple analyses of the data and reporting only those with certain p-values (typically those passing a significance threshold) renders the reported p-values essentially uninterpretable. Cherry-picking promising findings, also known by such terms as data dredging, significance chasing, significance questing, selective inference, and 'p-hacking,' leads to a spurious excess of statistically significant results in the published literature and should be vigorously avoided. One need not formally carry out multiple statistical tests for this problem to arise: Whenever a research chooses what to present based on statistical results, valid interpretation of those results is severely compromised if the reader is not informed of the choice and its basis (p. 131–132)."

big stocks 90%. With equal-weights, microcaps earn on average 1.32% per month relative to 1.03% for big stocks. In contrast, the value-weighted market return of 0.93% is close to 0.92% for big stocks. More important, microcaps have the highest cross-sectional standard deviations of monthly returns, 19.1%, followed by small stocks, 11.9%, and then by big stocks, 8.9%. Panel B shows further that except for standardized unexpected earnings (Sue), the cross-sectional dispersions in anomaly variables are the largest for microcaps, followed by small stocks, and then big stocks.

Figure 1 documents further that the economic significance of microcaps has declined in recent decades. Panel A shows that microcaps account for 47.6% of firms at the beginning of the sample. This fraction jumps to 66.6% in 1973 with the addition of NASDAQ, reaches to its maximum of 71.6% in 1987, and displays a downward trend afterward. At the end of 2014, microcaps account for 46.8% of firms. In contrast, the numbers of small and big stocks show a upward trend since the mid-1980s, and account for 26.1% and 27.1% of firms, respectively, at the end of our sample.

Panel B shows that microcaps represent 2.5% of the total market equity in 1967. This fraction increases to 4.6% with the addition of NASDAQ, reaches its maximum of 6.2% in 1984, and shows a downward trend afterward. At the end of 2014, microcaps represent only 1.4% of the total market capitalization, in contrast to 5.6% for small stocks and 93% for big stocks. Panel C shows that the breakpoints of microcaps and small stocks have increased over the years. At the end of 2014, the 20th percentile of NYSE market equity is 595 million dollars, and the median is 2.7 billion dollars. Finally, from 1973 to 2014, on average 77.5% of firms on NASDAQ are microcaps, which represent 18.1% of the total NASDAQ market equity. At the end of 2014, 59.5% of NASDAQ firms are microcaps, which represent only 2.9% of the total NASDAQ market equity (untabulated).

Our evidence that the economic weight of microcaps has declined in recent decades is consistent with Kahle and Stulz (2017). Kahle and Stulz document that the percentage of small public firms (defined as having market equity less than $100 million in 2015 dollars) has dropped dramatically, from 61.5% in 1975 to 43.9% in 1995 and to 22.6% in 2015. The steady decrease in microcaps accords well with both the low number of newly listed firms (Gao, Ritter, and Zhu 2013, Doidge, Karolyi, and Stulz 2013) and the high number of delists (Doidge, Karolyi, and Stulz 2017).

3.1.3 What Is Replication?

Our replication procedures are consistent with the bulk of the replication literature in economics. Building on Hunter (2001), Hamermesh (2007) defines three categories of replication. Pure replication is redoing a prior study in exactly the same way, statistical replication is the same statistical model but different sample from the same underlying population, and scientific replication is different sample, different population, and similar but not identical statistical model. Scientific replication "appears much more suited in type to our methods of research and, indeed, comprises most of what economists view as replication (p. 716)." However, Clemens (2017) distinguishes replication from robustness. Verification (replication) is defined as the same sample, population, and empirical specification; reproduction (replication) as different sample from the same population but with the same specification; reanalysis (robustness) as the same sample and population but different specifications; and extension (robustness) as different sample and population but the same specification.

We follow the bulk of the replication literature in economics in defining replication as "any study whose primary purpose is to establish the correctness of a previous study" (see, for example, The Replication Network, https://replicationnetwork.com).[6] The articles on replication published in the May 2017 issue of *American Economic Review* all adopt the same definition.[7]

[6] The Replication Network is endorsed by more than 370 economists worldwide as of May 2017.

[7] In particular, Berry, Coffman, Hanley, Gihleb, and Wilson (2017) define a replication as "any project that reports results that speak directly to the veracity of the original paper's main hypothesis (p. 27)." Sukhtankar (2017) considers "all papers conforming to any of the Clemens (2017) classifications—including those he classifies as robustness tests—as replications (p. 33)." Hamermesh (2017, p. 38) writes: "Applied microeconomics is not a laboratory science—at its best it consists of the generation of new ideas describing economic behavior, independent of time or space. The empirical validity of these ideas, after their relevance is first demonstrated for a particular time and place, can only be usefully replicated at other times and places: If they are general descriptions of behavior, they should hold up beyond their original testing ground." Finally, Duvendack, Palmer-Jones, and Reed (2017) operationalize replication as "any study whose main purpose is to determine the validity of one or more empirical results from a previously published study (p. 47)." Duvendack et al. further write: "By redoing the original data analysis, by adjusting model specifications, exploring the influence of unusual observations, using different estimation methods, and alternative datasets, replication can identify spurious or fragile results (p. 46)."

3.2 Anomalies That Cannot be Replicated

We treat an anomaly as a replication failure if the average return of its high-minus-low decile is insignificant at the 5% level ($t < 1.96$). This t-value cutoff is quite lenient from our perspective in that we view a t-value no lower than 1.96 as a success. Despite our lax criterion, Table 3 reports that 286 out of 447 anomaly variables (64%) earn insignificant average return spreads, including 20, 37, 11, 46, 77, and 95 anomalies from the momentum, value-versus-growth, investment, profitability, intangibles, and trading frictions categories, respectively. Imposing the t-cutoff of three increases the number of insignificance to 380 (85%), including 33, 61, 23, 66, 96, and 101 variables across the six categories, respectively. In this subsection, we detail the insignificant anomalies, and discuss possible procedural sources for their failed replications.

3.2.1 Momentum

Panel A of Table 3 reports 20 insignificant momentum anomalies. The high-minus-low Sue deciles at the 6- and 12-month horizons earn on average 0.19% and 0.11% per month ($t = 1.65$ and 1.00), respectively. These estimates are lower than those in Chan, Jegadeesh, and Lakonishok (1996), who report 6- and 12-month buy-and-hold returns of 6.8% and 7.5%, respectively. The differences likely arise because Chan et al. equal-weight the decile returns.

The high-minus-low revenue surprise (Rs) decile at the 6-month horizon earns an average return of only 0.14% per month ($t = 1.01$). This estimate is lower than the average 6-month buy-and-hold abnormal return of 4.42% for the high-minus-low quintile reported by Jegadeesh and Livnat (2006), who use NYSE-Amex-NASDAQ breakpoints and equal-weighted returns. Also, Jegadeesh and Livnat calculate abnormal returns against the size and book-to-market benchmark portfolios, which are in turn value-weighted. The high-minus-low tax expense surprise (Tes) deciles at the 1-, 6-, and 12-month earn average returns of 0.26%, 0.28%, and 0.18% per month ($t = 1.56, 1.9$, and 1.34), respectively. These estimates are lower than the average 3-month buy-and-hold return of 3.9% reported by Thomas and Zhang (2011) based on NYSE-Amex-NASDAQ breakpoints and equal-weighted returns. Also, the time lag between the fiscal quarter end and subsequent returns is only three months, not four months in our construction.

The high-minus-low segment momentum (Sm) deciles at the 6- and 12-month earn only 0.09% and 0.14% per month ($t = 0.88$ and 1.87), respectively. At the 1-month, Table 8 reports that the average return is 0.59% ($t = 2.57$). The 0.59% estimate is lower than 0.95% reported in Cohen and Lou (2012). Cohen and Lou use NYSE-Amex-NASDAQ breakpoints, and also impose a price screen of $5 at portfolio formation. We use NYSE breakpoints with no price screen. We also show that the average return is sensitive to the holding period.

Finally, the high-minus-low deciles formed on the industry lead-lag effect in earnings surprises (Ile) at the 6- and 12-month earn on average 0.27% ($t = 1.79$) and 0.11% ($t = 0.84$), respectively. In contrast, Hou (2007) shows stronger effects at shorter horizons using weekly cross-sectional regressions. Table 4 shows that the high-minus-low Ile decile earns 0.62% ($t = 3.7$) at the 1-month, and the industry lead-lag effect in prior returns (Ilr) is significant at all horizons.

3.2.2 Value-versus-growth

Panel B of Table 3 reports 37 insignificant value-versus-growth anomalies. Debt-to-market equity (Dm) is insignificant in both annual sorts and monthly sorts at all horizons. The average returns of the high-minus-low deciles vary from 0.27% to 0.32% per month, with t-values from 1.17 to 1.59. The estimates contrast with Bhandari's (1988) results from cross-sectional regressions. Dividend yield (Dp) and payout yield (Op) are also insignificant in both annual sorts and all monthly sorts. This evidence contrasts with Litzenberger and Ramaswamy's (1979) results on Dp from cross-sectional regressions, as well as Boudoukh, Michaely, Richardson, and Roberts's (2007) results on Op based on NYSE breakpoints but equal-weighted returns.

The high-minus-low five-year sales growth (Sr) decile earns an average return of only -0.2% per month ($t = -1.08$), which is much lower in magnitude than -7.3% per annum in Lakonishok, Shleifer, and Vishny (1994) based on NYSE-Amex breakpoints and equal-weighted returns (without

NASDAQ stocks). Net debt-to-price (Ndp) is insignificant in both annual sorts and monthly sorts at all horizons, with average return spreads ranging from 0.17% to 0.31% per month, and t-values from 0.71 to 1.62. The average returns are lower than 8.7% per annum in Penman, Richardson, and Tuna (2007) based on NYSE-Amex-NASDAQ breakpoints and equal-weighted size-adjusted returns.

3.2.3 Investment

Panel C of Table 3 reports 11 insignificant investment anomalies. The high-minus-low decile on the Richardson-Sloan-Soliman-Tuna (2005) total accruals (Ta) earns an average return of -0.23% ($t = -1.63$). In contrast, Richardson et al.'s Table 8 reports a negative slope of Ta more than six standard errors from zero in cross-sectional regressions of returns. Their Table 10 also shows an average (size-adjusted) return of -13.3% per annum ($t = -10.25$) for the high-minus-low decile based on NYSE-Amex-NASDAQ breakpoints and equal-weights. The high-minus-low deciles on net external finance (Nxf) and net equity finance (Nef) earn on average -0.27% and -0.17% per month ($t = -1.44$ and -0.86), respectively. These estimates are lower in magnitude than -15.5% ($t = -5.7$) and -11.2% ($t = -3.82$) per annum reported by Bradshaw, Richardson, and Sloan (2006) based on NYSE-Amex-NASDAQ breakpoints and equal-weighted size-adjusted returns.

3.2.4 Profitability

Panel D of Table 3 reports 46 insignificant anomalies in the profitability category. The return on equity (Roe) is significant mostly within short horizons. At the 6-month, the high-minus-low decile earns on average 0.42% ($t = 1.95$), and at the 12-month, 0.24% ($t = 1.19$). At the 1-month, the average return spread is 0.69% ($t = 3.07$) (Table 4). The evidence is largely consistent with Fama and French (2006), who use annual sorts, and Hou, Xue, and Zhang (2015), who use monthly sorts.

Many different measures of profitability have recently been proposed to predict returns, but not all are effective. The high-minus-low gross profits-to-lagged assets (Gla) decile earns an average return of only 0.16% per month ($t = 1.04$). This average return is lower than that of 0.38% ($t = 2.62$) for the high-minus-low gross profits-to-assets (Gpa) decile (Table 4). The difference between Gla and Gpa is that Gla scales gross profits with one-period-lagged assets, but Gpa scales with current assets. Because both profits and assets are measured at the end of a period in Compustat, profits should be scaled by lagged assets, which in turn produce current profits. In contrast, the current assets at the end of a period are accumulated through investment over the current period, and start to generate profits only in future periods. Most important, because Gpa equals Gla divided by asset growth (current assets-to-lagged assets), the Gpa effect is confounded with the investment effect. Purging the investment effect yields an economically small and statistically insignificant Gla effect.

Perhaps surprisingly, operating profits-to-book equity (Ope), which is the sorting variable underlying the Fama-French (2015) robust-minus-weak (RMW) profitability factor, is also insignificant. The high-minus-low Ope decile earns an average return of only 0.25% per month ($t = 1.2$). Ope scales operating profits with the current book equity. Scaling with the one-period-lagged book equity as in operating profits-to-lagged book equity (Ole) reduces the average return spread further to 0.07% ($t = 0.37$). Ball, Gerakos, Linnainmaa, and Nikolaev (2015) add research and development expenses to operating profits, show that the high-minus-low operating profits-to-assets (Opa) decile earns on average 0.29% ($t = 1.95$). We replicate their result with an average return of 0.37% ($t = 1.87$). However, scaling their operating profits with the lagged assets as in operating profits-to-lagged assets (Ola) reduces the average return to 0.2% ($t = 1.07$).

A bigger surprise is that the distress anomaly is virtually nonexistent in our replication. In annual sorts, the high-minus-low failure probability (Fp) decile earns an average return of −0.38% per month ($t = -1.28$) from July 1976 to December 2014. This estimate is much lower in magnitude than −9.66% per annum reported by Campbell, Hilscher, and Szilagyi (2008) in the 1981–2003 sample. We replicate their estimate in their sample period with an average return of −0.82% per month ($t = -2.1$). However, prior to their sample, the average return is strongly positive, 0.69% from July 1976 to December 1980 (0.09% from 2003 onward). In monthly sorts, the average returns are −0.48% and −0.36% at the 1- and 12-month, respectively, but both are within 1.5 standard errors from zero. At the 6-month, the average return is −0.63% ($t = -2.03$) (Table 4). Finally, while Campbell et al. use NYSE-Amex-NASDAQ breakpoints, we use NYSE breakpoints.

Several alternative measures of financial distress, including Altman's (1968) Z-score (Z), Ohlson's (1980) O-score (O), and credit rating (Cr), show even weaker forecasting power than failure probability. None of the high-minus-low deciles show any significant average returns in either annual sorts or monthly sorts at any horizon. In particular, the average returns of the high-minus-low O deciles range from -0.06% ($t = -0.3$) to -0.36% per month ($t = -1.57$), and those of the high-minus-low Z deciles from 0.01% ($t = 0.06$) to -0.09% ($t = -0.46$). These estimates contrast with those in Dichev (1998), who reports an average return of -1.17% ($t = -3.36$) for the highest-10%-minus-lowest-70% O portfolio based on NYSE-Amex-NASDAQ breakpoints and equal-weighted returns, as well as a significantly positive slope for Z-score in cross-sectional regressions.

Finally, the high-minus-low credit rating (Cr) deciles all earn average returns that are close to zero at the 1-, 6-, and 12-month horizons. These estimates contrast with Avramov, Chordia, Jostova, and Philipov (2009), who report a high-minus-low average return of -1.09% per month ($t = -2.61$) based on NYSE-Amex-NASDAQ breakpoints and equal-weighted returns. Besides the procedural difference, another difference is that Avramov et al. use credit ratings data from Ratings Xpress, to which we do not have access because it has been discontinued on WRDS.

3.2.5 Intangibles

Panel E of Table 3 reports 77 insignificant anomalies in the intangibles category. R&D-to-sales (Rds), the Kaplan-Zingales index, and the Whited-Wu index are all insignificant in annual sorts and monthly sorts at all horizons. This evidence replicates the insignificant results in Chan, Lakonishok, and Sougiannis (2001), Lamont, Polk, and Saa-Requejo (2001), and Whited and Wu (2006).

The high-minus-low hiring rate (Hn) decile earns an average return of -0.27% per month ($t = -1.79$). This estimate is lower in magnitude than -5.61% per annum ($t = -2.26$) reported in Belo, Lin, and Bazdresch (2014), who use all-but-microcap breakpoints, and include only firms with December fiscal year end. We instead use NYSE breakpoints, and include firms with all fiscal year end.

The average returns of the high-minus-low deciles on percentage change in sales minus that in inventory (dSi), percentage change in sales minus that in accounts receivable (dSa), percentage change in gross margin minus that in sales (dGs), percentage change in sales minus that in SG&A (dSs), and labor force efficiency (Lfe) are all small and insignificant, ranging from 0.04% to 0.2% per month, with t-values from 0.24 to 1.59. For comparison, Abarbanell and Bushee (1998) report insignificant results for dSa, dGs, and Lfe, but significant results for dSi and dSs based on cross-sectional regressions of size-adjusted buy-and-hold returns of up to 12 months. However, while Abarbanell and Bushee report insignificant results for effective tax rate (Etr), its average return spread is 0.25% ($t = 2.35$) in our replication (Table 4).

The high-minus-low corporate governance (Gind) decile earns a tiny average return of 0.02% per month ($t = 0.06$) in our sample from September 1990 to December 2006 (the last available date). In contrast, Gompers, Ishii, and Metrick (2003) report a significant high-minus-low Gind decile alpha of −0.71% ($t = -2.73$) in the Carhart (1997) four-factor model in their sample from September 1990 to December 1999. We come close to replicate their result, with a Carhart alpha of −0.59% ($t = -1.88$) and an average return of −0.73% ($t = -2.04$) in their sample period. However, outside their sample from January 2000 to December 2006, the high-minus-low Gind decile earns a positive average return of 1.01% ($t = 2.09$), and its Carhart alpha is insignificant, 0.2% ($t = 0.56$). Our evidence is consistent with Core, Guay, and Rusticus (2006), who document that the high-minus-low Gind return exhibits a reversal from 2000 to 2003.

The high-minus-low accruals quality (Acq) decile earns a tiny average return of −0.07% per month ($t = -0.36$) in annual sorts, and the average returns from monthly sorts are quantitatively close. The average returns of the high-minus-low deciles formed on earnings persistence (Eper), earnings smoothness (Esm), value relevance of earnings (Evr), and earnings conservatism (Ecs) are all small and insignificant, ranging from −0.06% to 0.18%, with t-values from −0.45 to 1.32. These results contrast with Francis, LaFond, Olsson, and Schipper (2004, 2005), who report that these earnings attributes have significant relations with the cost of equity. Francis et al. base their inferences on ex ante accounting-based measures of cost of capital, not average realized returns. Although Francis et al. construct factors based on the earnings attributes, their average returns are not reported. Our evidence accords with Core, Guay, and Verdi (2008), who also report that the accruals quality is not priced in asset pricing tests. We emphasize, however, that the two other attributes in Francis et al., earnings predictability (Eprd) and earnings timeliness (Etl), do produce significant average return spreads, -0.49% ($t = -2.75$) and 0.36% ($t = 2.85$), respectively (Table 4).

The high-minus-low deciles formed on dispersion of analysts' earnings forecasts (Dis) earn $-0.24\%, -0.22\%$, and -0.13% per month at the 1-, 6-, and 12-month, all of which are within one standard error from zero. The evidence contrasts with Diether, Malloy, and Scherbina (2002), who report an average return of -0.79% ($t = -2.88$) for the low-minus-high Dis quintile at the 1-month based on NYSE-Amex-NASDAQ breakpoints and equal-weighted returns. Diether et al. also exclude stocks with prices per share lower than \$5. We do not impose such a price screen.

3.2.6 Trading Frictions

The biggest casualty of our replication is the trading frictions (liquidity) category, with 95 out of 102 variables (93%) insignificant. Panel F of Table 3 shows that 15 out of 16 volatility measures earn insignificant average returns for their high-minus-low deciles. In particular, the high-minus-low deciles on idiosyncratic volatility calculated from the Fama-French (1993) three-factor model (Ivff) earn on average -0.51%, -0.33%, and -0.18% per month ($t = -1.62, -1.11$, and -0.62) at the 1-, 6-, and 12-month, respectively. The high-minus-low deciles on total volatility (Tv) earn on average $-0.4\%, -0.25\%$, and -0.2% ($t = -1.16, -0.77$, and -0.62) at the three horizons, respectively. The systematic volatility risk (Sv) is insignificant at the 6- and 12-month (Table 3), but significant at the 1-month with an average return of -0.53% ($t = -2.47$) (Table 4).

Our estimates are lower than -1.06%, -0.97%, and -1.04% per month ($t = -3.1, -2.86$ and -3.9) for the high-minus-low Ivff, Tv, and Sv quintiles, respectively, all at the 1-month, reported in Ang, Hodrick, Xing, and Zhang (2006) based on NYSE-Amex-NASDAQ breakpoints and value-weights. With these breakpoints, we obtain -1.28% ($t = -3.48$) and -1.22% ($t = 3$) for the high-minus-low Ivff and Tv deciles, respectively, in our sample. For the high-minus-low Sv decile, we obtain -1.1% ($t = -3.1$) in the original 1986–2000 sample in Ang et al., but only -0.56% ($t = -2.09$) in our sample. In the 2001–2014 period, the Sv effect has disappeared, with an average return of 0.01%. Our evidence is consistent with Bali and Cakici (2008).

Three market beta measures based on rolling window regressions, the Frazzini-Pedersen (2014) method, and the Dimson (1979) method are all insignificant. In particular, the high-minus-low Frazzini-Pedersen beta deciles earn around -0.2% per month at the 1-, 6-, and 12-month, and are all within one standard error from zero. Our evidence replicates the Frazzini-Pedersen results that high beta stocks do not earn significantly higher average returns than low beta stocks.

Traditional liquidity measures fare poorly in our replication. The high-minus-low deciles on the Amihud (2002) absolute return-to-volume (Ami) earn on average only 0.28% and 0.37% per month ($t = 1.31$ and 1.73) at the 1- and 6-month, respectively. At the 12-month, the average return is marginally significant, 0.42% ($t = 1.99$) (Table 4). In contrast, Amihud reports a highly significant liquidity effect using cross-sectional regressions that weight microcaps heavily.

All five versions of the Acharya-Pedersen (2005) liquidity betas, including return-return (β^{ret}), illiquidity-illiquidity (β^{lcc}), return-illiquidity (β^{lrc}), illiquidity-return (β^{lcr}), and net liquidity beta (β^{net}), earn insignificant average return spreads across all monthly horizons. The average returns range from -0.05% to 0.34% per month, and all except for that of β^{lcc} at the 1-month ($t = 1.54$) are within 1.5 standard errors from zero. In contrast, Acharya and Pedersen report significant pricing results for β^{ret} and β^{net} based on cross-sectional regressions.

Other insignificant liquidity variables include share turnover (Tur) and its coefficient of variation (Cvt), the coefficient of variation for dollar trading volume (Cvd), share price (Pps), and prior 1-, 6-, and 12-month turnover-adjusted number of zero daily trading volume (Lm^1, Lm^6, and Lm^{12}). In particular, the average returns of the high-minus-low Tur deciles range from -0.1% to

-0.15% per month, all of which are within 0.6 standard errors from zero. In contrast, Datar, Naik, and Radcliffe (1998) report highly significant pricing results for Tur in cross-sectional regressions with only NYSE stocks. The average returns of the high-minus-low Cvd deciles vary from 0.1% to 0.18%, all of which are within 1.3 standard errors from zero. This evidence contrasts with Chordia, Subrahmanyam, and Anshuman (2001), who report highly significant results for Cvd with cross-sectional regressions with NYSE and Amex stocks. Finally, none of the three Lm measures interacted with three holding periods (nine measures in total) produce any significance. The high-minus-low average returns range from -0.07% to 0.38%, with t-values from -0.33 to 1.82. In contrast, Liu (2006) reports significant average return spreads for eight out of the nine measures using NYSE breakpoints but equal-weighted returns (without NASDAQ stocks).

The high-minus-low short-term reversal (Srev) decile earns on average only -0.26% per month ($t = -1.31$). This estimate is much lower in magnitude than -1.99% ($t = -12.55$) reported in Jegadeesh (1990) based on NYSE-Amex-NASDAQ breakpoints and equal-weighted returns. The high-minus-low high-low bid-ask spread (Shl) deciles earn on average -0.16%, -0.16%, and -0.12% at the 1-, 6-, and 12-month, which are all within 0.6 standard errors from zero. In contrast, Corwin and Schultz (2012) report highly significant abnormal returns (three-factor alphas) of more than 1% by weighting decile returns based on prior-month returns, with weights closer to equal- than value-weights. Also, Corwin and Schultz use only NYSE and Amex stocks with a price screen of $5.

Several recently proposed friction variables are also insignificant. The high-minus-low tail risk (Tail) deciles earn on average 0.11%, 0.15%, and 0.19% per month ($t = 0.57$, 0.79, and 1.13) at the 1-, 6-, and 12-month, respectively. These estimates are lower than 0.36% ($t = 2$) at the 1-month and 0.35% ($t = 2.15$) at the 12-month reported by Kelly and Jiang (2014) based on NYSE-Amex-NASDAQ breakpoints. The high-minus-low deciles on maximum daily return (Mdr) earn on average -0.34%, -0.17%, and -0.07% ($t = -1.14$, -0.62, and -0.24) across the three horizons, respectively. These estimates are much lower in magnitude than -1.03% ($t = -2.83$) at the 1-month reported in Bali, Cakici, and Whitelaw (2011) based on NYSE-Amex-NASDAQ breakpoints. In particular, Bali et al. report that the average return starts at 1.01% for decile one, remains roughly flat at decile seven, drops to 0.52% for decile nine, and then precipitously to −0.02%. In our replication with NYSE breakpoints, the average return starts at 0.97% for decile one, remains roughly flat at 1.05% for decile nine, and then drops only to 0.64%. Finally, the high-minus-low decile on the Adrian-Etula-Muir (2014) financial intermediary leverage beta earns on average 0.43%, 0.3%, and 0.25% ($t = 1.78$, 1.31, and 1.15) at the 1-, 6-, and 12-month, respectively.

3.3 Replicated Anomalies That Are Significant at the 5% Level

Turning to significant anomalies, Table 4 shows that their magnitudes are often much lower than those reported in their original studies. In particular, the high-minus-low deciles formed on abnormal returns around earnings announcements (Abr) earn on average 0.3% and 0.22% per month across the 6- and 12-month. These estimates are lower than the buy-and-hold returns of 5.9% and 8.3% over the same horizons reported in Chan, Jegadeesh, and Lakonishok (1996), respectively. The high-minus-low deciles on revisions in analysts' earnings forecasts (Re) earn 0.54% ($t = 2.49$) and 0.28% ($t = 1.47$, Table 3) at the 6- and 12-month, which are lower than the buy-and-hold returns of 7.7% and 9.7% over the same horizons reported in Chan et al., respectively.

The Jegadeesh-Titman (1993) momentum anomaly fares well in our replication. The high-minus-low deciles on prior six-month returns (R^6) earn on average 0.82% ($t = 3.49$) and 0.55% ($t = 2.9$) at the 6- and 12-month, respectively. However, even these estimates are smaller than the estimates of 1.1% ($t = 3.61$) and 0.9% ($t = 3.54$), respectively, reported in Jegadeesh and Titman based on NYSE-Amex breakpoints and equal-weighted returns (without NASDAQ stocks).

The high-minus-low customer momentum (Cm) quintiles earn on average 0.79% ($t = 3.74$) and 0.16% ($t = 2.3$) at the 1- and 12-month, respectively. Following Cohen and Frazzini (2008), we form quintiles, not deciles, because a disproportionate number of firms can have the same Cm values, giving rise to fewer than ten portfolios in some months. At the 6-month, the high-minus-low quintile earns 0.18% ($t = 1.83$) (Table 3). These estimates are substantially lower than 1.58% ($t = 3.79$)

reported in Cohen and Frazzini (2008) based on NYSE-Amex-NASDAQ breakpoints as well as a \$5 price screen, albeit with value-weighted returns.

The high-minus-low cash flow-to-price (Cp) decile earns on average 0.49% per month ($t = 2.47$). This average return is much lower than 9.9% per annum reported in Lakonishok, Shleifer, and Vishny (1994) based on NYSE-Amex breakpoints and equal-weighted returns (without NASDAQ stocks). Also, sorting on operating cash flow-to-price (Ocp) yields an average return spread of 0.77% ($t = 3.5$), which is much lower than 14.9% per annum ($t = 2.65$) reported in Desai, Rajgopal, and Venkatachalam (2004) based on NYSE-Amex-NASDAQ breakpoints and equal-weighted returns.

The high-minus-low asset growth (investment-to-assets, I/A) decile earns on average −0.46% per month ($t = -2.92$). This average return is much lower in magnitude than −1.05% ($t = -5.04$) with value-weighted returns and −1.73% ($t = -8.45$) with equal-weighted returns reported by Cooper, Gulen, and Schill (2008), who use NYSE-Amex-NASDAQ breakpoints. Finally, the high-minus-low operating accruals (Oa) decile earns only −0.27% ($t = -2.13$). This average return is much smaller in magnitude than −10.4% per annum ($t = -4.71$) reported by Sloan (1996). Sloan uses NYSE-Amex breakpoints (without NASDAQ stocks), equal-weighted returns, and size-adjusted abnormal returns, in which the size-decile benchmark uses value-weighted returns.

3.4 Additional Results on Replication

In this subsection, we furnish supplementary results on replication, including average return spreads in the original samples (Section 3.4.1), average return spreads with NYSE-Amex-NASDAQ breakpoints and equal-weights (Section 3.4.2), and investment capacity of microcaps (Section 3.4.3).

3.4.1 Average Return Spreads in the Original Samples

We interpret the evidence in Table 3 that only 36% of anomalies can be replicated as indicative of p-hacking, mainly by overweighting microcaps. An alternative interpretation is that the insignificant anomalies exist in the original samples examined in original studies, but have since attenuated, perhaps due to time-varying expected returns and mispricing arbitrage. While we cannot rule it out entirely, Table 5 based on the original samples casts doubt on this alternative interpretation.

The empirical design of Table 5 is identical to that of Tables 3 and 4, except that we stop the sample of a given anomaly at the sample end of its original study. If the start of the sample in the original study is later than January 1967, we begin our sample at the same date. Otherwise, we start at January 1967, which is the earliest date in our sample, to be consistent with our later tests (Section 4).

Table 5 shows that out of 447 anomalies, 293 (66%) are insignificant at the 5% level, including 24, 44, 13, 38, 81, and 93 across the momentum, value-versus-growth, investment, profitability, intangibles, and trading frictions categories, respectively. The evidence is largely similar to Table 3. The total number of insignificance, 293, is even higher than 286 in the full sample. Imposing the t-cutoff of three raises the number of insignificance to 387 (86.6%), including 35, 64, 25, 66, 97, and 100 across the six categories, respectively. Across the 154 significant anomalies at the 5% level in the original samples, the average absolute return spread is 0.65% per month, and the average absolute t-value is 2.89. For comparison, across the 161 significant anomalies in the full sample, the average absolute return spread is 0.51%, and the average absolute t-value is 2.93.

Sampling variation plays a limited role. Once we extend the original samples to the full sample, 30 anomalies change from being significant to insignificant, but 37 anomalies from insignificant to significant. Among the former group that loses significance in the full sample, the average return spreads of five-year sales growth (Sr), O-score (O), F-score (F), and short-term reversal (Srev) are -0.45%, -0.6%, 0.65%, and -0.65% per month ($t = -1.99, -2.06, 2.19$, and -2.4), respectively, in their original samples. However, sample variation also helps 37 different anomalies gain significance in the full sample. For example, the average return spreads of Sue at 1-month, revisions in analysts' forecasts (Re) at 6-month, sales-to-price (Sp), analysts-based intrinsic value-to-market (Vfp), percent operating accruals (Poa), R&D-to-market (Rdm), and total skewness (Ts) at 1-month are all insignificant in the original samples, but become significant in the full sample.

3.4.2 Average Return Spreads with NYSE-Amex-NASDAQ Breakpoints and Equal-weighted Returns

To quantify the impact of overweighting microcaps in portfolio sorts, Table 6 reports average return spreads of all the anomaly deciles with NYSE-Amex-NASDAQ breakpoints and equal-weighted returns in the full sample. The table shows that out of 447 anomalies, 181 (40%) are insignificant at the 5% level, including 9, 14, 1, 36, 59, and 62 across the momentum, value-versus-growth, investment, profitability, intangibles, and trading frictions categories, respectively. Imposing the t-cutoff of three yields 241 (54%) insignificant anomalies, including 19, 23, 2, 51, 71, and 75 across the six categories, respectively. Among the 266 significant anomalies at the 5% level, the average magnitude of average return spreads is 0.87% per month, and the average absolute t-value is 4.71, in contrast to 0.51% and 2.93, respectively, from NYSE breakpoints and value-weights (Table 4).[8]

Overweighting microcaps inflates average return spreads and their t-values for all categories. Across the momentum, value-versus-growth, investment, profitability, intangibles, and trading frictions groups, the average magnitudes of significant average return spreads are 0.77%, 1%, 0.81%, 0.81%, 0.91%, and 0.89% per month, and the average absolute t-values are 5.79, 4.56, 5.96, 4.09, 4.1, and 3.77, respectively, with NYSE-Amex-NASDAQ breakpoints and equal-weights. For comparison, with NYSE breakpoints and value-weights, the average magnitudes of significant average return spreads are 0.56%, 0.56%, 0.41%, 0.49%, 0.58%, and 0.39%, and the average absolute t-values are 3.27, 2.67, 3.01, 2.81, 2.92, and 2.46, respectively. The inflation rate on average return spreads is on average 42%, ranging from 27.3% for momentum to 56% for trading frictions.

Table 6 also shows that, surprisingly, 62 out of 102 variables (61%) in the trading frictions category remain insignificant at the 5% level even with NYSE-Amex-NASDAQ breakpoints and

[8] The results with NYSE-Amex-NASDAQ breakpoints and equal-weighted returns in the original samples analyzed in the original studies are largely similar to those in the full sample (untabulated). Out of 447 anomalies, 191 (43%) are insignificant at the 5% level, including 9, 18, 2, 37, 61, and 64 across the momentum, value-versus-growth, investment, profitability, intangibles, and trading frictions categories, respectively. The total number of insignificance, 191, is again even higher than 181 in the full sample. Imposing the t-cutoff of three yields 262 (58.6%) insignificant anomalies, including 17, 35, 4, 48, 76, and 82 across the six categories, respectively. Among the 256 significant anomalies at the 5% level in the original samples, the average magnitude of aversage return spreads is 0.97% per month, and the average absolute t-value is 4.41. Both are largely comparable with those in the full sample, 0.87% and 4.71, respectively.

equal-weights. We interpret the evidence as indicating an excessive amount of flexibility with cross-sectional regressions commonly adopted in the liquidity literature (Section 3.1.1).

Again, 15 out of 16 volatility measures produce economically small and statistically insignificant average return spreads. Five measures even produce positive average return spreads, albeit all insignificant, and 13 measures have absolute t-values below one. The evidence is even weaker than that in Table 3 based on NYSE breakpoints and value-weights. In untabulated results, we show that 9 out of 16 volatility measures generate significant average return spreads with NYSE-Amex-NASDAQ breakpoints and value-weights. As such, the low volatility anomaly is extremely fragile.

The Acharya-Pedersen (2005) liquidity betas again fare poorly. All 15 variables from interacting five beta measures with three horizons earn economically small and statistically insignificant average return spreads. However, other liquidity measures perform well with NYSE-Amex-NASDAQ breakpoints and equal-weights, including share turnover (Tur), dollar trading volume (Dtv), share price (Pps), absolute return-to-volume (Ami), zero daily volume (Lm), and short-term reversal (Srev).

3.4.3 Portfolio Weights on Microcaps and Investment Capacity

Table 7 shows further why microcaps should be alleviated in any portfolio construction. Panel A reports the average portfolio weights allocated to microcaps for the extreme deciles across the six categories of anomalies. Our benchmark procedure with NYSE breakpoints and value-weights assigns a modest amount of weights on microcaps, while the alternative procedure with NYSE-Amex-NASDAQ breakpoints and equal-weights invests a disproportionately large amount. For instance, in the momentum category, the low decile assigns on average 7.34% on microcaps under the benchmark procedure, but 64.19% under the alternative. In the investment category, the high decile assigns 5.69% on microcaps under the benchmark procedure, but 60.89% under the alternative.

In addition, the investment capacity on microcaps is limited. We measure a portfolio's investment capacity as $\min_i\{\mathrm{Me}_i/w_i\}$, in which i is the index of all the stocks in the portfolio, Me_i is stock i's market equity, and w_i is its weight in the portfolio. Me_i/w_i is the maximum amount that the portfolio can invest in stock i by buying up all its shares, without considering the availability of shares of other stocks in the portfolio. We need to take the minimum Me_i/w_i across the index i because buying up any stock would exhaust the investment capacity of the portfolio.

For an equal-weighted portfolio, $w_i = 1/n$, in which n is the number of stocks in the portfolio. As such, the investment capacity equals $\min_i\{\text{Me}_i/w_i\} = n \times \min_i\{\text{Me}_i\}$. Intuitively, if an equal amount of dollars is invested in each stock in the portfolio, its investment capacity is restricted by the stock with the smallest market equity. For a value-weighted portfolio, $w_i = \text{Me}_i/\sum_i \text{Me}_i$. The investment capacity becomes $\min_i\{\text{Me}_i/w_i\} = \min_i\{\sum_i \text{Me}_i\} = \sum_i \text{Me}_i$, the total market equity of all stocks in the portfolio, which is much higher than the investment capacity under equal-weights.

Panel B of Table 7 shows that the investment capacity with NYSE breakpoints and value-weights is about several orders of magnitude larger than that with NYSE-Amex-NASDAQ breakpoints and equal-weights. For example, in the momentum category, the investment capacity of the low decile is on average 7.12% of the total market equity with our benchmark procedure, but only 0.016% with the alternative construction. In the investment category, the investment capacity of the high decile is on average 7.49% of the total market equity, but only 0.017% with the alternative procedure.

4 Explaining Significant Anomalies with the q-factor Model

In this section, we use the q-factor model to explain significant anomalies with NYSE breakpoints and value-weighted returns in the full sample. We discuss the model's performance in Section 4.1, and highlight its weaknesses in Section 4.2. Appendix C details the q-factors construction, including a new procedure that extends the sample of the q-factors backward from 1972 to 1967.

4.1 The q-factor Regressions

From January 1967 to December 2014, the size, investment, and Roe factors in the q-factor model earn on average 0.32%, 0.43%, and 0.56% per month ($t = 2.42, 5.08$, and 5.24), respectively. The investment and Roe factor premiums cannot be explained by the Carhart (1997) four-factor model, with alphas of 0.29% ($t = 4.57$) and 0.51% ($t = 5.58$), or the Fama-French (2015) five-factor model, with alphas of 0.12% ($t = 3.35$) and 0.45% ($t = 5.6$), respectively. (The data for the Carhart factors, including the momentum factor, UMD, and the five factors are from Kenneth French's Web site.) UMD earns an average return of 0.67% ($t = 3.66$), but its q-factor alpha is only 0.11% ($t = 0.43$). In the five-factor model, the average RMW and CMA returns are 0.27% ($t = 2.58$) and 0.34% ($t = 3.63$), but their q-factor alphas are only 0.04% and 0.01% ($t = 0.42$ and 0.32), respectively.

Table 8 shows that across the 161 significant anomalies, the average magnitude of the high-minus-low alphas is 0.26% per month, and the number of significant high-minus-low alphas is 46 at the 5% level (11 with $t \geq 3$). The mean absolute alpha is 0.12%, and the number of rejections by the Gibbons, Ross, and Shanken (1989, GRS) test is 107 at the 5% level and 72 at the 1% level.

Columns 1–37 in Table 8 report the q-factor regressions for the 37 significant momentum anomalies. For the high-minus-low deciles on prior 6-month returns (R^6) at the 1-, 6-, and 12-month, the q-factor alphas are -0.04%, 0.24%, and 0.16% per month ($t = -0.1$, 0.78, and 0.75), respectively. The Roe factor is the main source of the model's performance. In total 35 high-minus-low deciles have positive Roe-factor loadings, and the two negative loadings are tiny and insignificant. The average loading is 0.57. All but three of the positive loadings are significant, including 28 with t-values above three. In particular, the high-minus-low R^6 decile at the 6-month has an Roe-factor loading of 0.99 ($t = 5.33$), and its investment-factor loading is tiny, -0.01 ($t = -0.04$).

Columns 38–68 in Table 8 show the q-factor regressions for the 31 significant value-versus-growth anomalies. The high-minus-low book-to-market (Bm) decile has a q-factor alpha of 0.18% ($t = 1.15$). The investment factor is the main source of the model's performance. All 31 high-minus-low deciles have investment-factor loadings that go in the right direction in explaining average returns. The Roe-factor loadings often go in the wrong direction, and 18 are significant, but the investment-factor loadings dominate the Roe-factor loadings. In particular, the high-minus-low Bm decile has an investment-factor loadings of 1.33 ($t = 3.09$) relative to an Roe-factor loading of -0.55 ($t = -6.64$).

Columns 69–95 in Table 8 report the q-factor regressions for the 27 significant investment anomalies. The high-minus-low decile on composite equity issuance (Cei) has a q-factor alpha of -0.24% ($t = -1.85$). The investment factor is the main source of the model's explanatory power. Most high-minus-low deciles all have economically large and significantly negative loadings on the low-minus-high investment factor. In contrast, the Roe-factor loadings have mixed signs. The Roe-factor loadings can occasionally be significantly positive, going in the wrong direction, but are dominated by the strong investment-factor loadings. The high-minus-low Cei decile has an investment-factor loading of -1.04 ($t = -13.74$) relative to an Roe-factor loading of -0.12 ($t = -1.57$).

Columns 96–128 in Table 8 report the q-factor regressions for the 33 significant profitability anomalies. At the 1-, 6-, and 12-month, the high-minus-low quarterly F-score (F^{q}) decile earns q-factor alphas of 0.13%, 0.15%, and 0.07% ($t = 0.58$, 0.86, and 0.49), respectively. The Roe factor is the main source of the model's performance. All but one Roe-factor loadings are highly significant, with the t-value magnitudes above five, and the average magnitude of the loadings is 0.73. For example, at the 1-, 6-, and 12-month, the high-minus-low F^{q} decile have Roe-factor loadings of 0.73, 0.67, and 0.65 ($t = 6.97$, 6.9, and 7.11), respectively. Their investment-factor loadings are also significantly positive, but are dominated by the Roe-factor loadings. Finally, columns 129–154 in Table 8 report the q-factor regressions for the 26 significant intangibles anomalies, and the remaining columns report seven significant trading frictions anomalies. A combination of the investment- and Roe-factor loadings helps explain the model's performance.

4.2 The Weaknesses of the q-factor Model

In this subsection, we highlight the anomalies that the q-factor model cannot explain. We first detail the individual q-anomalies, and then explore their potential commonality.

4.2.1 Individual q-anomalies

From Table 8, nine momentum anomalies have significant q-factor alphas, including two with $t \geq 3$. The high-minus-low deciles on abnormal returns around earnings announcements (Abr) at the 1-, 6-, and 12-month earn q-factor alphas of 0.66%, 0.27%, and 0.23% per month ($t = 4.49, 2.41$, and 2.65), respectively. Their Roe-factor loadings are economically weak, ranging only from 0.16 to 0.26, albeit significant. In addition, the high-minus-low decile on industry lead-lag effect in prior returns (Ilr) has a q-alpha of 0.79% ($t = 3.15$) at the 1-month. The culprit is an extremely weak Roe-factor loading, 0.08 ($t = 0.59$). Large q-factor alphas also show up in the high-minus-low deciles on change in analysts' forecasts (dEf), supplier industries momentum (Sim), customer momentum (Cm), and customer industries momentum (Cim), all at the 1-month. Their q-factor alphas are 0.64%, 0.61%, 0.72%, and 0.64% ($t = 2.81, 2.18, 2.75$, and 2.29).

Six value-versus-growth anomalies have significant q-factor alphas, but none with $t \geq 3$. At the 1-, 6-, and 12-month, the q-factor alphas of the high-minus-low cash flow-to-price (Cp^{q}) deciles are 0.5%, 0.38%, and 0.22% per month ($t = 2.27$, 1.98, and 1.24), respectively. The strongly negative Roe-factor loadings, which go in the wrong direction, hurt the q-factor model. At the 1-, 6-, and 12-month, these loadings are -0.61, -0.56, and -0.45 ($t = -4.3$, -4.7, and -4.16), despite their strong investment-factor loadings of 0.99, 0.97, and 1.01 ($t = 6.12$, 6.74, and 7.57), respectively.

Seven investment anomalies have significant q-factor alphas, and three with $t \geq 3$. The q-factor model cannot explain the operating accruals (Oa) anomaly. The high-minus-low q-factor alpha is -0.54% per month ($t = -3.77$). The investment-factor loadings is tiny, -0.02 ($t = -0.23$). In contrast, the Roe-factor loading is large and significant, 0.26 ($t = 4.13$), which goes in the wrong direction. The problem deepens with discretionary accruals (Dac), which purge the sales change and property, plant, and equipment from Oa. The high-minus-low Dac decile has a q-factor alpha of -0.64% ($t = -4.37$). Both investment- and Roe-factor loadings go in the wrong direction, 0.23 and 0.19 ($t = 2.38$ and 3.05), respectively. Three other accrual measures also cause problems for the q-factor model, including net operating assets (Noa), change in net noncash working capital (dWc), and change in net financial assets (dFin). The high-minus-low Noa, dWc, and dFin deciles have q-factor alphas of $-0.41\%, -0.48\%$, and 0.44% ($t = -2.24, -3.43$, and 2.94), respectively. Their investment-factor loadings are insufficient to bring the q-factor alphas to insignificance.

Nine profitability anomalies have significant q-factor alphas, including three with $t \geq 3$. The high-minus-low cash-based operating profits-to-assets (Cop) decile has a q-factor alpha of 0.69% per month ($t = 4.77$). Scaling with lagged assets (Cla) raises the q-factor alpha to 0.74% ($t = 4.89$). Monthly sorts on Cla yield q-factor alphas of 0.43%, 0.4%, and 0.46% ($t = 2.69, 2.82,$ and 3.56) at the 1-, 6-, and 12-month, respectively. The size-factor loadings all go in the wrong direction in explaining average returns, and the investment-factor loadings too, but weakly. The Roe-factor loadings, all of which are significantly positive, are not large enough to undo the damage.

The q-factor model leaves 11 intangible anomalies significant, including four with $t \geq 3$. The q-factor model cannot capture the R&D-to-market (Rdm) anomaly. In annual sorts, the high-minus-low decile earns a q-factor alpha of 0.7% per month ($t = 2.89$). In monthly sorts at the 1-, 6-, and 12-month, the high-minus-low deciles have q-factor alphas of 1.47%, 0.97%, and 0.8% ($t = 2.97$, 2.73, and 2.8), respectively. The investment-factor loadings, most of which are significant, go in the right direction in explaining average returns. However, the Roe-factor loadings, all of which are economically large and statistically significant, go in the wrong direction.

The q-factor model also fails to capture the Heston-Sadka (2008) seasonality anomalies. At the beginning of each month t, we split stocks into deciles based on various measures of past performance, including returns in month $t-12$ (R_{a}^{1}), average returns across months $t-24, t-36, t-48$, and $t-60$ ($R_{\mathrm{a}}^{[2,5]}$), average returns across months $t-72, t-84, t-96, t-108$, and $t-120$ ($R_{\mathrm{a}}^{[6,10]}$), average returns across months t–$132, t$–$144, t$–$156, t$–168, and t–180 ($R_{\mathrm{a}}^{[11,15]}$), and average returns across months $t-192, t-204, t-216, t-228$, and $t-240$ ($R_{\mathrm{a}}^{[16,20]}$). Monthly decile returns are calculated for the current month t, and the deciles are rebalanced at the beginning of month $t+1$. The q-factor alphas of the high-minus-low deciles on R_{a}^{1}, $R_{\mathrm{a}}^{[2,5]}$, $R_{\mathrm{a}}^{[6,10]}$, $R_{\mathrm{a}}^{[11,15]}$, and $R_{\mathrm{a}}^{[16,20]}$ are 0.55%, 0.81%, 1.13%, 0.65%, and 0.64% per month ($t = 2.48$, 3.9, 4.88, 3.6, and 3.14), respectively. The investment- and Roe-factor loadings are mostly economically small and statistically insignificant.

Finally, four friction anomalies are significant in the q-factor model, including one with $t \geq 3$.

The high-minus-low deciles on total skewness (Ts), idiosyncratic skewness per the three-factor model (Isff), and idiosyncratic skewness per the q-factor model (Isq), have q-factor alphas all around 0.31% per month, with t-values from 2.64 to 3.01. Both q-factor loadings are close to zero.

4.2.2 Commonality in q-anomalies

To explore the potential commonality among the 46 significant q-anomalies, we calculate their pairwise cross-sectional rank correlations based on each anomaly variable's NYSE percentile rankings. Panel A of Table 9 shows average within-category and average cross-category rank correlations. Our categorization of anomalies based on a priori economic arguments is consistent with statistical clustering. In particular, average within-category correlations are generally large, but average cross-category correlations are close to zero. Panel B digs deeper by reporting average within-category correlations for each individual q-anomaly. Except for intangibles, anomalies within each category tend to be positively correlated. With a few exceptions such as Ile1, dRoe1, and Ami12, the positive correlations tend to be high. For intangibles, however, the Heston-Sadka (2008) seasonality variables have correlations close to zero, both among themselves and with other intangible variables. As a result, the average within-category correlation for intangibles is only 0.07.[9]

To evaluate the overall economic significance of the q-anomalies, we follow Stambaugh and Yu (2016) to form a composite measure for each category of q-anomalies by equal-weighting a stock's NYSE percentile rankings across the q-anomalies within the category. Some anomalies within a given category predict returns with opposite signs. We adjust the signs of all anomalies within the category to ensure a universally positive sign in forecasting returns. Also, some anomalies have different sample starting points. We start with January 1967, and always use all available anomaly variables at a given point of time in constructing a composite measure. We form deciles on the composite measure for each category as well as by combining all 46 q-anomalies.

[9]We have experimented with principle component analysis for the 46 q-anomalies. Consistent with the cluster analysis based on rank correlations, the first six principle components capture 15.3%, 12.9%, 7.8%, 5.4%, 4.9%, and 4.6% (in total 51%) of the time series variation of the 46 high-minus-low returns, respectively. As such, the q-anomalies tend to be relatively diffused, especially with the Heston-Sadka (2008) seasonality variables in the mix.

The q-factor model is far from perfect. The average return spreads on the composite measures for the momentum, value-versus-growth, investment, profitability, intangibles, and frictions categories are 1.1%, 0.6%, 0.6%, 0.71%, 1.08%, and 0.14% per month ($t = 5.72, 2.94, 4.27, 4.17, 6.92$, and 0.92), and their q-factor alphas 0.86%, 0.41%, 0.69%, 0.58%, 0.85%, and 0.16% ($t = 3.67, 2.09, 4.28, 4.11, 5.08$, and 1.52), respectively. Curiously, combining the four friction variables destroys their forecasting power. Digging deeper, we find that the average return spreads based on their individual sorts shrink quickly once calculated as the differences between deciles two and nine (untabulated). Taking the average across the rankings ends up adding noise into the extreme deciles. In contrast, the low within-category correlations among intangibles imply independent forecasting power for individual intangible anomalies, and taking the average rankings aggregates over the signals to produce a high average return spread. Finally, combining all 46 q-anomalies leads to an average return spread of 1.66% ($t = 10.28$), and the q-factor alpha is 1.4% ($t = 7.48$).

5 Summary and Implications

We have attempted to replicate the bulk of the published anomalies literature in finance and accounting by compiling a largest-to-date data library that consists of 447 anomalies. After we control for microcaps with NYSE breakpoints and value-weighted returns, 286 anomalies (64%) are insignificant at the conventional 5% level. Imposing the t-value cutoff of three increases the number of insignificance further to 380 (85%). In the trading frictions category that contains mostly liquidity variables, 95 out of 102 (93%) are insignificant at the 5% level. The distress anomaly is also virtually nonexistent in our replication. Even for significant anomalies, such as price momentum and operating accruals, their magnitudes are often much lower than originally reported. Finally, out of the 161 significant anomalies, the q-factor model leaves 115 alphas insignificant (150 with $t < 3$). In totality, our evidence suggests that capital markets are more efficient than previously reported.

How should we move forward in the anomalies literature? As noted, Ioannidis (2005) develops a theoretical model which predicts that results in a scientific field are more likely to be false when the studies use smaller samples, when the effects are smaller in magnitude, when there are many empirical but fewer theoretically predicted relations, when authors have greater flexibility in designs, variable definitions, and empirical specifications, when there exist greater financial and other interest and publication biases, and when more independent teams are involved in a given field. We apply this conceptual framework to discuss implications of our replication on future work.

5.1 Taking the Con out of Anomalies

First, on the flexibility in test designs, variable definitions, and empirical specifications, our replication indicates widespread p-hacking, mainly by overweighting microcaps. Many studies overweight microcaps via NYSE-Amex-NASDAQ (not NYSE) breakpoints, often also with equal-weights, in portfolio sorts. Hundreds of studies use Fama-MacBeth (1973) cross-sectional regressions of future returns on anomaly variables, which assign even higher weights to microcaps than equal-weights in sorts. As such, most published anomaly profits are greatly exaggerated. We recommend NYSE breakpoints and value-weights in sorts as the benchmark method, as evident in the construction of all common factors. While alternative specifications are not technically wrong, results from the benchmark method should always be presented in the spirit of Leamer (1983).

Second, on the sample size, most studies use the U.S.-centric CRSP-Compustat data. Karolyi (2016) shows that only 16% of all empirical studies in the top four finance journals examine non-U.S. markets, a percentage that is well below measures of their economic importance in the world economy. We agree with Karolyi that large-scale investigations of the global data available in Datastream and Worldscope are likely to improve the quality of the anomalies literature. These out-of-sample investigations are especially valuable for anomalies that are highly significant, but seem to lack a priori economic underpinnings, such as the Heston-Sadka (2008) seasonality anomalies.

Third, authors, referees, and editors should be keenly aware of the complex agency problem that can arise from financial conflicts of interest and publication biases. Referees can be more open to papers that take care in developing well grounded economic hypotheses, even though their empirical findings might not be (that) significant. With this publication bias alleviated, authors would most likely have fewer incentives to engage in p-hacking. When working with junior coauthors, senior academics should be alert to potential conflicts of interest in that junior coauthors are more likely to p-hack, perhaps due to tenure pressure (Brodeur, Lé, Sangnier, and Zylberberg 2016). Empirical results can be very sensitive to the adopted specifications, and those from the most standard specifications are the most persuasive.

5.2 Taking Economic Theory Seriously

Perhaps most important, the credibility of the anomalies literature can improve via a closer connection with economic theory. Ioannidis (2005) emphasizes the importance of theoretical predictions, specifically, by raising the ratio of ex ante true relations to false relations tested in a field, R_i, in equations (1) and (2). Harvey, Liu, and Zhu (2016, p. 7) also write: "A factor derived from a theory should have a lower hurdle than a factor discovered from a purely empirical exercise. Economic theories are based on a few economic principles and, as a result, there is less room for data mining."

In response to the theoretical vacuum left by the CAPM in the early 1990s, Fama and French (1993) form their three-factor model by augmenting the market factor with two characteristics-based factors on size and book-to-market. However, the empirical nature of these factors leaves the three-factor model vulnerable to the data mining critique. In contrast, the q-factor model is economically motivated from the first principle of real investment for individual firms. Our extensive evidence on the relative successes and weaknesses of the q-factor model suggests several fruitful directions for future research, all of which involve rich interactions between theory and empirics.

First, despite their economic motivation and $t > 5$ in our sample, the investment and Roe factors in the q-factor model are not entirely immune to p-hacking. For example, Linnainmaa and Roberts (2016) show that the Fama-French (2015) operating profitability premium is insignificant in the pre-Compustat sample (the Roe premium is not examined, probably due to the lack of quarterly earnings data). An effective way to address the lingering data mining concern is to examine global financial data, following Karolyi's (2016) advice. Another way to proceed is to examine alternative asset classes, such as corporate bonds, sovereign bonds, equity derivatives, real estate, private equity, and currencies. Are investment and Roe priced in the returns of these alternative assets? How does the q-factor model in these markets perform relative to their benchmark models?

Second, while the q-factor model is motivated from the first principle of real investment, the connection between theory and empirics can be strengthened. A theoretical literature based on real options and neoclassical investment models has been developing since the late 1990s, initially aiming at explaining the value premium (Berk, Green, and Naik 1999; Carlson, Fisher, and Giammarino 2004; Zhang 2005). More recently, the literature has focused on explaining the failure of the CAPM in capturing the value premium (Kogan and Papanikolaou 2013), as well as explaining momentum and value simultaneously (Li 2016). Can the investment and Roe premiums be explained simultaneously in a quantitative investment model? What drives the comovement behind the investment and Roe factors, the cross-sectional heterogeneity in investment and Roe, as well as the failure of the CAPM in explaining the two premiums? What explains the broad explanatory power of the q-factor model in the cross section, including anomalies formed on variables that are not directly related to investment and profitability? These theoretical questions are important. After all, Stambaugh and Yu (2016) interpret their two factors, despite being closely related to the q-factors, as driven by mispricing. When more empirical work is futile, careful theorizing can shed light on the risk-versus-mispricing debate, as in the case of the value premium.

Third, for the 46 q-anomalies, we suspect that the q-factor model's weaknesses might be attributed to a missing expected growth factor. In the multiperiod investment model, expected returns vary cross-sectionally, depending on investment, Roe, and expected investment growth. Prior work shows that the expected growth plays an important role in explaining earnings and price momentum as well as their short-lived dynamics (Liu, Whited, and Zhang 2009; Liu and Zhang 2014). George, Hwang, and Li (2016) show that the 52-week high variable better predicts future investment growth than Roe. However, concerned with the lack of a reliable expected growth proxy (Chan, Karceski, and Lakonishok 2003), Hou, Xue, and Zhang (2015) opt to drop the expected growth factor, and use only the two-period investment model to motivate the investment and Roe factors. This omission likely matters because some of the q-anomaly variables might be better predictors of future growth rates than Roe. Examples include abnormal returns around earnings announcements, industry lead-lag in prior returns, four-quarter-change in Roe, cash-based operating profitability, and R&D-to-market. In particular, R&D is expensed in the data. As such, R&D expenses depress current Roe, but raise future Roe, and consequently, the expected growth. Future work can explore the role of the expected growth in explaining the q-anomalies.

Finally, we emphasize that theories should be developed on the economic foundation of first principles, before doing the empirical work, to guard against HARKing (hypothesizing after the results are known) (Kerr 1998). Kerr defines HARKing as presenting a post hoc hypothesis based on or informed by one's evidence in the introduction of a research article as if it were an a priori hypothesis. Kerr argues that HARKing is hazardous for scientific progress: (i) it translates false positive findings into theories; (ii) it promotes theories that are more context-specific and ad hoc, less useful, and less refutable; (iii) it breeds statistical abuses and questionable practices in ethically ambiguous areas; and (iv) it discourages the identification of more general theories and plausible alternative hypotheses. In contrast, theories based on first principles are more general, less ad hoc, and more refutable, and can serve as an effective antidote of HARKing.

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Table 1 : List of Anomaly Variables

The anomalies are grouped into six categories: (i) momentum; (ii) value-versus-growth; (iii) investment; (iv) profitability; (v) intangibles; and (vi) trading frictions. The number in parenthesis in the title of a panel is the number of anomalies in the category. The total number of anomalies is 447. For each anomaly variable, we list its symbol, brief description, and its academic source. Appendix A details variable definition and portfolio construction.

Panel A: Momentum (57)			
Sue1	Earnings surprise (1-month holding period), Foster, Olsen, and Shevlin (1984)	Sue6	Earnings surprise (6-month holding period), Foster, Olsen, and Shevlin (1984)
Sue12	Earnings surprise (12-month holding period), Foster, Olsen, and Shevlin (1984)	Abr1	Cumulative abnormal stock returns around earnings announcements (1-month holding period), Chan, Jegadeesh, and Lakonishok (1996)
Abr6	Cumulative abnormal stock returns around earnings announcements (6-month holding period), Chan, Jegadeesh, and Lakonishok (1996)	Abr12	Cumulative abnormal stock returns around earnings announcements (12-month holding period), Chan, Jegadeesh, and Lakonishok (1996)
Re1	Revisions in analysts' earnings forecasts (1-month holding period), Chan, Jegadeesh, and Lakonishok (1996)	Re6	Revisions in analysts' earnings forecasts (6-month holding period), Chan, Jegadeesh, and Lakonishok (1996)
Re12	Revisions in analysts' earnings forecasts (12-month holding period), Chan, Jegadeesh, and Lakonishok (1996)	$R^6 1$	Price momentum (6-month prior returns, 1-month holding period), Jegadeesh and Titman (1993)
$R^6 6$	Price momentum (6-month prior returns, 6-month holding period), Jegadeesh and Titman (1993)	$R^6 12$	Price momentum (6-month prior returns, 12-month holding period), Jegadeesh and Titman (1993)
$R^{11} 1$	Price momentum (11-month prior returns, 1-month holding period), Fama and French (1996)	$R^{11} 6$	Price momentum (11-month prior returns, 6-month holding period), Fama and French (1996)
$R^{11} 12$	Price momentum, (11-month prior returns, 12-month holding period), Fama and French (1996)	Im1	Industry momentum, (1-month holding period), Moskowitz and Grinblatt (1999)
Im6	Industry momentum (6-month holding period), Moskowitz and Grinblatt (1999)	Im12	Industry momentum (12-month holding period), Moskowitz and Grinblatt (1999)
Rs1	Revenue surprise (1-month holding period), Jegadeesh and Livnat (2006)	Rs6	Revenue surprise (6-month holding period), Jegadeesh and Livnat (2006)
Rs12	Revenue surprise (12-month holding period), Jegadeesh and Livnat (2006)	Tes1	Tax expense surprise (1-month holding period), Thomas and Zhang (2011)
Tes6	Tax expense surprise (6-month holding period), Thomas and Zhang (2011)	Tes12	Tax expense surprise (12-month holding period), Thomas and Zhang (2011)
dEf1	Analysts' forecast change (1-month hold period), Hawkins, Chamberlin, and Daniel (1984)	dEf6	Analysts' forecast change (6-month hold period), Hawkins, Chamberlin, and Daniel (1984)
dEf12	Analysts' forecast change (12-month hold period), Hawkins, Chamberlin, and Daniel (1984)	Nei1	# of consecutive quarters with earnings increases (1-month holding period), Barth, Elliott, and Finn (1999)
Nei6	# consecutive quarters with earnings increases (6-month holding period), Barth, Elliott, and Finn (1999)	Nei12	# consecutive quarters with earnings increases (12-month holding period), Barth, Elliott, and Finn (1999)
52w1	52-week high (1-month holding period), George and Hwang (2004)	52w6	52-week high (6-month holding period), George and Hwang (2004)
52w12	52-week high (12-month holding period), George and Hwang (2004)	$\epsilon^6 1$	Six-month residual momentum (1-month holding period), Blitz, Huij, and Martens (2011)
$\epsilon^6 6$	Six-month residual momentum (6-month holding period), Blitz, Huij, and Martens (2011)	$\epsilon^6 12$	Six-month residual momentum (12-month holding period), Blitz, Huij, and Martens (2011)

$\epsilon^{11}1$	11-month residual momentum (1-month holding period), Blitz, Huij, and Martens (2011)	$\epsilon^{11}6$	11-month residual momentum (6-month holding period), Blitz, Huij, and Martens (2011)
$\epsilon^{11}12$	11-month residual momentum (12-month holding period), Blitz, Huij, and Martens (2011)	Sm1	Segment momentum (1-month holding period), Cohen and Lou (2012)
Sm6	Segment momentum (6-month holding period), Cohen and Lou (2012)	Sm12	Segment momentum (12-month holding period), Cohen and Lou (2012)
Ilr1	Industry lead-lag effect in prior returns (1-month holding period), Hou (2007)	Ilr6	Industry lead-lag effect in prior returns (6-month holding period), Hou (2007)
Ilr12	Industry lead-lag effect in prior returns (12-month holding period), Hou (2007)	Ile1	Industry lead-lag effect in earnings surprises (1-month holding period), Hou (2007)
Ile6	Industry lead-lag effect in earnings surprises (6-month holding period), Hou (2007)	Ile12	Industry lead-lag effect in earnings surprises (12-month holding period), Hou (2007)
Cm1	Customer momentum (1-month holding period), Cohen and Frazzini (2008)	Cm6	Customer momentum (6-month holding period), Cohen and Frazzini (2008)
Cm12	Customer momentum (12-month holding period), Cohen and Frazzini (2008)	Sim1	Supplier industries momentum (1-month holding period), Menzly and Ozbas (2010)
Sim6	Supplier industries momentum (6-month holding period), Menzly and Ozbas (2010)	Sim12	Supplier industries momentum (12-month holding period), Menzly and Ozbas (2010)
Cim1	Customer industries momentum (1-month holding period), Menzly and Ozbas (2010)	Cim6	Customer industries momentum (6-month holding period), Menzly and Ozbas (2010)
Cim12	Customer industries momentum (12-month holding period), Menzly and Ozbas (2010)		

Panel B: Value-versus-growth (68)

Bm	Book-to-market equity, Rosenberg, Reid, and Lanstein (1985)	Bmj	Book-to-June-end market equity, Asness and Frazzini (2013)
Bm^{q}1	Quarterly Book-to-market equity (1-month holding period)	Bm^{q}6	Quarterly Book-to-market equity (6-month holding period)
Bm^{q}12	Quarterly Book-to-market equity (12-month holding period)	Dm	Debt-to-market, Bhandari (1988)
Dm^{q}1	Quarterly Debt-to-market (1-month holding period)	Dm^{q}6	Quarterly Debt-to-market (6-month holding period)
Dm^{q}12	Quarterly Debt-to-market (12-month holding period)	Am	Assets-to-market, Fama and French (1992)
Am^{q}1	Quarterly Assets-to-market (1-month holding period)	Am^{q}6	Quarterly Assets-to-market (6-month holding period)
Am^{q}12	Quarterly Assets-to-market (12-month holding period)	Rev1	Reversal (1-month holding period) De Bondt and Thaler (1985)
Rev6	Reversal (6-month holding period), De Bondt and Thaler (1985)	Rev12	Reversal (12-month holding period) De Bondt and Thaler (1985)
Ep	Earnings-to-price, Basu (1983)	Ep^{q}1	Quarterly Earnings-to-price (1-month holding period)
Ep^{q}6	Quarterly Earnings-to-price (6-month holding period)	Ep^{q}12	Quarterly Earnings-to-price (12-month holding period)
Efp1	Analysts' earnings forecasts-to-price (1-month holding period), Elgers, Lo, and Pfeiffer (2001)	Efp6	Analysts' earnings forecasts-to-price (6-month holding period) Elgers, Lo, and Pfeiffer (2001)
Efp12	Analysts' earnings forecasts-to-price (12-month holding period), Elgers, Lo, and Pfeiffer (2001)	Cp	Cash flow-to-price, Lakonishok, Shleifer, and Vishny (1994)
Cp^{q}1	Quarterly Cash flow-to-price (1-month holding period)	Cp^{q}6	Quarterly Cash flow-to-price (6-month holding period)
Cp^{q}12	Quarterly Cash flow-to-price (12-month holding period)	Dp	Dividend yield, Litzenberger and Ramaswamy (1979)

Dp^{q}1	Quarterly Dividend yield (1-month holding period)	Dp^{q}6	Quarterly Dividend yield (6-month holding period)
Dp^{q}12	Quarterly Dividend yield (12-month holding period)	Op	Payout yield, Boudoukh, Michaely, Richardson, and Roberts (2007)
Op^{q}1	Quarterly Payout yield (1-month holding period)	Op^{q}6	Quarterly Payout yield (6-month holding period)
Op^{q}12	Quarterly Payout yield (12-month holding period)	Nop	Net payout yield, Boudoukh, Michaely, Richardson, and Roberts (2007)
Nop^{q}1	Quarterly Net payout yield (1-month holding period)	Nop^{q}6	Quarterly Net payout yield (6-month holding period)
Nop^{q}12	Quarterly Net payout yield (12-month holding period)	Sr	Five-year sales growth rank, Lakonishok, Shleifer, and Vishny (1994)
Sg	Annual sales growth, Lakonishok, Shleifer, and Vishny (1994)	Em	Enterprise multiple, Loughran and Wellman (2011)
Em^{q}1	Quarterly Enterprise multiple (1-month holding period)	Em^{q}6	Quarterly Enterprise multiple (6-month holding period)
Em^{q}12	Quarterly Enterprise multiple (12-month holding period)	Sp	Sales-to-price, Barbee, Mukherji, and Raines (1996)
Sp^{q}1	Quarterly Sales-to-price (1-month holding period)	Sp^{q}6	Quarterly Sales-to-price (6-month holding period)
Sp^{q}12	Quarterly Sales-to-price (12-month holding period)	Ocp	Operating cash flow-to-price, Desai, Rajgopal, and Venkatachalam (2004)
Ocp^{q}1	Quarterly Operating cash flow-to-price (1-month holding period)	Ocp^{q}6	Quarterly Operating cash flow-to-price (6-month holding period)
Ocp^{q}12	Quarterly Operating cash flow-to-price (12-month holding period)	Ir	Intangible return, Daniel and Titman (2006)
Vhp	Intrinsic value-to-market, Frankel and Lee (1998)	Vfp	Analysts-based intrinsic value-to-market, Frankel and Lee (1998)
Ebp	Enterprise book-to-price Penman, Richardson, and Tuna (2007)	Ebp^{q}1	Quarterly enterprise book-to-price (1-month holding period)
Ebp^{q}6	Quarterly enterprise book-to-price (6-month holding period)	Ebp^{q}12	Quarterly enterprise book-to-price (12-month holding period)
Ndp	Net debt-to-price Penman, Richardson, and Tuna (2007)	Ndp^{q}1	Quarterly net debt-to-price (1-month holding period)
Ndp^{q}6	Quarterly net debt-to-price (6-month holding period)	Ndp^{q}12	Quarterly net debt-to-price (12-month holding period)
Dur	Equity duration, Dechow, Sloan, and Soliman (2004)	Ltg1	Long-term growth forecasts of analysts (1-month holding period), La Porta (1996)
Ltg6	Long-term growth forecasts of analysts (6-month holding period), La Porta (1996)	Ltg12	Long-term growth forecasts of analysts (12-month holding period), La Porta (1996)

Panel C: Investment (38)

Aci	Abnormal corporate investment, Titman, Wei, and Xie (2004)	I/A	Investment-to-assets, Cooper, Gulen, and Schill (2008)
Ia^{q}1	Quarterly Investment-to-assets (1-month holding period)	Ia^{q}6	Quarterly Investment-to-assets (6-month holding period)
Ia^{q}12	Quarterly Investment-to-assets (12-month holding period)	dPia	Changes in PPE and inventory/assets, Lyandres, Sun, and Zhang (2008)
Noa	Net operating assets, Hirshleifer, Hou, Teoh, and Zhang (2004)	dNoa	Changes in net operating assets, Hirshleifer, Hou, Teoh, and Zhang (2004)
dLno	Change in long-term net operating assets, Fairfield, Whisenant, and Yohn (2003)	Ig	Investment growth, Xing (2008)
2Ig	Two-year investment growth, Anderson and Garcia-Feijoo (2006)	3Ig	Three-year investment growth, Anderson and Garcia-Feijoo (2006)
Nsi	Net stock issues, Pontiff and Woodgate (2008)	dIi	% change in investment − % change in industry investment, Abarbanell and Bushee (1998)
Cei	Composite equity issuance, Daniel and Titman (2006)	Cdi	Composite debt issuance, Lyandres, Sun, and Zhang (2008)

Ivg	Inventory growth, Belo and Lin (2011)	Ivc	Inventory changes, Thomas and Zhang (2002)
Oa	Operating accruals, Sloan (1996)	Ta	Total accruals, Richardson, Sloan, Soliman, and Tuna (2005)
dWc	Change in net non-cash working capital, Richardson, Sloan, Soliman, and Tuna (2005)	dCoa	Change in current operating assets, Richardson, Sloan, Soliman, and Tuna (2005)
dCol	Change in current operating liabilities, Richardson, Sloan, Soliman, and Tuna (2005)	dNco	Change in net non-current operating assets, Richardson, Sloan, Soliman, and Tuna (2005)
dNca	Change in non-current operating assets, Richardson, Sloan, Soliman, and Tuna (2005)	dNcl	Change in non-current operating liabilities, Richardson, Sloan, Soliman, and Tuna (2005)
dFin	Change in net financial assets, Richardson, Sloan, Soliman, and Tuna (2005)	dSti	Change in short-term investments, Richardson, Sloan, Soliman, and Tuna (2005)
dLti	Change in long-term investments, Richardson, Sloan, Soliman, and Tuna (2005)	dFnl	Change in financial liabilities, Richardson, Sloan, Soliman, and Tuna (2005)
dBe	Change in common equity, Richardson, Sloan, Soliman, and Tuna (2005)	Dac	Discretionary accruals, Xie (2001)
Poa	Percent operating accruals, Hafzalla, Lundholm, and Van Winkle (2011)	Pta	Percent total accruals, Hafzalla, Lundholm, and Van Winkle (2011)
Pda	Percent discretionary accruals	Nxf	Net external finance, Bradshaw, Richardson, and Sloan (2006)
Nef	Net equity finance, Bradshaw, Richardson, and Sloan (2006)	Ndf	Net debt finance, Bradshaw, Richardson, and Sloan (2006)

Panel D: Profitability (79)

Roe1	Return on equity (1-month holding period), Hou, Xue, and Zhang (2015)	Roe6	Return on equity (6-month holding period), Hou, Xue, and Zhang (2015)
Roe12	Return on equity (12-month holding period), Hou, Xue, and Zhang (2015)	dRoe1	Change in Roe (1-month holding period),
dRoe6	Change in Roe (6-month holding period)	dRoe12	Change in Roe (12-month holding period)
Roa1	Return on assets (1-month holding period), Balakrishnan, Bartov, and Faurel (2010)	Roa6	Return on assets (6-month holding period), Balakrishnan, Bartov, and Faurel (2010)
Roa12	Return on assets (12-month holding period), Balakrishnan, Bartov, and Faurel (2010)	dRoa1	Change in Roa (1-month holding period)
dRoa6	Change in Roa (6-month holding period)	dRoa12	Change in Roa (12-month holding period)
Rna	Return on net operating assets, Soliman (2008)	Pm	Profit margin, Soliman (2008)
Ato	Asset turnover, Soliman (2008)	Cto	Capital turnover, Haugen and Baker (1996)
Rna^{q}1	Quarterly return on net operating assets (1-month holding period)	Rna^{q}6	Quarterly return on net operating assets (6-month holding period)
Rna^{q}12	Quarterly return on net operating assets (12-month holding period)	Pm^{q}1	Quarterly profit margin (1-month holding period)
Pm^{q}6	Quarterly profit margin (6-month holding period)	Pm^{q}12	Quarterly profit margin (12-month holding period)
Ato^{q}1	Quarterly asset turnover (1-month holding period)	Ato^{q}6	Quarterly asset turnover (6-month holding period)
Ato^{q}12	Quarterly asset turnover (12-month holding period)	Cto^{q}1	Quarterly capital turnover (1-month holding period)
Cto^{q}6	Quarterly capital turnover (6-month holding period)	Cto^{q}12	Quarterly capital turnover (12-month holding period)
Gpa	Gross profits-to-assets, Novy-Marx (2013)	Gla	Gross profits-to-lagged assets
Gla^{q}1	Gross profits-to-lagged assets (1-month holding period)	Gla^{q}6	Gross profits-to-lagged assets (6-month holding period)
Gla^{q}12	Gross profits-to-lagged assets (12-month holding period)	Ope	Operating profits-to-equity, Fama and French (2015)
Ole	Operating profits-to-lagged equity	Ole^{q}1	Operating profits-to-lagged equity (1-month holding period)
Ole^{q}6	Operating profits-to-lagged equity (6-month holding period)	Ole^{q}12	Operating profits-to-lagged equity (12-month holding period)

Opa	Operating profits-to-assets, Ball, Gerakos, Linnainmaa, and Nikolaev (2015)	Ola	Operating profits-to-lagged assets
Ola^{q}1	Operating profits-to-lagged assets (1-month holding period)	Ola^{q}6	Operating profits-to-lagged assets (6-month holding period)
Ola^{q}12	Operating profits-to-lagged assets (12-month holding period)	Cop	Cash-based operating profitability, Ball, Gerakos, Linnainmaa, and Nikolaev (2016)
Cla	Cash-based operating profits-to-lagged assets	Cla^{q}1	Cash-based operating profits-to-lagged assets (1-month holding period)
Cla^{q}6	Cash-based operating profits-to-lagged assets (6-month holding period)	Cla^{q}12	Cash-based operating profits-to-lagged assets (12-month holding period)
F	Fundamental (F) score, Piotroski (2000)	F^{q}1	Quarterly F-score (1-month holding period)
F^{q}6	Quarterly F-score (6-month holding period)	F^{q}12	Quarterly F-score (12-month holding period)
Fp	Failure probability, Campbell, Hilscher, and Szilagyi (2008)	Fp^{q}1	Failure probability (1-month holding period) Campbell, Hilscher, and Szilagyi (2008)
Fp^{q}6	Failure probability (6-month holding period), Campbell, Hilscher, and Szilagyi (2008)	Fp^{q}12	Failure probability (12-month holding period) Campbell, Hilscher, and Szilagyi (2008)
O	O-score, Dichev (1998)	O^{q}1	Quarterly O-score (1-month holding period)
O^{q}6	Quarterly O-score (6-month holding period)	O^{q}12	Quarterly O-score (12-month holding period)
Z	Z-score, Dichev (1998)	Z^{q}1	Quarterly Z-score (1-month holding period)
Z^{q}6	Quarterly Z-score (6-month holding period)	Z^{q}12	Quarterly Z-score (12-month holding period)
G	Growth (G) score, Mohanram (2005)	Cr1	Credit ratings (1-month holding period)
Cr6	Credit ratings (6-month holding period) Avramov, Chordia, Jostova, and Philipov (2009)	Cr12	Credit ratings (12-month holding period) Avramov, Chordia, Jostova, and Philipov (2009)
Tbi	Taxable income-to-book income, Lev and Nissim (2004)	Tbi^{q}1	Quarterly taxable income-to-book income (1-month holding period)
Tbi^{q}6	Quarterly taxable income-to-book income (6-month holding period)	Tbi^{q}12	Quarterly taxable income-to-book income (12-month holding period)
Bl	Book leverage, Fama and French (1992)	Bl^{q}1	Quarterly book leverage (1-month holding period)
Bl^{q}6	Quarterly book leverage (6-month holding period)	Bl^{q}12	Quarterly book leverage (12-month holding period)
Sg^{q}1	Quarterly sales growth (1-month holding period)	Sg^{q}6	Quarterly sales growth (6-month holding period)
Sg^{q}12	Quarterly sales growth (12-month holding period)		

Panel E: Intangibles (103)

Oca	Organizational capital/assets, Eisfeldt and Papanikolaou (2013)	Ioca	Industry-adjusted organizational capital /assets, Eisfeldt and Papanikolaou (2013)
Adm	Advertising expense-to-market, Chan, Lakonishok, and Sougiannis (2001)	gAd	Growth in advertising expense, Lou (2014)
Rdm	R&D-to-market, Chan, Lakonishok, and Sougiannis (2001)	Rdm^{q}1	Quarterly R&D-to-market (1-month holding period)
Rdm^{q}6	Quarterly R&D-to-market (6-month holding period)	Rdm^{q}12	Quarterly R&D-to-market (12-month holding period)
Rds	R&D-to-sales, Chan, Lakonishok, and Sougiannis (2001)	Rds^{q}1	Quarterly R&D-to-sales (1-month holding period)
Rds^{q}6	Quarterly R&D-to-sales (6-month holding period)	Rds^{q}12	Quarterly R&D-to-sales (12-month holding period)
Ol	Operating leverage, Novy-Marx (2011)	Ol^{q}1	Quarterly operating leverage (1-month holding period)
Ol^{q}6	Quarterly operating leverage (6-month holding period)	Ol^{q}12	Quarterly operating leverage (12-month holding period)
Hn	Hiring rate, Belo, Lin, and Bazdresch (2014)	Rca	R&D capital-to-assets, Li (2011)
Bca	Brand capital-to-assets, Belo, Lin, and Vitorino (2014)	Aop	Analysts optimism, Frankel and Lee (1998)
Pafe	Predicted analysts forecast error, Frankel and Lee (1998)	Parc	Patent-to-R&D capital, Hirshleifer, Hsu, and Li (2013)

Crd	Citations-to-R&D expense, Hirshleifer, Hsu, and Li (2013)	Hs	Industry concentration (sales), Hou and Robinson (2006)
Ha	Industry concentration (total assets), Hou and Robinson (2006)	He	Industry concentration (book equity), Hou and Robinson (2006)
Age1	Firm age (1-month holding period), Jiang, Lee, and Zhang (2005)	Age6	Firm age (6-month holding period), Jiang, Lee, and Zhang (2005)
Age12	Firm age (12-month holding period), Jiang, Lee, and Zhang (2005)	D1	Price delay based on R^2, Hou and Moskowitz (2005)
D2	Price delay based on slopes, Hou and Moskowitz (2005)	D3	Price delay based on slopes adjusted for standard errors, Hou and Moskowitz (2005)
dSi	% change in sales − % change in inventory, Abarbanell and Bushee (1998)	dSa	% change in sales − % change in accounts receivable, Abarbanell and Bushee (1998)
dGs	% change in gross margin − % change in sales, Abarbanell and Bushee (1998)	dSs	% change in sales − % change in SG&A, Abarbanell and Bushee (1998)
Etr	Effective tax rate, Abarbanell and Bushee (1998)	Lfe	Labor force efficiency, Abarbanell and Bushee (1998)
Ana1	Analysts coverage (1-month holding period), Elgers, Lo, and Pfeiffer (2001)	Ana6	Analysts coverage (6-month holding period), Elgers, Lo, and Pfeiffer (2001)
Ana12	Analysts coverage (12-month holding period), Elgers, Lo, and Pfeiffer (2001)	Tan	Tangibility of assets, Hahn and Lee (2009)
Tan^q1	Quarterly tangibility (1-month holding period)	Tan^q6	Quarterly tangibility (6-month holding period)
Tan^q12	Quarterly tangibility (12-month holding period)	Rer	Real estate ratio, Tuzel (2010)
Kz	Financial constraints (the Kaplan-Zingales index), Lamont, Polk, and Saa-Requejo (2001)	Kz^q1	Quarterly Kaplan-Zingales index (1-month holding period)
Kz^q6	Quarterly Kaplan-Zingales index (6-month holding period)	Kz^q12	Quarterly Kaplan-Zingales index (12-month holding period)
Ww	Financial constraints (the Whited-Wu index), Whited and Wu (2006)	Ww^q1	Quarterly Whited-Wu index (1-month holding period)
Ww^q6	Quarterly Whited-Wu index (6-month holding period)	Ww^q12	Quarterly Whited-Wu index (12-month holding period)
Sdd	Secured debt-to-total debt, Valta (2016)	Cdd	Convertible debt-to-total debt, Valta (2016)
Vcf1	Cash flow volatility (1-month holding period), Huang (2009)	Vcf6	Cash flow volatility (6-month holding period), Huang (2009)
Vcf12	Cash flow volatility (12-month holding period), Huang (2009)	Cta1	Cash-to-assets (1-month holding period), Palazzo (2012)
Cta6	Cash-to-assets (6-month holding period), Palazzo (2012)	Cta12	Cash-to-assets (12-month holding period), Palazzo (2012)
Gind	Corporate governance, Gompers, Ishii, and Metrick (2003)	Acq	Accrual quality, Francis, Lafond, Olsson, and Schipper (2005)
Acq1	Accrual quality (1-month horizon), Francis, Lafond, Olsson, and Schipper (2005)	Acq6	Accrual quality (6-month horizon), Francis, Lafond, Olsson, and Schipper (2005)
Acq12	Accrual quality (12-month horizon), Francis, Lafond, Olsson, and Schipper (2005)	Ob	Order backlog, Rajgopal, Shevlin, and Venkatachalam (2003)
Eper	Earnings persistence, Francis, Lafond, Olsson, and Schipper (2004)	Eprd	Earnings predictability, Francis, Lafond, Olsson, and Schipper (2004)
Esm	Earnings smoothness, Francis, Lafond, Olsson, and Schipper (2004)	Evr	Value relevance of earnings, Francis, Lafond, Olsson, and Schipper (2004)
Etl	Earnings timeliness, Francis, Lafond, Olsson, and Schipper (2004)	Ecs	Earnings conservatism, Francis, Lafond, Olsson, and Schipper (2004)
Frm	Pension funding rate (scaled by market equity), Franzoni and Martin (2006)	Fra	Pension funding rate (scaled by assets), Franzoni and Martin (2006)
Ala	Asset liquidity (scaled by book assets) Ortiz-Molina and Phillips (2014)	Alm	Asset liquidity (scaled by market assets), Ortiz-Molina and Phillips (2014)

Ala^q1	Quarterly asset liquidity (book assets) (1-month holding period)	Ala^q6	Quarterly asset liquidity (book assets) (1-month holding period)
Ala^q12	Quarterly asset liquidity (book assets) (12-month holding period)	Alm^q1	Quarterly asset liquidity (market assets) (1-month holding period)
Alm^q6	Quarterly asset liquidity (market assets) (6-month holding period)	Alm^q12	Quarterly asset liquidity (market assets) (12-month holding period)
Dls1	Disparity between long- and short-term earnings growth forecasts (1-month holding period), Da and Warachka (2011)	Dls6	Disparity between long- and short-term earnings growth forecasts (6-month holding period), Da and Warachka (2011)
Dls12	Disparity between long- and short-term earnings growth forecasts (12-month holding period), Da and Warachka (2011)	Dis1	Dispersion of analysts' earnings forecasts (1-month holding period), Diether, Malloy, and Scherbina (2002)
Dis6	Dispersion of analysts' earnings forecasts (6-month holding period), Diether, Malloy, and Scherbina (2002)	Dis12	Dispersion of analysts' earnings forecasts (12-month holding period), Diether, Malloy, and Scherbina (2002)
Dlg1	Dispersion in analyst long-term growth forecasts (1-month holding period), Anderson, Ghysels, and Juergens (2005)	Dlg6	Dispersion in analyst long-term growth forecasts (6-month holding period), Anderson, Ghysels, and Juergens (2005)
Dlg12	Dispersion in analyst long-term growth forecasts (12-month holding period), Anderson, Ghysels, and Juergens (2005)	R^1_{a}	12-month-lagged return, Heston and Sadka (2008)
R^1_{n}	Year 1–lagged return, nonannual Heston and Sadka (2008)	$R^{[2,5]}_{\mathrm{a}}$	Years 2–5 lagged returns, annual Heston and Sadka (2008)
$R^{[2,5]}_{\mathrm{n}}$	Years 2–5 lagged returns, nonannual Heston and Sadka (2008)	$R^{[6,10]}_{\mathrm{a}}$	Years 6–10 lagged returns, annual Heston and Sadka (2008)
$R^{[6,10]}_{\mathrm{n}}$	Years 6–10 lagged returns, nonannual Heston and Sadka (2008)	$R^{[11,15]}_{\mathrm{a}}$	Years 11–15 lagged returns, annual Heston and Sadka (2008)
$R^{[11,15]}_{\mathrm{n}}$	Years 11–15 lagged returns, nonannual Heston and Sadka (2008)	$R^{[16,20]}_{\mathrm{a}}$	Years 16–20 lagged returns, annual Heston and Sadka (2008)
$R^{[16,20]}_{\mathrm{n}}$	Years 16–20 lagged returns, nonannual Heston and Sadka (2008)		

Panel F: Trading frictions (102)

Me	Market equity, Banz (1981)	Iv	Idiosyncratic volatility, Ali, Hwang, and Trombley (2003)
Ivff1	Idiosyncratic volatility per the FF 3-factor model (1-month holding period), Ang, Hodrick, Xing, and Zhang (2006)	Ivff6	Idiosyncratic volatility per the FF 3-factor model (6-month holding period), Ang, Hodrick, Xing, and Zhang (2006)
Ivff12	Idiosyncratic volatility per the FF 3-factor model (12-month holding period), Ang, Hodrick, Xing, and Zhang (2006)	Ivc1	Idiosyncratic volatility per the CAPM (1-month holding period)
Ivc6	Idiosyncratic volatility per the CAPM (6-month holding period)	Ivc12	Idiosyncratic volatility per the CAPM (12-month holding period)
Ivq1	Idiosyncratic volatility per the *q*-factor model (1-month holding period)	Ivq6	Idiosyncratic volatility per the *q*-factor model (6-month holding period)
Ivq12	Idiosyncratic volatility per the *q*-factor model (12-month holding period), Ang, Hodrick, Xing, and Zhang (2006)	Tv1	Total volatility (1-month holding period), Ang, Hodrick, Xing, and Zhang (2006)
Tv6	Total volatility (6-month holding period), Ang, Hodrick, Xing, and Zhang (2006)	Tv12	Total volatility (12-month holding period), Ang, Hodrick, Xing, and Zhang (2006)
Sv1	Systematic volatility risk (1-month holding period), Ang, Hodrick, Xing, and Zhang (2006)	Sv6	Systematic volatility risk (6-month holding period), Ang, Hodrick, Xing, and Zhang (2006)
Sv12	Systematic volatility risk (12-month holding period), Ang, Hodrick, Xing, and Zhang (2006)	$\beta1$	Market beta (1-month holding period) Fama and MacBeth (1973)

$\beta 6$	Market beta (6-month holding period) Fama and MacBeth (1973)	$\beta 12$	Market beta (12-month holding period) Fama and MacBeth (1973)
$\beta^{\mathrm{FP}}1$	The Frazzini-Pedersen (2014) beta (1-month holding period)	$\beta^{\mathrm{FP}}6$	The Frazzini-Pedersen (2014) beta (6-month holding period)
$\beta^{\mathrm{FP}}12$	The Frazzini-Pedersen (2014) beta (12-month holding period)	$\beta^{\mathrm{D}}1$	The Dimson (1979) beta (1-month holding period)
$\beta^{\mathrm{D}}6$	The Dimson (1979) beta (6-month holding period)	$\beta^{\mathrm{D}}12$	The Dimson (1979) beta (12-month holding period)
Tur1	Share turnover (1-month holding period), Datar, Naik, and Radcliffe (1998)	Tur6	Share turnover (6-month holding period), Datar, Naik, and Radcliffe (1998)
Tur12	Share turnover (12-month holding period), Datar, Naik, and Radcliffe (1998)	Cvt1	Coefficient of variation for share turnover (1-month holding period), Chordia, Subrahmanyam, and Anshuman (2001)
Cvt6	Coefficient of variation for share turnover (1-month holding period), Chordia, Subrahmanyam, and Anshuman (2001)	Cvt12	Coefficient of variation for share turnover (12-month holding period), Chordia, Subrahmanyam, and Anshuman (2001)
Dtv1	Dollar trading volume (1-month holding period), Brennan, Chordia, and Subrahmanyam (1998)	Dtv6	Dollar trading volume (6-month holding period), Brennan, Chordia, and Subrahmanyam (1998)
Dtv12	Dollar trading volume (12-month holding period), Brennan, Chordia, and Subrahmanyam (1998)	Cvd1	Coefficient of variation for dollar trading volume (1-month holding period), Chordia, Subrahmanyam, and Anshuman (2001)
Cvd6	Coefficient of variation for dollar trading volume (6-month holding period), Chordia, Subrahmanyam, and Anshuman (2001)	Cvd12	Coefficient of variation for dollar trading volume (12-month holding period), Chordia, Subrahmanyam, and Anshuman (2001)
Pps1	Share price (1-month holding period), Miller and Scholes (1982)	Pps6	Share price (6-month holding period), Miller and Scholes (1982)
Pps12	Share price (12-month holding period), Miller and Scholes (1982)	Ami1	Absolute return-to-volume (1-month holding period), Amihud (2002)
Ami6	Absolute return-to-volume (6-month holding period), Amihud (2002)	Ami12	Absolute return-to-volume (12-month holding period), Amihud (2002)
$\mathrm{Lm}^{1}1$	Prior 1-month turnover-adjusted number of zero daily trading volume (1-month holding period), Liu (2006)	$\mathrm{Lm}^{1}6$	Prior 1-month turnover-adjusted number of zero daily trading volume (6-month holding period), Liu (2006)
$\mathrm{Lm}^{1}12$	Prior 1-month turnover-adjusted number of zero daily trading volume (12-month holding period), Liu (2006)	$\mathrm{Lm}^{6}1$	Prior 6-month turnover-adjusted number of zero daily trading volume (1-month holding period), Liu (2006)
$\mathrm{Lm}^{6}6$	Prior 6-month turnover-adjusted number of zero daily trading volume (6-month holding period), Liu (2006)	$\mathrm{Lm}^{6}12$	Prior 6-month turnover-adjusted number of zero daily trading volume (12-month holding period), Liu (2006)
$\mathrm{Lm}^{12}1$	Prior 12-month turnover-adjusted number of zero daily trading volume (1-month holding period), Liu (2006)	$\mathrm{Lm}^{12}6$	Prior 12-month turnover-adjusted number of zero daily trading volume (6-month holding period), Liu (2006)
$\mathrm{Lm}^{12}12$	Prior 12-month turnover-adjusted number of zero daily trading volume (12-month holding period), Liu (2006)	Mdr1	Maximum daily return (1-month holding period), Bali, Cakici, and Whitelaw (2011)
Mdr6	Maximum daily returns (6-month holding period), Bali, Cakici, and Whitelaw (2011)	Mdr12	Maximum daily return (12-month holding period), Bali, Cakici, and Whitelaw (2011)
Ts1	Total skewness (1-month holding period), Bali, Engle, and Murray (2015)	Ts6	Total skewness (6-month holding period), Bali, Engle, and Murray (2015)
Ts12	Total skewness (12-month holding period), Bali, Engle, and Murray (2015)	Isc1	Idiosyncratic skewness per the CAPM (1-month holding period)
Isc6	Idiosyncratic skewness per the CAPM (6-month holding period)	Isc12	Idiosyncratic skewness per the CAPM (12-month holding period)
Isff1	Idiosyncratic skewness per the FF 3-factor model (1-month holding period)	Isff6	Idiosyncratic skewness per the FF 3-factor model (6-month holding period)

Isff12	Idiosyncratic skewness per the FF 3-factor model (12-month holding period)	Isq1	Idiosyncratic skewness per the q-factor model (1-month holding period)
Isq6	Idiosyncratic skewness per the q-factor model (6-month holding period)	Isq12	Idiosyncratic skewness per the q-factor model (12-month holding period)
Cs1	Coskewness (1-month holding period), Harvey and Siddique (2000)	Cs6	Coskewness (6-month holding period), Harvey and Siddique (2000)
Cs12	Coskewness (12-month holding period), Harvey and Siddique (2000)	Srev	Short-term reversal, Jegadeesh (1990)
$\beta^{-}1$	Downside beta (1-month holding period) Ang, Chen, and Xing (2006)	$\beta^{-}6$	Downside beta (6-month holding period) Ang, Chen, and Xing (2006)
$\beta^{-}12$	Downside beta (12-month holding period) Ang, Chen, and Xing (2006)	Tail1	Tail risk (1-month holding period) Kelly and Jiang (2014)
Tail6	Tail risk (6-month holding period) Kelly and Jiang (2014)	Tail12	Tail risk (12-month holding period) Kelly and Jiang (2014)
$\beta^{\mathrm{ret}}1$	Liquidity beta (return-return) (1-month holding period), Acharya and Pedersen (2005)	$\beta^{\mathrm{ret}}6$	Liquidity beta (return-return) (6-month holding period), Acharya and Pedersen (2005)
$\beta^{\mathrm{ret}}12$	Liquidity beta (return-return) (12-month holding period), Acharya and Pedersen (2005)	$\beta^{\mathrm{lcc}}1$	Liquidity beta (illiquidity-illiquidity) (1-month holding period), Acharya and Pedersen (2005)
$\beta^{\mathrm{lcc}}6$	Liquidity beta (illiquidity-illiquidity) (6-month holding period), Acharya and Pedersen (2005)	$\beta^{\mathrm{lcc}}12$	Liquidity beta (illiquidity-illiquidity) (12-month holding period), Acharya and Pedersen (2005)
$\beta^{\mathrm{lrc}}1$	Liquidity beta (return-illiquidity) (1-month holding period), Acharya and Pedersen (2005)	$\beta^{\mathrm{lrc}}6$	Liquidity beta (return-illiquidity) (6-month holding period), Acharya and Pedersen (2005)
$\beta^{\mathrm{lrc}}12$	Liquidity beta (return-illiquidity) (12-month holding period), Acharya and Pedersen (2005)	$\beta^{\mathrm{lcr}}1$	Liquidity beta (illiquidity-return) (1-month holding period), Acharya and Pedersen (2005)
$\beta^{\mathrm{lcr}}6$	Liquidity beta (illiquidity-return) (6-month holding period), Acharya and Pedersen (2005)	$\beta^{\mathrm{lcr}}12$	Liquidity beta (illiquidity-return) (12-month holding period), Acharya and Pedersen (2005)
$\beta^{\mathrm{net}}1$	Net liquidity beta (1-month holding period), Acharya and Pedersen (2005)	$\beta^{\mathrm{net}}6$	Net liquidity beta (6-month holding period), Acharya and Pedersen (2005)
$\beta^{\mathrm{net}}12$	Net liquidity beta (12-month holding period), Acharya and Pedersen (2005)	Shl1	The high-low bid-ask spread estimator (1-month holding period), Corwin and Schultz (2012)
Shl6	The high-low bid-ask spread estimator (6-month holding period), Corwin and Schultz (2012)	Shl12	The high-low bid-ask spread estimator (12-month holding period), Corwin and Schultz (2012)
Sba1	Bid-ask spread (1-month holding period), Hou and Loh (2016)	Sba6	Bid-ask spread (6-month holding period), Hou and Loh (2016)
Sba12	Bid-ask spread (12-month holding period), Hou and Loh (2016)	$\beta^{\mathrm{lev}}1$	Leverage beta (1-month holding period) Adrian, Etula, and Muir (2014)
$\beta^{\mathrm{lev}}6$	Leverage beta (6-month holding period), Adrian, Etula, and Muir (2014)	$\beta^{\mathrm{lev}}12$	Leverage beta (12-month holding period), Adrian, Etula, and Muir (2014)

Table 2 : Value- and Equal-weight Average Monthly Returns, and Averages and Cross-sectional Standard Deviations of Selected Anomaly Variables, January 1967 to December 2014, 576 Months

Pane A shows averages of monthly value- and equal-weighted average returns, and monthly cross-sectional standard deviations (std) of returns for all stocks (Market) and microcaps (Micro), small, big, and all but micro stocks. Panel A also shows the average number of stocks and the average percent of the total market capitalization in each size group each month. Panel B shows average monthly cross-sectional standard deviations of selected anomaly variables. Micro stocks are below the 20th percentile of NYSE market equity, small stocks are between the 20th and 50th percentiles, and big stocks are above the NYSE median. The anomaly variables are size (Me), book-to-market (Bm), standardized unexpected earnings (Sue), prior six-month returns (R^6), investment-to-assets (I/A), return on equity (Roe), net payout yield (Nop), operating accruals (Oa), R&D-to-market (Rdm), and cash-based operating profits-to-assets (Cop). Appendix A details variable definitions.

Panel A: Average monthly values

	Number of firms	% of total market cap	Value-weighted returns Average	Value-weighted returns Std	Equal-weighted returns Average	Equal-weighted returns Std	Cross-sectional std of returns
Market	3,938	100.00	0.93	4.52	1.21	6.32	16.39
Micro	2,406	3.28	1.10	6.93	1.32	7.16	19.07
Small	769	6.77	1.16	6.33	1.17	6.44	11.85
Big	764	89.95	0.92	4.41	1.03	5.11	8.88
All but micro	1,533	96.72	0.93	4.49	1.10	5.70	10.54

Panel B: Average monthly cross-sectional standard deviations

	Me	Bm	Sue	R^6	I/A	Roe	Nop	Oa	Rdm	Cop
Market	1.93	0.72	1.91	0.41	0.40	0.13	0.10	0.13	0.11	0.15
Micro	1.09	0.82	1.74	0.46	0.42	0.15	0.12	0.14	0.13	0.16
Small	0.47	0.52	1.93	0.36	0.39	0.09	0.08	0.11	0.06	0.12
Big	1.03	0.44	2.09	0.26	0.31	0.07	0.06	0.08	0.05	0.10
All but micro	1.25	0.49	2.03	0.31	0.35	0.08	0.07	0.10	0.06	0.11

Table 3 : Anomalies That Cannot Be Replicated at the 5% Significance Level, January 1967 to December 2014, 576 Months

Insignificant anomalies are defined as those with the average returns of their high-minus-low deciles insignificant at the 5% level. For each insignificant anomaly, this table reports the average return (m) and its t-statistics for the high-minus-low decile. The t-statistics are adjusted for heteroscedasticity and autocorrelations. The number in parentheses in the title of each panel denotes the number insignificant anomalies in the category of anomalies in question. Table 1 describes the symbols. Appendix A details variable definitions and portfolio construction.

	Panel A: Momentum (20)													
	Sue6	Sue12	Re12	R^{11}12	Rs6	Rs12	Tes1	Tes6	Tes12	Nei12	52w1	52w12	$\epsilon^6$1	Sm6
m	0.19	0.11	0.28	0.43	0.14	0.06	0.26	0.28	0.18	0.14	0.14	0.45	0.20	0.09
t_m	1.65	1.00	1.47	1.92	1.01	0.44	1.56	1.90	1.34	1.36	0.43	1.88	1.20	0.88
	Sm12	Ile6	Ile12	Cm6	Sim6	Sim12								
m	0.14	0.27	0.11	0.18	0.12	0.15								
t_m	1.87	1.79	0.84	1.83	1.11	1.80								
	Panel B: Value-versus-growth (37)													
	Bm^{q}1	Bm^{q}6	Dm	Dm^{q}1	Dm^{q}6	Dm^{q}12	Am	Am^{q}1	Am^{q}6	Am^{q}12	Efp6	Efp12	Dp	Dp^{q}1
m	0.46	0.45	0.31	0.30	0.27	0.32	0.36	0.37	0.42	0.40	0.43	0.40	0.21	0.26
t_m	1.79	1.90	1.59	1.26	1.17	1.50	1.72	1.33	1.58	1.69	1.78	1.71	0.86	1.02
	Dp^{q}6	Dp^{q}12	Op	Op^{q}1	Op^{q}6	Op^{q}12	Nop^{q}1	Nop^{q}6	Nop^{q}12	Sr	Sg	Ocp^{q}6	Ocp^{q}12	Ebp^{q}1
m	0.19	0.20	0.37	0.10	0.10	0.17	0.22	0.25	0.31	−0.20	−0.01	0.51	0.41	0.27
t_m	0.76	0.85	1.70	0.42	0.52	0.87	0.91	1.14	1.48	−1.08	−0.08	1.89	1.71	1.00
	Ebp^{q}6	Ebp^{q}12	Ndp	Ndp^{q}1	Ndp^{q}6	Ndp^{q}12	Ltg1	Ltg6	Ltg12					
m	0.26	0.35	0.31	0.17	0.18	0.27	−0.03	−0.04	−0.01					
t_m	1.01	1.44	1.62	0.71	0.77	1.22	−0.09	−0.10	−0.02					
	Panel C: Investment (11)													
	Ia^{q}1	3Ig	Cdi	Ta	dCol	dNcl	dSti	dLti	dBe	Nxf	Nef			
m	−0.32	−0.21	−0.00	−0.23	−0.11	−0.11	0.15	−0.22	−0.31	−0.27	−0.17			
t_m	−1.72	−1.46	−0.01	−1.63	−0.76	−0.95	0.98	−1.44	−1.89	−1.44	−0.86			
	Panel D: Profitability (46)													
	Roe6	Roe12	Roa6	Roa12	dRoa12	Rna	Pm	Ato	Cto	Rna^{q}1	Rna^{q}12	Pm^{q}1	Pm^{q}6	Pm^{q}12
m	0.42	0.24	0.39	0.25	0.21	0.12	0.01	0.32	0.27	0.43	0.35	0.35	0.17	0.18
t_m	1.95	1.19	1.78	1.26	1.78	0.63	0.03	1.76	1.60	1.95	1.63	1.59	0.82	0.89
	Gla	Ope	Ole	Ole^{q}12	Opa	Ola	F	Fp	Fp^{q}1	Fp^{q}12	O	O^{q}1	O^{q}6	O^{q}12
m	0.16	0.25	0.07	0.35	0.37	0.20	0.29	−0.38	−0.48	−0.36	−0.06	−0.36	−0.21	−0.14
t_m	1.04	1.20	0.37	1.78	1.87	1.07	1.06	−1.28	−1.43	−1.25	−0.30	−1.57	−0.96	−0.64
	Z	Z^{q}1	Z^{q}6	Z^{q}12	G	Cr1	Cr6	Cr12	Tbi	Tbi^{q}1	Tbi^{q}6	Bl	Bl^{q}1	Bl^{q}6
m	−0.00	0.01	−0.03	−0.09	0.27	0.04	0.01	0.01	0.16	0.17	0.21	−0.02	0.10	0.13
t_m	−0.02	0.06	−0.15	−0.46	1.35	0.12	0.02	0.03	1.20	1.28	1.84	−0.10	0.58	0.73
	Bl^{q}12	Sg^{q}1	Sg^{q}6	Sg^{q}12										
m	0.10	0.32	0.14	−0.06										
t_m	0.55	1.81	0.86	−0.40										

	Panel E: Intangibles (77)													
	gAd	Rds	Rds^q1	Rds^q6	Rds^q12	Hn	Rca	Bca	Aop	Pafe	Parc	Crd	Ha	He
m	−0.06	0.08	0.33	0.44	0.47	−0.27	0.34	0.17	−0.21	0.20	0.09	0.16	−0.23	−0.22
t_m	−0.31	0.31	1.08	1.57	1.68	−1.79	1.40	0.71	−1.18	0.58	0.39	0.64	−1.54	−1.48
	Age1	Age6	Age12	D1	D2	D3	dSi	dSa	dGs	dSs	Lfe	Ana1	Ana6	Ana12
m	0.01	0.02	0.00	0.21	0.27	0.27	0.14	0.16	0.06	0.04	0.20	−0.15	−0.12	−0.11
t_m	0.04	0.09	0.02	0.97	1.22	1.25	1.02	1.25	0.46	0.24	1.59	−0.89	−0.73	−0.65
	Tan	Tan^q1	Tan^q6	Tan^q12	Kz	Kz^q1	Kz^q6	Kz^q12	Ww	Ww^q1	Ww^q6	Ww^q12	Sdd	Cdd
m	0.04	0.22	0.21	0.15	−0.09	−0.11	−0.13	−0.11	0.22	0.04	0.09	0.09	0.09	−0.05
t_m	0.27	1.14	1.22	0.93	−0.46	−0.56	−0.64	−0.56	0.90	0.16	0.31	0.32	0.36	−0.21
	Vcf1	Vcf6	Vcf12	Cta1	Cta6	Cta12	Gind	Acq	Acq1	Acq6	Acq12	Ob	Eper	Esm
m	−0.37	−0.33	−0.27	0.22	0.11	0.09	0.02	−0.07	−0.06	−0.03	−0.01	0.17	0.01	−0.06
t_m	−1.68	−1.56	−1.31	1.08	0.55	0.45	0.06	−0.36	−0.28	−0.13	−0.06	0.71	0.10	−0.45
	Evr	Ecs	Frm	Fra	Ala	Alm	Ala^q1	Ala^q6	Ala^q12	Dls1	Dls6	Dls12	Dis1	Dis6
m	0.18	0.07	0.09	−0.11	−0.10	0.14	0.42	0.28	0.19	−0.24	0.01	0.06	−0.24	−0.22
t_m	1.32	0.65	0.46	−0.77	−0.49	0.73	1.68	1.12	0.79	−1.19	0.05	0.44	−0.89	−0.87
	Dis12	Dlg1	Dlg6	Dlg12	R_n^1	$R_n^{[11,15]}$	$R_n^{[16,20]}$							
m	−0.13	−0.13	−0.08	−0.10	0.54	−0.31	−0.26							
t_m	−0.53	−0.52	−0.34	−0.41	1.74	−1.86	−1.60							

	Panel F: Trading frictions (95)													
	Me	Iv	Ivff1	Ivff6	Ivff12	Ivc1	Ivc6	Ivc12	Ivq1	Ivq6	Ivq12	Tv1	Tv6	Tv12
m	−0.28	−0.22	−0.51	−0.33	−0.18	−0.48	−0.32	−0.20	−0.48	−0.30	−0.19	−0.40	−0.25	−0.20
t_m	−1.12	−0.66	−1.62	−1.11	−0.62	−1.48	−1.07	−0.69	−1.53	−1.05	−0.68	−1.16	−0.77	−0.62
	Sv6	Sv12	$\beta 1$	$\beta 6$	$\beta 12$	$\beta^{\text{FP}}1$	$\beta^{\text{FP}}6$	$\beta^{\text{FP}}12$	$\beta^{\text{D}}1$	$\beta^{\text{D}}6$	$\beta^{\text{D}}12$	Tur1	Tur6	Tur12
m	−0.19	−0.16	0.06	0.06	0.01	−0.22	−0.23	−0.18	0.04	0.05	0.03	−0.15	−0.14	−0.10
t_m	−1.36	−1.43	0.18	0.17	0.04	−0.65	−0.72	−0.57	0.21	0.30	0.19	−0.57	−0.53	−0.38
	Cvt1	Cvt6	Cvt12	Dtv1	Cvd1	Cvd6	Cvd12	Pps1	Pps6	Pps12	Ami1	Ami6	$\text{Lm}^1 1$	$\text{Lm}^1 6$
m	0.13	0.11	0.17	−0.27	0.10	0.12	0.18	−0.02	0.04	−0.04	0.28	0.37	−0.07	0.21
t_m	0.87	0.73	1.26	−1.45	0.65	0.85	1.25	−0.06	0.15	−0.14	1.31	1.73	−0.33	0.95
	$\text{Lm}^1 12$	$\text{Lm}^6 1$	$\text{Lm}^6 6$	$\text{Lm}^6 12$	$\text{Lm}^{12} 1$	$\text{Lm}^{12} 6$	$\text{Lm}^{12} 12$	Mdr1	Mdr6	Mdr12	Ts6	Ts12	Isc1	Isc6
m	0.20	0.38	0.35	0.30	0.38	0.33	0.24	−0.34	−0.17	−0.07	0.03	0.03	0.17	−0.02
t_m	0.93	1.82	1.67	1.40	1.78	1.57	1.13	−1.14	−0.62	−0.24	0.50	0.56	1.66	−0.33
	Isc12	Isff6	Isff12	Isq1	Isq12	Cs1	Cs6	Cs12	Srev	$\beta^{-}1$	$\beta^{-}6$	$\beta^{-}12$	Tail1	Tail6
m	0.05	0.08	0.10	0.07	0.08	−0.10	−0.02	−0.03	−0.26	−0.12	−0.17	−0.12	0.11	0.15
t_m	1.04	1.48	1.88	1.14	1.71	−0.85	−0.40	−0.59	−1.31	−0.41	−0.60	−0.45	0.57	0.79
	Tail12	$\beta^{\text{ret}}1$	$\beta^{\text{ret}}6$	$\beta^{\text{ret}}12$	$\beta^{\text{lcc}}1$	$\beta^{\text{lcc}}6$	$\beta^{\text{lcc}}12$	$\beta^{\text{lrc}}1$	$\beta^{\text{lrc}}6$	$\beta^{\text{lrc}}12$	$\beta^{\text{lcr}}1$	$\beta^{\text{lcr}}6$	$\beta^{\text{lcr}}12$	$\beta^{\text{net}}1$
m	0.19	0.05	0.04	0.01	0.34	0.31	0.31	0.05	0.02	0.05	0.06	−0.02	−0.05	0.14
t_m	1.13	0.16	0.12	0.03	1.54	1.45	1.49	0.17	0.07	0.17	0.46	−0.17	−0.49	0.41
	$\beta^{\text{net}}6$	$\beta^{\text{net}}12$	Shl1	Shl6	Shl12	Sba1	Sba6	Sba12	$\beta^{\text{Lev}}1$	$\beta^{\text{Lev}}6$	$\beta^{\text{Lev}}12$			
m	0.15	0.10	−0.16	−0.16	−0.12	−0.20	−0.10	−0.07	0.43	0.30	0.25			
t_m	0.47	0.32	−0.54	−0.57	−0.45	−0.73	−0.36	−0.26	1.78	1.31	1.15			

Table 4 : Replicated Anomalies That Are Significant at the 5% Level, January 1967 to December 2014, 576 Months

For each high-minus-low decile, m is the average return, and t_m is its t-statistic adjusted for heteroscedasticity and autocorrelations. Table 1 describes the symbols, and Appendix A details variable definitions and portfolio construction.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
	Sue1	Abr1	Abr6	Abr12	Re1	Re6	$R^6$1	$R^6$6	$R^6$12	R^{11}1	R^{11}6	Im1	Im6	Im12	Rs1	dEf1	dEf6	dEf12
m	0.47	0.74	0.30	0.22	0.81	0.54	0.60	0.82	0.55	1.19	0.81	0.67	0.60	0.64	0.31	1.03	0.58	0.35
t_m	3.42	5.85	3.24	2.84	3.28	2.49	2.04	3.49	2.90	4.06	3.14	2.74	3.08	3.71	2.21	4.65	3.23	2.45
	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
	Nei1	Nei6	52w6	$\epsilon^6$6	$\epsilon^6$12	ϵ^{11}1	ϵ^{11}6	ϵ^{11}12	Sm1	Ilr1	Ilr6	Ilr12	Ile1	Cm1	Cm12	Sim1	Cim1	Cim6
m	0.37	0.22	0.57	0.49	0.39	0.67	0.55	0.36	0.59	0.74	0.33	0.35	0.62	0.79	0.16	0.77	0.78	0.30
t_m	3.31	2.03	2.02	3.86	3.92	3.91	3.94	2.96	2.57	3.61	3.18	4.18	3.70	3.74	2.30	3.37	3.45	2.83
	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54
	Cim12	Bm	Bmj	Bm^{q}12	Rev1	Rev6	Rev12	Ep	Ep^{q}1	Ep^{q}6	Ep^{q}12	Efp1	Cp	Cp^{q}1	Cp^{q}6	Cp^{q}12	Nop	Em
m	0.26	0.59	0.49	0.51	−0.45	−0.44	−0.41	0.47	0.98	0.65	0.49	0.48	0.49	0.69	0.55	0.45	0.65	−0.59
t_m	3.38	2.84	2.27	2.35	−1.98	−2.04	−2.04	2.34	5.08	3.69	2.93	1.99	2.47	3.25	2.77	2.44	3.36	−3.12
	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72
	Em^{q}1	Em^{q}6	Em^{q}12	Sp	Sp^{q}1	Sp^{q}6	Sp^{q}12	Ocp	Ocp^{q}1	Ir	Vhp	Vfp	Ebp	Dur	Aci	I/A	Ia^{q}6	Ia^{q}12
m	−0.81	−0.53	−0.53	0.53	0.61	0.58	0.55	0.77	0.66	−0.51	0.38	0.53	0.47	−0.47	−0.31	−0.46	−0.52	−0.50
t_m	−3.67	−2.57	−2.62	2.44	2.39	2.43	2.49	3.50	2.24	−2.41	2.03	2.42	2.36	−2.39	−2.20	−2.92	−3.04	−3.19
	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90
	dPia	Noa	dNoa	dLno	Ig	2Ig	Nsi	dIi	Cei	Ivg	Ivc	Oa	dWc	dCoa	dNco	dNca	dFin	dFnl
m	−0.51	−0.40	−0.53	−0.40	−0.45	−0.37	−0.66	−0.30	−0.56	−0.36	−0.45	−0.27	−0.41	−0.29	−0.40	−0.41	0.28	−0.34
t_m	−3.76	−2.94	−3.89	−3.03	−3.56	−2.74	−4.45	−2.70	−3.16	−2.57	−3.32	−2.13	−3.13	−2.08	−3.33	−3.32	2.31	−3.21
	91	92	93	94	95	96	97	98	99	100	101	102	103	104	105	106	107	108
	Dac	Poa	Pta	Pda	Ndf	Roe1	dRoe1	dRoe6	dRoe12	Roa1	dRoa1	dRoa6	Rna^{q}1	Ato^{q}1	Ato^{q}6	Ato^{q}12	Cto^{q}1	Cto^{q}6
m	−0.36	−0.40	−0.42	−0.37	−0.31	0.69	0.76	0.39	0.27	0.57	0.58	0.31	0.64	0.58	0.50	0.40	0.44	0.41
t_m	−2.73	−2.85	−3.00	−3.19	−2.44	3.07	5.43	3.28	2.57	2.59	3.77	2.19	2.68	3.17	2.87	2.37	2.37	2.30
	109	110	111	112	113	114	115	116	117	118	119	120	121	122	123	124	125	126
	Cto^{q}12	Gpa	Gla^{q}1	Gla^{q}6	Gla^{q}12	Ole^{q}1	Ole^{q}6	Ola^{q}1	Ola^{q}6	Ola^{q}12	Cop	Cla	Cla^{q}1	Cla^{q}6	Cla^{q}12	F^{q}1	F^{q}6	F^{q}12
m	0.37	0.38	0.51	0.34	0.29	0.67	0.45	0.72	0.51	0.47	0.63	0.53	0.49	0.48	0.47	0.58	0.53	0.42
t_m	2.13	2.62	3.40	2.43	2.12	3.14	2.22	3.35	2.51	2.46	3.44	3.02	3.02	3.45	3.57	2.47	2.52	2.22
	127	128	129	130	131	132	133	134	135	136	137	138	139	140	141	142	143	144
	Fp^{q}6	Tbi^{q}12	Oca	Ioca	Adm	Rdm	Rdm^{q}1	Rdm^{q}6	Rdm^{q}12	Ol	Ol^{q}1	Ol^{q}6	Ol^{q}12	Hs	Etr	Rer	Eprd	Etl
m	−0.63	0.22	0.54	0.55	0.70	0.68	1.19	0.83	0.83	0.46	0.49	0.49	0.49	−0.31	0.25	0.32	−0.49	0.36
t_m	−2.03	1.96	2.64	4.34	2.73	2.58	2.93	2.12	2.32	2.70	2.52	2.58	2.73	−2.08	2.35	2.25	−2.75	2.85
	145	146	147	148	149	150	151	152	153	154	155	156	157	158	159	160	161	
	Alm^{q}1	Alm^{q}6	Alm^{q}12	R_a^1	$R_a^{[2,5]}$	$R_n^{[2,5]}$	$R_a^{[6,10]}$	$R_n^{[6,10]}$	$R_a^{[11,15]}$	$R_a^{[16,20]}$	Sv1	Dtv6	Dtv12	Ami12	Ts1	Isff1	Isq1	
m	0.62	0.63	0.57	0.65	0.69	−0.51	0.83	−0.45	0.67	0.56	−0.53	−0.37	−0.42	0.42	0.23	0.34	0.27	
t_m	2.87	3.13	2.94	3.23	4.00	−2.22	4.91	−2.24	4.66	3.29	−2.47	−1.99	−2.28	1.99	2.11	3.50	2.88	

Table 5 : Average Return Spreads and Their t-values for High-minus-low Anomaly Deciles with NYSE Breakpoints and Value-weighted Returns in the Original Samples

Insignificant anomalies are identified as those with the average returns of the high-minus-low deciles insignificant at the 5% level, and significant anomalies are those with significant average return spreads. For the high-minus-low decile formed on each anomaly variable, this table reports the average return (m) and its t-statistic adjusted for heteroscedasticity and autocorrelations. Table 1 describes the symbols, and Appendix A details variable definitions and portfolio construction.

Panel A: Momentum

Insignificant (24)

	Sue1	Sue6	Sue12	Re6	Re12	Rs1	Rs6	Rs12	Tes1	Tes12	dEf12	Nei1	Nei6	Nei12
m	0.50	0.37	0.00	0.59	0.27	0.31	0.24	0.24	0.26	0.28	0.84	0.44	0.29	0.23
t_m	1.14	0.85	0.01	1.78	0.86	1.15	0.93	0.99	1.40	1.82	1.80	1.82	1.20	0.98

	52w1	$\epsilon^6$1	Sm6	Sm12	Ile6	Ile12	Cm6	Cm12	Sim6	Sim12
m	0.35	0.29	0.14	0.16	0.27	0.11	0.15	0.14	0.15	0.18
t_m	1.09	1.58	1.29	1.85	1.60	0.74	1.19	1.62	1.20	1.76

Significant (33)

	Abr1	Abr6	Abr12	Re1	$R^6$1	$R^6$6	$R^6$12	R^{11}1	R^{11}6	R^{11}12	Im1	Im6	Im12	Tes6
m	0.96	0.41	0.30	1.07	0.90	1.06	0.85	1.58	1.26	0.79	0.76	0.69	0.75	0.37
t_m	5.35	3.41	2.70	3.10	2.95	3.82	3.66	4.95	4.48	3.17	2.68	2.90	3.71	2.19

	dEf1	dEf6	52w6	52w12	$\epsilon^6$6	$\epsilon^6$12	ϵ^{11}1	ϵ^{11}6	ϵ^{11}12	Sm1	Ilr1	Ilr6	Ilr12	Ile1
m	1.91	1.47	0.86	0.65	0.56	0.45	0.77	0.62	0.38	0.64	0.83	0.36	0.41	0.63
t_m	3.68	2.89	3.15	2.66	4.12	4.12	4.11	4.07	2.88	2.54	3.57	2.94	4.27	3.36

	Cm1	Sim1	Cim1	Cim6	Cim12
m	0.89	0.88	0.90	0.34	0.29
t_m	3.34	3.23	3.44	2.79	3.22

Panel B: Value-versus-growth

Insignificant (44)

	Bm^{q}1	Dm	Dm^{q}1	Dm^{q}6	Dm^{q}12	Am	Am^{q}1	Am^{q}6	Am^{q}12	Ep^{q}12	Efp1	Efp6	Efp12	Dp
m	0.54	0.51	0.94	0.92	0.87	0.38	0.27	0.27	0.30	0.64	−0.01	−0.07	−0.03	0.49
t_m	1.959	1.38	1.55	1.69	1.70	1.44	0.91	0.95	1.10	1.84	−0.03	−0.26	−0.12	1.10

	Dp^{q}1	Dp^{q}6	Dp^{q}12	Op^{q}1	Op^{q}6	Op^{q}12	Nop^{q}1	Nop^{q}6	Nop^{q}12	Sg	Sp	Sp^{q}1	Sp^{q}6	Sp^{q}12
m	0.50	0.46	0.44	0.24	0.17	0.28	0.41	0.47	0.53	−0.20	0.41	0.24	0.20	0.29
t_m	1.10	1.04	0.99	0.77	0.61	1.06	1.20	1.47	1.72	−0.91	1.30	0.69	0.60	0.95

	Ocp^{q}1	Ocp^{q}6	Ocp^{q}12	Vhp	Vfp	Ebp	Ebp^{q}1	Ebp^{q}6	Ebp^{q}12	Ndp	Ndp^{q}1	Ndp^{q}6	Ndp^{q}12	Ltg1
m	0.16	0.12	0.10	0.19	0.33	0.43	0.22	0.19	0.33	0.23	−0.10	−0.04	0.11	0.05
t_m	0.50	0.41	0.38	0.63	1.15	1.88	0.70	0.63	1.19	1.08	−0.34	−0.16	0.43	0.07

	Ltg6	Ltg12
m	−0.05	0.01
t_m	−0.07	0.02

Significant (24)

	Bm	Bmj	Bm^{q}6	Bm^{q}12	Rev1	Rev6	Rev12	Ep	Ep^{q}1	Ep^{q}6	Cp	Cp^{q}1	Cp^{q}6	Cp^{q}12
m	1.41	0.53	0.50	0.55	−0.87	−0.81	−0.76	0.77	1.17	0.81	0.77	0.84	0.63	0.63
t_m	3.09	2.31	2.00	2.43	−2.11	−2.06	−2.06	1.97	2.91	2.26	2.65	2.88	2.35	2.45

	Op	Nop	Sr	Em	Em^{q}1	Em^{q}6	Em^{q}12	Ocp	Ir	Dur
m	0.56	0.89	−0.45	−0.67	−0.91	−0.61	−0.61	0.54	−0.63	−0.63
t_m	2.11	3.71	−1.99	−3.25	−3.69	−2.64	−2.72	2.03	−2.40	−2.64

Panel C: Investment

Insignificant (13)

	Ia^{q}1	3Ig	dIi	Cdi	Ta	dCol	dNcl	dLti	dBe	Poa	Pta	Pda	Nef
m	−0.44	−0.15	−0.28	0.01	−0.30	−0.11	−0.22	−0.29	−0.38	−0.41	−0.23	−0.34	−0.32
t_m	−1.89	−0.80	−1.82	0.06	−1.82	−0.65	−1.57	−1.61	−1.86	−1.70	−0.92	−1.87	−1.35

Significant (25)

	Aci	Ia	Ia^{q}6	Ia^{q}12	dPia	Noa	dNoa	dLno	Ig	2Ig	Nsi	Cei	Ivg	Ivc
m	−0.39	−0.58	−0.69	−0.66	−0.55	−0.46	−0.47	−0.39	−0.55	−0.34	−0.87	−0.69	−0.45	−0.45
t_m	−2.51	−3.05	−3.26	−3.40	−3.61	−2.75	−3.18	−2.32	−3.91	−2.13	−4.80	−3.13	−3.17	−2.62

	Oa	dWc	dCoa	dNco	dNca	dFin	dSti	dFnl	Dac	Nxf	Ndf
m	−0.33	−0.53	−0.40	−0.48	−0.51	0.36	0.40	−0.38	−0.38	−0.44	−0.36
t_m	−1.97	−3.35	−2.47	−3.40	−3.46	2.50	2.23	−2.99	−2.42	−1.97	−2.23

Panel D: Profitability

Insignificant (38)

	Roe6	Roe12	Roa6	Roa12	Rna	Pm	Ato	Cto	Rna^{q}12	Pm^{q}1	Pm^{q}6	Pm^{q}12	Cto^{q}6	Cto^{q}12
m	0.48	0.28	0.35	0.27	0.34	0.37	0.48	0.44	0.63	0.69	0.49	0.45	0.61	0.56
t_m	1.93	1.23	1.34	1.11	1.09	0.91	1.47	1.26	1.90	1.61	1.21	1.15	1.80	1.63

	Gla	Ope	Ole	Ole^{q}12	Opa	Ola	Z	Z^{q}1	Z^{q}6	Z^{q}12	Cr1	Cr6	Cr12	Tbi
m	0.17	0.26	0.07	0.36	0.34	0.17	−0.04	0.08	0.06	−0.01	−0.07	−0.11	−0.08	0.14
t_m	1.07	1.21	0.36	1.81	1.69	0.91	−0.13	0.23	0.18	−0.02	−0.19	−0.28	−0.21	0.66

	Tbi^{q}1	Tbi^{q}6	Tbi^{q}12	Bl	Bl^{q}1	Bl^{q}6	Bl^{q}12	Sg^{q}1	Sg^{q}6	Sg^{q}12
m	0.18	0.24	0.27	−0.02	0.14	0.19	0.13	0.30	0.06	−0.23
t_m	0.82	1.17	1.34	−0.10	0.68	0.93	0.63	1.19	0.27	−1.08

Significant (41)

	Roe1	dRoe1	dRoe6	dRoe12	Roa1	dRoa1	dRoa6	dRoa12	Rna^{q}1	Rna^{q}6	Ato^{q}1	Ato^{q}6	Ato^{q}12	Cto^{q}1
m	0.82	0.83	0.42	0.31	0.68	0.71	0.39	0.31	0.89	0.69	0.94	0.80	0.64	0.69
t_m	3.22	5.36	3.17	2.66	2.50	4.24	2.52	2.25	2.39	2.00	3.27	2.91	2.32	2.06

	Gpa	Gla^{q}1	Gla^{q}6	Gla^{q}12	Ole^{q}1	Ole^{q}6	Ola^{q}1	Ola^{q}6	Ola^{q}12	Cop	Cla	Cla^{q}1	Cla^{q}6	Cla^{q}12
m	0.41	0.53	0.38	0.32	0.68	0.47	0.71	0.49	0.45	0.63	0.53	0.49	0.48	0.47
t_m	2.64	3.28	2.53	2.26	3.12	2.25	3.21	2.34	2.29	3.44	3.02	3.02	3.45	3.57

	F	F^{q}1	F^{q}6	F^{q}12	Fp	Fp^{q}1	Fp^{q}6	Fp^{q}12	O	O^{q}1	O^{q}6	O^{q}12	G
m	0.65	0.65	0.61	0.55	−0.82	−0.96	−1.15	−0.74	−0.60	−0.84	−0.76	−0.69	0.70
t_m	2.19	2.36	2.43	2.55	−2.10	−2.31	−2.92	−2.04	−2.06	−2.73	−2.50	−2.29	2.69

Panel E: Intangibles

Insignificant (81)

	gAd	Rdm	Rdm^{q}1	Rdm^{q}6	Rdm^{q}12	Rds	Rds^{q}1	Rds^{q}6	Rds^{q}12	Hn	Rca	Bca	Aop	Pafe
m	−0.13	0.47	1.12	0.79	0.76	0.08	0.46	0.69	0.73	−0.30	0.31	0.28	−0.16	−0.06
t_m	−0.63	1.38	1.76	1.21	1.43	0.25	0.98	1.66	1.87	−1.82	1.08	1.01	−0.60	−0.09

	Parc	Crd	Ha	He	Age1	Age6	Age12	D1	D2	D3	dSi	dGs	dSs	Etr
m	0.09	0.16	−0.27	−0.28	0.07	0.07	0.05	0.17	0.23	0.24	0.05	0.10	−0.10	0.20
t_m	0.39	0.64	−1.56	−1.62	0.28	0.29	0.24	0.67	0.87	0.90	0.27	0.54	−0.54	1.46

	Lfe	Ana1	Ana6	Ana12	Tan	Tan^{q}1	Tan^{q}6	Tan^{q}12	Kz	Kz^{q}1	Kz^{q}6	Kz^{q}12	Ww	Ww^{q}1
m	0.12	0.33	0.38	0.39	−0.11	0.06	−0.01	−0.08	−0.19	−0.24	−0.26	−0.27	0.25	0.08
t_m	0.69	1.32	1.53	1.59	−0.64	0.26	−0.05	−0.44	−0.85	−0.93	−1.01	−1.02	0.67	0.20

	Ww^{q}6	Ww^{q}12	Sdd	Cdd	Vcf12	Cta1	Cta6	Cta12	Acq	Acq1	Acq6	Acq12	Ob	Eper
m	0.13	0.14	0.16	−0.06	−0.50	0.19	0.05	0.04	−0.17	−0.19	−0.17	−0.15	0.09	−0.04
t_m	0.34	0.35	0.56	−0.16	−1.79	0.83	0.24	0.16	−0.60	−0.69	−0.59	−0.54	0.24	−0.23

	Esm	Evr	Etl	Ecs	Frm	Fra	Ala	Alm	$\text{Ala}^{\text{q}}1$	$\text{Ala}^{\text{q}}6$	$\text{Ala}^{\text{q}}12$	$\text{Alm}^{\text{q}}1$	$\text{Alm}^{\text{q}}12$	Dls1
m	−0.06	0.18	0.31	0.09	0.31	−0.13	−0.10	−0.05	0.36	0.16	0.14	0.56	0.47	−0.19
t_m	−0.31	0.86	1.72	0.63	1.21	−0.65	−0.35	−0.20	0.98	0.43	0.40	1.89	1.77	−0.83

	Dls6	Dls12	Dis1	Dis6	Dis12	Dlg1	Dlg6	Dlg12	$R_{\text{n}}^{[6,10]}$	$R_{\text{n}}^{[11,15]}$	$R_{\text{n}}^{[16,20]}$
m	0.05	0.08	−0.62	−0.60	−0.47	−0.25	−0.26	−0.21	−0.41	−0.29	−0.27
t_m	0.27	0.44	−1.47	−1.47	−1.22	−0.66	−0.67	−0.57	−1.64	−1.45	−1.42

Significant (22)

	Oca	Ioca	Adm	Ol	$\text{Ol}^{\text{q}}1$	$\text{Ol}^{\text{q}}6$	$\text{Ol}^{\text{q}}12$	Hs	dSa	Rer	Vcf1	Vcf6	Gind	Eprd
m	0.51	0.59	0.83	0.50	0.53	0.54	0.55	−0.38	0.29	0.40	−0.60	−0.57	−0.73	−0.54
t_m	2.16	4.21	2.74	2.66	2.44	2.55	2.76	−2.34	2.02	2.43	−2.02	−2.03	−2.04	−2.33

	$\text{Alm}^{\text{q}}6$	R_a^1	R_n^1	$R_{\text{a}}^{[2,5]}$	$R_{\text{n}}^{[2,5]}$	$R_{\text{a}}^{[6,10]}$	$R_{\text{a}}^{[11,15]}$	$R_{\text{a}}^{[16,20]}$
m	0.59	0.93	0.77	0.97	−0.81	0.94	0.84	0.67
t_m	2.17	3.89	2.26	4.97	−2.92	4.75	4.96	3.34

Panel F: Trading frictions

Insignificant (93)

	Me	Iv	Ivff6	Ivff12	Ivc1	Ivc6	Ivc12	Ivq6	Ivq12	Tv1	Tv6	Tv12	Sv6	Sv12
m	−0.26	−0.14	−0.42	−0.25	−0.69	−0.42	−0.27	−0.42	−0.28	−0.55	−0.33	−0.24	−0.27	−0.27
t_m	−0.41	−0.31	−1.26	−0.74	−1.89	−1.24	−0.82	−1.27	−0.87	−1.43	−0.88	−0.66	−1.37	−1.70

	$\beta 1$	$\beta 6$	$\beta 12$	$\beta^{\text{FP}}1$	$\beta^{\text{FP}}6$	$\beta^{\text{FP}}12$	$\beta^{\text{D}}1$	$\beta^{\text{D}}6$	$\beta^{\text{D}}12$	Tur1	Tur6	Tur12	Cvt1	Cvt6
m	2.33	1.95	1.82	−0.17	−0.19	−0.14	−0.04	−0.14	−0.19	−0.31	−0.27	−0.24	0.14	0.16
t_m	1.85	1.57	1.43	−0.48	−0.58	−0.43	−0.11	−0.50	−0.73	−0.99	−0.85	−0.76	0.88	1.06

	Cvt12	Dtv1	Dtv6	Dtv12	Cvd1	Cvd6	Cvd12	Pps1	Pps6	Pps12	Ami1	Ami6	Ami12	$\text{Lm}^1 1$
m	0.26	−0.20	−0.29	−0.36	0.15	0.17	0.27	−0.69	−0.44	−0.48	0.18	0.27	0.34	−0.07
t_m	1.72	−0.88	−1.30	−1.66	0.93	1.08	1.79	−1.12	−0.75	−0.84	0.68	1.06	1.33	−0.27

	$\text{Lm}^1 6$	$\text{Lm}^1 12$	$\text{Lm}^6 12$	$\text{Lm}^{12} 6$	$\text{Lm}^{12} 12$	Mdr1	Mdr6	Mdr12	Ts1	Ts6	Ts12	Isc1	Isc6	Isc12
m	0.32	0.31	0.43	0.45	0.39	−0.39	−0.22	−0.10	0.22	0.02	0.02	0.17	−0.03	0.05
t_m	1.28	1.29	1.84	1.89	1.60	−1.19	−0.69	−0.33	1.93	0.27	0.42	1.57	−0.45	0.91

	Isff6	Isff12	Isq6	Isq12	Cs1	Cs6	Cs12	$\beta^{-}1$	$\beta^{-}6$	$\beta^{-}12$	Tail1	Tail6	Tail12	$\beta^{\text{ret}}1$
m	0.08	0.09	0.06	0.08	0.07	−0.05	−0.08	−0.18	−0.20	−0.12	0.11	0.14	0.19	0.19
t_m	1.33	1.70	1.00	1.65	0.54	−0.79	−1.49	−0.58	−0.65	−0.42	0.52	0.69	1.04	0.51

	$\beta^{\text{ret}}6$	$\beta^{\text{ret}}12$	$\beta^{\text{lcc}}1$	$\beta^{\text{lcc}}6$	$\beta^{\text{lcc}}12$	$\beta^{\text{lrc}}1$	$\beta^{\text{lrc}}6$	$\beta^{\text{lrc}}12$	$\beta^{\text{lcr}}1$	$\beta^{\text{lcr}}6$	$\beta^{\text{lcr}}12$	$\beta^{\text{net}}1$	$\beta^{\text{net}}6$	$\beta^{\text{net}}12$
m	0.22	0.20	0.25	0.27	0.29	0.07	0.10	0.07	0.06	0.03	−0.02	0.34	0.39	0.34
t_m	0.59	0.55	0.94	1.03	1.15	0.23	0.31	0.24	0.37	0.23	−0.12	0.93	1.06	0.95

	Shl1	Shl6	Shl12	Sba1	Sba6	Sba12	$\beta^{\text{lev}}1$	$\beta^{\text{lev}}6$	$\beta^{\text{lev}}12$
m	−0.16	−0.21	−0.15	−0.21	−0.12	−0.12	0.46	0.30	0.25
t_m	−0.51	−0.71	−0.56	−0.75	−0.46	−0.44	1.72	1.19	1.00

Significant (9)

	Ivff1	Ivq1	Sv1	$\text{Lm}^6 1$	$\text{Lm}^6 6$	$\text{Lm}^{12} 1$	Isf1	Isq1	Srev
m	−0.72	−0.71	−0.99	0.49	0.49	0.49	0.34	0.27	−0.65
t_m	−2.01	−1.97	−3.30	2.09	2.08	2.03	3.38	2.86	−2.40

Table 6 : Average Return Spreads and Their t-values for High-minus-low Anomaly Deciles with NYSE-Amex-NASDAQ Breakpoints and Equal-weighted Returns in the Full Sample

Insignificant anomalies are identified as those with the average returns of the high-minus-low deciles insignificant at the 5% level, and significant anomalies are those with significant average return spreads. For the high-minus-low decile formed on each anomaly variable, this table reports the average return (m) and its t-statistic adjusted for heteroscedasticity and autocorrelations. Table 1 describes the symbols, and Appendix A details variable definitions and portfolio construction.

Panel A: Momentum

Insignificant (9)

	$R^{6}12$	$R^{11}6$	$R^{11}12$	Rs12	Nei12	52w1	52w6	52w12	Ile12
m	0.25	0.41	−0.14	0.09	0.15	−0.77	0.26	0.09	0.15
t_m	1.08	1.36	−0.52	0.64	1.10	−1.79	0.68	0.26	1.20

Significant (48)

	Sue1	Sue6	Sue12	Abr1	Abr6	Abr12	Re1	Re6	Re12	$R^{6}1$	$R^{6}6$	$R^{11}1$	Im1	Im6
m	1.38	0.68	0.26	1.60	0.87	0.53	1.43	0.85	0.47	0.74	0.71	0.89	1.41	0.89
t_m	10.44	5.51	2.30	15.61	11.11	7.96	7.26	4.78	2.98	2.41	2.62	2.67	6.90	5.39

	Im12	Rs1	Rs6	Tes1	Tes6	Tes12	dEf1	dEf6	dEf12	Nei1	Nei6	$\epsilon^{6}1$	$\epsilon^{6}6$	$\epsilon^{6}12$
m	0.78	0.92	0.42	0.89	0.46	0.18	1.76	0.96	0.56	0.77	0.39	0.76	0.67	0.40
t_m	5.11	5.86	2.81	8.54	5.07	2.21	11.04	7.57	5.19	5.49	2.83	5.35	5.66	4.10

	$\epsilon^{11}1$	$\epsilon^{11}6$	$\epsilon^{11}12$	Sm1	Sm6	Sm12	Ilr1	Ilr6	Ilr12	Ile1	Ile6	Cm1	Cm6	Cm12
m	1.25	0.69	0.31	1.42	0.51	0.45	1.40	0.63	0.48	0.78	0.37	0.86	0.43	0.33
t_m	8.35	5.37	2.86	7.37	4.93	6.16	8.37	6.60	6.22	5.00	2.74	5.65	6.38	6.09

	Sim1	Sim6	Sim12	Cim1	Cim6	Cim12
m	1.38	0.51	0.35	1.35	0.54	0.44
t_m	6.18	3.87	3.90	6.18	5.13	5.83

Panel B: Value-versus-growth

Insignificant (14)

	Dm^{q}6	Dm^{q}12	Efp6	Efp12	Dp	Dp^{q}6	Dp^{q}12	Vfp	Ndp^{q}1	Ndp^{q}6	Ndp^{q}12	Ltg1	Ltg6	Ltg12
m	0.40	0.46	0.31	0.31	0.21	0.20	0.25	0.31	0.52	0.33	0.41	−0.52	−0.58	−0.55
t_m	1.51	1.82	1.23	1.32	1.10	1.06	1.40	1.43	1.68	1.13	1.57	−1.26	−1.47	−1.38

Significant (54)

	Bm	Bmj	Bm^{q}1	Bm^{q}6	Bm^{q}12	Dm	Dm^{q}1	Am	Am^{q}1	Am^{q}6	Am^{q}12	Rev1	Rev6	Rev12
m	1.44	1.28	1.83	1.30	1.31	0.54	0.66	1.11	1.39	0.94	0.97	−1.22	−1.09	−1.03
t_m	6.55	5.53	6.07	4.94	5.43	2.40	2.27	4.48	4.04	3.07	3.46	−4.47	−4.22	−4.26

	Ep	Ep^{q}1	Eo^{q}6	Ep^{q}12	Efp1	Cp	Cp^{q}1	Cp^{q}6	Cp^{q}12	Dp^{q}1	Op	Op^{q}1	Op^{q}6	Op^{q}12
m	0.76	1.85	1.15	0.76	0.65	1.03	1.54	1.05	0.93	0.37	0.60	0.45	0.42	0.38
t_m	4.80	10.36	7.88	5.89	2.45	5.41	6.98	5.36	5.09	1.99	3.52	2.88	3.11	3.00

	Nop	Nop^{q}1	Nop^{q}6	Nop^{q}12	Sr	Sg	Em	Em^{q}1	Em^{q}6	Em^{q}12	Sp	Sp^{q}1	Sp^{q}6	Sp^{q}12
m	0.78	0.58	0.79	0.74	−0.54	−0.88	−1.00	−1.90	−1.16	−0.98	1.16	1.59	1.20	1.11
t_m	3.92	2.18	3.20	3.20	−3.72	−6.44	−5.72	−8.88	−6.71	−6.08	4.35	5.18	4.27	4.10

	Ocp	Ocp^{q}1	Ocp^{q}6	Ocp^{q}12	Ir	Vhp	Ebp	Ebp^{q}1	Ebp^{q}6	Ebp^{q}12	Ndp	Dur
m	0.93	0.99	0.72	0.71	−1.12	0.59	1.15	1.76	1.25	1.24	0.50	−0.83
t_m	4.52	3.22	2.60	2.79	−5.15	3.90	5.27	5.86	4.57	4.83	2.50	−3.42

Panel C: Investment

Insignificant (1)

	dSTI
m	−0.25
t_m	−1.78

Significant (37)

	Aci	Ia	Ia^{q}1	Ia^{q}6	Ia^{q}12	dPia	Noa	dNoa	dLno	Ig	2Ig	3Ig	Nsi	dIi
m	−0.38	−1.31	−1.33	−1.47	−1.45	−1.10	−1.06	−1.24	−0.93	−0.72	−0.58	−0.56	−1.11	−0.56
t_m	−4.52	−7.04	−5.70	−6.43	−6.70	−8.08	−5.38	−8.06	−6.65	−6.55	−5.04	−4.73	−6.45	−6.79

	Cei	Cdi	Ivg	Ivc	Oa	Ta	dWc	dCoa	dCol	dNco	dNca	dNcl	dFin	dLti
m	−0.76	−0.41	−0.86	−0.83	−0.49	−0.57	−0.68	−1.02	−0.78	−1.09	−1.08	−0.25	0.56	−0.52
t_m	−3.59	−5.12	−6.55	−6.85	−3.74	−3.49	−5.80	−7.71	−7.13	−7.77	−7.48	−2.90	5.78	−4.52

	dFnl	dBe	Dac	Poa	Pta	Pda	Nxf	Nef	Ndf
m	−0.90	−0.86	−0.39	−0.67	−0.47	−0.32	−0.96	−0.75	−0.81
t_m	−10.61	−4.83	−3.56	−6.83	−5.90	−4.10	−5.58	−3.36	−9.08

Panel D: Profitability

Insignificant (36)

	Roe12	Roa12	Rna	Pm	Ato	Cto	Rna^{q}6	Rna^{q}12	Pm^{q}6	Pm^{q}12	Gla	Ope	Ole	Ole^{q}12
m	0.37	0.26	−0.08	−0.01	0.25	0.22	0.57	0.29	0.47	0.22	0.21	0.25	0.09	0.40
t_m	1.51	0.92	−0.32	−0.04	1.57	1.01	1.87	0.97	1.66	0.79	1.08	0.86	0.33	1.43

	Ola	F	Fp	Fp^{q}12	O	O^{q}1	O^{q}6	O^{q}12	Z^{q}1	G	Cr1	Cr6	Cr12	Tbi
m	0.13	0.39	−0.27	−0.29	−0.04	−0.17	−0.02	0.03	−0.46	0.12	−0.59	−0.55	−0.53	0.07
t_m	0.57	1.72	−0.79	−0.90	−0.15	−0.51	−0.07	0.09	−1.65	0.52	−1.47	−1.41	−1.38	0.66

	Tbi^{q}1	Tbi^{q}6	Tbi^{q}12	Bl	Bl^{q}1	Bl^{q}6	Bl^{q}12	Sg^{q}6
m	−0.04	0.04	0.07	−0.18	−0.11	−0.17	−0.18	−0.04
t_m	−0.36	0.36	0.70	−1.21	−0.65	−1.00	−1.09	−0.32

Significant (43)

	Roe1	Roe6	dRoe1	dRoe6	dRoe12	Roa1	Roa6	dRoa1	dRoa6	dRoa12	Rna^{q}1	Pm^{q}1	Ato^{q}1	Ato^{q}6
m	1.34	0.86	1.59	0.87	0.38	1.11	0.67	1.44	0.74	0.31	0.85	0.77	1.05	0.82
t_m	5.24	3.36	12.08	7.89	3.96	3.87	2.33	10.70	6.23	3.04	2.74	2.67	6.52	5.07

	Ato^{q}12	Cto^{q}1	Cto^{q}6	Cto^{q}12	Gpa	Gla^{q}1	Gla^{q}6	Gla^{q}12	Ole^{q}1	Ole^{q}6	Opa	Ola^{q}1	Ola^{q}6	Ola^{q}12
m	0.63	1.03	0.83	0.62	0.65	0.98	0.67	0.47	1.16	0.72	0.54	1.29	0.87	0.54
t_m	3.88	4.90	3.94	2.96	3.28	4.37	2.92	2.00	3.97	2.58	2.19	4.81	3.32	2.14

	Cop	Cla	Cla^{q}1	Cla^{q}6	Cla^{q}12	F^{q}1	F^{q}6	F^{q}12	Fp^{q}1	Fp^{q}6	Z	Z^{q}6	Z^{q}12	Sg^{q}1
m	0.77	0.68	1.05	0.89	0.78	1.42	0.98	0.64	−0.77	−0.69	−0.48	−0.57	−0.58	0.51
t_m	3.84	3.38	5.60	5.21	5.01	5.30	3.92	2.60	−2.33	−2.09	−2.48	−2.17	−2.36	3.50

	Sg^{q}12
m	−0.42
t_m	−3.30

Panel E: Intangibles

Insignificant (59)

	Rds	Rds^{q}1	Rds^{q}6	Rds^{q}12	Aop	Pafe	Parc	Crd	Hs	Ha	He	Age1	Age6	Age12
m	0.03	−0.08	0.12	0.14	−0.14	−0.04	−0.09	0.22	−0.20	−0.19	−0.17	0.29	0.35	0.33
t_m	0.07	−0.16	0.22	0.26	−1.13	−0.12	−0.62	1.52	−1.61	−1.18	−0.89	1.31	1.59	1.52

	dSa	dGs	Etr	Lfe	Ana1	Ana6	Ana12	Kz	Kz^{q}6	Kz^{q}12	Ww^{q}1	Ww^{q}6	Ww^{q}12	Sdd
m	0.12	0.14	0.00	−0.10	−0.12	−0.14	−0.15	−0.12	−0.30	−0.27	0.32	0.41	0.47	0.08
t_m	1.66	1.58	0.06	−1.27	−0.67	−0.77	−0.82	−0.67	−1.36	−1.28	0.89	1.16	1.35	0.73

	Cdd	Vcf1	Vcf6	Vcf12	Cta1	Cta6	Cta12	Gind	Acq	Acq1	Acq6	Acq12	Ob	Eper
m	−0.13	−0.59	−0.58	−0.53	0.22	0.10	0.09	−0.20	0.09	0.04	0.06	0.11	0.00	−0.19
t_m	−0.64	−1.72	−1.72	−1.60	0.87	0.41	0.36	−0.81	0.37	0.15	0.24	0.44	−0.02	−1.73

	Esm	Evr	Etl	Ecs	Frm	Fra	Ala^{q}1	Ala^{q}6	Ala^{q}12	Dls6	Dls12	Dis12	Dlg1	Dlg6
m	0.10	0.06	0.16	0.06	0.07	0.09	0.33	0.09	−0.10	−0.21	−0.12	−0.29	−0.18	−0.12
t_m	0.74	0.66	1.74	0.88	0.40	0.72	1.53	0.44	−0.52	−1.17	−0.81	−1.41	−0.80	−0.58

	Dlg12	R_n^1	$R_n^{[11,15]}$
m	−0.11	−0.36	−0.24
t_m	−0.53	−1.05	−1.76

Significant (44)

	Oca	Ioca	Adm	gAd	Rdm	Rdm^{q}1	Rdm^{q}6	Rdm^{q}12	Ol	Ol^{q}1	Ol^{q}6	Ol^{q}12	Hn	Rca
m	0.78	0.74	0.97	−0.66	1.89	3.43	2.69	2.62	0.58	0.69	0.65	0.60	−0.86	0.89
t_m	3.52	5.18	3.59	−4.30	5.64	5.99	5.26	5.72	3.21	3.54	3.34	3.11	−6.26	2.02

	Bca	D1	D2	D3	dSi	dSs	Tan	Tan^{q}1	Tan^{q}6	Tan^{q}12	Rer	Kz^{q}1	Ww	Eprd
m	0.37	1.02	1.11	1.09	0.15	−0.22	0.49	0.78	0.71	0.59	0.23	−0.51	0.72	−0.72
t_m	2.09	3.78	3.86	3.80	2.10	−2.26	2.82	4.35	4.00	3.42	2.11	−2.13	2.15	−3.88

	Ala	Alm	Alm^{q}1	Alm^{q}6	Alm^{q}12	Dls1	Dis1	Dis6	R_a^1	$R_a^{[2,5]}$	$R_n^{[2,5]}$	$R_a^{[6,10]}$	$R_n^{[6,10]}$	$R_a^{[11,15]}$
m	−0.65	0.36	1.59	1.48	1.30	−0.64	−0.67	−0.46	0.77	0.85	−1.43	0.82	−0.67	0.70
t_m	−4.31	2.29	7.09	7.04	6.40	−3.31	−2.99	−2.11	4.96	5.92	−6.25	6.05	−4.61	6.19

	$R_a^{[16,20]}$	$R_n^{[16,20]}$
m	0.61	−0.30
t_m	5.18	−2.50

Panel F: Trading frictions

Insignificant (62)

	Iv	Ivff1	Ivff6	Ivff12	Ivc1	Ivc6	Ivc12	Ivq1	Ivq6	Ivq12	Tv1	Tv6	Tv12	Sv6
m	0.31	−0.27	−0.03	0.16	−0.28	−0.03	0.15	−0.28	−0.04	0.14	−0.28	−0.04	0.13	−0.11
t_m	0.75	−0.75	−0.09	0.45	−0.78	−0.09	0.44	−0.79	−0.12	0.41	−0.76	−0.11	0.37	−1.63

	Sv12	β1	β6	β12	β^{FP}1	β^{FP}6	β^{FP}12	β^{D}6	Cvd1	Lm^{1}1	Mdr6	Mdr12	Ts6	Ts12
m	−0.07	−0.08	−0.06	−0.11	−0.47	−0.38	−0.33	−0.23	0.36	0.44	−0.17	0.03	−0.02	0.03
t_m	−1.19	−0.27	−0.21	−0.38	−1.40	−1.17	−1.07	−1.96	1.92	1.89	−0.54	0.09	−0.22	0.40

	Isc6	Isc12	Isff6	Isff12	Isq6	Isq12	Cs1	Cs6	Cs12	Tail1	Tail6	β^{ret}1	β^{ret}6	β^{ret}12
m	−0.01	0.03	0.01	0.04	0.01	0.04	−0.04	0.00	0.00	0.20	0.29	−0.12	−0.11	−0.15
t_m	−0.15	0.46	0.16	0.69	0.16	0.63	−0.54	−0.01	−0.11	1.11	1.88	−0.40	−0.38	−0.54

	β^{lcc}1	β^{lcc}6	β^{lcc}12	β^{lrc}1	β^{lrc}6	β^{lrc}12	β^{lcr}1	β^{lcr}6	β^{lcr}12	β^{net}1	β^{net}6	β^{net}12	Shl1	Shl6
m	0.30	0.29	0.27	−0.02	−0.06	−0.02	0.03	0.00	0.00	0.13	0.05	−0.00	0.64	0.63
t_m	1.63	1.64	1.59	−0.06	−0.25	−0.08	0.26	0.03	0.01	0.47	0.18	−0.02	1.84	1.93

	Sba1	Sba6	Sba12	β^{lev}1	β^{lev}6	β^{lev}12
m	0.50	0.59	0.59	0.35	0.24	0.16
t_m	1.19	1.55	1.63	1.85	1.40	0.98

Significant (40)

	Me	Sv1	β^D1	β^D12	Tur1	Tur6	Tur12	Cvt1	Cvt6	Cvt12	Dtv1	Dtv6	Dtv12	Cvd6
m	−1.20	−0.36	−0.45	−0.26	−0.85	−0.97	−0.95	0.43	0.50	0.54	−1.19	−1.20	−1.21	0.48
t_m	−4.01	−2.37	−2.62	−2.44	−3.39	−4.02	−4.06	2.57	3.07	3.47	−4.73	−4.90	−5.04	2.68

	Cvd12	Pps1	Pps6	Pps12	Ami1	Ami6	Ami12	Lm^{1}6	Lm^{1}12	Lm^{6}1	Lm^{6}6	Lm^{6}12	Lm^{12}1	Lm^{12}6
m	0.52	−1.44	−1.01	−1.02	1.06	1.17	1.21	1.00	1.04	1.20	1.23	1.16	1.20	1.17
t_m	3.06	−3.53	−2.57	−2.72	3.52	3.93	4.12	4.50	4.89	5.02	5.36	5.27	5.09	5.18

	Lm^{12}12	Mdr1	Ts1	Isc1	Isff1	Isq1	Srev	β^-1	β^-6	β^-12	Tail12	Shl12
m	1.09	−0.73	−0.46	−0.38	−0.24	−0.23	−2.65	−0.80	−0.96	−0.79	0.33	0.73
t_m	5.00	−2.29	−3.95	−3.48	−2.40	−2.45	−9.22	−2.79	−3.49	−3.02	2.31	2.34

Table 7 : Portfolio Weights on Microcaps and Investment Capacity, January 1967 to December 2014, 576 Months

The six categories of anomalies, momentum, value-versus-growth, investment, profitability, intangibles, and trading frictions are denoted by Mom, VvG, Inv, Prof, Intan, and Fric, respectively. In Panel A, we calculate the time series average of portfolio weights on microcaps for the low and high deciles of each anomaly variable, and then report the average across all the anomalies within a given category. In Panel B, the investment capacity of a portfolio is defined as $\min_i\{\mathrm{Me}_i/w_i\}$, in which Me_i is the market equity of stock i, and w_i is its portfolio weight. For the low and high deciles of each anomaly variable, we calculate the investment capacity at each month, take time series average, and then report the average across all the anomalies within a given category.

	Mom	VvG	Inv	Prof	Intan	Fric
	Panel A: Portfolio weights (in percent) allocated to microcaps					
	NYSE breakpoints and value-weights					
Low	7.34	4.04	7.58	9.65	4.09	10.50
High	3.50	7.56	5.69	5.98	10.43	20.53
	NYSE-Amex-NASDAQ breakpoints and equal-weights					
Low	64.19	51.88	71.67	68.90	47.97	55.12
High	49.06	64.86	60.89	55.31	62.54	73.65
Panel B: Investment capacity as a fraction of the total market equity (in percent)						
	NYSE breakpoints and value-weights					
Low	7.119	13.394	5.886	8.553	9.900	15.676
High	10.342	5.697	7.487	11.162	8.662	8.807
	NYSE-Amex-NASDAQ breakpoints and equal-weights					
Low	0.016	0.028	0.012	0.029	0.181	0.207
High	0.027	0.015	0.017	0.019	0.046	0.185

Table 8 : Using the q-factor Model to Explain Significant Anomalies with NYSE Breakpoints and Value-weighted Returns, January 1967 to December 2014, 576 Months

For each high-minus-low decile, α_q is the q-factor alpha, t_q its t-statistic, $\beta_{\text{Mkt}}, \beta_{\text{Me}}, \beta_{\text{I/A}}$, and β_{Roe} the loadings on the market, size, investment, and Roe factors, respectively, and $t_{\text{Mkt}}, t_{\text{Me}}, t_{\text{I/A}}$, and t_{Roe} their t-statistics, $\overline{|\alpha_q|}$ the mean absolute alpha across a given set of deciles, and p_q the p-value (in percent) of the GRS test on the null that the alphas across the deciles are jointly zero. All the t-values are adjusted for heteroscedasticity and autocorrelations. Table 1 describes the symbols, and Appendix A details variable definitions and portfolio construction.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
	Sue1	Abr1	Abr6	Abr12	Re1	Re6	$R^6 1$	$R^6 6$	$R^6 12$	$R^{11} 1$	$R^{11} 6$	Im1	Im6	Im12	Rs1	dEf1	dEf6	dEf12
α_q	0.05	0.66	0.27	0.23	0.11	0.02	−0.04	0.24	0.16	0.31	0.12	0.26	0.06	0.32	0.22	0.64	0.20	0.09
t_q	0.40	4.49	2.41	2.65	0.45	0.11	−0.10	0.78	0.75	0.77	0.41	0.80	0.23	1.44	1.52	2.81	1.15	0.70
β_{Mkt}	−0.04	−0.06	−0.03	−0.02	−0.06	−0.06	−0.21	−0.08	−0.02	−0.13	−0.05	−0.20	−0.07	−0.04	−0.05	0.02	0.06	0.03
β_{Me}	−0.04	0.07	0.09	0.07	−0.19	−0.17	0.21	0.22	0.07	0.32	0.16	0.15	0.24	0.15	−0.12	−0.10	−0.03	−0.08
$\beta_{\text{I/A}}$	−0.09	−0.13	−0.17	−0.26	0.07	−0.09	0.06	−0.01	−0.20	0.10	−0.11	0.05	0.10	−0.16	−0.41	−0.18	−0.31	−0.34
β_{Roe}	0.86	0.26	0.17	0.16	1.28	1.07	1.17	0.99	0.83	1.43	1.27	0.79	0.83	0.66	0.60	0.80	0.79	0.68
t_{Mkt}	−0.93	−1.39	−1.32	−0.75	−0.93	−1.13	−2.39	−1.13	−0.34	−1.38	−0.63	−2.50	−1.17	−0.81	−0.98	0.45	1.26	0.76
t_{Me}	−0.64	0.75	1.89	1.86	−2.20	−1.86	1.01	1.27	0.51	1.50	0.89	0.75	1.51	1.12	−2.39	−1.03	−0.36	−1.28
$t_{\text{I/A}}$	−0.95	−1.28	−2.40	−4.27	0.45	−0.61	0.18	−0.04	−1.11	0.33	−0.47	0.19	0.45	−0.86	−4.77	−1.25	−2.47	−3.57
t_{Roe}	11.24	3.12	2.87	3.71	9.71	8.96	4.09	5.33	5.88	5.67	6.52	3.91	5.01	4.44	7.96	7.13	7.86	8.95
$\overline{\|\alpha_q\|}$	0.11	0.13	0.08	0.07	0.11	0.12	0.18	0.09	0.07	0.13	0.11	0.13	0.11	0.13	0.08	0.17	0.12	0.12
p_q	0.49	0.01	0.26	0.43	8.22	1.34	0.00	0.01	2.65	0.03	0.63	50.7	2.86	10.6	3.02	0.12	0.05	2.85

	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
	Nei1	Nei6	52w6	$\epsilon^6 6$	$\epsilon^6 12$	$\epsilon^{11} 1$	$\epsilon^{11} 6$	$\epsilon^{11} 12$	Sm1	Ilr1	Ilr6	Ilr12	Ile1	Cm1	Cm12	Sim1	Cim1	Cim6
α_q	0.16	0.10	−0.01	0.30	0.22	0.32	0.25	0.15	0.61	0.79	0.17	0.18	0.37	0.72	0.05	0.54	0.64	0.05
t_q	1.60	1.07	−0.04	1.79	1.66	1.46	1.39	0.94	2.18	3.15	1.22	1.59	2.13	2.75	0.49	1.65	2.29	0.27
β_{Mkt}	0.01	−0.01	−0.44	−0.03	−0.02	0.01	0.01	0.01	−0.03	−0.19	−0.11	−0.05	−0.05	0.07	0.02	0.04	0.01	−0.04
β_{Me}	−0.08	−0.09	−0.36	0.11	0.05	0.12	0.10	0.02	−0.19	−0.10	0.08	0.08	0.00	−0.17	0.09	0.02	−0.18	0.11
$\beta_{\text{I/A}}$	−0.32	−0.42	0.52	0.08	0.00	0.19	0.10	0.01	0.14	0.08	0.01	−0.03	−0.18	0.21	0.00	0.16	0.19	0.19
β_{Roe}	0.65	0.60	1.24	0.25	0.29	0.40	0.39	0.34	−0.01	0.08	0.35	0.33	0.62	−0.04	0.13	0.23	0.19	0.28
t_{Mkt}	0.46	−0.33	−6.35	−0.73	−0.40	0.12	0.17	0.23	−0.44	−2.67	−3.27	−2.12	−0.89	0.90	0.54	0.50	0.12	−1.22
t_{Me}	−2.03	−2.61	−2.20	1.48	0.73	1.75	1.19	0.30	−1.85	−0.99	0.97	1.29	0.04	−1.95	1.47	0.18	−1.81	1.47
$t_{\text{I/A}}$	−4.46	−6.32	2.46	0.75	−0.05	1.48	0.84	0.14	0.74	0.47	0.10	−0.36	−1.40	1.18	0.05	0.70	0.89	1.22
t_{Roe}	11.51	11.64	6.53	2.63	4.22	3.30	3.87	4.00	−0.07	0.59	4.17	5.11	6.11	−0.27	2.28	1.46	1.13	2.89
$\overline{\|\alpha_q\|}$	0.09	0.08	0.05	0.06	0.06	0.10	0.06	0.06	0.13	0.21	0.10	0.10	0.13	0.24	0.13	0.15	0.16	0.06
p_q	1.88	0.80	24.7	0.03	0.00	0.20	0.33	0.93	26.5	2.11	20.0	9.71	5.73	6.62	2.40	27.2	2.24	26.1

	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54
	Cim12	Bm	Bmj	Bm^{q}12	Rev1	Rev6	Rev12	Ep	Ep^{q}1	Ep^{q}6	Ep^{q}12	Efp1	Cp	Cp^{q}1	Cp^{q}6	Cp^{q}12	Nop	Em
α_q	0.06	0.18	0.30	0.39	−0.16	−0.20	−0.13	0.03	0.46	0.13	0.01	0.22	0.09	0.50	0.38	0.22	0.36	−0.27
t_q	0.49	1.15	1.70	2.25	−0.91	−1.15	−0.76	0.14	1.86	0.68	0.06	1.22	0.49	2.27	1.98	1.24	2.41	−1.56
β_{Mkt}	−0.01	0.00	−0.05	0.02	0.05	0.08	0.09	−0.09	0.00	−0.03	−0.06	−0.19	0.00	0.08	0.00	−0.03	−0.17	0.12
β_{Me}	0.10	0.41	0.31	0.32	−0.63	−0.60	−0.60	0.28	0.29	0.25	0.27	−0.09	0.23	0.18	0.17	0.22	−0.34	−0.17
$\beta_{\text{I/A}}$	0.07	1.33	1.32	1.22	−1.18	−1.04	−0.95	1.01	0.82	0.84	0.82	0.79	1.26	0.99	0.97	1.01	1.05	−0.95
β_{Roe}	0.27	−0.55	−0.82	−0.94	0.72	0.66	0.50	−0.07	0.13	0.17	0.13	−0.07	−0.39	−0.61	−0.56	−0.45	0.04	0.14
t_{Mkt}	−0.67	0.10	−1.21	0.47	1.05	1.52	1.68	−1.60	−0.01	−0.55	−1.13	−2.78	−0.02	1.24	−0.01	−0.65	−3.46	2.37
t_{Me}	1.70	5.04	3.29	3.06	−7.76	−7.72	−8.37	2.41	2.16	2.01	2.34	−0.65	1.89	1.31	1.37	1.99	−4.34	−2.08
$t_{\text{I/A}}$	0.63	13.09	11.07	9.42	−10.63	−9.77	−8.48	6.55	4.77	6.10	6.37	4.76	9.36	6.12	6.74	7.57	10.23	−7.24
t_{Roe}	4.10	−6.64	−9.67	−8.85	7.44	6.89	4.75	−0.55	0.90	1.36	1.23	−0.44	−3.33	−4.30	−4.70	−4.16	0.37	1.20
$\overline{\|\alpha_q\|}$	0.06	0.09	0.12	0.13	0.08	0.07	0.06	0.10	0.17	0.14	0.11	0.18	0.12	0.20	0.15	0.12	0.12	0.12
p_q	22.3	10.8	1.36	0.04	31.6	8.80	26.8	9.40	0.02	0.00	0.12	0.02	0.27	0.07	0.02	1.17	0.53	0.48

	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72
	Em^q1	Em^q6	Em^q12	Sp	Sp^q1	Sp^q6	Sp^q12	Ocp	Ocp^q1	Ir	Vhp	Vfp	Ebp	Dur	Aci	I/A	Ia^q6	Ia^q12
α_q	−0.63	−0.34	−0.30	−0.04	0.21	0.15	0.06	0.41	0.46	−0.18	−0.01	0.22	0.09	−0.10	−0.17	0.07	−0.11	0.00
t_q	−2.55	−1.59	−1.55	−0.19	0.70	0.59	0.28	2.25	1.47	−1.13	−0.05	0.95	0.66	−0.53	−1.05	0.61	−0.96	0.04
β_{Mkt}	0.07	0.09	0.11	0.09	0.13	0.09	0.07	−0.02	0.11	−0.03	−0.04	−0.05	0.05	0.07	0.01	0.03	0.07	0.04
β_{Me}	0.02	−0.02	−0.07	0.62	0.59	0.61	0.64	0.16	0.13	−0.57	0.24	0.15	0.51	−0.27	−0.29	−0.13	−0.18	−0.21
$\beta_{\mathrm{I/A}}$	−0.67	−0.67	−0.71	1.14	1.07	1.11	1.08	1.37	1.19	−1.16	0.91	0.50	1.19	−0.97	0.13	−1.37	−1.35	−1.36
β_{Roe}	0.03	0.03	−0.01	−0.30	−0.56	−0.51	−0.39	−0.50	−0.58	0.65	−0.10	0.18	−0.59	0.18	−0.20	0.16	0.34	0.21
t_{Mkt}	1.26	1.77	2.33	1.77	1.88	1.47	1.31	−0.33	1.23	−0.64	−0.62	−0.84	1.01	1.14	0.18	1.06	2.23	1.41
t_{Me}	0.19	−0.18	−0.76	4.50	3.43	3.98	4.54	1.40	0.64	−7.94	2.01	1.46	6.51	−1.97	−4.98	−2.31	−3.30	−4.28
$t_{\mathrm{I/A}}$	−4.56	−5.53	−5.95	9.49	5.92	7.02	7.99	9.73	5.54	−10.70	5.82	3.04	12.49	−6.69	1.04	−16.72	−12.31	−13.62
t_{Roe}	0.25	0.23	−0.09	−2.87	−3.13	−3.37	−3.20	−4.31	−2.96	7.39	−0.78	1.51	−7.49	1.42	−2.26	2.54	4.37	3.11
$\overline{\lvert\alpha_q\rvert}$	0.23	0.15	0.13	0.06	0.08	0.07	0.07	0.11	0.19	0.07	0.14	0.15	0.12	0.08	0.13	0.09	0.07	0.06
p_q	0.00	0.16	0.05	27.4	32.0	40.7	21.5	2.74	27.6	43.8	1.28	6.23	0.40	42.0	0.17	0.02	5.33	14.3

	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90
	dPia	Noa	dNoa	dLno	Ig	2Ig	Nsi	dIi	Cei	Ivg	Ivc	Oa	dWc	dCoa	dNco	dNca	dFin	dFnl
α_q	−0.22	−0.41	−0.10	0.03	−0.03	0.05	−0.29	0.12	−0.24	0.01	−0.30	−0.54	−0.48	0.12	−0.03	0.00	0.44	−0.08
t_q	−1.77	−2.24	−0.66	0.16	−0.27	0.42	−2.19	1.14	−1.85	0.11	−2.11	−3.77	−3.43	1.16	−0.23	0.03	2.94	−0.73
β_{Mkt}	0.04	−0.01	0.00	−0.08	−0.02	0.07	0.04	0.03	0.22	−0.02	0.05	0.06	0.03	0.05	−0.02	−0.05	−0.03	0.03
β_{Me}	−0.09	0.11	0.03	−0.16	−0.15	−0.30	0.15	−0.17	0.28	0.07	0.00	0.31	0.35	−0.04	−0.08	−0.10	−0.11	−0.06
$\beta_{\mathrm{I/A}}$	−0.82	−0.07	−1.05	−0.81	−0.75	−0.73	−0.67	−0.64	−1.04	−0.94	−0.67	−0.02	−0.33	−1.15	−0.78	−0.87	−0.30	−0.42
β_{Roe}	0.14	0.00	0.02	0.02	−0.06	−0.07	−0.28	−0.21	−0.12	0.04	0.20	0.26	0.14	0.13	0.00	0.03	0.03	−0.14
t_{Mkt}	1.14	−0.14	−0.11	−1.60	−0.70	1.88	1.07	1.01	6.28	−0.66	1.44	1.83	0.62	1.97	−0.59	−1.42	−1.08	1.00
t_{Me}	−1.86	1.04	0.55	−2.34	−2.64	−4.76	2.15	−3.68	4.25	1.70	−0.08	5.06	4.32	−0.85	−1.61	−1.94	−2.19	−1.50
$t_{\mathrm{I/A}}$	−8.63	−0.44	−9.49	−6.86	−10.47	−9.36	−7.67	−7.58	−13.74	−12.85	−6.21	−0.23	−3.20	−16.21	−10.85	−11.77	−2.54	−5.58
t_{Roe}	1.83	0.04	0.25	0.15	−0.90	−1.01	−4.39	−2.99	−1.57	0.59	2.26	4.13	2.18	2.10	0.00	0.41	0.45	−2.05
$\overline{\lvert\alpha_q\rvert}$	0.12	0.11	0.07	0.05	0.09	0.08	0.11	0.07	0.12	0.10	0.08	0.13	0.13	0.08	0.10	0.10	0.08	0.09
p_q	0.22	0.06	20.9	61.8	1.22	7.65	0.10	41.8	0.44	6.74	27.2	0.03	0.04	6.16	0.39	1.09	2.46	4.83

	91	92	93	94	95	96	97	98	99	100	101	102	103	104	105	106	107	108
	Dac	Poa	Pta	Pda	Ndf	Roe1	dRoe1	dRoe6	dRoe12	Roa1	dRoa1	dRoa6	Rna^q1	Ato^q1	Ato^q6	Ato^q12	Cto^q1	Cto^q6
α_q	−0.64	−0.07	−0.15	−0.28	0.03	−0.03	0.34	−0.02	−0.09	0.04	0.06	−0.18	0.18	0.31	0.32	0.30	−0.11	−0.08
t_q	−4.37	−0.57	−1.07	−1.88	0.25	−0.27	2.29	−0.20	−0.96	0.31	0.36	−1.23	1.32	1.75	1.88	1.85	−0.65	−0.48
β_{Mkt}	0.01	−0.01	0.06	0.05	0.06	−0.08	0.03	0.04	0.01	−0.13	0.11	0.09	−0.14	0.11	0.09	0.08	0.12	0.12
β_{Me}	0.19	0.14	0.17	0.05	−0.12	−0.37	−0.06	−0.02	−0.01	−0.37	0.09	0.11	−0.44	0.43	0.38	0.33	0.33	0.32
$\beta_{\mathrm{I/A}}$	0.23	−0.94	−0.87	−0.18	−0.44	0.12	0.23	0.21	0.14	−0.08	0.25	0.19	−0.14	−0.49	−0.61	−0.69	−0.14	−0.21
β_{Roe}	0.19	0.07	0.05	−0.09	−0.26	1.49	0.58	0.56	0.52	1.34	0.59	0.59	1.29	0.55	0.53	0.47	0.83	0.77
t_{Mkt}	0.32	−0.35	1.69	1.32	1.76	−2.22	0.64	0.97	0.26	−4.17	2.44	1.96	−3.48	1.87	1.69	1.52	2.08	2.29
t_{Me}	3.27	3.36	2.66	0.63	−2.34	−6.34	−0.88	−0.42	−0.16	−6.34	1.30	1.59	−8.60	5.44	5.41	5.64	3.03	3.34
$t_{\mathrm{I/A}}$	2.38	−11.07	−8.94	−1.34	−5.80	1.24	2.75	2.60	2.53	−0.95	2.15	2.13	−1.40	−4.70	−5.95	−6.82	−1.31	−2.04
t_{Roe}	3.05	1.39	0.65	−0.97	−3.79	19.40	6.76	6.02	8.01	17.49	5.18	5.51	19.43	5.73	7.03	6.73	10.37	10.61
$\overline{\lvert\alpha_q\rvert}$	0.15	0.12	0.08	0.17	0.08	0.10	0.09	0.07	0.08	0.06	0.10	0.08	0.07	0.11	0.07	0.08	0.09	0.09
p_q	0.01	0.08	4.22	0.00	36.2	0.63	4.31	4.84	0.77	85.3	42.1	4.25	22.5	3.39	14.3	9.13	24.5	1.39

	109	110	111	112	113	114	115	116	117	118	119	120	121	122	123	124	125	126
	Cto^{q}12	Gpa	Gla^{q}1	Gla^{q}6	Gla^{q}12	Ole^{q}1	Ole^{q}6	Ola^{q}1	Ola^{q}6	Ola^{q}12	Cop	Cla	Cla^{q}1	Cla^{q}6	Cla^{q}12	F^{q}1	F^{q}6	F^{q}12
α_q	−0.05	0.18	0.20	0.10	0.13	−0.04	−0.16	0.37	0.25	0.33	0.69	0.74	0.43	0.40	0.46	0.13	0.15	0.07
t_q	−0.31	1.24	1.41	0.79	1.01	−0.25	−1.06	2.34	1.78	2.48	4.77	4.89	2.69	2.82	3.56	0.58	0.86	0.49
β_{Mkt}	0.11	0.04	0.00	0.02	0.01	−0.05	−0.06	−0.11	−0.10	−0.13	−0.23	−0.21	−0.08	−0.04	−0.07	−0.07	−0.03	−0.05
β_{Me}	0.30	0.03	0.11	0.06	0.05	−0.24	−0.29	−0.33	−0.37	−0.37	−0.60	−0.62	−0.32	−0.32	−0.31	−0.33	−0.40	−0.41
$\beta_{\mathrm{I/A}}$	−0.27	−0.31	−0.28	−0.37	−0.45	0.38	0.33	−0.24	−0.31	−0.42	−0.06	−0.31	−0.13	−0.13	−0.19	0.44	0.33	0.32
β_{Roe}	0.72	0.55	0.66	0.60	0.53	1.15	1.05	1.08	0.98	0.89	0.49	0.40	0.48	0.45	0.40	0.73	0.67	0.65
t_{Mkt}	2.06	0.95	−0.10	0.82	0.23	−1.08	−1.43	−2.44	−3.08	−4.28	−5.84	−5.46	−1.87	−1.46	−2.79	−1.03	−0.70	−0.99
t_{Me}	3.48	0.69	2.20	1.23	1.11	−2.25	−3.31	−3.82	−5.62	−5.68	−7.78	−8.65	−4.77	−5.77	−6.01	−3.16	−4.55	−4.82
$t_{\mathrm{I/A}}$	−2.68	−3.21	−3.03	−4.56	−5.22	2.63	2.64	−2.09	−3.25	−4.60	−0.66	−3.35	−1.07	−1.24	−2.14	3.07	2.80	3.18
t_{Roe}	10.25	7.66	12.26	10.83	8.96	10.91	9.99	13.43	14.45	12.18	7.88	6.00	5.25	7.12	7.34	6.97	6.90	7.11
$\overline{\lvert\alpha_q\rvert}$	0.09	0.12	0.11	0.11	0.10	0.07	0.09	0.12	0.08	0.08	0.17	0.14	0.18	0.10	0.11	0.10	0.15	0.11
p_q	0.62	10.7	11.6	20.2	41.4	8.56	0.82	0.82	2.91	4.49	0.00	0.00	0.03	5.14	0.04	10.2	0.01	0.09

	127	128	129	130	131	132	133	134	135	136	137	138	139	140	141	142	143	144
	Fp^{q}6	Tbi^{q}12	Oca	Ioca	Adm	Rdm	Rdm^{q}1	Rdm^{q}6	Rdm^{q}12	Ol	Ol^{q}1	Ol^{q}6	Ol^{q}12	Hs	Etr	Rer	Eprd	Etl
α_q	−0.17	0.34	0.13	0.07	0.08	0.70	1.47	0.97	0.80	0.03	0.07	0.09	0.12	−0.31	0.09	0.39	−0.49	0.28
t_q	−0.63	2.93	0.65	0.53	0.31	2.89	2.97	2.73	2.80	0.19	0.37	0.54	0.69	−1.51	0.69	2.20	−2.77	1.55
β_{Mkt}	0.41	−0.07	−0.16	−0.06	0.07	0.16	0.01	−0.08	−0.08	−0.04	−0.10	−0.13	−0.13	−0.17	0.01	0.05	0.10	0.01
β_{Me}	0.40	−0.17	0.22	0.25	0.48	0.62	0.14	0.52	0.62	0.30	0.27	0.32	0.32	−0.08	0.12	−0.13	0.35	0.29
$\beta_{\mathrm{I/A}}$	0.10	−0.14	0.27	0.36	1.36	0.17	0.61	0.69	0.82	0.11	0.04	0.05	0.04	0.28	0.04	−0.15	0.41	−0.13
β_{Roe}	−1.54	0.05	0.55	0.51	−0.30	−0.62	−1.02	−0.90	−0.70	0.55	0.67	0.62	0.59	−0.03	0.18	0.01	−0.62	0.05
t_{Mkt}	5.87	−2.10	−2.41	−1.88	0.76	2.45	0.05	−0.96	−1.04	−0.80	−1.84	−2.66	−2.85	−3.35	0.36	0.93	1.63	0.25
t_{Me}	2.19	−3.37	2.89	5.60	2.75	6.37	0.71	3.56	4.72	3.18	3.34	3.64	4.03	−0.96	2.19	−1.28	4.21	3.18
$t_{\mathrm{I/A}}$	0.39	−2.07	2.05	3.73	5.94	0.95	1.99	3.17	4.35	0.95	0.33	0.38	0.34	1.69	0.40	−1.17	3.59	−0.87
t_{Roe}	−8.64	0.65	4.38	7.32	−1.49	−4.26	−3.50	−4.82	−4.62	5.07	6.80	5.82	5.75	−0.21	2.29	0.10	−6.46	0.54
$\overline{\lvert\alpha_q\rvert}$	0.12	0.10	0.12	0.10	0.07	0.27	0.55	0.49	0.47	0.11	0.09	0.09	0.09	0.14	0.10	0.15	0.17	0.08
p_q	0.04	0.00	4.95	1.18	69.1	0.05	0.00	0.00	0.00	2.57	15.3	2.77	1.04	3.05	1.86	2.06	0.62	22.7

	145	146	147	148	149	150	151	152	153	154	155	156	157	158	159	160	161
	Alm^{q}1	Alm^{q}6	Alm^{q}12	R_{a}^{1}	$R_{\mathrm{a}}^{[2,5]}$	$R_{\mathrm{n}}^{[2,5]}$	$R_{\mathrm{a}}^{[6,10]}$	$R_{\mathrm{n}}^{[6,10]}$	$R_{\mathrm{a}}^{[11,15]}$	$R_{\mathrm{a}}^{[16,20]}$	Sv1	Dtv6	Dtv12	Ami12	Ts1	Isff1	Isq1
α_q	0.28	0.25	0.15	0.55	0.81	−0.16	1.13	0.07	0.65	0.64	−0.35	−0.11	−0.13	0.15	0.31	0.31	0.31
t_q	1.77	1.78	1.08	2.48	3.90	−0.86	4.88	0.35	3.60	3.14	−1.42	−1.21	−1.65	2.03	2.75	2.64	3.01
β_{Mkt}	0.07	0.06	0.07	0.23	0.06	0.19	−0.03	0.16	−0.01	−0.07	0.04	0.14	0.13	−0.03	0.03	−0.01	−0.02
β_{Me}	0.67	0.71	0.72	−0.14	−0.18	−0.27	0.03	−0.31	−0.07	−0.07	0.35	−1.08	−1.14	1.30	0.06	0.17	0.19
$\beta_{\mathrm{I/A}}$	0.83	0.77	0.70	−0.15	−0.28	−1.32	−0.37	−0.81	−0.03	−0.04	−0.14	−0.38	−0.36	0.15	−0.08	0.01	−0.06
β_{Roe}	−0.44	−0.33	−0.24	0.18	0.05	0.38	−0.23	−0.28	0.10	0.00	−0.44	0.33	0.29	−0.36	−0.15	−0.04	−0.13
t_{Mkt}	1.83	2.04	2.23	4.14	1.06	3.03	−0.64	3.06	−0.25	−1.37	0.65	4.54	5.12	−1.14	1.13	−0.27	−0.66
t_{Me}	7.56	10.54	11.47	−1.28	−1.75	−2.08	0.31	−3.40	−0.83	−1.21	2.58	−17.69	−31.71	42.18	1.41	4.25	2.54
$t_{\mathrm{I/A}}$	8.07	9.20	8.45	−0.97	−2.46	−9.56	−2.22	−5.88	−0.23	−0.34	−0.80	−5.64	−7.11	2.95	−0.83	0.13	−0.74
t_{Roe}	−5.96	−5.55	−3.73	1.25	0.47	2.77	−1.97	−2.30	1.09	−0.01	−3.45	6.94	7.17	−8.56	−3.04	−0.77	−2.40
$\overline{\lvert\alpha_q\rvert}$	0.09	0.10	0.07	0.15	0.17	0.13	0.24	0.15	0.18	0.17	0.12	0.08	0.09	0.12	0.10	0.10	0.11
p_q	7.29	4.37	21.9	9.37	0.01	0.03	0.00	0.34	0.05	0.57	4.77	0.01	0.06	0.01	0.95	0.26	0.22

Table 9 : Pairwise Cross-sectional Rank Correlations for q-anomailes, January 1967 to December 2014, 576 Months

The six categories of anomalies, including momentum, value-versus-growth, investment, profitability, intangibles, and trading frictions are denoted by Mom, VvG, Inv, Prof, Intan, and Fric, respectively. Rank correlations are calculated with each anomaly variable's NYSE percentile rankings in the cross section. Panel A reports average within-category correlations, which are averaged across all the pairwise rank correlations within a category, as well as average cross-category rank correlations, which are averaged across all possible pairwise ranking correlations across a given pair of categories. Panel B shows average within-category rank correlations for each q-anomaly. Table 1 describes the symbols, and Appendix A details variable definitions.

Panel A: Average within-category and cross-category rank correlations

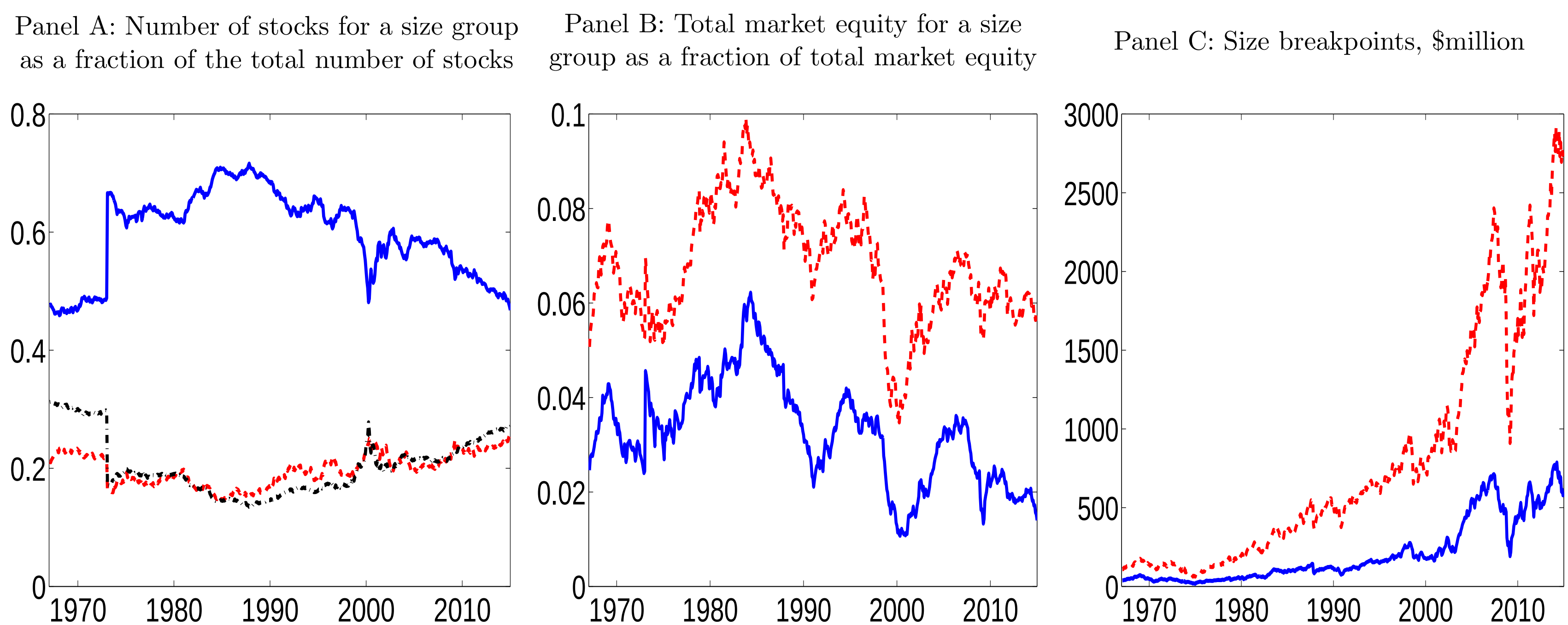
	Mom	VvG	Inv	Prof	Intan	Fric
Mom	0.13	0.00	0.01	0.05	0.00	0.02
VvG		0.42	0.08	0.04	0.01	−0.01
Inv			0.32	0.07	0.02	0.01
Prof				0.39	0.02	−0.07
Intan					0.07	0.02
Fric						0.42

Panel B: Average within-category rank correlations for individual q-anomalies

	Mom		VvG		Inv		Prof		Intan		Fric
Abr1	0.17	$\text{Bm}^{\text{q}}12$	0.37	Noa	0.29	dRoe1	0.02	Rdm	0.20	Ami12	0.06
Abr6	0.21	$\text{Cp}^{\text{q}}1$	0.53	Nsi	0.09	$\text{Ola}^{\text{q}}1$	0.50	$\text{Rdm}^{\text{q}}1$	0.22	Ts1	0.52
Abr12	0.19	$\text{Cp}^{\text{q}}6$	0.54	Ivc	0.37	$\text{Ola}^{\text{q}}12$	0.53	$\text{Rdm}^{\text{q}}6$	0.22	Isff1	0.56
dEf1	0.10	Nop	0.23	Oa	0.41	Cop	0.47	$\text{Rdm}^{\text{q}}12$	0.23	Isq1	0.54
Sm1	0.12	$\text{Em}^{\text{q}}1$	0.43	dWc	0.45	Cla	0.47	Rer	0.01		
Ilr1	0.14	Ocp	0.40	dFin	0.25	$\text{Cla}^{\text{q}}1$	0.40	Eprd	−0.08		
Ile1	0.04			Dac	0.38	$\text{Cla}^{\text{q}}6$	0.50	R_{a}^{1}	−0.02		
Cm1	0.07					$\text{Cla}^{\text{q}}12$	0.54	$R_{\text{a}}^{[2,5]}$	−0.01		
Cim1	0.12					$\text{Tbi}^{\text{q}}12$	0.09	$R_{\text{a}}^{[6,10]}$	0.01		
								$R_{\text{a}}^{[11,15]}$	0.02		
								$R_{\text{a}}^{[16,20]}$	0.02		

Figure 1 : Time Series Properties of Microcaps, 1967–2014

Microcaps are stocks that are smaller than the 20th percentile of market equity for NYSE stocks, small stocks are those bigger than the 20th percentile but smaller than the NYSE median, and big stocks are those bigger than the NYSE median. Panel A shows the time series of the number of microcaps (blue solid line), small stocks (red dashed line), and big stocks (black dashdot line) as a fraction of the total number of stocks at NYSE, Amex, and NASDAQ. Panel B plots the time series of the total market capitalization of microcaps (blue solid line) and small stocks (red dashed line) as a percentage of total market equity. Finally, Panel C plots the breakpoints for the 20th percentile of NYSE market equity (blue solid line) and the NYSE median (red dashed line) in millions of dollars.



A Variable Definitions and Portfolio Construction

When forming testing deciles, we always use NYSE breakpoints and value-weight decile returns.

A.1 Momentum

A.1.1 Sue1, Sue6, and Sue12, Standardized Unexpected Earnings

Per Foster, Olsen, and Shevlin (1984), Sue denotes Standardized Unexpected Earnings, and 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). At the beginning of each month t, we split all NYSE, Amex, and NASDAQ stocks into deciles based on their most recent past Sue. Before 1972, we use the most recent Sue computed with quarterly earnings from fiscal quarters ending at least four months prior to the portfolio formation. Starting from 1972, we use Sue computed 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. We do so to exclude stale information on earnings. To avoid potentially erroneous records, we also require the earnings announcement date to be after the corresponding fiscal quarter end. Monthly portfolio returns are calculated, separately, for the current month t (Sue1), from month t to $t+5$ (Sue6), and from month t to $t+11$ (Sue12). The holding period that is longer than one month as in, for instance, Sue6, means that for a given decile in each month there exist six sub-deciles, each of which is initiated in a different month in the prior six-month period. We take the simple average of the sub-decile returns as the monthly return of the Sue6 decile.

A.1.2 Abr1, Abr6, and Abr12, Cumulative Abnormal Returns Around Earnings Announcement Dates

We calculate cumulative abnormal stock return (Abr) around the latest quarterly earnings announcement date (Compustat quarterly item RDQ) (Chan, Jegadeesh, and Lakonishok 1996)):

$$\text{Abr}_i = \sum_{d=-2}^{+1} r_{id} - r_{md}, \tag{A1}$$

in which r_{id} is stock i's return on day d (with the earnings announced on day 0) and r_{md} is the market index return. We cumulate returns until one (trading) day after the announcement date to account for the one-day-delayed reaction to earnings news. r_{md} is the value-weighted market return for the Abr deciles with NYSE breakpoints and value-weighted returns.

At the beginning of each month t, we split all stocks into deciles based on their most recent past Abr. For a firm to enter our portfolio formation, we require the end of the fiscal quarter that corresponds to its most recent Abr to be within six months prior to the portfolio formation. We do so to exclude stale information on earnings. To avoid potentially erroneous records, we also require the earnings announcement date to be after the corresponding fiscal quarter end. Monthly decile returns are calculated for the current month t (Abr1), and, separately, from month t to $t+5$ (Abr6) and from month t to $t+11$ (Abr12). The deciles are rebalanced monthly. The six-month holding period for Abr6 means that for a given decile in each month there exist six sub-deciles, each of which is initiated in a different month in the prior six-month period. We take the simple average of the sub-decile returns as the monthly return of the Abr6 decile. Because quarterly earnings announcement dates are largely unavailable before 1972, the Abr portfolios start in January 1972.

A.1.3 Re1, Re6, and Re12, Revisions in Analyst Earnings Forecasts

Following Chan, Jegadeesh, and Lakonishok (1996), we measure earnings surprise as the revisions in analysts' forecasts of earnings obtained from the Institutional Brokers' Estimate System (IBES). Because analysts' forecasts are not necessarily revised each month, we construct a six-month moving average of past changes in analysts' forecasts:

$$\mathrm{RE}_{it} = \sum_{\tau=1}^{6} \frac{f_{it-\tau} - f_{it-\tau-1}}{p_{it-\tau-1}}, \tag{A2}$$

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. At the beginning of each month t, we split all stocks into deciles based on their Re. Monthly decile returns are calculated for the current month t (Re1), and, separately, from month t to $t+5$ (Re6) and from month t to $t+11$ (Re12). The deciles are rebalanced monthly. The six-month holding period for Re6 means that for a given decile in each month there exist six sub-deciles, each of which is initiated in a different month in the prior six-month period. We take the simple average of the sub-decile returns as the monthly return of the Re6 decile. Because analyst forecast data start in January 1976, the Re portfolios start in July 1976.

A.1.4 $R^6 1$, $R^6 6$, and $R^6 12$, Prior Six-month Returns

At the beginning of each month t, we split all stocks into deciles based on their prior six-month returns from month $t-7$ to $t-2$. Skipping month $t-1$, we calculate monthly decile returns, separately, for month t ($R^6 1$), from month t to $t+5$ ($R^6 6$), and from month t to $t+11$ ($R^6 12$). The deciles are rebalanced at the beginning of month $t+1$. The holding period that is longer than one month as in, for instance, $R^6 6$, means that for a given decile in each month there exist six sub-deciles, each of which is initiated in a different month in the prior six-month period. We take the simple average of the sub-deciles returns as the monthly return of the $R^6 6$ decile. We do not impose a price screen to exclude stocks with prices per share below \$5 as in Jegadeesh and Titman (1993). These stocks are mostly microcaps. Value-weighting returns assigns only tiny weights to these stocks, which in turn do not need to be excluded.

A.1.5 $R^{11} 1$, $R^{11} 6$, and $R^{11} 12$, Prior 11-month Returns

We split all stocks into deciles at the beginning of each month t based on their prior 11-month returns from month $t-12$ to $t-2$. Skipping month $t-1$, we calculate monthly decile returns for month t ($R^{11} 1$), from month t to $t+5$ ($R^{11} 6$), and from month t to $t+11$ ($R^{11} 12$). All the deciles are rebalanced at the beginning of month $t+1$. The holding period that is longer than one month as in, for instance, $R^{11} 6$, means that for a given decile in each month there exist six subdeciles, each of which is initiated in a different month in the prior six-month period. We take the simple average of the subdecile returns as the monthly return of the $R^{11}6$ decile. Because we exclude financial firms, these decile returns are different from those posted on Kenneth French's Web site.

A.1.6 Im1, Im6, and Im12, Industry Momentum

We start with the FF 49-industry classifications. Excluding financial firms from the sample leaves 45 industries. At the beginning of each month t, we sort industries based on their prior six-month value-weighted returns from $t-6$ to $t-1$. Following Moskowitz and Grinblatt (1999), we do not skip month $t-1$. We form nine portfolios ($9 \times 5 = 45$), each of which contains five different industries. We define the return of a given portfolio as the simple average of the five industry returns within the portfolio. We calculate portfolio returns for the nine portfolios for the current month t (Im1), from month t to $t+5$ (Im6), and from month t to $t+11$ (Im12). The portfolios are rebalanced at the beginning of $t+1$. The holding period that is longer than one month as in, for instance, Im6, means that for a given portfolio in each month there exist six subportfolios, each of which is initiated in a different month in the prior six-month period. We take the simple average of the subportfolio returns as the monthly return of the Im6 portfolio.

A.1.7 Rs1, Rs6, and Rs12, Revenue Surprises

Following Jegadeesh and Livnat (2006), we measure revenue surprises (Rs) as changes in revenue per share (Compustat quarterly item SALEQ/(item CSHPRQ times item AJEXQ)) from its value four quarters ago divided by the standard deviation of this change in quarterly revenue per share over the prior eight quarters (six quarters minimum). At the beginning of each month t, we split stocks into deciles based on their most recent past Rs. Before 1972, we use the most recent Rs computed with quarterly revenue from fiscal quarters ending at least four months prior to the portfolio formation. Starting from 1972, we use Rs computed with quarterly revenue from the most recent quarterly earnings announcement dates (Compustat quarterly item RDQ). Jegadeesh and Livnat find that quarterly revenue data are generally available when earnings are announced. For a firm to enter the portfolio formation, we require the end of the fiscal quarter that corresponds to its most recent Rs to be within six months prior to the portfolio formation. This restriction is imposed to exclude stale revenue information. To avoid potentially erroneous records, we also require the earnings announcement date to be after the corresponding fiscal quarter end. Monthly deciles returns are calculated for the current month t (Rs1), from month t to $t+5$ (Rs6), and from month t to $t+11$ (Rs12). The deciles are rebalanced at the beginning of month $t+1$. The holding period that is longer than one month as in, for instance, Rs6, means that for a given decile in each month there exist six subdeciles, each of which is initiated in a different month in the prior six-month period. We take the simple average of the subdeciles returns as the monthly return of the Rs6 decile.

A.1.8 Tes1, Tes6, and Tes12, Tax Expense Surprises

Following Thomas and Zhang (2011), we measure tax expense surprises (Tes) as changes in tax expense, which is tax expense per share (Compustat quarterly item TXTQ/(item CSHPRQ times item AJEXQ)) in quarter q minus tax expense per share in quarter $q-4$, scaled by assets per share (item ATQ/(item CSHPRQ times item AJEXQ)) in quarter $q-4$. At the beginning of each month t, we sort stocks into deciles based on their Tes calculated with Compustat quarterly data items from at least four months ago. We exclude firms with zero Tes (most of these firms pay no taxes). We calculate decile returns the current month t (Tes1), from month t to $t+5$ (Tes6), and from month t to $t+11$ (Tes12). The deciles are rebalanced at the beginning of month $t+1$. The holding period that is longer than one month as in, for instance, Tes6, means that for a given decile in each month there exist six subdeciles, each of which is initiated in a different month in the prior six-month period. We take the simple average of the subdeciles returns as the monthly return of the Tes6 decile. For sufficient data coverage, we start the sample in January 1976.

A.1.9 dEf1, dEf6, and dEf12, Changes in Analyst Earnings Forecasts

Following Hawkins, Chamberlin, and Daniel (1984), we define dEf $\equiv (f_{it-1} - f_{it-2})/(0.5\,|f_{it-1}| + 0.5\,|f_{it-2}|)$, in which f_{it-1} is the consensus mean forecast (IBES unadjusted file, item MEANEST) issued in month $t-1$ for firm i's current fiscal year earnings (fiscal period indicator = 1). We require earnings forecasts to be denominated in US dollars (currency code = USD). We also adjust for any stock splits between months $t-2$ and $t-1$ when constructing dEf. At the beginning of each month t, we sort stocks into deciles on the prior month dEf, and calculate returns for the current month t (dEf1), from month t to $t+5$ (dEf6), and from month t to $t+11$ (dEf12). The deciles are rebalanced at the beginning of month $t+1$. The holding period longer than one month as in, for instance, dEf6, means that for a given decile in each month there exist six subdeciles, each of which is initiated in a different month in the prior six months. We take the simple average of the subdecile returns as the monthly return of the dEf6 decile. Because analyst forecast data start in January 1976, the dEf portfolios start in March 1976.

A.1.10 Nei1, Nei6, and Nei12, The Number of Quarters with Consecutive Earnings Increase

We follow Barth, Elliott, and Finn (1999) and Green, Hand, and Zhang (2013) in measuring Nei as the number of consecutive quarters (up to eight quarters) with an increase in earnings (Compustat quarterly item IBQ) over the same quarter in the prior year. At the beginning of each month t, we sort stocks into nine portfolios (with Nei $= 0, 1, 2, \ldots, 7$, and 8, respectively) based on their most recent past Nei. Before 1972, we use Nei computed with quarterly earnings from fiscal quarters ending at least four months prior to the portfolio formation. Starting from 1972, we use Nei computed with earnings from the most recent quarterly earnings announcement dates (Compustat quarterly item RDQ). For a firm to enter the portfolio formation, we require the end of the fiscal quarter that corresponds to its most recent Nei 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. We calculate monthly portfolio returns for the current month t (Nei1), from month t to $t+5$ (Nei6), and from month t to $t+11$ (Nei12). The deciles are rebalanced at the beginning of month $t+1$. The holding period that is longer than one month as in, for instance, Nei6, means that for a given decile in each month there exist six subdeciles, each of which is initiated in a different month in the prior six-month period. We take the simple average of the subdeciles returns as the monthly return of the Nei6 decile. For sufficient data coverage, the Nei portfolios start in January 1969.

A.1.11 52w1, 52w6, and 52w12, 52-week High

At the beginning of each month t, we split stocks into deciles based on 52w, which is the ratio of its split-adjusted price per share at the end of month $t-1$ to its highest (daily) split-adjusted price per share during the 12-month period ending on the last day of month $t-1$. Monthly decile returns are calculated for the current month t (52w1), from month t to $t+5$ (52w6), and from month t to $t+11$ (52w12), and the deciles are rebalanced at the beginning of month $t+1$. The holding period longer than one month as in 52w6 means that for a given decile in each month there exist six subdeciles, each of which is initiated in a different month in the prior six months. We take the simple average of the subdecile returns as the monthly return of the 52w6 decile. Because a disproportionately large number of stocks can reach the 52-week high at the same time and have 52w equal to one, we use only 52w smaller than one to form the portfolio breakpoints. Doing so helps avoid missing portfolio observations.

A.1.12 $\epsilon^6$1, $\epsilon^6$6, and $\epsilon^6$12, Six-month Residual Momentum

We split all stocks into deciles at the beginning of each month t based on their prior six-month average residual returns from month $t-7$ to $t-2$ scaled by their standard deviation over the same period. Skipping month $t-1$, we calculate monthly decile returns for month t ($\epsilon^6 1$), from month t to $t+5$ ($\epsilon^6 6$), and from month t to $t+11$ ($\epsilon^6 12$). Residual returns are estimated each month for all stocks over the prior 36 months from month $t-36$ to month $t-1$ from regressing stock excess returns on the Fama-French three factors. To reduce the noisiness of the estimation, we require returns to be available for all prior 36 months. All the deciles are rebalanced at the beginning of month $t+1$. The holding period that is longer than 1 month as in $\epsilon^6 6$ means that for a given decile in each month there exist six subdeciles, each of which is initiated in a different month in the prior six-month period. We take the simple average of the subdecile returns as the monthly return of the $\epsilon^6 6$ decile.

A.1.13 ϵ^{11}1, ϵ^{11}6, and ϵ^{11}12, 11-month Residual Momentum

We split all stocks into deciles at the beginning of each month t based on their prior 11-month residual returns from month $t-12$ to $t-2$ scaled by their standard deviation over the same period. Skipping month $t-1$, we calculate monthly decile returns for month t ($\epsilon^{11} 1$), from month t to $t+5$ ($\epsilon^{11} 6$), and from month t to $t+11$ ($\epsilon^{11} 12$). Residual returns are estimated each month for all stocks over the prior 36 months from month $t-36$ to month $t-1$ from regressing stock excess returns on the Fama-French three factors. To reduce the noisiness of the estimation, we require returns to be available for all prior 36 months. All the deciles are rebalanced at the beginning of month $t+1$. The holding period that is longer than 1 month as in $\epsilon^{11} 6$ means that for a given decile in each month there exist six subdeciles, each of which is initiated in a different month in the prior six-month period. We take the simple average of the subdecile returns as the monthly return of the $\epsilon^{11} 6$ decile.

A.1.14 Sm1, Sm6, and Sm12, Segment Momentum

Following Cohen and Lou (2012), we extract firms' segment accounting and financial information from Compustat segment files. Industries are based on two-digit SIC codes. Standalone firms are those that operate in only one industry with segment sales, reported in Compustat segment files, accounting for more than 80% of total sales reported in Compustat annual files. Conglomerate firms are those that operating in more than one industry with aggregate sales from all reported segments accounting for more than 80% of total sales.

At the end of June of each year, we form a pseudo-conglomerate for each conglomerate firm. The pseudo-conglomerate is a portfolio of the conglomerate's industry segments constructed with solely the standalone firms in each industry. The segment portfolios (value-weighted across standalone firms) are then weighted by the percentage of sales contributed by each industry segment within the conglomerate. At the beginning of each month t (starting in July), using segment information form the previous fiscal year, we sort all conglomerate firms into deciles based on the returns of their pseudo-conglomerate portfolios in month $t-1$. Monthly deciles are calculated for month t (Sm1), from month t to $t+5$ (Sm6), and from month t to $t+11$ (Sm12), and the deciles are rebalanced at the beginning of month $t+1$. The holding period that is longer than one month as in Sm6 means that for a given decile in each month there exist six subdeciles, each of which is initiated in a different month in the prior six-month period. We take the simple average of the subdecile returns as the monthly return of the Sm6 decile. Because the segment data start in 1976, the Sm portfolios start in July 1977.

A.1.15 Ilr1, Ilr6, Ilr12, Ile1, Ile6, Ile12, Industry Lead-lag Effect in Prior Returns (Earnings Surprises)

We start with the Fama-French (1997) 49-industry classifications. Excluding financial firms from the sample leaves 45 industries. At the beginning of each month t, we sort industries based on the month $t-1$ value-weighted return of the portfolio consisting of the 30% biggest (market equity) firms within a given industry. We form nine portfolios ($9 \times 5 = 45$), each of which contains five different industries. We define the return of a given portfolio as the simple average of the five value-weighted industry returns within the portfolio. The nine portfolio returns are calculated for the current month t (Ilr1), from month t to $t+5$ (Ilr6), and from month t to $t+11$ (Ilr12), and the portfolios are rebalanced at the beginning of month $t+1$. The holding period that is longer than one month as in, for instance, Ilr6, means that for a given portfolio in each month there exist six subportfolios, each of which is initiated in a different month in the prior six-month period. We take the simple average of the subportfolio returns as the monthly return of the Ilr6 portfolio.

We calculate Standardized Unexpected Earnings, Sue, 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). At the beginning of each month t, we sort industries based on their most recent Sue averaged across the 30% biggest firms within a given industry.[10] To mitigate the impact of outliers, we winsorize Sue at the 1st and 99th percentiles of its distribution each month. We form nine portfolios ($9 \times 5 = 45$), each of which contains five different industries. We define the return of a given portfolio as the simple average of the five value-weighted industry returns within the portfolio. The nine portfolio returns are calculated for the current month t (Ile1), from month t to $t+5$ (Ile6), and from month t to $t+11$ (Ile12), and the portfolios are rebalanced at the beginning of month $t+1$. The holding period that is longer than one month as in, for instance, Ile6, means that for a given portfolio in each month there exist six subportfolios, each of which is initiated in a different month in the prior six-month period. We take the simple average of the subportfolio returns as the monthly return of the Ile6 portfolio.

A.1.16 Cm1, Cm6, and Cm12, Customer Momentum

Following Cohen and Frazzini (2008), we extract firms' principal customers from Compustat segment files. For each firm we determine whether the customer is another company listed on the CRSP/Compustat tape, and we assign it the corresponding CRSP permno number. At the end of June of each year t, we form a customer portfolio for each firm with identifiable firm-customer

[10] Before 1972, we use the most recent Sue with earnings from fiscal quarters ending at least four months prior to the portfolio month. Starting from 1972, we use Sue with 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 month. We also require the earnings announcement date to be after the corresponding fiscal quarter end.

relations for the fiscal year ending in calendar year $t-1$. For firms with multiple customer firms, we form equal-weighted customer portfolios. The customer portfolio returns are calculated from July of year t to June of $t+1$, and the portfolios are rebalanced in June.

At the beginning of each month t, we sort all stocks into quintiles based on their customer portfolio returns, Cm, in month $t-1$. We do not form deciles because a disproportionate number of firms can have the same Cm, which leads to fewer than ten portfolios in some months. Monthly quintile returns are calculated for month t (Cm1), from month t to $t+5$ (Cm6), and from month t to $t+11$ (Cm12), and the quintiles are rebalanced at the beginning of month $t+1$. The holding period that is longer than one month as in Cm6 means that for a given quintile in each month there exist six subquintiles, each of which is initiated in a different month in the prior six-month period. We take the simple average of the subquintile returns as the monthly return of the Cm6 quintile. For sufficient data coverage, we start the Cm portfolios in July 1979.

A.1.17 Sim1, Sim6, Sim12, Cim1, Cim6, and Cim12, Supplier (Customer) industries Momentum

Following Menzly and Ozbas (2010), we use Benchmark Input-Output Accounts at the Bureau of Economic Analysis (BEA) to identify supplier and customer industries for a given industry. BEA Surveys are conducted roughly once every five years in 1958, 1963, 1967, 1972, 1977, 1982, 1987, 1992, 1997, 2002, and 2007. We delay the use of any data from a given survey until the end of the year in which the survey is publicly released during 1964, 1969, 1974, 1979, 1984, 1991, 1994, 1997, 2002, 2007, and 2013, respectively. The BEA industry classifications are based on SIC codes in the surveys from 1958 to 1992 and based on NAICS codes afterwards. In the surveys from 1997 to 2007, we merge three separate industry accounts, 2301, 2302, and 2303 into a single account. We also merge "Housing" (HS) and "Other Real Estate" (ORE) in the 2007 Survey. In the surveys from 1958 to 1992, we merge industry account pairs 1–2, 5–6, 9–10, 11–12, 20–21, and 33–34. We also merge industry account pairs 22–23 and 44–45 in the 1987 and 1992 surveys. We drop miscellaneous industry accounts related to government, import, and inventory adjustments.

At the end of June of each year t, we assign each stock to an BEA industry based on its reported SIC or NAICS code in Compustat (fiscal year ending in t-1) or CRSP (June of t). Monthly value-weighted industry returns are calculated from July of year t to June of $t+1$, and the industry portfolios are rebalanced in June of $t+1$. For each industry, we further form two separate portfolios, the suppliers portfolio and the customers portfolios. The share of an industry's total purchases from other industries is used to calculate the supplier industries portfolio returns, and the share of the industry's total sales to other industries is used to calculate the customer industries portfolio returns.

At the beginning of each month t, we split industries into deciles based on the supplier portfolio returns, Sim, and separately, on the customer portfolio returns, Cim, in month $t-1$. We then assign the decile rankings of each industry to its member stocks. Monthly decile returns are calculated for month t (Sim1 and Cim1), from month t to $t+5$ (Sim6 and Cim6), and from month t to $t+11$ (Sim12 and Cim12), and the deciles are rebalanced at the beginning of month $t+1$. The holding period that is longer than one month as in Sim6 means that for a given decile in each month there exist six subdeciles, each initiated in a different month in the prior six months. We take the simple average of the subdecile returns as the monthly return of the Sim6 decile.

A.2 Value-versus-growth

A.2.1 Bm, Book-to-market Equity

At the end of June of each year t, we split stocks into deciles based on Bm, which is the book equity for the fiscal year ending in calendar year $t-1$ divided by the market equity (from CRSP) at the end of December of $t-1$. For firms with more than one share class, we merge the market equity for all share classes before computing Bm. Monthly decile returns are calculated from July of year t to June of $t+1$, and the deciles are rebalanced in June of $t+1$. Following Davis, Fama, and French (2000), we measure book equity 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 it is available. If not, we measure stockholders' equity as 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 (item PSTKRV), liquidating (item PSTKL), or par value (item PSTK) for the book value of preferred stock.

A.2.2 Bmj, Book-to-June-end Market Equity

Following Asness and Frazzini (2013), at the end of June of each year t, we sort stocks into deciles based on Bmj, which is book equity per share for the fiscal year ending in calendar year $t-1$ divided by share price (from CRSP) at the end of June of t. We adjust for any stock splits between the fiscal year end and the end of June. Book equity per share is book equity divided by the number of shares outstanding (Compustat annual item CSHO). Following Davis, Fama, and French (2000), we measure book equity as stockholders' book equity, plus balance sheet deferred taxes and investment tax credit (item TXDITC) if available, minus the book value of preferred stock. Stockholders' equity is the value reported by Compustat (item SEQ), if it is available. If not, we measure stockholders' equity as 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 (item PSTKRV), liquidating (item PSTKL), or par value (item PSTK) for the book value of preferred stock. Monthly decile returns are calculated from July of year t to June of $t+1$, and the deciles are rebalanced in June of $t+1$.

A.2.3 Bm^q1, Bm^q6, and Bm^q12, Quarterly Book-to-market Equity

At the beginning of each month t, we split stocks into deciles based on Bm^q, which is the book equity for the latest fiscal quarter ending at least four months ago divided by the market equity (from CRSP) at the end of month $t-1$. For firms with more than one share class, we merge the market equity for all share classes before computing Bm^q. We calculate decile returns for the current month t (Bm^q1), from month t to $t+5$ (Bm^q6), and from month t to $t+11$ (Bm^q12), and the deciles are rebalanced at the beginning of month $t+1$. The holding period longer than one month as in, for instance, Bm^q6, means that for a given decile in each month there exist six subdeciles, each of which is initiated in a different month in the prior six months. We take the simple average of the subdecile returns as the monthly return of the Bm^q6 decile. 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 book value of preferred stock, or total assets (item ATQ) minus total liabilities (item LTQ) in that order as shareholders' equity.

Before 1972, the sample coverage is limited for quarterly book equity in Compustat quarterly files. We expand the coverage by using book equity from Compustat annual files as well as by imputing quarterly book equity with clean surplus accounting. Specifically, whenever available we first use quarterly book equity from Compustat quarterly files. We then supplement the coverage for fiscal quarter four with annual book equity from Compustat annual files. Following Davis, Fama, and French (2000), we measure annual book equity 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. If not, stockholders' equity is 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 (item PSTKRV), liquidating (item PSTKL), or par value (item PSTK) for the book value of preferred stock.

If both approaches are unavailable, we apply the clean surplus relation to impute the book equity. Specifically, we impute the book equity for quarter t forward based on book equity from prior quarters. Let 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 quarterly dividends from quarter $t-j+1$ to t, respectively. BEQ_t can then 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 (i.e., $1 \leq j \leq 4$) to reduce imputation errors. 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). Because we use quarterly book equity at least four months after the fiscal quarter end, all the Compustat data used in the imputation are at least four-month lagged prior to the portfolio formation. In addition, we do not impute quarterly book equity backward using future earnings and book equity information to avoid look-ahead bias.

A.2.4 Dm, Debt-to-market

At the end of June of each year t, we split stocks into deciles based on debt-to-market, Dm, which is total debt (Compustat annual item DLC plus DLTT) for the fiscal year ending in calendar year $t-1$ divided by the market equity (from CRSP) at the end of December of $t-1$. For firms with more than one share class, we merge the market equity for all share classes before computing Dm. Firms with no debt are excluded. Monthly decile returns are calculated from July of year t to June of $t+1$, and the deciles are rebalanced in June of $t+1$.

A.2.5 Dm^q1, Dm^q6, and Dm^q12, Quarterly Debt-to-market

At the beginning of each month t, we split stocks into deciles based on quarterly debt-to-market, Dm^q, which is total debt (Compustat quarterly item DLCQ plus item DLTTQ) for the latest fiscal quarter ending at least four months ago divided by the market equity (from CRSP) at the end of month $t-1$. For firms with more than one share class, we merge the market equity for all share classes before computing Dm^q. Firms with no debt are excluded. We calculate decile returns for the current month t (Dm^q1), from month t to $t+5$ (Dm^q6), and from month t to $t+11$ (Dm^q12), and the deciles are rebalanced at the beginning of month $t+1$. The holding period longer than one month as in, for instance, $\mathrm{Dm}^{\mathrm{q}}6$, means that for a given decile in each month there exist six subdeciles, each of which is initiated in a different month in the prior six months. We take the simple average of the subdecile returns as the monthly return of the $\mathrm{Dm}^{\mathrm{q}}6$ decile. For sufficient data coverage, the Dm^{q} portfolios start in January 1972.

A.2.6 Am, Assets-to-market

At the end of June of each year t, we split stocks into deciles based on asset-to-market, Am, which is total assets (Compustat annual item AT) for the fiscal year ending in calendar year $t-1$ divided by the market equity (from CRSP) at the end of December of $t-1$. For firms with more than one share class, we merge the market equity for all share classes before computing Am. Monthly decile returns are calculated from July of year t to June of $t+1$, and the deciles are rebalanced in June of $t+1$.

A.2.7 $\mathrm{Am}^{\mathrm{q}}1$, $\mathrm{Am}^{\mathrm{q}}6$, and $\mathrm{Am}^{\mathrm{q}}12$, Quarterly assets-to-market

At the beginning of each month t, we split stocks into deciles based on quarterly asset-to-market, Am^{q}, which is total assets (Compustat quarterly item ATQ) for the latest fiscal quarter ending at least four months ago divided by the market equity (from CRSP) at the end of month $t-1$. For firms with more than one share class, we merge the market equity for all share classes before computing Am^{q}. We calculate decile returns for the current month t ($\mathrm{Am}^{\mathrm{q}}1$), from month t to $t+5$ ($\mathrm{Am}^{\mathrm{q}}6$), and from month t to $t+11$ ($\mathrm{Am}^{\mathrm{q}}12$), and the deciles are rebalanced at the beginning of month $t+1$. The holding period longer than one month as in, for instance, $\mathrm{Am}^{\mathrm{q}}6$, means that for a given decile in each month there exist six subdeciles, each of which is initiated in a different month in the prior six months. We take the simple average of the subdecile returns as the monthly return of the $\mathrm{Am}^{\mathrm{q}}6$ decile. For sufficient data coverage, the Am^{q} portfolios start in January 1972.

A.2.8 Rev1, Rev6, and Rev12, Reversal

To capture the De Bondt and Thaler (1985) long-term reversal (Rev) effect, at the beginning of each month t, we split stocks into deciles based on the prior returns from month $t-60$ to $t-13$. Monthly decile returns are computed for the current month t (Rev1), from month t to $t+5$ (Rev6), and from month t to $t+11$ (Rev12), and the deciles are rebalanced at the beginning of $t+1$. The holding period longer than one month as in, for instance, Rev6, means that for a given decile in each month there exist six subdeciles, each of which is initiated in a different month in the prior six months. We take the simple average of the subdeciles returns as the monthly return of the Rev6 decile. To be included in a portfolio for month t, a stock must have a valid price at the end of $t-61$ and a valid return for $t-13$. In addition, any missing returns from month $t-60$ to $t-14$ must be -99.0, which is the CRSP code for a missing ending price.

A.2.9 Ep, Earnings-to-price

At the end of June of each year t, we split stocks into deciles based on earnings-to-price, Ep, which is income before extraordinary items (Compustat annual item IB) for the fiscal year ending in calendar year $t-1$ divided by the market equity (from CRSP) at the end of December of $t-1$. For firms with more than one share class, we merge the market equity for all share classes before computing Ep. Firms with non-positive earnings are excluded. Monthly decile returns are calculated from July of year t to June of $t+1$, and the deciles are rebalanced in June of $t+1$.

A.2.10 $\text{Ep}^{\text{q}}1$, $\text{Ep}^{\text{q}}6$, and $\text{Ep}^{\text{q}}12$, Quarterly Earnings-to-price

At the beginning of each month t, we split stocks into deciles based on quarterly earnings-to-price, Ep^{q}, which is income before extraordinary items (Compustat quarterly item IBQ) divided by the market equity (from CRSP) at the end of month $t-1$. Before 1972, we use quarterly earnings from fiscal quarters ending at least four months prior to the portfolio formation. Starting from 1972, we use quarterly earnings from the most recent quarterly earnings announcement dates (item RDQ). For a firm to enter the portfolio formation, we require the end of the fiscal quarter that corresponds to its most recent quarterly earnings 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. Firms with non-positive earnings are excluded. For firms with more than one share class, we merge the market equity for all share classes before computing Ep^{q}. We calculate decile returns for the current month t ($\text{Ep}^{\text{q}}1$), from month t to $t+5$ ($\text{Ep}^{\text{q}}6$), and from month t to $t+11$ ($\text{Ep}^{\text{q}}12$), and the deciles are rebalanced at the beginning of month $t+1$. The holding period longer than one month as in, for instance, $\text{Ep}^{\text{q}}6$, means that for a given decile in each month there exist six subdeciles, each of which is initiated in a different month in the prior six months. We take the simple average of the subdecile returns as the monthly return of the $\text{Ep}^{\text{q}}6$ decile.

A.2.11 Efp1, Efp6, and Efp12, Earnings Forecast-to-price

Following Elgers, Lo, and Pfeiffer (2001), we define analysts' earnings forecast-to-price, Efp, as the consensus median forecasts (IBES unadjusted file, item MEDEST) for the current fiscal year (fiscal period indicator = 1) divided by share price (unadjusted file, item PRICE). We require earnings forecasts to be denominated in US dollars (currency code = USD). At the beginning of each month t, we sort stocks into deciles based on Efp estimated with forecasts in month $t-1$. Firms with non-positive forecasts are excluded. Monthly decile returns are calculated for the current month t (Efp1), from month t to $t+5$ (Efp6), and from month t to $t+11$ (Efp12), and the deciles are rebalanced at the beginning of $t+1$. The holding period longer than one month as in, for instance, Efp6, means that for a given decile in each month there exist six subdeciles, each of which is initiated in a different month in the prior six months. We take the simple average of the subdeciles returns as the monthly return of the Efp6 decile. Because the earnings forecast data start in January 1976, the Efp deciles start in February 1976.

A.2.12 Cp, Cash Flow-to-price

At the end of June of each year t, we split stocks into deciles based on cash flow-to-price, Cf, which is cash flows for the fiscal year ending in calendar year $t-1$ divided by the market equity (from CRSP) at the end of December of $t-1$. Cash flows are income before extraordinary items (Compustat annual item IB) plus depreciation (item DP)). For firms with more than one share class, we merge the market equity for all share classes before computing Cp. Firms with non-positive cash flows are excluded. Monthly decile returns are calculated from July of year t to June of $t+1$, and the deciles are rebalanced in June of $t+1$.

A.2.13 $\text{Cp}^{\text{q}}1$, $\text{Cp}^{\text{q}}6$, and $\text{Cp}^{\text{q}}12$, Quarterly Cash Flow-to-price

At the beginning of each month t, we split stocks into deciles based on quarterly cash flow-to-price, Cp^{q}, which is cash flows for the latest fiscal quarter ending at least four months ago divided by the market equity (from CRSP) at the end of month $t-1$. Quarterly cash flows are income before extraordinary items (Compustat quarterly item IBQ) plus depreciation (item DPQ). For firms with more than one share class, we merge the market equity for all share classes before computing Cp^{q}. Firms with non-positive cash flows are excluded. We calculate decile returns for the current month t ($\text{Ep}^{\text{q}}1$), from month t to $t+5$ ($\text{Ep}^{\text{q}}6$), and from month t to $t+11$ ($\text{Ep}^{\text{q}}12$), and the deciles are rebalanced at the beginning of month $t+1$. The holding period longer than one month as in, for instance, $\text{Ep}^{\text{q}}6$, means that for a given decile in each month there exist six subdeciles, each of which is initiated in a different month in the prior six months. We take the simple average of the subdecile returns as the monthly return of the $\text{Ep}^{\text{q}}6$ decile.

A.2.14 Dp, Dividend Yield

At the end of June of each year t, we sort stocks into deciles based on dividend yield, Dp, which is the total dividends paid out from July of year $t-1$ to June of t divided by the market equity (from CRSP) at the end of June of t. We calculate monthly dividends as the begin-of-month market equity times the difference between returns with and without dividends. Monthly dividends are then accumulated from July of $t-1$ to June of t. We exclude firms that do not pay dividends. Monthly decile returns are calculated from July of year t to June of $t+1$, and the deciles are rebalanced in June of $t+1$.

A.2.15 $\text{Dp}^{\text{q}}1$, $\text{Dp}^{\text{q}}6$, and $\text{Dp}^{\text{q}}12$, Quarterly Dividend Yield

At the beginning of each month t, we split stocks into deciles on quarterly dividend yield, Dp^{q}, which is the total dividends paid out from months $t-3$ to $t-1$ divided by the market equity (from CRSP) at the end of month $t-1$. We calculate monthly dividends as the begin-of-month market equity times the difference between returns with and without dividends. Monthly dividends are then accumulated from month $t-3$ to $t-1$. We exclude firms that do not pay dividends. We calculate monthly decile returns for the current month t ($\text{Dp}^{\text{q}}1$), from month t to $t+5$ ($\text{Dp}^{\text{q}}6$), and from month t to $t+11$ ($\text{Dp}^{\text{q}}12$), and the deciles are rebalanced at the beginning of month $t+1$. The holding period longer than one month as in, for instance, $\text{Dp}^{\text{q}}6$, means that for a given decile in each month there exist six subdeciles, each of which is initiated in a different month in the prior six months. We take the simple average of the subdecile returns as the monthly return of the $\text{Dp}^{\text{q}}6$ decile.

A.2.16 Op and Nop, (Net) Payout Yield

Per Boudoukh, Michaely, Richardson, and Roberts (2007), total payouts are dividends on common stock (Compustat annual item DVC) plus repurchases. Repurchases are the total expenditure on the purchase of common and preferred stocks (item PRSTKC) plus any reduction (negative change over the prior year) in the value of the net number of preferred stocks outstanding (item PSTKRV). Net payouts equal total payouts minus equity issuances, which are the sale of common and preferred stock (item SSTK) minus any increase (positive change over the prior year) in the value of the net number of preferred stocks outstanding (item PSTKRV). At the end of June of each year t, we sort stocks into deciles based on total payouts (net payouts) for the fiscal year ending in calendar year $t-1$ divided by the market equity (from CRSP) at the end of December of $t-1$ (Op and Nop, respectively). For firms with more than one share class, we merge the market equity for all share classes before computing Op and Nop. Firms with non-positive total payouts (zero net payouts) are excluded. Monthly decile returns are calculated from July of year t to June of $t+1$, and the deciles are rebalanced in June of $t+1$. Because the data on total expenditure and the sale of common and preferred stocks start in 1971, the Op and Nop portfolios start in July 1972.

A.2.17 Op^{q}1, Op^{q}6, Op^{q}12, Nop^{q}1, Nop^{q}6, and Nop^{q}12, Quarterly (Net) Payout Yield

Quarterly total payouts are dividends plus repurchases from the latest fiscal quarter. Quarterly dividends are zero if dividends per share (Compustat quarterly item DVPSXQ) are zero. Otherwise, quarterly dividends are dividends per share times beginning-of-quarter shares outstanding (item CSHOQ) adjusted for stock splits during the quarter (item AJEXQ for the adjustment factor). Quarterly repurchases are the quarterly change in year-to-date expenditure on the purchase of common and preferred stocks (item PRSTKCY) plus any reduction (negative change in the prior quarter) in the book value of preferred stocks (item PSTKQ). Quarterly net payouts equal total payouts minus equity issuances, which are the quarterly change in year-to-date sale of common and preferred stock (item SSTKY) minus any increase (positive change over the prior quarter) in the book value of preferred stocks (item PSTKQ). At the beginning of month t, we split stocks into deciles based on quarterly payouts (net payouts) for the latest fiscal quarter ending at least four months ago, divided by the market equity at the end of month $t-1$ (Op^q and Nop^q, respectively). For firms with more than one share class, we merge the market equity for all share classes before computing Op^q and Nop^q. Firms with non-positive total payouts (zero net payouts) are excluded. We calculate monthly decile returns for the current month t (Op^{q}1 and Nop^{q}1), from month t to $t+5$ (Op^{q}6 and Nop^{q}6), and from month t to $t+11$ (Op^{q}12 and Nop^{q}12), and the deciles are rebalanced at the beginning of month $t+1$. The holding period longer than one month as in, for instance, Op^{q}6, means that for a given decile in each month there exist six subdeciles, each of which is initiated in a different month in the prior six months. We take the simple average of the subdecile returns as the monthly return of the Op^{q}6 decile. For sufficient data coverage, the Op^q and Nop^q portfolios start in January 1985.

A.2.18 Sr, Five-year Sales Growth Rank

Following Lakonishok, Shleifer, and Vishny (1994), we measure five-year sales growth rank, Sr, in June of year t as the weighted average of the annual sales growth ranks for the prior five years: $\sum_{j=1}^{5}(6-j)\times\text{Rank}(t-j)$. The sales growth for year $t-j$ is the growth rate in sales (Compustat annual item SALE) from the fiscal year ending in $t-j-1$ to the fiscal year ending in $t-j$. Only firms with data for all five prior years are used to determine the annual sales growth ranks, and we exclude firms with non-positive sales. For each year from $t-5$ to $t-1$, we rank stocks into deciles based on their annual sales growth, and then assign rank i ($i=1,\ldots,10$) to a firm if its annual sales growth falls into the i^{th} decile. At the end of June of each year t, we assign stocks into deciles based on Sr. Monthly decile returns are calculated from July of year t to June of $t+1$, and the deciles are rebalanced at the end of June in year $t+1$.

A.2.19 Sg, Sales Growth

At the end of June of each year t, we assign stocks into deciles based on Sg, which is the growth in annual sales (Compustat annual item SALE) from the fiscal year ending in calendar year $t-2$ to the fiscal year ending in $t-1$. Firms with non-positive sales are excluded. Monthly decile returns are calculated from July of year t to June of $t+1$, and the deciles are rebalanced at the end of June in year $t+1$.

A.2.20 Em, Enterprise Multiple

Enterprise multiple, Em, is enterprise value divided by operating income before depreciation (Compustat annual item OIBDP). Enterprise value is the market equity plus the total debt (item DLC plus item DLTT) plus the book value of preferred stocks (item PSTKRV) minus cash and short-term investments (item CHE). At the end of June of each year t, we split stocks into deciles based on Em for the fiscal year ending in calendar year $t-1$. The Market equity (from CRSP) is measured at the end of December of $t-1$. For firms with more than one share class, we merge the market equity for all share classes before computing Em. Firms with negative enterprise value or operating income before depreciation are excluded. Monthly decile returns are calculated from July of year t to June of $t+1$, and the deciles are rebalanced in June of $t+1$.

A.2.21 $\text{Em}^\text{q}1$, $\text{Em}^\text{q}6$, and $\text{Em}^\text{q}12$, Quarterly Enterprise Multiple

Em^q, is enterprise value scaled by operating income before depreciation (Compustat quarterly item OIBDPQ). Enterprise value is the market equity plus total debt (item DLCQ plus item DLTTQ) plus the book value of preferred stocks (item PSTKQ) minus cash and short-term investments (item CHEQ). At the beginning of each month t, we split stocks into deciles on Em^q for the latest fiscal quarter ending at least four months ago. The Market equity (from CRSP) is measured at the end of month $t-1$. For firms with more than one share class, we merge the market equity for all share classes before computing Em^q. Firms with negative enterprise value or operating income before depreciation are excluded. Monthly decile returns are calculated for the current month t ($\text{Em}^\text{q}1$), from month t to $t+5$ ($\text{Em}^\text{q}6$), and from month t to $t+11$ ($\text{Em}^\text{q}12$), and the deciles are rebalanced at the beginning of $t+1$. The holding period longer than one month as in $\text{Em}^\text{q}6$ means that for a given decile in each month there exist six subdeciles, each initiated in a different month in the prior six months. We take the simple average of the subdecile returns as the monthly return of the $\text{Em}^\text{q}6$ decile. For sufficient data coverage, the EM^q portfolios start in January 1975.

A.2.22 Sp, Sales-to-price

At the end of June of each year t, we sort stocks into deciles based on sales-to-price, Sp, which is sales (Compustat annual item SALE) for the fiscal year ending in calendar year $t-1$ divided by the market equity (from CRSP) at the end of December of $t-1$. For firms with more than one share class, we merge the market equity for all share classes before computing Sp. Firms with non-positive sales are excluded. Monthly decile returns are calculated from July of year t to June of $t+1$, and the deciles are rebalanced in June of $t+1$.

A.2.23 $\text{Sp}^\text{q}1$, $\text{Sp}^\text{q}6$, and $\text{Sp}^\text{q}12$, Quarterly Sales-to-price

At the beginning of each month t, we sort stocks into deciles based on quarterly sales-to-price, Sp^q, which is sales (Compustat quarterly item SALEQ) divided by the market equity at the end of month $t-1$. Before 1972, we use quarterly sales from fiscal quarters ending at least four months prior to the portfolio formation. Starting from 1972, we use quarterly sales from the most recent quarterly earnings announcement dates (item RDQ). Sales are generally announced with earnings during quarterly earnings announcements (Jegadeesh and Livnat 2006). For a firm to enter the portfolio formation, we require the end of the fiscal quarter that corresponds to its most recent quarterly sales 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. Firms with non-positive sales are excluded. For firms with more than one share class, we merge the market equity for all share classes before computing Sp^{q}. Monthly decile returns are calculated for the current month t ($\text{Sp}^{\text{q}}1$), from month t to $t+5$ ($\text{Sp}^{\text{q}}6$), and from month t to $t+11$ ($\text{Sp}^{\text{q}}12$), and the deciles are rebalanced at the beginning of $t+1$. The holding period longer than one month as in $\text{Sp}^{\text{q}}6$ means that for a given decile in each month there exist six subdeciles, each of which is initiated in a different month in the prior six months. We take the simple average of the subdecile returns as the monthly return of the $\text{Sp}^{\text{q}}6$ decile.

A.2.24 Ocp, Operating Cash Flow-to-price

At the end of June of each year t, we sort stocks into deciles based on operating cash flows-to-price, Ocp, which is operating cash flows for the fiscal year ending in calendar year $t-1$ divided by the market equity (from CRSP) at the end of December of $t-1$. Operating cash flows are measured as funds from operation (Compustat annual item FOPT) minus change in working capital (item WCAP) prior to 1988, and then as net cash flows from operating activities (item OANCF) stating from 1988. For firms with more than one share class, we merge the market equity for all share classes before computing Ocp. Firms with non-positive operating cash flows are excluded. Monthly decile returns are calculated from July of year t to June of $t+1$, and the deciles are rebalanced in June of $t+1$. Because the data on funds from operation start in 1971, the Ocp portfolios start in July 1972.

A.2.25 $\text{Ocp}^{\text{q}}1$, $\text{Ocp}^{\text{q}}6$, and $\text{Ocp}^{\text{q}}12$, Quarterly Operating Cash Flow-to-price

At the beginning of each month t, we split stocks on quarterly operating cash flow-to-price, Ocp^{q}, which is operating cash flows for the latest fiscal quarter ending at least four months ago divided by the market equity at the end of month $t-1$. Operating cash flows are measured as the quarterly change in year-to-date funds from operation (Compustat quarterly item FOPTY) minus change in quarterly working capital (item WCAPQ) prior to 1988, and then as the quarterly change in year-to-date net cash flows from operating activities (item OANCFY) stating from 1988. For firms with more than one share class, we merge the market equity for all share classes before computing Ocp^{q}. Firms with non-positive operating cash flows are excluded. Monthly decile returns are calculated for the current month t ($\text{Ocp}^{\text{q}}1$), from month t to $t+5$ ($\text{Ocp}^{\text{q}}6$), and from month t to $t+11$ ($\text{Ocp}^{\text{q}}12$), and the deciles are rebalanced at the beginning of $t+1$. The holding period longer than one month as in, for instance, $\text{Ocp}^{\text{q}}6$, means that for a given decile in each month there exist six subdeciles, each of which is initiated in a different month in the prior six months. We take the simple average of the subdecile returns as the monthly return of the $\text{Ocp}^{\text{q}}6$ decile. Because the data on year-to-date funds from operation start in 1984, the Ocp^{q} portfolios start in January 1985.

A.2.26 Ir, Intangible Return

Following Daniel and Titman (2006), at the end of June of each year t, we perform the cross-sectional regression of each firm's past five-year log stock return on its five-year-lagged log book-to-market and five-year log book return:

$$r(t-5,t) = \gamma_0 + \gamma_1 bm_{t-5} + \gamma_2 r^B(t-5,t) + u_t \tag{A3}$$

in which $r(t-5,t)$ is the past five-year log stock return from the end of year $t-6$ to the end of $t-1$, bm_{t-5} is the five-year-lagged log book-to-market, and $r^B(t-5,t)$ is the five-year log book return.

The five-year-lagged log book-to-market is computed as $bm_{t-5} = \log(B_{t-5}/M_{t-5})$, in which B_{t-5} is the book equity for the fiscal year ending in calendar year $t-6$ and M_{t-5} is the market equity (from CRSP) at the end of December of $t-6$. For firms with more than one share class, we merge the market equity for all share classes before computing bm_{t-5}. The five-year log book return is computed as $r^B(t-5,t) = \log(B_t/B_{t-5}) + \sum_{s=t-5}^{t-1}(r_s - \log(P_s/P_{s-1}))$, in which B_t is the book equity for the fiscal year ending in calendar year $t-1$, r_s is the stock return from the end of year $s-1$ to the end of year s, and P_s is the stock price per share at the end of year s. Following Davis, Fama, and French (2000), we measure book equity 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 it is available. If not, we measure stockholders' equity as 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 (item PSTKRV), liquidating (item PSTKL), or par value (item PSTK) for the book value of preferred stock.

A firm's intangible return, Ir, is defined as its residual from the annual cross-sectional regression. At the end of June of each year t, we sort stocks based on Ir for the fiscal year ending in calendar year $t-1$. Monthly decile returns are calculated from July of year t to June of $t+1$, and the deciles are rebalanced in June of year $t+1$.

A.2.27 Vhp and Vfp, (Analyst-based) Intrinsic Value-to-market

Following Frankel and Lee (1998), at the end of June of each year t, we implement the residual income model to estimate the intrinsic value:

$$\mathrm{Vh}_t = \mathrm{B}_t + \frac{(E_t[\mathrm{Roe}_{t+1}] - r)}{(1+r)}\mathrm{B}_t + \frac{(E_t[\mathrm{Roe}_{t+2}] - r)}{(1+r)r}\mathrm{B}_{t+1} \tag{A4}$$

$$\mathrm{Vf}_t = \mathrm{B}_t + \frac{(E_t[\mathrm{Roe}_{t+1}] - r)}{(1+r)}\mathrm{B}_t + \frac{(E_t[\mathrm{Roe}_{t+2}] - r)}{(1+r)^2}\mathrm{B}_{t+1} + \frac{(E_t[\mathrm{Roe}_{t+3}] - r)}{(1+r)^2 r}\mathrm{B}_{t+2} \tag{A5}$$

in which Vh_t is the historical Roe-based intrinsic value and Vf_t is the analysts earnings forecast-based intrinsic value. B_t is the book equity (Compustat annual item CEQ) for the fiscal year ending in calendar year $t-1$. Future book equity is computed using the clean surplus accounting: $\mathrm{B}_{t+1} = (1 + (1-k)E_t[\mathrm{Roe}_{t+1}])\mathrm{B}_t$, and $\mathrm{B}_{t+2} = (1 + (1-k)E_t[\mathrm{Roe}_{t+2}])\mathrm{B}_{t+1}$. $E_t[\mathrm{Roe}_{t+1}]$ and $E_t[\mathrm{Roe}_{t+2}]$ are the return on equity expected for the current and next fiscal years. k is the dividend payout ratio, measured as common stock dividends (item DVC) divided by earnings (item IBCOM) for the fiscal year ending in calendar year $t-1$. For firms with negative earnings, we divide dividends by 6% of average total assets (item AT). r is a constant discount rate of 12%. When estimating Vh_t, we replace all Roe expectations with most recent Roe_t: $\mathrm{Roe}_t = \mathrm{Ni}_t/[(\mathrm{B}_t + \mathrm{B}_{t-1})/2]$, in which Ni_t is earnings for the fiscal year ending in $t-1$, and B_t and B_{t-1} are the book equity from the fiscal years ending in $t-1$ and $t-2$.

When estimating Vf_t, we use analyst earnings forecasts from IBES to construct Roe expectations. Let Fy1 and Fy2 be the one-year-ahead and two-year-ahead consensus mean forecasts (IBES unadjusted file, item MEANEST; fiscal period indicator = 1 and 2) reported in June of year t. Let s be the number of shares outstanding 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. Then $E_t[\mathrm{Roe}_{t+1}] = s\mathrm{Fy1}/[(\mathrm{B}_{t+1} + \mathrm{B}_t)/2]$, in which $\mathrm{B}_{t+1} = (1 + s(1-k)\mathrm{Fy1})\mathrm{B}_t$. Analogously, $E_t[\mathrm{Roe}_{t+2}] = s\mathrm{Fy2}/[(\mathrm{B}_{t+2} + \mathrm{B}_{t+1})/2]$, in which

$\mathrm{B}_{t+2} = (1+s(1-k)\mathrm{Fy2})\mathrm{B}_{t+1}$. Let Ltg denote the long-term earnings growth rate forecast from IBES (item MEANEST; fiscal period indicator = 0). Then $E_t[\mathrm{Roe}_{t+3}] = s\mathrm{Fy2}(1+\mathrm{Ltg})/[(\mathrm{B}_{t+3}+\mathrm{B}_{t+2})/2]$, in which $\mathrm{B}_{t+3} = (1+s(1-k)\mathrm{Fy2}(1+\mathrm{Ltg}))\mathrm{B}_{t+2}$. If Ltg is missing, we set $E_t[\mathrm{Roe}_{t+3}]$ to be $E_t[\mathrm{Roe}_{t+2}]$. Firms are excluded if their expected Roe or dividend payout ratio is higher than 100%. We also exclude firms with negative book equity.

At the end of June of each year t, we sort stocks into deciles on the ratios of Vh and Vf scaled by the market equity (from CRSP) at the end of December of $t-1$, denoted Vhp and Vfp, respectively. For firms with more than one share class, we merge the market equity for all share classes before computing intrinsic value-to-market. Firms with non-positive intrinsic value are excluded. Monthly decile returns are calculated from July of year t to June of $t+1$, and the deciles are rebalanced in June of $t+1$. Because analyst forecast data start in 1976, the Vfp deciles start in July 1977.

A.2.28 Ebp, Enterprise Book-to-price, and Ndp, Net Debt-to-price

Following Penman, Richardson, and Tuna (2007), we measure enterprise book-to-price, Ebp, as the ratio of the book value of net operating assets (net debt plus book equity) to the market value of net operating assets (net debt plus market equity). Net Debt-to-price, Ndp, is the ratio of net debt to the market equity. Net debt is financial liabilities minus financial assets. We measure financial liabilities as the sum of long-term debt (Compustat annual item DLTT), debt in current liabilities (item DLC), carrying value of preferred stock (item PSTK), and preferred dividends in arrears (item DVPA, zero if missing), less preferred treasury stock (item TSTKP, zero if missing). We measure financial assets as cash and short-term investments (item CHE). Book equity is common equity (item CEQ) plus any preferred treasury stock (item TSTKP, zero if missing) less any preferred dividends in arrears (item DVPA, zero if missing). Market equity is the number of common shares outstanding times share price (from CRSP).

At the end of June of each year t, we sort stocks into deciles based on Ebp, and separately, on Ndp, for the fiscal year ending in calendar year $t-1$. Market equity is measured at the end of December of $t-1$. For firms with more than one share class, we merge the market equity for all share classes before computing Ebp and Ndp. When forming the Ebp portfolios, we exclude firms with non-positive book or market value of net operating assets. For the Ndp portfolios, we exclude firms with non-positive net debt. Monthly decile returns are calculated from July of year t to June of $t+1$, and the deciles are rebalanced in June of $t+1$.

A.2.29 $\mathrm{Ebp^q}$1, $\mathrm{Ebp^q}$6, $\mathrm{Ebp^q}$12, $\mathrm{Ndp^q}$1, $\mathrm{Ndp^q}$6, and $\mathrm{Ndp^q}$12, Quarterly Enterprise Book-to-price, Quarterly Net Debt-to-price

We measure quarterly enterprise book-to-price, $\mathrm{Ebp^q}$, as the ratio of the book value of net operating assets (net debt plus book equity) to the market value of net operating assets (net debt plus market equity). Quarterly net debt-to-price, $\mathrm{Ndp^q}$, is the ratio of net debt to market equity. Net debt is financial liabilities minus financial assets. Financial liabilities are the sum of long-term debt (Compustat quarterly item DLTTQ), debt in current liabilities (item DLCQ), and the carrying value of preferred stock (item PSTKQ). Financial assets are cash and short-term investments (item CHEQ). Book equity is common equity (item CEQQ). Market equity is the number of common shares outstanding times share price (from CRSP).

At the beginning of each month t, we split stocks into deciles based on $\mathrm{Ebp^q}$, and separately, on $\mathrm{Ndp^q}$, for the latest fiscal quarter ending at least four months ago. Market equity is measured at the end of month $t-1$. For firms with more than one share class, we merge the market equity for all share classes before computing Ebp^{q} and Ndp^{q}. When forming the Ebp^{q} portfolios, we exclude firms with non-positive book or market value of net operating assets. For the Ndp^{q} portfolios, we exclude firms with non-positive net debt. Monthly decile returns are calculated for the current month t ($\text{Ebp}^{\text{q}}1$ and $\text{Ndp}^{\text{q}}1$), from month t to $t+5$ ($\text{Ebp}^{\text{q}}6$ and $\text{Ndp}^{\text{q}}6$), and from month t to $t+11$ ($\text{Ebp}^{\text{q}}12$ and $\text{Ndp}^{\text{q}}12$), and the deciles are rebalanced at the beginning of $t+1$. The holding period longer than one month as in, for instance, $\text{Ebp}^{\text{q}}6$, means that for a given decile in each month there exist six subdeciles, each of which is initiated in a different month in the prior six months. We take the simple average of the subdecile returns as the monthly return of the $\text{Ebp}^{\text{q}}6$ decile. For sufficient data coverage, the Ebp^{q} and Ndp^{q} portfolios start in January 1976.

A.2.30 Dur, Equity Duration

Following Dechow, Sloan, and Soliman (2004), we calculate firm-level equity duration, Dur, as:

$$\text{Dur} = \frac{\sum_{t=1}^{T} t \times \text{CD}_t/(1+r)^t}{\text{ME}} + \left(T + \frac{1+r}{r}\right) \frac{\text{ME} - \sum_{t=1}^{T} \text{CD}_t/(1+r)^t}{\text{ME}}, \tag{A6}$$

in which CD_t is the net cash distribution in year t, ME is market equity, T is the length of forecasting period, and r is the cost of equity. Market equity is price per share times shares outstanding (Compustat annual item PRCC_F times item CSHO). Net cash distribution, $\text{CD}_t = \text{BE}_{t-1}(\text{ROE}_t - g_t)$, in which BE_{t-1} is the book equity at the end of year $t-1$, ROE_t is return on equity in year t, and g_t is the book equity growth in t. Following Dechow et al., we use autoregressive processes to forecast ROE and book equity growth in future years. We model ROE as a first-order autoregressive process with an autocorrelation coefficient of 0.57 and a long-run mean of 0.12, and the growth in book equity as a first-order autoregressive process with an autocorrelation coefficient of 0.24 and a long-run mean of 0.06. For the starting year ($t = 0$), we measure ROE as income before extraordinary items (item IB) divided by one-year lagged book equity (item CEQ), and the book equity growth rate as the annual change in sales (item SALE). Nissim and Penman (2001) show that past sales growth is a better indicator of future book equity growth than past book equity growth. Finally, we use a forecasting period of $T = 10$ years and a cost of equity of $r = 0.12$. Firms are excluded if book equity ever becomes negative during the forecasting period. At the end of June of each year t, we sort stocks into deciles based on Dur constructed with data from the fiscal year ending in calendar year $t-1$. Monthly decile returns are calculated from July of year t to June of $t+1$, and the deciles are rebalanced in June of $t+1$.

A.2.31 Ltg1, Ltg6, and Ltg12, Long-term Growth Forecasts

The long-term growth forecast, Ltg, is measured as the consensus median forecast of the long-term earnings growth rate from IBES (item MEDEST, fiscal period indictor = 0). At the beginning of each month t, we sort stocks into deciles based on Ltg reported in $t-1$. Monthly decile returns are calculated for the current month t (Ltg1), from month t to $t+5$ (Ltg6), and from month t to $t+11$ (Ltg12), and the deciles are rebalanced at the beginning of $t+1$. The holding period longer than one month as in, for instance, Ltg6, means that for a given decile in each month there exist six subdeciles, each of which is initiated in a different month in the prior six months. We take the simple average of the subdecile returns as the monthly return of the Ltg6 decile. Because the long-term growth forecasts data start in December 1981, the deciles start in January 1982.

A.3 Investment

A.3.1 Aci, Abnormal Corporate Investment

At the end of June of year t, we measure abnormal corporate investment, Aci, as $\text{Ce}_{t-1}/[(\text{Ce}_{t-2}+\text{Ce}_{t-3}+\text{Ce}_{t-4})/3]-1$, in which Ce_{t-j} is capital expenditure (Compustat annual item CAPX) scaled by sales (item SALE) for the fiscal year ending in calendar year $t-j$. The last three-year average capital expenditure is designed to project the benchmark investment in the portfolio formation year. We exclude firms with sales less than ten million dollars. At the end of June of each year t, we sort stocks into deciles based on Aci. Monthly decile returns are computed from July of year t to June of $t+1$, and the deciles are rebalanced in June of $t+1$.

A.3.2 I/A, Investment-to-assets

At the end of June of each year t, we sort stocks into deciles based on investment-to-assets, I/A, which is measured as total assets (Compustat annual item AT) for the fiscal year ending in calendar year $t-1$ divided by total assets for the fiscal year ending in $t-2$ minus one. Monthly decile returns are computed from July of year t to June of $t+1$, and the deciles are rebalanced in June of $t+1$.

A.3.3 $\text{Ia}^{\text{q}}1$, $\text{Ia}^{\text{q}}6$, and $\text{Ia}^{\text{q}}12$, Quarterly Investment-to-assets

Quarterly investment-to-assets, Ia^{q}, is defined as quarterly total assets (Compustat quarterly item ATQ) divided by four-quarter-lagged total assets minus one. At the beginning of each month t, we sort stocks into deciles based on Ia^{q} for the latest fiscal quarter ending at least four months ago. Monthly decile returns are calculated for the current month t ($\text{Ia}^{\text{q}}1$), from month t to $t+5$ ($\text{Ia}^{\text{q}}6$), and from month t to $t+11$ ($\text{Ia}^{\text{q}}12$), and the deciles are rebalanced at the beginning of month $t+1$. The holding period longer than one month as in, for instance, $\text{Ia}^{\text{q}}6$, means that for a given decile in each month there exist six subdeciles, each of which is initiated in a different month in the prior six months. We take the simple average of the subdecile returns as the monthly return of the $\text{Ia}^{\text{q}}6$ decile.

A.3.4 dPia, Changes in PPE and Inventory-to-assets

Changes in PPE and Inventory-to-assets, dPia, is defined as the annual change in gross property, plant, and equipment (Compustat annual item PPEGT) plus the annual change in inventory (item INVT) scaled by one-year-lagged total assets (item AT). At the end of June of each year t, we sort stocks into deciles based on dPia for the fiscal year ending in calendar year $t-1$. Monthly decile returns are computed from July of year t to June of $t+1$, and the deciles are rebalanced in June of $t+1$.

A.3.5 Noa and dNoa, (Changes in) Net Operating Assets

Following Hirshleifer, Hou, Teoh, and Zhang (2004), 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). Noa is net operating assets scalded by one-year-lagged total assets. Changes in net operating assets, dNoa, is the annual change in net operating assets scaled by one-year-lagged total assets. At the end of June of each year t, we sort stocks into deciles based on Noa, and separately, on dNOA, for the fiscal year ending in calendar year $t-1$. Monthly decile returns are computed from July of year t to June of $t+1$, and the deciles are rebalanced in June of $t+1$.

A.3.6 dLno, Changes in Long-term Net Operating Assets

Following Fairfield, Whisenant, and Yohn (2003), we measure changes in long-term net operating assets as the annual change in net property, plant, and equipment (Compustat item PPENT) plus the change in intangibles (item INTAN) plus the change in other long-term assets (item AO) minus the change in other long-term liabilities (item LO) and plus depreciation and amortization expense (item DP). dLno is the change in long-term net operating assets scaled by the average of total assets (item AT) from the current and prior years. At the end of June of each year t, we sort stocks into deciles based on dLno for the fiscal year ending in calendar year $t-1$. Monthly decile returns are calculated from July of year t to June of $t+1$, and the deciles are rebalanced in June of $t+1$.

A.3.7 Ig, Investment Growth

At the end of June of each year t, we sort stocks into deciles based on investment growth, Ig, which is the growth rate in capital expenditure (Compustat annual item CAPX) from the fiscal year ending in calendar year $t-2$ to the fiscal year ending in $t-1$. Monthly decile returns are calculated from July of year t to June of $t+1$, and the deciles are rebalanced in June of $t+1$.

A.3.8 2Ig, Two-year Investment Growth

At the end of June of each year t, we sort stocks into deciles based on two-year investment growth, 2Ig, which is the growth rate in capital expenditure (Compustat annual item CAPX) from the fiscal year ending in calendar year $t-3$ to the fiscal year ending in $t-1$. Monthly decile returns are calculated from July of year t to June of $t+1$, and the deciles are rebalanced in June of $t+1$.

A.3.9 3Ig, Three-year Investment Growth

At the end of June of each year t, we sort stocks into deciles based on three-year investment growth, 3Ig, which is the growth rate in capital expenditure (Compustat annual item CAPX) from the fiscal year ending in calendar year $t-4$ to the fiscal year ending in $t-1$. Monthly decile returns are calculated from July of year t to June of $t+1$, and the deciles are rebalanced in June of $t+1$.

A.3.10 Nsi, Net Stock Issues

At the end of June of year t, we measure net stock issues, Nsi, as the natural log of the ratio of the split-adjusted shares outstanding at the fiscal year ending in calendar year $t-1$ to the split-adjusted shares outstanding at the fiscal year ending in $t-2$. The split-adjusted shares outstanding is shares outstanding (Compustat annual item CSHO) times the adjustment factor (item AJEX). At the end of June of each year t, we sort stocks with negative Nsi into two portfolios (1 and 2), stocks with zero Nsi into one portfolio (3), and stocks with positive Nsi into seven portfolios (4 to 10). Monthly decile returns are from July of year t to June of $t+1$, and the deciles are rebalanced in June of $t+1$.

A.3.11 dIi, % Change in Investment - % Change in Industry Investment

Following Abarbanell and Bushee (1998), we define the %d($\cdot$) operator as the percentage change in the variable in the parentheses from its average over the prior two years, e.g., %d(Investment) =

[Investment(t) − E[Investment(t)]]/E[Investment(t)], in which E[Investment(t)] = [Investment($t-1$) + Investment($t-2$)]/2. dIi is defined as %d(Investment) − %d(Industry investment), in which investment is capital expenditure in property, plant, and equipment (Compustat annual item CAPXV). Industry investment is the aggregate investment across all firms with the same two-digit SIC code. Firms with non-positive $E[Investment(\mathrm{t})]$ are excluded and we require at least two firms in each industry. At the end of June of each year t, we sort stocks into deciles based on dIi for the fiscal year ending in calendar year $t-1$. Monthly decile returns are calculated from July of year t to June of $t+1$, and the deciles are rebalanced in June of $t+1$.

A.3.12 Cei, Composite Equity Issuance

At the end of June of each year t, we sort stocks into deciles based on composite equity issuance, Cei, which is the log growth rate in the market equity not attributable to stock return, $\log\left(\mathrm{ME_t}/\mathrm{ME_{t-5}}\right) - r(t-5,t)$. $r(t-5,t)$ 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. Monthly decile returns are from July of year t to June of $t+1$, and the deciles are rebalanced in June of $t+1$.

A.3.13 Cdi, Composite Debt Issuance

Following Lyandres, Sun, and Zhang (2008), at the end of June of each year t, we sort stocks into deciles based on composite debt issuance, Cdi, which is the log growth rate of the book value of debt (Compustat annual item DLC plus item DLTT) from the fiscal year ending in calendar year $t-6$ to the fiscal year ending in year $t-1$. Monthly decile returns are calculated from July of year t to June of $t+1$, and the deciles are rebalanced in June of year $t+1$.

A.3.14 Ivg, Inventory Growth

At the end of June of each year t, we sort stocks into deciles based on inventory growth, Ivg, which is the annual growth rate in inventory (Compustat annual item INVT) from the fiscal year ending in calendar year $t-2$ to the fiscal year ending in $t-1$. Monthly decile returns are calculated from July of year t to June of $t+1$, and the deciles are rebalanced in June of $t+1$.

A.3.15 Ivc, Inventory Changes

At the end of June of each year t, we sort stocks into deciles based on inventory changes, Ivc, which is the annual change in inventory (Compustat annual item INVT) scaled by the average of total assets (item AT) for the fiscal years ending in $t-2$ and $t-1$. We exclude firms that carry no inventory for the past two fiscal years. Monthly decile returns are calculated from July of year t to June of $t+1$, and the deciles are rebalanced in June of $t+1$.

A.3.16 Oa, Operating Accruals

Prior to 1988, we use the balance sheet approach in Sloan (1996) to measure operating accruals, Oa, 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, Oa 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. Starting from 1988, we follow Hribar and Collins (2002) to measure Oa using the statement of cash flows as net income (item NI) minus net cash flow from operations (item OANCF). Doing so helps mitigate measurement errors that can arise from nonoperating activities such as acquisitions and divestitures. Data from the statement of cash flows are only available since 1988. At the end of June of each year t, we sort stocks into deciles on Oa for the fiscal year ending in calendar year $t-1$ scaled by total assets (item AT) for the fiscal year ending in $t-2$. Monthly decile returns are calculated from July of year t to June of $t+1$, and the deciles are rebalanced in June of $t+1$.

A.3.17 Ta, Total Accruals

Prior to 1988, we use the balance sheet approach in Richardson, Sloan, Soliman, and Tuna (2005) to measure total accruals, Ta, as dWc + dNco + dFin. dWc is the change in net non-cash working capital. Net non-cash working capital is current operating asset (Coa) minus current operating liabilities (Col), with Coa = current assets (Compustat annual item ACT) − cash and short-term investments (item CHE) and Col = current liabilities (item LCT) − debt in current liabilities (item DLC). dNco is the change in net non-current operating assets. Net non-current operating assets are non-current operating assets (Nca) minus non-current operating liabilities (Ncl), with Nca = total assets (item AT) − current assets − long-term investments (item IVAO), and Ncl = total liabilities (item LT) − current liabilities − long-term debt (item DLTT). dFin is the change in net financial assets. Net financial assets are financial assets (Fna) minus financial liabilities (Fnl), with Fna = short-term investments (item IVST) + long-term investments, and Fnl = long-term debt + debt in current liabilities + preferred stocks (item PSTK). Missing changes in debt in current liabilities, long-term investments, long-term debt, short-term investments, and preferred stocks are set to zero.

Starting from 1988, we use the cash flow approach to measure Ta as net income (item NI) minus total operating, investing, and financing cash flows (items OANCF, IVNCF, and FINCF) plus sales of stocks (item SSTK, zero if missing) minus stock repurchases and dividends (items PRSTKC and DV, zero if missing). Data from the statement of cash flows are only available since 1988. At the end of June of each year t, we sort stocks into deciles based on Ta for the fiscal year ending in calendar year $t-1$ scaled by total assets for the fiscal year ending in $t-2$. Monthly decile returns are calculated from July of year t to June of $t+1$, and the deciles are rebalanced in June of $t+1$.

A.3.18 dWc, dCoa, and dCol, Changes in Net Non-cash Working Capital, in Current Operating Assets, and in Current Operating Liabilities

Richardson, Sloan, Soliman, and Tuna (2005, Table 10) show that several components of total accruals also forecast returns in the cross section. dWc is the change in net non-cash working capital. Net non-cash working capital is current operating asset (Coa) minus current operating liabilities (Col), with Coa = current assets (Compustat annual item ACT) − cash and short term investments (item CHE) and Col = current liabilities (item LCT) − debt in current liabilities (item DLC). dCoa is the change in current operating asset and dCol is the change in current operating liabilities. Missing changes in debt in current liabilities are set to zero. At the end of June of each year t, we sort stocks into deciles based, separately, on dWc, dCoa, and dCol for the fiscal year ending in calendar year $t-1$, all scaled by total assets (item AT) for the fiscal year ending in calendar year $t-2$. Monthly decile returns are calculated from July of year t to June of $t+1$, and the deciles are rebalanced in June of $t+1$.

A.3.19 dNco, dNca, and dNcl, Changes in Net Non-current Operating Assets, in Non-current Operating Assets, and in Non-current Operating Liabilities

dNco is the change in net non-current operating assets. Net non-current operating assets are non-current operating assets (Nca) minus non-current operating liabilities (Ncl), with Nca = total assets (Compustat annual item AT) − current assets (item ACT) − long-term investments (item IVAO), and Ncl = total liabilities (item LT) − current liabilities (item LCT) − long-term debt (item DLTT). dNca is the change in non-current operating assets and dNcl is the change in non-current operating liabilities. Missing changes in long-term investments and long-term debt are set to zero. At the end of June of each year t, we sort stocks into deciles based, separately, on dNco, dNca, and dNcl for the fiscal year ending in calendar year $t-1$, all scaled by total assets for the fiscal year ending in calendar year $t-2$. Monthly decile returns are calculated from July of year t to June of $t+1$, and the deciles are rebalanced in June of $t+1$.

A.3.20 dFin, dSti, dLti, dFnl, and dBe, Changes in Net Financial Assets, in Short-term Investments, in Long-term Investments, in Financial Liabilities, and in Book Equity

dFin is the change in net financial assets. Net financial assets are financial assets (Fna) minus financial liabilities (Fnl), with Fna = short-term investments (Compustat annual item IVST) + long-term investments (item IVAO), and Fnl = long-term debt (item DLTT) + debt in current liabilities (item DLC) + preferred stock (item PSTK). dSti is the change in short-term investments, dLti is the change in long-term investments, and dFnl is the change in financial liabilities. dBe is the change in book equity (item CEQ). Missing changes in debt in current liabilities, long-term investments, long-term debt, short-term investments, and preferred stocks are set to zero (at least one change has to be non-missing when constructing any variable). When constructing dSti (dLti), we exclude firms that do not have long-term (short-term) investments in the past two fiscal years. At the end of June of each year t, we sort stocks into deciles based, separately, on dFin, dSti, dLti, dFnl, and dBe for the fiscal year ending in calendar year $t-1$, all scaled by total assets (item AT) for the fiscal year ending in calendar year $t-2$. Monthly decile returns are calculated from July of year t to June of $t+1$, and the deciles are rebalanced in June of $t+1$.

A.3.21 Dac, Discretionary Accruals

We measure discretionary accruals, Dac, using the modified Jones model from Dechow, Sloan, and Sweeney (1995):

$$\frac{\mathrm{Oa}_{i,t}}{\mathrm{A}_{i,t-1}} = \alpha_1 \frac{1}{\mathrm{A}_{i,t-1}} + \alpha_2 \frac{\mathrm{dSALE}_{i,t} - \mathrm{dREC}_{i,t}}{\mathrm{A}_{i,t-1}} + \alpha_3 \frac{\mathrm{PPE}_{i,t}}{\mathrm{A}_{i,t-1}} + e_{i,t}, \tag{A7}$$

in which $\mathrm{Oa}_{i,t}$ is operating accruals for firm i (see Appendix A.3.16), A_{t-1} is total assets (Compustat annual item AT) at the end of year $t-1$, $\mathrm{dSALE}_{i,t}$ is the annual change in sales (item SALE) from year $t-1$ to t, $\mathrm{dREC}_{i,t}$ is the annual change in net receivables (item RECT) from year $t-1$ to t, and $\mathrm{PPE}_{i,t}$ is gross property, plant, and equipment (item PPEGT) at the end of year t. We estimate the cross-sectional regression (A7) for each two-digit SIC industry and year combination, formed separately for NYSE/AMEX firms and for NASDAQ firms. We require at least six firms for each regression. The discretionary accrual for stock i is defined as the residual from the regression, $e_{i,t}$. At the end of June of each year t, we sort stocks into deciles based on Dac for the fiscal year ending in calendar year $t-1$. Monthly decile returns are calculated from July of year t to June of $t+1$, and the deciles are rebalanced in June of $t+1$.

A.3.22 Poa, Percent Operating Accruals

Accruals are traditionally scaled by total assets. Hafzalla, Lundholm, and Van Winkle (2011) show that scaling accruals by the absolute value of earnings (percent accruals) is more effective in selecting firms for which the differences between sophisticated and naive forecasts of earnings are the most extreme. To construct the percent operating accruals (Poa) deciles, at the end of June of each year t, we sort stocks into deciles based on operating accruals scaled by the absolute value of net income (Compustat annual item NI) for the fiscal year ending in calendar year $t-1$. See Appendix A.3.16 for the measurement of operating accruals. Monthly decile returns are calculated from July of year t to June of $t+1$, and the deciles are rebalanced in June of $t+1$.

A.3.23 Pta, Percent Total Accruals

At the end of June of each year t, we sort stocks into deciles on percent total accruals, Pta, calculated as total accruals scaled by the absolute value of net income (Compustat annual item NI) for the fiscal year ending in calendar year $t-1$. See Appendix A.3.17 for the measurement of total accruals. Monthly decile returns are calculated from July of year t to June of $t+1$, and the deciles are rebalanced in June of year $t+1$.

A.3.24 Pda, Percent Discretionary Accruals

At the end of June of each year t, we split stocks into deciles based on percent discretionary accruals, Pda, calculated as the discretionary accruals, Dac, for the fiscal year ending in calendar year $t-1$ multiplied with total assets (Compustat annual item AT) for the fiscal year ending in $t-2$ scaled by the absolute value of net income (item NI) for the fiscal year ending in $t-1$. See Appendix A.3.21 for the measurement of discretionary accruals. Monthly decile returns are calculated from July of year t to June of $t+1$, and the deciles are rebalanced in June of $t+1$.

A.3.25 Nxf, Nef, and Ndf, Net External, Equity, and Debt Financing

Net external financing, Nxf, is the sum of net equity financing, Nef, and net debt financing, Ndf (Bradshaw, Richardson, and Sloan 2006). Nef is the proceeds from the sale of common and preferred stocks (Compustat annual item SSTK) less cash payments for the repurchases of common and preferred stocks (item PRSTKC) less cash payments for dividends (item DV). Ndf is the cash proceeds from the issuance of long-term debt (item DLTIS) less cash payments for long-term debt reductions (item DLTR) plus the net changes in current debt (item DLCCH, zero if missing). At the end of June of each year t, we sort stocks into deciles based on Nxf, and, separately, on Nef and Ndf, for the fiscal year ending in calendar year $t-1$ scaled by the average of total assets for fiscal years ending in $t-2$ and $t-1$. Monthly decile returns are calculated from July of year t to June of $t+1$, and the deciles are rebalanced in June of $t+1$. Because the data on financing activities start in 1971, the portfolios start in July 1972.

A.4 Profitability

A.4.1 Roe1, Roe6, and Roe12, Return on Equity

Return on equity, Roe, is income before extraordinary items (Compustat quarterly item IBQ) divided by one-quarter-lagged book equity (Hou, Xue, and Zhang 2015). Book equity is shareholders' equity, plus balance sheet deferred taxes and investment tax credit (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 book value of preferred stock, or total assets (item ATQ) minus total liabilities (item LTQ) in that order as shareholders' equity.

Before 1972, the sample coverage is limited for quarterly book equity in Compustat quarterly files. We expand the coverage by using book equity from Compustat annual files as well as by imputing quarterly book equity with clean surplus accounting. Specifically, whenever available we first use quarterly book equity from Compustat quarterly files. We then supplement the coverage for fiscal quarter four with annual book equity from Compustat annual files. Following Davis, Fama, and French (2000), we measure annual book equity 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. If not, stockholders' equity is 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 (item PSTKRV), liquidating (item PSTKL), or par value (item PSTK) for the book value of preferred stock.

If both approaches are unavailable, we apply the clean surplus relation to impute the book equity. First, if available, we backward impute the beginning-of-quarter book equity as the end-of-quarter book equity minus quarterly earnings plus quarterly dividends. 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). Because we impose a four-month lag between earnings and the holding period month (and the book equity in the denominator of ROE is one-quarter-lagged relative to earnings), all the Compustat data in the backward imputation are at least four-month lagged prior to the portfolio formation. 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 BEQ_{t-j}, $1 \leq j \leq 4$ denote the latest available quarterly book equity as of quarter t, and $\mathrm{IBQ}_{t-j+1,t}$ and $\mathrm{DVQ}_{t-j+1,t}$ be the sum of quarterly earnings and quarterly dividends from quarter $t-j+1$ to t, respectively. BEQ_t can then be imputed as $\mathrm{BEQ}_{t-j}+\mathrm{IBQ}_{t-j+1,t}-\mathrm{DVQ}_{t-j+1,t}$. We do not use prior book equity from more than four quarters ago (i.e., $1 \leq j \leq 4$) to reduce imputation errors.

At the beginning of each month t, we sort all stocks into deciles based on their most recent past Roe. Before 1972, we use the most recent Roe computed with quarterly earnings from fiscal quarters ending at least four months prior to the portfolio formation. Starting from 1972, we use Roe computed with quarterly earnings from the most recent quarterly earnings announcement dates (Compustat quarterly item RDQ). For a firm to enter the portfolio formation, we require the end of the fiscal quarter that corresponds to its most recent Roe 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. Monthly decile returns are calculated for the current month t (Roe1), from month t to $t+5$ (Roe6), and from month t to $t+11$ (Roe12). The deciles are rebalanced monthly. The holding period that is longer than one month as in, for instance, Roe6, means that for a given decile in each month there exist six subdeciles, each of which is initiated in a different month in the prior six-month period. We take the simple average of the subdeciles returns as the monthly return of the Roe6 decile.

A.4.2 dRoe1, dRoe6, and dRoe12, Changes in Return on Equity

Change in return on equity, dRoe, is return on equity minus its value from four quarters ago. See Appendix A.4.1 for the measurement of return on equity. At the beginning of each month t, we sort all stocks into deciles on their most recent past dRoe. 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 computed with quarterly earnings from the most recent quarterly earnings announcement dates (Compustat quarterly item RDQ). For a firm to enter the portfolio formation, we require the end of the fiscal quarter that corresponds to its most recent dRoe 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. Monthly decile returns are calculated for the current month t (dRoe1), from month t to $t+5$ (dRoe6), and from month t to $t+11$ (dRoe12). The deciles are rebalanced monthly. The holding period that is longer than one month as in, for instance, dRoe6, means that for a given decile in each month there exist six subdeciles, each of which is initiated in a different month in the prior six-month period. We take the simple average of the subdeciles returns as the monthly return of the dRoe6 decile.

A.4.3 Roa1, Roa6, and Roa12, Return on Assets

Return on assets, Roa, is income before extraordinary items (Compustat quarterly item IBQ) divided by one-quarter-lagged total assets (item ATQ). At the beginning of each month t, we sort all stocks into deciles based on Roa computed with quarterly earnings from the most recent earnings announcement dates (item RDQ). For a firm to enter the portfolio formation, we require the end of the fiscal quarter that corresponds to its most recent Roa 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. Monthly decile returns are calculated for month t (Roa1), from month t to $t+5$ (Roe6), and from month t to $t+11$ (Roe12). The deciles are rebalanced at the beginning of $t+1$. The holding period that is longer than one month as in, for instance, Roa6, means that for a given decile in each month there exist six subdeciles, each of which is initiated in a different month in the prior six-month period. We take the simple average of the subdeciles returns as the monthly return of the Roa6 decile. For sufficient data coverage, the Roa portfolios start in January 1972.

A.4.4 dRoa1, dRoa6, and dRoa12, Changes in Return on Assets

Change in return on assets, dRoa, is return on assets minus its value from four quarters ago. See Appendix A.4.3 for the measurement of return on assets. At the beginning of each month t, we sort all stocks into deciles based on dRoa computed with quarterly earnings from the most recent earnings announcement dates (Compustat quarterly item RDQ). For a firm to enter the portfolio formation, we require the end of the fiscal quarter that corresponds to its most recent dRoa 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. Monthly decile returns are calculated for month t (dRoa1), from month t to $t+5$ (dRoa6), and from month t to $t+11$ (dRoa12). The deciles are rebalanced at the beginning of $t+1$. The holding period that is longer than one month as in, for instance, dRoa6, means that for a given decile in each month there exist six subdeciles, each of which is initiated in a different month in the prior six-month period. We take the simple average of the subdecile returns as the monthly return of the dRoa6 decile. For sufficient data coverage, the dRoa portfolios start in January 1973.

A.4.5 Rna, Pm, and Ato, Return on Net Operating Assets, Profit Margin, Asset Turnover

Soliman (2008) use DuPont analysis to decompose Roe as Rna + FLEV $\times$ SPREAD, in which Roe is return on equity, Rna is return on net operating assets, FLEV is financial leverage, and SPREAD is the difference between return on net operating assets and borrowing costs. We can further decompose Rna as Pm $\times$ Ato, in which Pm is profit margin and Ato is asset turnover.

Following Soliman (2008), we use annual sorts to form Rna, Pm, and Ato deciles. At the end of June of year t, we measure Rna as operating income after depreciation (Compustat annual item OIADP) for the fiscal year ending in calendar year $t-1$ divided by net operating assets (Noa) for the fiscal year ending in $t-2$. Noa is operating assets minus operating liabilities. Operating assets are total assets (item AT) minus cash and short-term investment (item CHE), and minus other investment and advances (item IVAO, zero if missing). Operating liabilities are total assets minus debt 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). Pm is operating income after depreciation divided by sales (item SALE) for the fiscal year ending in calendar year $t-1$. Ato is sales for the fiscal year ending in calendar year $t-1$ divided by Noa for the fiscal year ending in $t-2$. At the end of June of each year t, we sort stocks into three sets of deciles based on Rna, Pm, and Ato. We exclude firms with non-positive Noa for the fiscal year ending in calendar year $t-2$ when forming the Rna and the Ato portfolios. Monthly decile returns are calculated from July of year t to June of $t+1$, and the deciles are rebalanced in June of $t+1$.

A.4.6 Cto, Capital Turnover

At the end of June of each year t, we split stocks into deciles based on capital turnover, Cto, measured as sales (Compustat annual item SALE) for the fiscal year ending in calendar year $t-1$ divided by total assets (item AT) for the fiscal year ending in $t-2$. Monthly decile returns are calculated from July of year t to June of $t+1$, and the deciles are rebalanced in June of $t+1$.

A.4.7 Rna^{q}1, Rna^{q}6, Rna^{q}12, Pm^{q}1, Pm^{q}6, Pm^{q}12, Ato^{q}1, Ato^{q}6, and Ato^{q}12, Quarterly Return on Net Operating Assets, Quarterly Profit Margin, Quarterly Asset Turnover

Quarterly return on net operating assets, Rna^q, is quarterly operating income after depreciation (Compustat quarterly item OIADPQ) divided by one-quarter-lagged net operating assets (Noa).

Noa is operating assets minus operating liabilities. Operating assets are total assets (item ATQ) minus cash and short-term investments (item CHEQ), and minus other investment and advances (item IVAOQ, zero if missing). Operating liabilities are total assets minus debt in current liabilities (item DLCQ, zero if missing), minus long-term debt (item DLTTQ, zero if missing), minus minority interests (item MIBQ, zero if missing), minus preferred stocks (item PSTKQ, zero if missing), and minus common equity (item CEQQ). Quarterly profit margin, Pm^{q}, is quarterly operating income after depreciation divided by quarterly sales (item SALEQ). Quarterly asset turnover, $\mathrm{Ato}^{\mathrm{q}}$, is quarterly sales divided by one-quarter-lagged Noa.

At the beginning of each month t, we sort stocks into deciles based on $\mathrm{Rna}^{\mathrm{q}}$ or Pm^{q} for the latest fiscal quarter ending at least four months ago. Separately, we sort stocks into deciles based on $\mathrm{Ato}^{\mathrm{q}}$ computed with quarterly sales from the most recent earnings announcement dates (item RDQ). Sales are generally announced with earnings during quarterly earnings announcements (Jegadeesh and Livnat 2006). For a firm to enter the portfolio formation, we require the end of the fiscal quarter that corresponds to its most recent $\mathrm{Ato}^{\mathrm{q}}$ to be within six months prior to the portfolio formation. This restriction is imposed to exclude stale information. To avoid potentially erroneous records, we also require the earnings announcement date to be after the corresponding fiscal quarter end. Monthly decile returns are calculated for month t ($\mathrm{Rna}^{\mathrm{q}}1$, $\mathrm{Pm}^{\mathrm{q}}1$, and $\mathrm{Ato}^{\mathrm{q}}1$), from month t to $t+5$ ($\mathrm{Rna}^{\mathrm{q}}6$, $\mathrm{Pm}^{\mathrm{q}}6$, and $\mathrm{Ato}^{\mathrm{q}}6$), and from month t to $t+11$ ($\mathrm{Rna}^{\mathrm{q}}12$, $\mathrm{Pm}^{\mathrm{q}}12$, and $\mathrm{Ato}^{\mathrm{q}}12$). The deciles are rebalanced at the beginning of $t+1$. The holding period that is longer than one month as in, for instance, $\mathrm{Ato}^{\mathrm{q}}6$, means that for a given decile in each month there exist six subdeciles, each of which is initiated in a different month in the prior six-month period. We take the simple average of the subdecile returns as the monthly return of the Atoq6 decile. For sufficient data coverage, the $\mathrm{Rna}^{\mathrm{q}}$ portfolios start in January 1976 and the $\mathrm{Ato}^{\mathrm{q}}$ portfolios start in January 1972.

A.4.8 $\mathrm{Cto}^{\mathrm{q}}1$, $\mathrm{Cto}^{\mathrm{q}}6$, and $\mathrm{Cto}^{\mathrm{q}}12$, Quarterly Capital Turnover

Quarterly capital turnover, $\mathrm{Cto}^{\mathrm{q}}$, is quarterly sales (Compustat quarterly item SALEQ) scaled by one-quarter-lagged total assets (item ATQ). At the beginning of each month t, we sort stocks into deciles based on $\mathrm{Cto}^{\mathrm{q}}$ computed with quarterly sales from the most recent earnings announcement dates (item RDQ). Sales are generally announced with earnings during quarterly earnings announcements (Jegadeesh and Livnat 2006). For a firm to enter the portfolio formation, we require the end of the fiscal quarter that corresponds to its most recent $\mathrm{Ato}^{\mathrm{q}}$ to be within six months prior to the portfolio formation. This restriction is imposed to exclude stale information. To avoid potentially erroneous records, we also require the earnings announcement date to be after the corresponding fiscal quarter end. Monthly decile returns are calculated for month t ($\mathrm{Cto}^{\mathrm{q}}1$), from month t to $t+5$ ($\mathrm{Cto}^{\mathrm{q}}6$), and from month t to $t+11$ ($\mathrm{Cto}^{\mathrm{q}}12$). The deciles are rebalanced at the beginning of $t+1$. The holding period that is longer than one month as in, for instance, $\mathrm{Cto}^{\mathrm{q}}6$, means that for a given decile in each month there exist six subdeciles, each of which is initiated in a different month in the prior six-month period. We take the simple average of the subdecile returns as the monthly return of the $\mathrm{Cto}^{\mathrm{q}}6$ decile. For sufficient data coverage, the $\mathrm{Cto}^{\mathrm{q}}$ portfolios start in January 1972.

A.4.9 Gpa, Gross Profits-to-assets

Following Novy-Marx (2013), we measure gross profits-to-assets, Gpa, as total revenue (Compustat annual item REVT) minus cost of goods sold (item COGS) divided by total assets (item AT, the denominator is current, not lagged, total assets). At the end of June of each year t, we sort stocks into deciles based on Gpa for the fiscal year ending in calendar year $t-1$. Monthly decile returns are calculated from July of year t to June of $t+1$, and the deciles are rebalanced in June of $t+1$.

A.4.10 Gla, Gross Profits-to-lagged assets

Gross profits-to-lagged assets, Gla, is total revenue (Compustat annual item REVT) minus cost of goods sold (item COGS) divided by one-year-lagged total assets (item AT). At the end of June of each year t, we sort stocks into deciles based on Gla for the fiscal year ending in calendar year $t-1$. Monthly decile returns are calculated from July of year t to June of $t+1$, and the deciles are rebalanced in June of $t+1$.

A.4.11 $\text{Gla}^{\text{q}}1$, $\text{Gla}^{\text{q}}6$, and $\text{Gla}^{\text{q}}12$, Quarterly Gross Profits-to-lagged Assets

Gla^{q}, is quarterly total revenue (Compustat quarterly item REVTQ) minus cost of goods sold (item COGSQ) divided by one-quarter-lagged total assets (item ATQ). At the beginning of each month t, we sort stocks into deciles based on Gla^{q} for the fiscal quarter ending at least four months ago. Monthly decile returns are calculated for month t ($\text{Gla}^{\text{q}}1$), from month t to $t+5$ ($\text{Gla}^{\text{q}}6$), and from month t to $t+11$ ($\text{Gla}^{\text{q}}12$). The deciles are rebalanced at the beginning of $t+1$. The holding period that is longer than one month as in, for instance, $\text{Gla}^{\text{q}}6$, means that for a given decile in each month there exist six subdeciles, each of which is initiated in a different month in the prior six-month period. We take the simple average of the subdecile returns as the monthly return of the $\text{Gla}^{\text{q}}6$ decile. For sufficient data coverage, the Gla^{q} portfolios start in January 1976.

A.4.12 Ope, Operating Profits to Equity

Following Fama and French (2015), we measure operating profitability to equity, Ope, 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). We require at least one of the three expense items (COGS, XSGA, and XINT) to be non-missing. Book equity is stockholders' book equity, plus balance sheet deferred taxes and investment tax credit (item TXDITC) if available, minus the book value of preferred stock. Stockholders' equity is the value reported by Compustat (item SEQ), if it is available. If not, we measure stockholders' equity as 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 (item PSTKRV), liquidating (item PSTKL), or par value (item PSTK) for the book value of preferred stock. At the end of June of each year t, we sort stocks into deciles based on Ope for the fiscal year ending in calendar year $t-1$. Monthly decile returns are calculated from July of year t to June of $t+1$, and the deciles are rebalanced in June of $t+1$.

A.4.13 Ole, Operating profits-to-lagged Equity

Ole is 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 one-year-lagged book equity. We require at least one of the three expense items (COGS, XSGA, and XINT) to be non-missing. Book equity is stockholders' book equity, plus balance sheet deferred taxes and investment tax credit (item TXDITC) if available, minus the book value of preferred stock. Stockholders' equity is the value reported by Compustat (item SEQ), if it is available. If not, we measure stockholders' equity as 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 (item PSTKRV), liquidating (item PSTKL), or par value (item PSTK) for the book value of preferred stock. At the end of June of each year t, we sort stocks into deciles on Ole for the fiscal year ending in calendar year $t-1$. Monthly decile returns are calculated from July of year t to June of $t+1$, and the deciles are rebalanced in June of $t+1$.

A.4.14 Ole^{q}1, Ole^{q}6, and Ole^{q}12, Quarterly Operating Profits-to-lagged Equity

Quarterly operating profits-to-lagged equity, Ole^q, is quarterly total revenue (Compustat quarterly item REVTQ) minus cost of goods sold (item COGSQ, zero if missing), minus selling, general, and administrative expenses (item XSGAQ, zero if missing), and minus interest expense (item XINTQ, zero if missing), scaled by one-quarter-lagged book equity. We require at least one of the three expense items (COGSQ, XSGAQ, and XINTQ) to be non-missing. Book equity is shareholders' equity, plus balance sheet deferred taxes and investment tax credit (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 book value of preferred stock, or total assets (item ATQ) minus total liabilities (item LTQ) in that order as shareholders' equity.

At the beginning of each month t, we split stocks on Ole^q for the fiscal quarter ending at least four months ago. Monthly decile returns are calculated for month t (Ole^{q}1), from month t to $t+5$ (Ole^{q}6), and from month t to $t+11$ (Ole^{q}12). The deciles are rebalanced at the beginning of $t+1$. The holding period longer than one month as in Ole^{q}6 means that for a given decile in each month there exist six subdeciles, each initiated in a different month in the prior six months. We take the simple average of the subdecile returns as the monthly return of the Ole^{q}6 decile. For sufficient data coverage, the Ole^q portfolios start in January 1972.

A.4.15 Opa, Operating Profits-to-assets

Following Ball, Gerakos, Linnainmaa, and Nikolaev (2015), we measure operating profits-to-assets, Opa, as total revenue (Compustat annual item REVT) minus cost of goods sold (item COGS), minus selling, general, and administrative expenses (item XSGA), and plus research and development expenditures (item XRD, zero if missing), scaled by book assets (item AT, the denominator is current, not lagged, total assets). At the end of June of each year t, we sort stocks into deciles based on Opa for the fiscal year ending in calendar year $t-1$. Monthly decile returns are calculated from July of year t to June of $t+1$, and the deciles are rebalanced in June of $t+1$.

A.4.16 Ola, Operating Profits-to-lagged Assets

Operating profits-to-lagged assets, Ola, is total revenue (Compustat annual item REVT) minus cost of goods sold (item COGS), minus selling, general, and administrative expenses (item XSGA), and plus research and development expenditures (item XRD, zero if missing), scaled by one-year-lagged book assets (item AT). At the end of June of each year t, we sort stocks into deciles based on Ola for the fiscal year ending in calendar year $t-1$. Monthly decile returns are calculated from July of year t to June of $t+1$, and the deciles are rebalanced in June of $t+1$.

A.4.17 Ola^{q}1, Ola^{q}6, and Ola^{q}12, Quarterly Operating Profits-to-lagged Assets

Quarterly operating profits-to-lagged assets, Ola^q, is quarterly total revenue (Compustat quarterly item REVTQ) minus cost of goods sold (item COGSQ), minus selling, general, and administrative expenses (item XSGAQ), plus research and development expenditures (item XRDQ, zero if missing), scaled by one-quarter-lagged book assets (item ATQ). At the beginning of each month t, we sort stocks into deciles based on Ola^q for the fiscal quarter ending at least four months ago. Monthly decile returns are calculated for month t (Ola^{q}1), from month t to $t+5$ (Ola^{q}6), and from month t to $t+11$ (Ola^{q}12). The deciles are rebalanced at the beginning of $t+1$. The holding period longer than one month as in Ola^{q}6 means that for a given decile in each month there exist six subdeciles, each initiated in a different month in the prior six months. We take the simple average of the subdecile returns as the monthly return of the Ola^{q}6 decile. For sufficient data coverage, the Ola^q portfolios start in January 1976.

A.4.18 Cop, Cash-based Operating Profitability

Following Ball, Gerakos, Linnainmaa, and Nikolaev (2016), we measure cash-based operating profitability, Cop, as total revenue (Compustat annual 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), all scaled by book assets (item AT, the denominator is current, not lagged, total assets). All changes are annual changes in balance sheet items and we set missing changes to zero. At the end of June of each year t, we sort stocks into deciles based on Cop for the fiscal year ending in calendar year $t-1$. Monthly decile returns are calculated from July of year t to June of $t+1$, and the deciles are rebalanced in June of $t+1$.

A.4.19 Cla, Cash-based Operating Profits-to-lagged Assets

Cash-based operating profits-to-lagged assets, Cla, is total revenue (Compustat annual 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), all scaled by one-year-lagged book assets (item AT). All changes are annual changes in balance sheet items and we set missing changes to zero. At the end of June of each year t, we sort stocks into deciles based on Cla for the fiscal year ending in calendar year $t-1$. Monthly decile returns are calculated from July of year t to June of $t+1$, and the deciles are rebalanced in June of $t+1$.

A.4.20 Cla^{q}1, Cla^{q}6, and Cla^{q}12, Quarterly Cash-based Operating Profits-to-lagged Assets

Quarterly cash-based operating profits-to-lagged assets, Cla, is quarterly total revenue (Compustat quarterly item REVTQ) minus cost of goods sold (item COGSQ), minus selling, general, and administrative expenses (item XSGAQ), plus research and development expenditures (item XRDQ, zero if missing), minus change in accounts receivable (item RECTQ), minus change in inventory (item INVTQ), plus change in deferred revenue (item DRCQ plus item DRLTQ), and plus change in trade accounts payable (item APQ), all scaled by one-quarter-lagged book assets (item ATQ). All changes are quarterly changes in balance sheet items and we set missing changes to zero. At the beginning of each month t, we split stocks on Cla^{q} for the fiscal quarter ending at least four months ago. Monthly decile returns are calculated for month t ($\text{Cla}^{\text{q}}1$), from month t to $t+5$ ($\text{Cla}^{\text{q}}6$), and from month t to $t+11$ ($\text{Cla}^{\text{q}}12$). The deciles are rebalanced at the beginning of $t+1$. The holding period longer than one month as in $\text{Cla}^{\text{q}}6$ means that for a given decile in each month there exist six subdeciles, each initiated in a different month in the prior six months. We take the simple average of the subdecile returns as the monthly return of the $\text{Cla}^{\text{q}}6$ decile. For sufficient data coverage, the Cla^{q} portfolios start in January 1976.

A.4.21 F, Fundamental Score

Piotroski (2000) classifies each fundamental signal as either good or bad depending on the signal's implication for future stock prices and profitability. An indicator variable for a particular signal is one if its realization is good and zero if it is bad. The aggregate signal, denoted F, is the sum of the nine binary signals. F is designed to measure the overall quality, or strength, of the firm's financial position. Nine fundamental signals are chosen to measure three areas of a firm's financial condition, profitability, liquidity, and operating efficiency.

Four variables are selected to measure profitability: (i) Roa is income before extraordinary items (Compustat annual item IB) scaled by one-year-lagged total assets (item AT). If the firm's Roa is positive, the indicator variable F_{Roa} equals one and zero otherwise. (ii) Cf/A is cash flow from operation scaled by one-year-lagged total assets. Cash flow from operation is net cash flow from operating activities (item OANCF) if available, or funds from operation (item FOPT) minus the annual change in working capital (item WCAP). If the firm's Cf/A is positive, the indicator variable $\text{F}_{\text{Cf/A}}$ equals one and zero otherwise. (iii) dRoa is the current year's Roa less the prior year's Roa. If dRoa is positive, the indicator variable F_{dROA} is one and zero otherwise. Finally, (iv) the indicator F_{Acc} equals one if Cf/A $>$ Roa and zero otherwise.

Three variables are selected to measure changes in capital structure and a firm's ability to meet future debt obligations. Piotroski (2000) assumes that an increase in leverage, a deterioration of liquidity, or the use of external financing is a bad signal about financial risk. (i) dLever is the change in the ratio of total long-term debt (Compustat annual item DLTT) to the average of current and one-year-lagged total assets. F_{dLever} is one if the firm's leverage ratio falls, i.e., dLever < 0, and zero otherwise. (ii) dLiquid measures the change in a firm's current ratio from the prior year, in which the current ratio is the ratio of current assets (item ACT) to current liabilities (item LCT). An improvement in liquidity (ΔdLiquid > 0) is a good signal about the firm's ability to service current debt obligations. The indicator $\text{F}_{\text{dLiquid}}$ equals one if the firm's liquidity improves and zero otherwise. (iii) The indicator, Eq, equals one if the firm does not issue common equity during the current year and zero otherwise. The issuance of common equity is sales of common and preferred stocks (item SSTK) minus any increase in preferred stocks (item PSTK). Issuing equity is interpreted as a bad signal (inability to generate sufficient internal funds to service future obligations).

The remaining two signals are designed to measure changes in the efficiency of the firm's operations that reflect two key constructs underlying the decomposition of return on assets. (i) dMargin is the firm's current gross margin ratio, measured as gross margin (Compustat annual item SALE minus item COGS) scaled by sales (item SALE), less the prior year's gross margin ratio. An improvement in margins signifies a potential improvement in factor costs, a reduction in inventory costs, or a rise in the price of the firm's product. The indictor F_{dMargin} equals one if dMargin > 0 and zero otherwise. (ii) dTurn is the firm's current year asset turnover ratio, measured as total sales scaled by one-year-lagged total assets (item AT), minus the prior year's asset turnover ratio. An improvement in asset turnover ratio signifies greater productivity from the asset base. The indicator, F_{dTurn}, equals one if dTurn > 0 and zero otherwise.

Piotroski (2000) forms a composite score, F, as the sum of the individual binary signals:

$$F \equiv F_{\text{Roa}} + F_{\text{dRoa}} + F_{\text{Cf/A}} + F_{\text{Acc}} + F_{\text{dMargin}} + F_{\text{dTurn}} + F_{\text{dLever}} + F_{\text{dLiquid}} + \text{Eq}. \tag{A8}$$

At the end of June of each year t, we sort stocks based on F for the fiscal year ending in calender year $t-1$ to form seven portfolios: low (F = 0,1,2), 3, 4, 5, 6, 7, and high (F = 8, 9). Because extreme F scores are rare, we combine scores 0, 1, and 2 into the low portfolio and scores 8 and 9 into the high portfolio. Monthly portfolio returns are calculated from July of year t to June of $t+1$, and the portfolios are rebalanced in June of $t+1$. For sufficient data coverage, the F portfolio returns start in July 1972.

A.4.22 F^q1, F^q6, and F^q12, Quarterly Fundamental Score

To construct quarterly F-score, F^q, we use quarterly accounting data and the same nine binary signals from Piotroski (2000). Among the four signals related to profitability: (i) Roa is quarterly income before extraordinary items (Compustat quarterly item IBQ) scaled by one-quarter-lagged total assets (item ATQ). If the firm's Roa is positive, the indicator variable F_{Roa} equals one and zero otherwise. (ii) Cf/A is quarterly cash flow from operation scaled by one-quarter-lagged total assets. Cash flow from operation is the quarterly change in year-to-date net cash flow from operating activities (item OANCFY) if available, or the quarterly change in year-to-date funds from operation (item FOPTY) minus the quarterly change in working capital (item WCAPQ). If the firm's Cf/A is positive, the indicator variable $F_{\text{Cf/A}}$ equals one and zero otherwise. (iii) dRoa is the current quarter's Roa less the Roa from four quarters ago. If dRoa is positive, the indicator variable F_{dROA} is one and zero otherwise. Finally, (iv) the indicator F_{Acc} equals one if Cf/A $>$ Roa and zero otherwise.

Among the three signals related changes in capital structure and a firm's ability to meet future debt obligations: (i) dLever is the change in the ratio of total long-term debt (Compustat quarterly item DLTTQ) to the average of current and one-quarter-lagged total assets. F_{dLever} is one if the firm's leverage ratio falls, i.e., dLever < 0, relative to its value four quarters ago, and zero otherwise. (ii) dLiquid measures the change in a firm's current ratio between the current quarter and four quarters ago, in which the current ratio is the ratio of current assets (item ACTQ) to current liabilities (item LCTQ). An improvement in liquidity (dLiquid > 0) is a good signal about the firm's ability to service current debt obligations. The indicator F_{dLiquid} equals one if the firm's liquidity improves and zero otherwise. (iii) The indicator, Eq, equals one if the firm does not issue common equity during the past four quarters and zero otherwise. The issuance of common equity is sales of common and preferred stocks minus any increase in preferred stocks (item PSTKQ). To measure sales of common and preferred stocks, we first compute the quarterly change in year-to-date sales of common and preferred stocks (item SSTKY) and then take the total change for the past four quarters. Issuing equity is interpreted as a bad signal (inability to generate sufficient internal funds to service future obligations). For the remaining two signals, (i) dMargin is the firm's current gross margin ratio, measured as gross margin (item SALEQ minus item COGSQ) scaled by sales (item SALEQ), less the gross margin ratio from four quarters ago. The indictor F_{dMargin} equals one if dMargin > 0 and zero otherwise. (ii) dTurn is the firm's current asset turnover ratio, measured as (item SALEQ) scaled by one-quarter-lagged total assets (item ATQ), minus the asset turnover ratio from four quarters ago. The indicator, $\mathrm{F}_{\mathrm{dTurn}}$, equals one if $\mathrm{dTurn} > 0$ and zero otherwise.

The composite score, F^{q}, is the sum of the individual binary signals:

$$\mathrm{F}^{\mathrm{q}} \equiv \mathrm{F}_{\mathrm{Roa}} + \mathrm{F}_{\mathrm{dRoa}} + \mathrm{F}_{\mathrm{Cf/A}} + \mathrm{F}_{\mathrm{Acc}} + \mathrm{F}_{\mathrm{dMargin}} + \mathrm{F}_{\mathrm{dTurn}} + \mathrm{F}_{\mathrm{dLever}} + \mathrm{F}_{\mathrm{dLiquid}} + \mathrm{Eq}. \tag{A9}$$

At the beginning of each month t, we sort stocks based on Fq for the fiscal quarter ending at least four quarters ago to form seven portfolios: low (F^{q} = 0,1,2), 3, 4, 5, 6, 7, and high (F^{q} = 8, 9). Monthly portfolio returns are calculated for month t ($\mathrm{F}^{\mathrm{q}}1$), from month t to $t+5$ ($\mathrm{F}^{\mathrm{q}}6$), and from month t to $t+11$ ($\mathrm{F}^{\mathrm{q}}12$), and the portfolios are rebalanced at the beginning of month $t+1$. The holding period longer than one month as in, for instance, $\mathrm{F}^{\mathrm{q}}6$, means that for a given portfolio in each month there exist six subportfolios, each of which is initiated in a different month in prior six months. We take the simple average of the subportfolio returns as the monthly return of the $\mathrm{F}^{\mathrm{q}}6$ portfolio. For sufficient data coverage, the F^{q} portfolios start in January 1985.

A.4.23 Fp, Fp$^{\mathrm{q}}$1, Fp$^{\mathrm{q}}$6, and Fp$^{\mathrm{q}}$12, Failure Probability

Failure probability (Fp) is from Campbell, Hilscher, and Szilagyi (2008, Table IV, Column 3):

$$\begin{aligned}\mathrm{Fp}_t \equiv & -9.164 - 20.264\mathrm{NIMTAAVG}_t + 1.416\mathrm{TLMTA}_t - 7.129\mathrm{EXRETAVG}_t \\ & + 1.411\mathrm{SIGMA}_t - 0.045\mathrm{RSIZE}_t - 2.132\mathrm{CASHMTA}_t + 0.075\mathrm{MB}_t - 0.058\mathrm{PRICE}_t\end{aligned} \tag{A10}$$

in which

$$\mathrm{NIMTAAVG}_{t-1,t-12} \equiv \frac{1-\phi^3}{1-\phi^{12}}\left(\mathrm{NIMTA}_{t-1,t-3} + \cdots + \phi^9\mathrm{NIMTA}_{t-10,t-12}\right) \tag{A11}$$

$$\mathrm{EXRETAVG}_{t-1,t-12} \equiv \frac{1-\phi}{1-\phi^{12}}\left(\mathrm{EXRET}_{t-1} + \cdots + \phi^{11}\mathrm{EXRET}_{t-12}\right), \tag{A12}$$

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. $\mathrm{EXRET} \equiv \log(1+R_{it}) - \log(1+R_{\mathrm{S\&P500},t})$ 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. We winsorize the variables on the right-hand side of equation (A10) at the 1th and 99th percentiles of their distributions each month.

To form the Fp deciles, we sort stocks at the end of June of year t based on Fp calculated with accounting data from the fiscal quarter ending at least four months ago. Because unlike earnings, other quarterly data items in the definition of Fp might not be available upon earnings announcement, we impose a four-month gap between the fiscal quarter end and portfolio formation to guard against look-ahead bias. We calculate decile returns from July of year t to June of year $t+1$, and the deciles are rebalanced in June. For sufficient data coverage, the Fp deciles start in July 1976.

At the beginning of each month t, we split stocks into deciles based on Fp calculated with accounting data from the fiscal quarter ending at least four months ago. We calculate decile returns for the current month t (Fp^q1), from month t to $t+5$ (Fp^q6), and from month t to $t+11$ (Fp^q12). The deciles are rebalanced at the beginning of month $t+1$. The holding period that is longer than one month as in, for instance, Fp^q6, means that for a given decile in each month there exist six subdeciles, each of which is initiated in a different month in the prior six-month period. We take the simple average of the subdeciles returns as the monthly return of the Fp^q6 decile. For sufficient data coverage, the quarterly Fp deciles start in January 1976.

A.4.24 O, O^q1, O^q6, and O^q12, Ohlson's O-score

We follow Ohlson (1980, Model One in Table 4) to construct O-score (Dichev 1998):

$$\begin{aligned} \text{O} \equiv\ & -1.32 - 0.407\log(\text{TA}) + 6.03\text{TLTA} - 1.43\text{WCTA} + 0.076\text{CLCA} \\ & - 1.72\text{OENEG} - 2.37\text{NITA} - 1.83\text{FUTL} + 0.285\text{INTWO} - 0.521\text{CHIN}, \end{aligned} \tag{A13}$$

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 (A13) at the 1th and 99th percentiles of their distributions each year. At the end of June of each year t, we sort stocks into deciles based on O-score for the fiscal year ending in calendar year $t-1$. Monthly decile returns are calculated from July of year t to June of $t+1$, and the deciles are rebalanced in June of $t+1$.

We use quarterly accounting data to construct the quarterly O-score as:

$$\begin{aligned} \text{O}^q \equiv\ & -1.32 - 0.407\log(\text{TA}^q) + 6.03\text{TLTA}^q - 1.43\text{WCTA}^q + 0.076\text{CLCA}^q \\ & - 1.72\text{OENEG}^q - 2.37\text{NITA}^q - 1.83\text{FUTL}^q + 0.285\text{INTWO}^q - 0.521\text{CHIN}^q, \end{aligned} \tag{A14}$$

in which TA^q is total assets (Compustat quarterly item ATQ). TLTA^q is the leverage ratio defined as total debt (item DLCQ plus item DLTTQ) divided by total assets. WCTA^q is working capital (item ACTQ minus item LCT) divided by total assets. CLCA^{q} is current liability (item LCTQ) divided by current assets (item ACTQ). OENEG^{q} is one if total liabilities (item LTQ) exceeds total assets and zero otherwise. NITA^{q} is the sum of net income (item NIQ) for the trailing four quarters divided by total assets at the end of the current quarter. FUTL^{q} is the the sum of funds provided by operations (item PIQ plus item DPQ) for the trailing four quarters divided by total liabilities at the end of the current quarter. INTWO^{q} is equal to one if net income is negative for the current quarter and four quarters ago, and zero otherwise. CHIN^{q} is $(\text{NIQ}_s - \text{NIQ}_{s-4})/(|\text{NIQ}_s| + |\text{NIQ}_{s-4}|)$, in which NIQ_s and NIQ_{s-4} are the net income for the current quarter and four quarters ago. We winsorize all non-dummy variables on the right-hand side of equation (A14) at the 1th and 99th percentiles of their distributions each month.

At the beginning of each month t, we sort stocks into deciles based on O^{q} calculated with accounting data from the fiscal quarter ending at least four months ago. We calculate decile returns for the current month t ($\text{O}^{\text{q}}1$), from month t to $t+5$ ($\text{O}^{\text{q}}6$), and from month t to $t+11$ ($\text{O}^{\text{q}}12$). The deciles are rebalanced at the beginning of month $t+1$. The holding period that is longer than one month as in, for instance, $\text{O}^{\text{q}}6$, means that for a given decile in each month there exist six subdeciles, each of which is initiated in a different month in the prior six-month period. We take the simple average of the subdecile returns as the monthly return of the $\text{O}^{\text{q}}6$ decile. For sufficient data coverage, the O^{q} portfolios start in January 1973.

A.4.25 Z, $\text{Z}^{\text{q}}1$, $\text{Z}^{\text{q}}6$, and $\text{Z}^{\text{q}}12$, Altman's Z-score

We follow Altman (1968) to construct the Z-score (Dichev 1998):

$$\text{Z} \equiv 1.2\text{WCTA} + 1.4\text{RETA} + 3.3\text{EBITTA} + 0.6\text{METL} + \text{SALETA}, \tag{A15}$$

in which WCTA is working capital (Compustat annual item ACT minus item LCT) divided by total assets (item AT), RETA is retained earnings (item RE) divided by total assets, EBITTA is earnings before interest and taxes (item OIADP) divided by total assets, METL is the market equity (from CRSP, at fiscal year end) divided by total liabilities (item LT), and SALETA is sales (item SALE) divided by total assets. For firms with more than one share class, we merge the market equity for all share classes before computing Z. We winsorize all non-dummy variables on the right-hand side of equation (A15) at the 1th and 99th percentiles of their distributions each year. At the end of June of each year t, we split stocks into deciles based on Z-score for the fiscal year ending in calendar year $t-1$. Monthly decile returns are calculated from July of year t to June of $t+1$, and the deciles are rebalanced in June of $t+1$.

We use quarterly accounting data to construct the quarterly Z-score as:

$$\text{Z}^{\text{q}} \equiv 1.2\text{WCTA}^{\text{q}} + 1.4\text{RETA}^{\text{q}} + 3.3\text{EBITTA}^{\text{q}} + 0.6\text{METL}^{\text{q}} + \text{SALETA}^{\text{q}}, \tag{A16}$$

in which WCTA^{q} is working capital (Compustat quarterly item ACTQ minus item LCTQ) divided by total assets (item ATQ), RETA^{q} is retained earnings (item REQ) divided by total assets, EBITTA^{q} is the sum of earnings before interest and taxes (item OIADPQ) for the trailing four quarters divided by total assets at the end of the current quarter, METL^{q} is the market equity (from CRSP, at fiscal quarter end) divided by total liabilities (item LTQ), and SALETA^{q} is the sum of sales (item SALEQ) for the trailing four quarters divided by total assets at the end of the current quarter. For firms with more than one share class, we merge the market equity for all share classes before computing Z^{q}. We winsorize all non-dummy variables on the right-hand side of equation (A16) at the 1th and 99th percentiles of their distributions each month.

At the beginning of each month t, we split stocks into deciles based on Z^q calculated with accounting data from the fiscal quarter ending at least four months ago. We calculate decile returns for the current month t (Z^q1), from month t to $t+5$ (Z^q6), and from month t to $t+11$ (Z^q12). The deciles are rebalanced at the beginning of month $t+1$. The holding period that is longer than one month as in, for instance, Z^q6, means that for a given decile in each month there exist six subdeciles, each of which is initiated in a different month in the prior six-month period. We take the simple average of the subdecile returns as the monthly return of the Z^q6 decile. For sufficient data coverage, the Z^q portfolios start in January 1973.

A.4.26 G, Growth Score

Following Mohanram (2005), we construct the G-score as the sum of eight binary signals: $G \equiv G_1 + \ldots + G_8$. G_1 equals one if a firm's return on assets (Roa) is greater than the median Roa in the same industry (two-digit SIC code), and zero otherwise. Roa is net income before extraordinary items (Compustat annual item IB) scaled by the average of total assets (item AT) from the current and prior years. We also calculate an alternative measure of Roa using cash flow from operations instead of net income. Cash flow from operation is net cash flow from operating activities (item OANCF) if available, or funds from operation (item FOPT) minus the annual change in working capital (item WCAP). G_2 equals one if a firm's cash flow Roa exceeds the industry median, and zero otherwise. G_3 equals one if a firm's cash flow from operations exceeds net income, and zero otherwise.

G_4 equals one if a firm's earnings variability is less than the industry median. Earnings variability is the variance of a firm's quarterly Roa during the past 16 quarters (six quarters minimum). Quarterly Roa is quarterly net income before extraordinary items (Compustat quarterly item IBQ) scaled by one-quarter-lagged total assets (item ATQ). G_5 equals one if a firm's sales growth variability is less the industry median, and zero otherwise. Sales growth variability is the variance of a firm's quarterly sales growth during the past 16 quarters (six quarters minimum). Quarterly sales growth is the growth in quarterly sales (item SALEQ) from its value four quarters ago.

G_6 equals one if a firm's R&D (Compustat annual item XRD) deflated by one-year-lagged total assets is greater than the industry median, and zero otherwise. G_7 equals one if a firm's capital expenditure (item CAPX) deflated by one-year-lagged total assets is greater than the industry median, and zero otherwise. G_8 equals one if a firm's advertising expenses (item XAD) deflated by one-year-lagged total assets is greater than the industry median, and zero otherwise.

At the end of June of each year t, we sort stocks on G for the fiscal year ending in calender year $t-1$ to form seven portfolios: low (F = 0,1), 2, 3, 4, 5, 6, and high (F = 7,8). Because extreme G scores are rare, we combine scores 0, and 1 into the low portfolio and scores 7 and 8 into the high portfolio. Monthly portfolio returns are calculated from July of year t to June of $t+1$, and the portfolios are rebalanced in June of $t+1$. For sufficient data coverage, the G portfolio returns start in July 1976.

A.4.27 Cr1, Cr6, and Cr12, Credit Ratings

Following Avramov, Chordia, Jostova, and Philipov (2009), we measure credit ratings, Cr, by transforming S&P ratings into numerical scores as follows: AAA=1, AA+=2, AA=3, AA−=4, A+=5, A=6, A−=7, BBB+=8, BBB=9, BBB−=10, BB+=11, BB=12, BB−=13, B+=14, B=15, B−=16, CCC+=17, CCC=18, CCC−=19, CC=20, C=21, and D=22. At the beginning of each month t, we sort stocks into quintiles based on Cr at the end of $t-1$. We do not form deciles because a disproportional number of firms can have the same rating, which leads to fewer than ten portfolios. We calculate quintile returns for the current month t (Cr1), from month t to $t+5$ (Cr6), and from month t to $t+11$ (Cr12). The quintiles are rebalanced at the beginning of month $t+1$. The holding period that is longer than one month as in, for instance, Cr6, means that for a given quintile in each month there exist six subquintiles, each of which is initiated in a different month in the prior six-month period. We take the simple average of the subquintiles returns as the monthly return of the Cr6 quintile. For sufficient data coverage, the Cr portfolios start in January 1986.

A.4.28 Tbi, Taxable Income-to-book Income

Following Green, Hand, and Zhang (2013), we measure taxable income-to-book income, Tbi, as pretax income (Compustat annual item PI) divided by net income (item NI). At the end of June of each year t, we sort stocks into deciles based on Tbi for the fiscal year ending in calendar year $t-1$. We exclude firms with non-positive pretax income or net income. Monthly decile returns are calculated from July of year t to June of $t+1$, and the deciles are rebalanced in June of $t+1$.

A.4.29 Tbi^{q}1, Tbi^{q}6, and Tbi^{q}12, Quarterly Taxable Income-to-book Income

Quarterly taxable income-to-book income, Tbi^{q}, is quarterly pretax income (Compustat quarterly item PIQ) divided by net income (NIQ). At the beginning of each month t, we split stocks into deciles based on Tbi^{q} calculated with accounting data from the fiscal quarter ending at least four months ago. We exclude firms with non-positive pretax income or net income. We calculate monthly decile returns for the current month t (Tbi^{q}1), from month t to $t+5$ (Tbi^{q}6), and from month t to $t+11$ (Tbi^{q}12). The deciles are rebalanced at the beginning of month $t+1$. The holding period that is longer than one month as in, for instance, Tbi^{q}6, means that for a given decile in each month there exist six subdeciles, each of which is initiated in a different month in the prior six-month period. We take the simple average of the subdecile returns as the monthly return of the Tbi^{q}6 decile.

A.4.30 Bl, Book Leverage

Following Fama and French (1992), we measure book leverage, Bl, as total assets (Compustat annual item AT) divided by book equity. Following Davis, Fama, and French (2000), we measure book equity as stockholders' book equity, plus balance sheet deferred taxes and investment tax credit (item TXDITC) if available, minus the book value of preferred stock. Stockholders' equity is the value reported by Compustat (item SEQ), if it is available. If not, we measure stockholders' equity as 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 (item PSTKRV), liquidating (item PSTKL), or par value (item PSTK) for the book value of preferred stock. At the end of June of each year t, we sort stocks into deciles based on Bl for the fiscal year ending in calendar year $t-1$. Monthly decile returns are calculated from July of year t to June of $t+1$, and the deciles are rebalanced in June of $t+1$.

A.4.31 Bl^{q}1, Bl^{q}6, and Bl^{q}12, Quarterly Book Leverage

Quarterly book leverage, Bl^{q}, is total assets (Compustat quarterly item ATQ) divided by book equity. Book equity is shareholders' equity, plus balance sheet deferred taxes and investment tax credit (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 book value of preferred stock, or total assets (item ATQ) minus total liabilities (item LTQ) in that order as shareholders' equity. At the beginning of each month t, we split stocks into deciles on Bl^{q} for the fiscal quarter ending at least four months ago. We calculate monthly decile returns for the current month t ($\text{Bl}^{\text{q}}1$), from month t to $t+5$ ($\text{Bl}^{\text{q}}6$), and from month t to $t+11$ ($\text{Bl}^{\text{q}}12$). The deciles are rebalanced at the beginning of month $t+1$. The holding period that is longer than one month as in, for instance, $\text{Bl}^{\text{q}}6$, means that for a given decile in each month there exist six subdeciles, each of which is initiated in a different month in the prior six-month period. We take the simple average of the subdecile returns as the monthly return of the $\text{Bl}^{\text{q}}6$ decile. For sufficient data coverage, the Bl^{q} portfolios start in January 1972.

A.4.32 $\text{Sg}^{\text{q}}1$, $\text{Sg}^{\text{q}}6$, and $\text{Sg}^{\text{q}}12$, Quarterly Sales Growth

Quarterly sales growth, Sg^{q}, is quarterly sales (Compustat quarterly item SALEQ) divided by its value four quarters ago. At the beginning of each month t, we sort stocks into deciles based on the latest Sg^{q}. Before 1972, we use the most recent Sg^{q} from fiscal quarters ending at least four months ago. Starting from 1972, we use Sg^{q} from the most recent quarterly earnings announcement dates (item RDQ). Sales are generally announced with earnings during quarterly earnings announcements (Jegadeesh and Livnat 2006). For a firm to enter the portfolio formation, we require the end of the fiscal quarter that corresponds to its most recent Sg^{q} to be within six months prior to the portfolio formation. This restriction is imposed to exclude stale information. To avoid potentially erroneous records, we also require the earnings announcement date to be after the corresponding fiscal quarter end. We calculate monthly decile returns for the current month t ($\text{Sg}^{\text{q}}1$), from month t to $t+5$ ($\text{Sg}^{\text{q}}6$), and from month t to $t+11$ ($\text{Sg}^{\text{q}}12$). The deciles are rebalanced at the beginning of month $t+1$. The holding period that is longer than one month as in, for instance, $\text{Sg}^{\text{q}}6$, means that for a given decile in each month there exist six subdeciles, each of which is initiated in a different month in the prior six-month period. We take the simple average of the subdecile returns as the monthly return of the $\text{Sg}^{\text{q}}6$ decile.

A.5 Intangibles

A.5.1 Oca and Ioca, (Industry-adjusted) Organizational Capital-to-assets

Following Eisfeldt and Papanikolaou (2013), we construct the stock of organization capital, Oc, using the perpetual inventory method:

$$\text{Oc}_{it} = (1-\delta)\text{Oc}_{it-1} + \text{SG\&A}_{it}/\text{CPI}_t, \tag{A17}$$

in which Oc_{it} is the organization capital of firm i at the end of year t, $\text{SG\&A}_{it}$ is selling, general, and administrative (SG&A) expenses (Compustat annual item XSGA) in t, CPI_t is the average consumer price index during year t, and δ is the annual depreciation rate of Oc. The initial stock of Oc is $\text{Oc}_{i0} = \text{SG\&A}_{i0}/(g+\delta)$, in which $\text{SG\&A}_{i0}$ is the first valid SG&A observation (zero or positive) for firm i and g is the long-term growth rate of SG&A. We assume a depreciation rate of 15% for Oc and a long-term growth rate of 10% for SG&A. Missing SG&A values after the starting date are treated as zero. For portfolio formation at the end of June of year t, we require SG&A to be non-missing for the fiscal year ending in calendar year $t-1$ because this SG&A value receives the highest weight in Oc. In addition, we exclude firms with zero Oc. Organizational Capital-to-assets, Oca, is Oc scaled by total assets (item AT). We also industry-standardize Oca using the FF (1997) 17-industry classification. To calculate the industry-adjusted Oca, Ioca, we demean a firm's Oca by its industry mean and then divide the demeaned Oca by the standard deviation of Oca within its industry. To alleviate the impact of outliers, we winsorize Oca at the 1 and 99 percentiles of all firms each year before the industry standardization. At the end of June of each year t, we sort stocks into deciles based on Oca, and separately, on Ioca, for the fiscal year ending in calendar year $t-1$. Monthly decile returns are calculated from July of year t to June of $t+1$, and the deciles are rebalanced in June of $t+1$.

A.5.2 Adm, Advertising Expense-to-market

At the end of June of each year t, we sort stocks into deciles based on advertising expenses-to-market, Adm, which is advertising expenses (Compustat annual item XAD) for the fiscal year ending in calendar year $t-1$ divided by the market equity (from CRSP) at the end of December of $t-1$. For firms with more than one share class, we merge the market equity for all share classes before computing Adm. We keep only firms with positive advertising expenses. Monthly decile returns are calculated from July of year t to June of $t+1$, and the deciles are rebalanced in June of $t+1$. Because sufficient XAD data start in 1972, the Adm portfolios start in July 1973.

A.5.3 gAd, Growth in Advertising Expense

At the end of June of each year t, we sort stocks into deciles based on growth in advertising expenses, gAd, which is the growth rate of advertising expenses (Compustat annual item XAD) from the fiscal year ending in calendar year $t-2$ to the fiscal year ending in calendar year $t-1$. Following Lou (2014), we keep only firms with advertising expenses of at least 0.1 million dollars. Monthly decile returns are calculated from July of year t to June of $t+1$, and the deciles are rebalanced in June of $t+1$. Because sufficient XAD data start in 1972, the gAd portfolios start in July 1974.

A.5.4 Rdm, R&D Expense-to-market

At the end of June of each year t, we sort stocks into deciles based on R&D-to-market, Rdm, which is R&D expenses (Compustat annual item XRD) for the fiscal year ending in calendar year $t-1$ divided by the market equity (from CRSP) at the end of December of $t-1$. For firms with more than one share class, we merge the market equity for all share classes before computing Rdm. We keep only firms with positive R&D expenses. Monthly decile returns are calculated from July of year t to June of $t+1$, and the deciles are rebalanced in June of $t+1$. Because the accounting treatment of R&D expenses was standardized in 1975, the Rdm portfolios start in July 1976.

A.5.5 Rdm^q1, Rdm^q6, and Rdm^q12, Quarterly R&D Expense-to-market

At the beginning of each month t, we split stocks into deciles based on quarterly R&D-to-market, Rdm^q, which is quarterly R&D expense (Compustat quarterly item XRDQ) for the fiscal quarter ending at least four months ago scaled by the market equity (from CRSP) at the end of $t-1$. For firms with more than one share class, we merge the market equity for all share classes before computing Rdm^q. We keep only firms with positive R&D expenses. We calculate decile returns for the current month t (Rdm^q1), from month t to $t+5$ (Rdm^q6), and from month t to $t+11$ (Rdm^q12), and the deciles are rebalanced at the beginning of month $t+1$. The holding period longer than one month as in, for instance, Rdm^q6, means that for a given decile in each month there exist six subdeciles, each of which is initiated in a different month in the prior six months. We take the simple average of the subdecile returns as the monthly return of the Rdm^q6 decile. Because the quarterly R&D data start in late 1989, the Rdm^q portfolios start in January 1990.

A.5.6 Rds, R&D Expenses-to-sales

At the end of June of each year t, we sort stocks into deciles based on R&D-to-sales, Rds, which is R&D expenses (Compustat annual item XRD) divided by sales (item SALE) for the fiscal year ending in calendar year $t-1$. We keep only firms with positive R&D expenses. Monthly decile returns are calculated from July of year t to June of $t+1$, and the deciles are rebalanced in June of $t+1$. Because the accounting treatment of R&D expenses was standardized in 1975, the Rds portfolios start in July 1976.

A.5.7 Rds^{q}1, Rds^{q}6, and Rds^{q}12, Quarterly R&D Expense-to-sales

At the beginning of each month t, we split stocks into deciles based on quarterly R&D-to-sales, Rds^q, which is quarterly R&D expense (Compustat quarterly item XRDQ) scaled by sales (item SALEQ) for the fiscal quarter ending at least four months ago. We keep only firms with positive R&D expenses. We calculate decile returns for the current month t (Rds^{q}1), from month t to t+5 (Rds^{q}6), and from month t to $t+11$ (Rds^{q}12), and the deciles are rebalanced at the beginning of month $t+1$. The holding period longer than one month as in, for instance, Rds^{q}6, means that for a given decile in each month there exist six subdeciles, each of which is initiated in a different month in the prior six months. We take the simple average of the subdecile returns as the monthly return of the Rds^{q}6 decile. Because the quarterly R&D data start in late 1989, the Rds^q portfolios start in January 1990.

A.5.8 Ol, Operating Leverage

Following Novy-Marx (2011), operating leverage, Ol, is operating costs scaled by total assets (Compustat annual item AT, the denominator is current, not lagged, total assets). Operating costs are cost of goods sold (item COGS) plus selling, general, and administrative expenses (item XSGA). At the end of June of year t, we sort stocks into deciles based on Ol for the fiscal year ending in calendar year $t-1$. Monthly decile returns are calculated from July of year t to June of $t+1$, and the deciles are rebalanced in June of $t+1$.

A.5.9 Ol^{q}1, Ol^{q}6, and Ol^{q}12, Quarterly Operating Leverage

At the beginning of each month t, we split stocks into deciles based on quarterly operating leverage, Ol^q, which is quarterly operating costs divided by assets (Compustat quarterly item ATQ) for the fiscal quarter ending at least four months ago. Operating costs are the cost of goods sold (item COGSQ) plus selling, general, and administrative expenses (item XSGAQ). We calculate decile returns for the current month t (Ol^{q}1), from month t to $t+5$ (Ol^{q}6), and from month t to $t+11$ (Ol^{q}12), and the deciles are rebalanced at the beginning of month $t+1$. The holding period longer than one month as in, for instance, Ol^{q}6, means that for a given decile in each month there exist six subdeciles, each of which is initiated in a different month in the prior six months. We take the simple average of the subdecile returns as the monthly return of the Ol^{q}6 decile. For sufficient data coverage, the Ol^q portfolios start in January 1972.

A.5.10 Hn, Hiring Rate

Following Belo, Lin, and Bazdresch (2014), at the end of June of year t, we measure the hiring rate (Hn) as $(N_{t-1}-N_{t-2})/(0.5N_{t-1}+0.5N_{t-2})$, in which N_{t-j} is the number of employees (Compustat annual item EMP) from the fiscal year ending in calendar year $t-j$. At the end of June of year t, we sort stocks into deciles based on Hn. We exclude firms with zero Hn (these observations are often due to stale information on firm employment). Monthly decile returns are calculated from July of year t to June of $t+1$, and the deciles are rebalanced in June of $t+1$.

A.5.11 Rca, R&D Capital-to-assets

Following Li (2011), we measure R&D capital, Rc, by accumulating annual R&D expenses over the past five years with a linear depreciation rate of 20%:

$$\mathrm{Rc}_{it} = \mathrm{XRD}_{it} + 0.8\,\mathrm{XRD}_{it-1} + 0.6\,\mathrm{XRD}_{it-2} + 0.4\,\mathrm{XRD}_{it-3} + 0.2\,\mathrm{XRD}_{it-4}, \tag{A18}$$

in which XRD_{it-j} is firm i's R&D expenses (Compustat annual item XRD) in year $t-j$. R&D capital-to-assets, Rca, is Rc scaled by total assets (item AT). At the end of June of each year t, we sort stocks into deciles based on Rca for the fiscal year ending in calendar year $t-1$. We keep only firms with positive Rc. Monthly decile returns are calculated from July of year t to June of $t+1$, and the deciles are rebalanced in June of $t+1$. For portfolio formation at the end of June of year t, we require R&D expenses to be non-missing for the fiscal year ending in calendar year $t-1$, because this value of R&D expenses receives the highest weight in Rc. Because Rc requires past five years of R&D expenses data and the accounting treatment of R&D expenses was standardized in 1975, the Rca portfolios start in July 1980.

A.5.12 Bca, Brand Capital-to-assets

Following Belo, Lin, and Vitorino (2014), we construct brand capital, Bc, by accumulating advertising expenses with the perpetual inventory method:

$$\mathrm{Bc}_{it} = (1-\delta)\mathrm{Bc}_{it-1} + \mathrm{XAD}_{it}. \tag{A19}$$

in which Bc_{it} is the brand capital for firm i at the end of year t, XAD_{it} is the advertising expenses (Compustat annual item XAD) in t, and δ is the annual depreciation rate of Bc. The initial stock of Bc is $\mathrm{Bc}_{i0} = \mathrm{XAD}_{i0}/(g+\delta)$, in which XAD_{i0} is first valid XAD (zero or positive) for firm i and g is the long-term growth rate of XAD. Following Belo et al., we assume a depreciation rate of 50% for Bc and a long-term growth rate of 10% for XAD. Missing values of XAD after the starting date are treated as zero. For the portfolio formation at the end of June of year t, we exclude firms with zero Bc and require XAD to be non-missing for the fiscal year ending in calendar year $t-1$. Brand capital-to-assets, Bca, is Bc scaled by total assets (item AT). At the end of June of each year t, we sort stocks into deciles based on Bca for the fiscal year ending in calendar year $t-1$. Monthly decile returns are calculated from July of year t to June of $t+1$, and the deciles are rebalanced in June of $t+1$. Because sufficient XAD data start in 1972, the Bc portfolios start in July 1973.

A.5.13 Aop, Analysts Optimism

Following Frankel and Lee (1998), we measure analysts optimism, Aop, as (Vf−Vh)/|Vh|, in which Vf is the analysts forecast-based intrinsic value, and Vh is the historical Roe-based intrinsic value. See section A.2.27 for the construction of intrinsic values. At the end of June of each year t, we sort stocks into deciles based on Aop. Monthly decile returns are calculated from July of year t to June of $t+1$, and the deciles are rebalanced in June of $t+1$.

A.5.14 Pafe, Predicted Analysts Forecast Error

Following Frankel and Lee (1998), we define analysts forecast errors for year t as the actual realized Roe in year $t+3$ minus the predicted Roe for $t+3$ based on analyst forecasts. See section A.2.27 for the measurement of realized and predicted Roe. To calculate predicted analysts forecast errors, Pafe, for the portfolio formation at the end of June of year t, we estimate the intercept and slopes of the annual cross-sectional regressions of $\text{Roe}_{t-1} - E_{t-4}[\text{Roe}_{t-1}]$ on four firm characteristics for the fiscal year ending in calendar year $t-4$, including prior five-year sales growth, book-to-market, long-term earnings growth forecast, and analysts optimism. Prior five-year sale growth is the growth rate in sales (Compustat annual item SALE) from the fiscal year ending in calendar year $t-9$ to the fiscal year ending in $t-4$. Book-to-market is book equity (item CEQ) for the fiscal year ending in calendar year $t-4$ divided by the market equity (form CRSP) at the end of June in $t-3$. Long-term earnings growth forecast is from IBES (unadjusted file, item MEANEST; fiscal period indicator = 0), reported in June of $t-3$. See Section A.5.13 for the construction of analyst optimism. We winsorize the regressors at the 1st and 99th percentiles of their respective pooled distributions each year, and standardize all the regressors (by subtracting mean and dividing by standard deviation). Pafe for the portfolio formation year t is then obtained by applying the estimated intercept and slopes on the winsorized and standardized regressors for the fiscal year ending in calendar year $t-1$. At the end of June of each year t, we sort stocks into deciles based on Pafe. Monthly decile returns are calculated from July of year t to June of $t+1$, and the deciles are rebalanced in June of $t+1$. Because the long-term earnings growth forecast data start in 1981, the Pafe portfolios start in July 1985.

A.5.15 Parc, Patent-to-R&D Capital

Following Hirshleifer, Hsu, and Li (2013), we measure patent-to-R&D capital, Parc, as the ratio of firm i's patents granted in year t, Patents_{it}, scaled by its R&D capital for the fiscal year ending in calendar year $t-2$, $\text{Patents}_{it}/(\text{XRD}_{it-2} + 0.8\,\text{XRD}_{it-3} + 0.6\,\text{XRD}_{it-4} + 0.4\,\text{XRD}_{it-5} + 0.2\,\text{XRD}_{it-6})$, in which XRD_{it-j} is R&D expenses (Compustat annual item XRD) for the fiscal year ending in calendar year $t-j$. We require non-missing R&D expenses for the fiscal year ending in $t-2$ but set missing values to zero for other years ($t-6$ to $t-3$). The patent data are from the National Bureau of Economic Research patent database and are available from 1976 to 2006. At the end of June of each year t, we use Parc for $t-1$ to form deciles. Stocks with zero Parc are grouped into one portfolio (1) and stocks with positive Parc are sorted into nine portfolios (2 to 10). Monthly decile returns are calculated from July of year t to June of $t+1$, and the deciles are rebalanced in June of $t+1$. Because the accounting treatment of R&D expenses was standardized in 1975 and the NBER patent data stop in 2006, the Parc portfolios are available from July 1982 to June 2008.

A.5.16 Crd, Citations-to-R&D Expenses

Following Hirshleifer, Hsu, and Li (2013), we measure citations-to-R&D expenses, Crd, in year t as the adjusted number of citations occurring in year t to firm i's patents granted over the previous five years scaled by the sum of corresponding R&D expenses:

$$\text{Crd}_\text{t} = \frac{\sum_{s=1}^{5}\sum_{k=1}^{N_{t-s}} C_{ik}^{t-s}}{\sum_{s=1}^{5}\text{XRD}_{it-2-s}}, \tag{A20}$$

in which C_{ik}^{t-s} is the number of citations received in year t by patent k, granted in year $t-s$ scaled by the average number of citations received in year t by all patents of the same subcategory granted in year $t-s$. N_{t-s} is the total number of patents granted in year $t-s$ to firm i. XRD_{it-2-s} is R&D expenses (Compustat annual item XRD) for the fiscal year ending in calendar year $t-2-s$. At the end of June of each year t, we use Crd for $t-1$ to form deciles. Stocks with zero Crd are grouped into one portfolio (1) and stocks with positive Crd are sorted into nine portfolios (2 to 10). Monthly decile returns are calculated from July of year t to June of $t+1$, and the deciles are rebalanced in June of $t+1$.

A.5.17 Hs, Ha, and He, Industry Concentration (Sales, Assets, Book Equity)

Following Hou and Robinson (2006), we measure a firm's industry concentration with the Herfindahl index, $\sum_{i=1}^{N_j} s_{ij}^2$, in which s_{ij} is the market share of firm i in industry j, and N_j is the total number of firms in the industry. We calculate the market share of a firm using sales (Compustat annual item SALE), total assets (item AT), or book equity. Following Davis, Fama, and French (2000), we measure book equity as stockholders' book equity, plus balance sheet deferred taxes and investment tax credit (item TXDITC) if available, minus the book value of preferred stock. Stockholders' equity is the value reported by Compustat (item SEQ), if it is available. If not, we measure stockholders' equity as 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 (item PSTKRV), liquidating (item PSTKL), or par value (item PSTK) for the book value of preferred stock. Industries are defined by three-digit SIC codes. We exclude financial firms (SIC between 6000 and 6999) and firms in regulated industries. Following Barclay and Smith (1995), the regulated industries include: railroads (SIC=4011) through 1980, trucking (4210 and 4213) through 1980, airlines (4512) through 1978, telecommunication (4812 and 4813) through 1982, and gas and electric utilities (4900 to 4939). To improve the accuracy of the concentration measure, we exclude an industry if the market share data are available for fewer than five firms or 80% of all firms in the industry. We measure industry concentration as the average Herfindahl index during the past three years. Industry concentrations calculated with sales, assets, and book equity are denoted, Hs, Ha, and He, respectively. At the end of June of each year t, we sort stocks into deciles based on Hs, Ha, and He for the fiscal year ending in calendar year $t-1$. Monthly decile returns are calculated from July of year t to June of $t+1$, and the deciles are rebalanced in June of $t+1$.

A.5.18 Age1, Age6, and Age12, Firm Age

Following Jiang, Lee, and Zhang (2005), we measure firm age, Age, as the number of months between the portfolio formation date and the first month that a firm appears in Compustat or CRSP (item permco). At the beginning of each month t, we sort stocks into quintiles based on Age at the end of $t-1$. We do not form deciles because a disproportional number of firms can have the same Age (e.g., caused by the inception of Nasdaq coverage in 1973). Monthly quintile returns are calculated for the current month t (Age1), from month t to $t+5$ (Age6), and from month t to $t+11$ (Age12), and the quintiles are rebalanced at the beginning of month $t+1$. The holding period longer than one month as in, for instance, Age6, means that for a given quintile in each month there exist six subquintiles, each of which is initiated in a different month in the prior six months. We take the simple average of the subquintiles returns as the monthly return of the Age6 quintile.

A.5.19 D1, D2, and D3, Price Delay

At the end of June of each year, we regress each stock's weekly returns over the prior year on the contemporaneous and four weeks of lagged market returns:

$$r_{it} = \alpha_i + \beta_i R_{mt} + \sum_{n=1}^{4} \delta_i^{(-n)} R_{mt-n} + \epsilon_{it}, \tag{A21}$$

in which r_{it} is the return on stock j in week t, and R_{mt} is the return on the CRSP value-weighted market index. Weekly returns are measured from Wednesday market close to the next Wednesday market close. Following Hou and Moskowitz (2005), we calculate three price delay measures:

$$\text{D1}_i \equiv 1 - \frac{R^2_{\delta_i^{(-4)}=\delta_i^{(-3)}=\delta_i^{(-2)}=\delta_i^{(-1)}=0}}{R^2}, \tag{A22}$$

in which $R^2_{\delta_i^{(-4)}=\delta_i^{(-3)}=\delta_i^{(-2)}=\delta_i^{(-1)}=0}$ is the R^2 from regression equation (A21) with the restriction $\delta_i^{(-4)} = \delta_i^{(-3)} = \delta_i^{(-2)} = \delta_i^{(-1)} = 0$, and R^2 is without this restriction. In addition,

$$\text{D2}_i \equiv \frac{\sum_{n=1}^{4} n\delta_i^{(-n)}}{\beta_i + \sum_{n=1}^{4} \delta_i^{(-n)}} \tag{A23}$$

$$\text{D3}_i \equiv \frac{\sum_{n=1}^{4} \frac{n\delta_i^{(-n)}}{\text{se}\left(\delta_i^{(-n)}\right)}}{\frac{\beta_i}{\text{se}(\beta_i)} + \sum_{n=1}^{4} \frac{\delta_i^{(-n)}}{\text{se}\left(\delta_i^{(-n)}\right)}}, \tag{A24}$$

in which se$(\cdot)$ is the standard error of the point estimate in parentheses.

To improve precision of the price delay estimate, we sort firms into portfolios based on market equity and individual delay measure, compute the delay measure for the portfolio, and assign the portfolio delay measure to each firm in the portfolio. At the end of June of each year t, we sort stocks into size deciles based on the market equity (from CRSP) at the end of June in $t - j$ ($j = 1, 2, \ldots$). Within each size decile, we then sort stocks into deciles based on their first-stage individual delay measure, estimated using weekly return data from July of year $t - j - 1$ to June of year $t - j$. The equal-weighted weekly returns of the 100 size-delay portfolios are computed over the following year from July of year $t - j$ to June of $t - j + 1$. We then re-estimate the delay measure for each of the 100 portfolios using the entire past sample of weekly returns up to June of year t. The second-stage portfolio delay measure is then assigned to individual stocks within the 100 portfolios formed at end of June in year t. At the end of June of year t, we sort stocks into deciles based on D1, D2, and D3. Monthly decile returns are calculated from July of year t to June of $t + 1$, and the deciles are rebalanced in June of $t + 1$.

A.5.20 dSi, % Change in Sales Minus % Change in Inventory

Following Abarbanell and Bushee (1998), we define the %d$(\cdot)$ operator as the percentage change in the variable in the parentheses from its average over the prior two years, e.g., %d(Sales) = [Sales(t) − E[Sales(t)]]/E[Sales(t)], in which E[Sales(t)] = [Sales($t-1$) + Sales($t-2$)]/2. dSi is calculated as %d(Sales) − %d(Inventory), in which sales is net sales (Compustat annual item SALE), and inventory is finished goods inventories (item INVFG) if available, or total inventories (item INVT). Firms with non-positive average sales or inventory during the past two years are excluded. At the end of June of each year t, we sort stocks into deciles based on dSi for the fiscal year ending in calendar year $t-1$. Monthly decile returns are calculated from July of year t to June of $t+1$, and the deciles are rebalanced in June of $t+1$.

A.5.21 dSa, % Change in Sales Minus % Change in Accounts Receivable

Following Abarbanell and Bushee (1998), we define the %d(·) operator as the percentage change in the variable in the parentheses from its average over the prior two years, e.g., %d(Sales) = [Sales(t) − E[Sales(t)]]/E[Sales(t)], in which E[Sales(t)] = [Sales($t-1$) + Sales($t-2$)]/2. dSa is calculated as %d(Sales) − %d(Accounts receivable), in which sales is net sales (Compustat annual item SALE) and accounts receivable is total receivables (item RECT). Firms with non-positive average sales or receivables during the past two years are excluded. At the end of June of each year t, we sort stocks into deciles based on dSa for the fiscal year ending in calendar year $t-1$. Monthly decile returns are calculated from July of year t to June of $t+1$, and the deciles are rebalanced in June of $t+1$.

A.5.22 dGs, % Change in Gross Margin Minus % Change in Sales

Following Abarbanell and Bushee (1998), we define the %d(·) operator as the percentage change in the variable in the parentheses from its average over the prior two years, e.g., %d(Sales) = [Sales(t) − E[Sales(t)]]/E[Sales(t)], in which E[Sales(t)] = [Sales($t-1$) + Sales($t-2$)]/2. dGs is calculated as %d(Gross margin) − %d(Sales), in which sales is net sales (Compustat annual item SALE) and gross margin is sales minus cost of goods sold (item COGS). Firms with non-positive average gross margin or sales during the past two years are excluded. At the end of June of each year t, we sort stocks into deciles based on dGs for the fiscal year ending in calendar year $t-1$. Monthly decile returns are calculated from July of year t to June of $t+1$, and the deciles are rebalanced in June of $t+1$.

A.5.23 dSs, % Change in Sales Minus % Change in SG&A

Following Abarbanell and Bushee (1998), we define the %d(·) operator as the percentage change in the variable in the parentheses from its average over the prior two years, e.g., %d(Sales) = [Sales(t) − E[Sales(t)]]/E[Sales(t)], in which E[Sales(t)] = [Sales($t-1$) + Sales($t-2$)]/2. dSs is calculated as %d(Sales) − %d(SG&A), in which sales is net sales (Compustat annual item SALE) and SG&A is selling, general, and administrative expenses (item XSGA). Firms with non-positive average sales or SG&A during the past two years are excluded. At the end of June of each year t, we sort stocks into deciles based on dSs for the fiscal year ending in calendar year $t-1$. Monthly decile returns are calculated from July of year t to June of $t+1$, and the deciles are rebalanced in June of $t+1$.

A.5.24 Etr, Effective Tax Rate

Following Abarbanell and Bushee (1998), we measure effective tax rate, Etr, as:

$$\mathrm{Etr}(t) = \left[\frac{\mathrm{TaxExpense}(t)}{\mathrm{EBT}(t)} - \frac{1}{3}\sum_{\tau=1}^{3}\frac{\mathrm{TaxExpense}(t-\tau)}{\mathrm{EBT}(t-\tau)}\right] \times \mathrm{dEPS}(t), \tag{A25}$$

in which TaxExpense(t) is total income taxes (Compustat annual item TXT) paid in year t, EBT(t) is pretax income (item PI) plus amortization of intangibles (item AM), and dEPS is the change in split-adjusted earnings per share (item EPSPX divided by item AJEX) between years $t-1$ and t, deflated by stock price (item PRCC_F) at the end of $t-1$. At the end of June of each year t, we sort stocks into deciles based on Etr for the fiscal year ending in calendar year $t-1$. Monthly decile returns are calculated from July of year t to June of t+1, and the deciles are rebalanced in June of t+1.

A.5.25 Lfe, Labor Force Efficiency

Following Abarbanell and Bushee (1998), we measure labor force efficiency, Lfe, as:

$$\mathrm{Lfe}(t) = \left[\frac{\mathrm{Sales}(t)}{\mathrm{Employees}(t)} - \frac{\mathrm{Sales}(t-1)}{\mathrm{Employees}(t-1)}\right] / \frac{\mathrm{Sales}(t-1)}{\mathrm{Employees}(t-1)}, \tag{A26}$$

in which Sales(t) is net sales (Compustat annual item SALE) in year t, and Employees(t) is the number of employees (item EMP). At the end of June of each year t, we sort stocks into deciles based on Lfe for the fiscal year ending in calendar year $t-1$. Monthly decile returns are calculated from July of year t to June of $t+1$, and the deciles are rebalanced in June of $t+1$.

A.5.26 Ana1, Ana6, and Ana12, Analysts Coverage

Following Elgers, Lo, and Pfeiffer (2001), we measure analysts coverage, Ana, as the number of analysts' earnings forecasts from IBES (item NUMEST) for the current fiscal year (fiscal period indicator = 1). We require earnings forecasts to be denominated in US dollars (currency code = USD). At the beginning of each month t, we sort stocks into quintiles on Ana from the IBES report in $t-1$. We do not form deciles because a disproportional number of firms can have the same Ana before 1980. Monthly quintile returns are calculated for the current month t (Ana1), from month t to t+5 (Ana6), and from month t to $t+11$ (Ana12). The quintiles are rebalanced at the beginning of month $t+1$. The holding period longer than one month as in Ana6 means that for a given quintile in each month there exist six subquintiles, each of which is initiated in a different month in the prior six months. We take the simple average of the subquintile returns as the monthly return of the Ana6 quintile. Because the earnings forecast data start in January 1976, the Ana portfolios start in February 1976.

A.5.27 Tan, Tangibility

Following Hahn and Lee (2009), we measure tangibility, Tan, as cash holdings (Compustat annual item CHE) + 0.715 × accounts receivable (item RECT) + 0.547 × inventory (item INVT) + 0.535 × gross property, plant, and equipment (item PPEGT), all scaled by total assets (item AT). At the end of June of each year t, we sort stocks into deciles on Tan for the fiscal year ending in calendar year $t-1$. Monthly decile returns are calculated from July of year t to June of $t+1$, and the deciles are rebalanced in June of $t+1$.

A.5.28 $\mathrm{Tan}^q 1$, $\mathrm{Tan}^q 6$, and $\mathrm{Tan}^q 12$, Quarterly Tangibility

Tan^q is cash holdings (Compustat quarterly item CHEQ) + 0.715 × accounts receivable (item RECTQ) + 0.547 × inventory (item INVTQ) + 0.535 × gross property, plant, and equipment (item PPEGTQ), all scaled by total assets (item ATQ). At the beginning of each month t, we sort stocks into deciles based on Tan^q for the fiscal quarter ending at least four months ago. Monthly decile returns are calculated for the current month t ($\mathrm{Tan}^q 1$), from month t to $t+5$ ($\mathrm{Tan}^q 6$), and from month t to $t+11$ ($\mathrm{Tan}^q 12$), and the deciles are rebalanced at the beginning of month $t+1$. The holding period longer than one month as in, for instance, $\mathrm{Tan}^q 6$, means that for a given decile in each month there exist six subdeciles, each of which is initiated in a different month in the prior six months. We take the simple average of the subdecile returns as the monthly return of the $\text{Tan}^{\text{q}}6$ decile. For sufficient data coverage, the Tan^{q} portfolios start in January 1972.

A.5.29 Rer, Industry-adjusted Real Estate Ratio

Following Tuzel (2010), we measure the real estate ratio as the sum of buildings (Compustat annual item PPENB) and capital leases (item PPENLS) divided by net property, plant, and equipment (item PPENT) prior to 1983. From 1984 onward, the real estate ratio is the sum of buildings at cost (item FATB) and leases at cost (item FATL) divided by gross property, plant, and equipment (item PPEGT). Industry-adjusted real estate ratio, Rer, is the real estate ratio minus its industry average. Industries are defined by two-digit SIC codes. To alleviate the impact of outliers, we winsorize the real estate ratio at the 1st and 99th percentiles of its distribution each year before computing Rer. Following Tuzel (2010), we exclude industries with fewer than five firms. At the end of June of each year t, we sort stocks into deciles based on Rer for the fiscal year ending in calendar year $t-1$. Monthly decile returns are calculated from July of year t to June of $t+1$, and the deciles are rebalanced in June of $t+1$. Because the real estate data start in 1969, the Rer portfolios start in July 1970.

A.5.30 Kz, Financial Constraints (the Kaplan-Zingales Index)

Following Lamont, Polk, and Saa-Requejo (2001), we construct the Kaplan-Zingales index, Kz, as:

$$\text{Kz}_{it} \equiv -1.002\times\frac{\text{CF}_{it}}{\text{K}_{it-1}}+0.283\times\text{Q}_{it}+3.139\times\frac{\text{Debt}_{it}}{\text{Total Capital}_{it}}-39.368\times\frac{\text{Dividends}_{it}}{\text{K}_{it-1}}-1.315\times\frac{\text{Cash}_{it}}{\text{K}_{it-1}}, \tag{A27}$$

in which CF_{it} is firm i's cash flows in year t, measured as income before extraordinary items (Compustat annual item IB) plus depreciation and amortization (item DP). K_{it-1} is net property, plant, and equipment (item PPENT) at the end of year $t-1$. Q_{it} is Tobin's Q, measured as total assets (item AT) plus the December-end market equity (from CRSP), minus book equity (item CEQ), and minus deferred taxes (item TXDB), scaled by total assets. Debt_{it} is the sum of short-term debt (item DLC) and long-term debt (item DLTT). TotalCapital_{it} is the sum of total debt and stockholders' equity (item SEQ). Dividends_{it} is total dividends (item DVC plus item DVP). Cash_{it} is cash holdings (item CHE). At the end of June of each year t, we sort stocks into deciles based on Kz for the fiscal year ending in calendar year $t-1$. Monthly decile returns are calculated from July of year t to June of $t+1$, and the deciles are rebalanced in June of $t+1$.

A.5.31 $\text{Kz}^{\text{q}}1$, $\text{Kz}^{\text{q}}6$, and $\text{Kz}^{\text{q}}12$, Quarterly Kaplan-Zingales Index

We construct the quarterly Kaplan-Zingales index, Kz^{q}, as:

$$\text{Kz}^{\text{q}}_{it} \equiv -1.002\frac{\text{CF}^{\text{q}}_{it}}{\text{K}^{\text{q}}_{it-1}}+0.283\text{Q}^{\text{q}}_{it}+3.139\frac{\text{Debt}^{\text{q}}_{it}}{\text{Total Capital}^{\text{q}}_{it}}-39.368\frac{\text{Dividends}^{\text{q}}_{it}}{\text{K}^{\text{q}}_{it-1}}-1.315\frac{\text{Cash}^{\text{q}}_{it}}{\text{K}^{\text{q}}_{it-1}}, \tag{A28}$$

in which $\text{CF}^{\text{q}}_{it}$ is firm i's trailing four-quarter total cash flows from quarter $t-3$ to t. Quarterly cash flows are measured as income before extraordinary items (Compustat quarterly item IBQ) plus depreciation and amortization (item DPQ). $\text{K}^{\text{q}}_{it-1}$ is net property, plant, and equipment (item PPENTQ) at the end of quarter $t-1$. Q^{q}_{it} is Tobin's Q, measured as total assets (item ATQ) plus the fiscal-quarter-end market equity (from CRSP), minus book equity (item CEQQ), and minus deferred taxes (item TXDBQ, zero if missing), scaled by total assets. $\text{Debt}^{\text{q}}_{it}$ is the sum of short-term debt (item DLCQ) and long-term debt (item DLTTQ). $\text{TotalCapital}^{\text{q}}_{it}$ is the sum of total debt and stockholders' equity (item SEQQ). $\text{Dividends}^{\text{q}}_{it}$ is the total dividends (item DVPSXQ times item CSHOQ), accumulated over the past four quarters from $t-3$ to t.

At the beginning of each month t, we sort stocks into deciles based on Kz^{q} for the fiscal quarter ending at least four months ago. Monthly decile returns are calculated for the current month t ($\text{Kz}^{\text{q}}1$), from month t to $t+5$ ($\text{Kz}^{\text{q}}6$), and from month t to $t+11$ ($\text{Kz}^{\text{q}}12$), and the deciles are rebalanced at the beginning of month $t+1$. The holding period longer than one month as in, for instance, $\text{Kz}^{\text{q}}6$, means that for a given decile in each month there exist six subdeciles, each of which is initiated in a different month in the prior six months. We take the simple average of the subdecile returns as the monthly return of the $\text{Kz}^{\text{q}}6$ decile. For sufficient data coverage, the Kz^{q} portfolios start in January 1977.

A.5.32 Ww, Financial Constraints (the Whited-Wu Index)

Following Whited and Wu (2006, Equation 13), we construct the Whited-Wu index, Ww, as:

$$\text{Ww}_{it} \equiv -0.091\text{CF}_{it} - 0.062\text{DIVPOS}_{it} + 0.021\text{TLTD}_{it} - 0.044\text{LNTA}_{it} + 0.102\text{ISG}_{it} - 0.035\text{SG}_{it}, \tag{A29}$$

in which CF_{it} is the ratio of firm i's cash flows in year t scaled by total assets (Compustat annual item AT) at the end of t. Cash flows are measured as income before extraordinary items (item IB) plus depreciation and amortization (item DP). DIVPOS_{it} is an indicator that takes the value of one if the firm pays cash dividends (item DVPSX), and zero otherwise. TLTD_{it} is the ratio of the long-term debt (item DLTT) to total assets. LNTA_{it} is the natural log of total assets. ISG_{it} is the firm's industry sales growth, computed as the sum of current sales (item SALE) across all firms in the industry divided by the sum of one-year-lagged sales minus one. Industries are defined by three-digit SIC codes and we exclude industries with fewer than two firms. SG_{it} is the firm's annual growth in sales. Because the coefficients in equation (A29) were estimated with quarterly accounting data in Whited and Wu (2006), we convert annual cash flow and sales growth rates into quarterly terms. Specifically, we divide CF_{it} by four and use the compounded quarterly growth for sales ($(1+\text{ISG}_{it})^{1/4}-1$ and $(1+\text{SG}_{it})^{1/4}-1$). At the end of June of each year t, we split stocks into deciles based on Ww for the fiscal year ending in calendar year $t-1$. Monthly decile returns are calculated from July of year t to June of $t+1$, and the deciles are rebalanced in June of $t+1$.

A.5.33 $\text{Ww}^{\text{q}}1$, $\text{Ww}^{\text{q}}6$, and $\text{Ww}^{\text{q}}12$, the Quarterly Whited-Wu Index

We construct the quarterly Whited-Wu index, Ww^{q}, as:

$$\text{Ww}^{\text{q}}_{it} \equiv -0.091\text{CF}^{\text{q}}_{it} - 0.062\text{DIVPOS}^{\text{q}}_{it} + 0.021\text{TLTD}^{\text{q}}_{it} - 0.044\text{LNTA}^{\text{q}}_{it} + 0.102\text{ISG}^{\text{q}}_{it} - 0.035\text{SG}^{\text{q}}_{it}, \tag{A30}$$

in which $\text{CF}^{\text{q}}_{it}$ is the ratio of firm i's cash flows in quarter t scaled by total assets (Compustat quarterly item ATQ) at the end of t. Cash flows are measured as income before extraordinary items (item IBQ) plus depreciation and amortization (item DPQ). $\text{DIVPOS}^{\text{q}}_{it}$ is an indicator that takes the value of one if the firm pays cash dividends (item DVPSXQ), and zero otherwise. $\text{TLTD}^{\text{q}}_{it}$ is the ratio of the long-term debt (item DLTTQ) to total assets. $\text{LNTA}^{\text{q}}_{it}$ is the natural log of total assets. $\text{ISG}^{\text{q}}_{it}$ is the firm's industry sales growth, computed as the sum of current sales (item SALEQ) across all firms in the industry divided by the sum of one-quarter-lagged sales minus one. Industries are defined by three-digit SIC codes and we exclude industries with fewer than two firms.

$\mathrm{SG}^{\mathrm{q}}_{it}$ is the firm's quarterly growth in sales. At the beginning of each month t, we sort stocks into deciles based on Ww^{q} for the fiscal quarter ending at least four months ago. Monthly decile returns are calculated for the current month t ($\mathrm{Ww}^{\mathrm{q}}1$), from month t to $t+5$ ($\mathrm{Ww}^{\mathrm{q}}6$), and from month t to $t+11$ ($\mathrm{Ww}^{\mathrm{q}}12$), and the deciles are rebalanced at the beginning of month $t+1$. The holding period longer than one month as in, for instance, $\mathrm{Ww}^{\mathrm{q}}6$, means that for a given decile in each month there exist six subdeciles, each of which is initiated in a different month in the prior six months. We take the simple average of the subdecile returns as the monthly return of the $\mathrm{Ww}^{\mathrm{q}}6$ decile. For sufficient data coverage, the Ww^{q} portfolios start in January 1972.

A.5.34 Sdd, Secured Debt-to-total Debt

Following Valta (2014), we measure secured debt-to-total debt, Sdd, as mortgages and other secured debt (Compustat annual item DM) divided by total debt. Total debt is debt in current liabilities (item DLC) plus long-term debt (item DLTT). At the end of June of each year t, we sort stocks into deciles based on Sdd for the fiscal year ending in calendar year $t-1$. Firms with no secured debt are excluded. Monthly decile returns are calculated from July of year t to June of $t+1$, and the deciles are rebalanced in June of $t+1$. Because the data on secured debt start in 1981, the Sdd portfolios start in July 1982.

A.5.35 Cdd, Convertible Debt-to-total Debt

Following Valta (2014), we measure convertible debt-to-total debt, Cdd, as convertible debt (Compustat annual item DCVT) divided by total debt. Total debt is debt in current liabilities (item DLC) plus long-term debt (item DLTT). At the end of June of each year t, we sort stocks into deciles based on Cdd for the fiscal year ending in calendar year $t-1$. Firms with no convertible debt are excluded. Monthly decile returns are calculated from July of year t to June of $t+1$, and the deciles are rebalanced in June of $t+1$. Because the data on convertible debt start in 1969, the Sdd portfolios start in July 1970.

A.5.36 Vcf1, Vcf6, and Vcf12, Cash Flow Volatility

Following Huang (2009), we measure cash flow volatility, Vcf, as the standard deviation of the ratio of operating cash flows to sales (Compustat quarterly item SALEQ) during the past 16 quarters (eight non-missing quarters minimum). Operating cash flows are income before extraordinary items (item IBQ) plus depreciation and amortization (item DPQ), and plus the change in working capital (item WCAPQ) from the last quarter. At the beginning of each month t, we sort stocks into deciles based on Vcf for the fiscal quarter ending at least four months ago. Monthly decile returns are calculated for the current month t (Vcf1), from month t to $t+5$ (Vcf6), and from month t to $t+11$ (Vcf12). The deciles are rebalanced at the beginning of month $t+1$. The holding period longer than one month as in Vcf6 means that for a given decile in each month there exist six subdeciles, each of which is initiated in a different month in the prior six months. We take the simple average of the subdecile returns as the monthly return of the Vcf6 decile. For sufficient data coverage, the Vcf portfolios start in January 1978.

A.5.37 Cta1, Cta6, and Cta12, Cash-to-assets

Following Palazzo (2012), we measure cash-to-assets, Cta, as cash holdings (Compustat quarterly item CHEQ) scaled by total assets (item ATQ). At the beginning of each month t, we sort stocks into deciles based on Cta from the fiscal quarter ending at least four months ago. Monthly decile returns are calculated for the current month t (Cta1), from month t to $t+5$ (Cta6), and from month t to $t+11$ (Cta12), and the deciles are rebalanced at the beginning of $t+1$. The holding period longer than one month as in, for instance, Cta6, means that for a given decile in each month there exist six subdeciles, each of which is initiated in a different month in the prior six months. We take the simple average of the subdeciles returns as the monthly return of the Cta6 decile. For sufficient data coverage, the Cta portfolios start in January 1972.

A.5.38 Gind, Corporate Governance

The data for Gompers, Ishii, and Metrick's (2003) firm-level corporate governance index (Gind, from September 1990 to December 2006) are from Andrew Metrick's Web site. Following Gompers et al. (Table VI), we use the following breakpoints to form the Gind portfolios: Gind $\leq 5, 6, 7, 8, 9, 10, 11, 12, 13$, and ≥ 14. Firms with dual share classes are excluded. We rebalance the portfolios in the months immediately following each publication of Gind, and calculate monthly portfolio returns between two adjacent publication dates. The first months following the publication dates are September 1990, July 1993, July 1995, February 1998, November 1999, January 2002, January 2004, and January 2006. The sample period for the Gind portfolios is from September 1990 to December 2006.

A.5.39 Acq, Acq1, Acq6, Acq12, Accrual Quality

Following Francis, Lafond, Olsson, and Schipper (2005), we estimate accrual quality (Acq) with the following cross-sectional regression:

$$\text{TCA}_{it} = \phi_{0,i} + \phi_{1,i}\text{CFO}_{it-1} + \phi_{2,i}\text{CFO}_{it} + \phi_{3,i}\text{CFO}_{it+1} + \phi_{4,i}\text{dREV}_{it} + \phi_{5,i}\text{PPE}_{it} + v_{it}, \quad \text{(A31)}$$

in which TCA_{it} is firm i's total current accruals in year t, CFO_{it} is cash flow from operations, dREV_{it} is change in revenues (Compustat annual item SALE) from $t-1$ to t, and PPE_{it} is gross property, plant, and equipment (item PPEGT). $\text{TCA}_{it} = \text{dCA}_{it} - \text{dCL}_{it} - \text{dCASH}_{it} + \text{dSTDEBT}_{it}$, in which dCA_{it} is the change in current assets (item ACT) from year $t-1$ to t, dCL_{it} is the change in current liabilities (item LCT), dCASH_{it} is the change in cash (item CHE), and dSTDEBT_{it} is the change in debt in current liabilities (item DLC). $\text{CFO}_{it} = \text{NIBE}_{it} - (\text{dCA}_{it} - \text{dCL}_{it} - \text{dCASH}_{it} + \text{dSTDEBT}_{it} - \text{DEPN}_{it})$, in which NIBE_{it} is income before extraordinary items (item IB), and DEPN_{it} is depreciation and amortization expense (item DP). All variables are scaled by the average of total assets in t and $t-1$.

We estimate annual cross-sectional regressions in equation (A31) for each of Fama-French (1997) 48 industries (excluding four financial industries) with at least 20 firms in year t. We winsorize the regressors at the 1st and 99th percentiles of their distributions each year. The annual cross-sectional regressions yield firm- and year-specific residuals, v_{it}. We measure accrual quality of firm i, $\text{Acq}_i = \sigma(v_i)$, as the standard deviation of firm i's residuals during the past five years from $t-4$ to t. For a firm to be included in our portfolio, its residual has to be available for all five years.

At the end of June of each year t, we sort stocks into deciles based on Acq for the fiscal year ending in calendar year $t-2$. To avoid look-ahead bias, we do not sort on Acq for the fiscal year ending in $t-1$, because the regression in equation (A31) requires the next year's CFO. Monthly decile returns are calculated from July of year t to June of $t+1$, and the deciles are rebalanced in June of $t+1$. In addition, at the beginning of each month t, we sort stocks into deciles based on Acq calculated with data up to the fiscal year ending at least four months ago. Monthly decile returns are calculated for the current month t (Acq1), from month t to $t+5$ (Acq6), and from month t to $t+11$ (Acq12), and the deciles are rebalanced at the beginning of $t+1$. The holding period longer than one month as in, for instance, Acq6, means that for a given decile in each month there exist six subdeciles, each of which is initiated in a different month in the prior six months. We take the simple average of the subdeciles returns as the monthly return of the Acq6 decile.

A.5.40 Eper and Eprd, Earnings Persistence, Earnings Predictability

Following Francis, Lafond, Olsson, and Schipper (2004), we estimate earnings persistence, Eper, and earnings predictability, Eprd, from a first-order autoregressive model for annual split-adjusted earnings per share (Compustat annual item EPSPX divided by item AJEX). At the end of June of each year t, we estimate the autoregressive model in the ten-year rolling window up to the fiscal year ending in calendar year $t-1$. Only firms with a complete ten-year history are included. Eper is measured as the slope coefficient and Eprd is measured as the residual volatility. We sort stocks into deciles based on Eper, and separately, on Eper. Monthly decile returns are calculated from July of year t to June of $t+1$, and the deciles are rebalanced in June of $t+1$.

A.5.41 Esm, Earnings Smoothness

Following Francis, Lafond, Olsson, and Schipper (2004), we measure earnings smoothness, Esm, as the ratio of the standard deviation of earnings (Compustat annual item IB) scaled by one-year-lagged total assets (item AT) to the standard deviation of cash flow from operations scaled by one-year-lagged total assets. Cash flow from operations is income before extraordinary items minus operating accruals. We measure operating accruals as the one-year change in current assets (item ACT) minus the change in current liabilities (item LCT), minus the change in cash (item CHE), plus the change in debt in current liabilities (item DLC), and minus depreciation and amortization (item DP). At the end of June of each year t, we sort stocks into deciles based on Esm, calculated over the ten-year rolling window up to the fiscal year ending in calendar year $t-1$. Only firms with a complete ten-year history are included. Monthly decile returns are calculated from July of year t to June of $t+1$, and the deciles are rebalanced in June of $t+1$.

A.5.42 Evr, Value Relevance of Earnings

Following Francis, Lafond, Olsson, and Schipper (2004), we measure value relevance of earnings, Evr, as the R^2 from the following rolling-window regression:

$$R_{it} = \delta_{i0} + \delta_{i1}\,\mathrm{EARN}_{it} + \delta_{i2}\,\mathrm{dEARN}_{it} + \epsilon_{it}, \tag{A32}$$

in which R_{it} is firm i's 15-month stock return ending three months after the end of fiscal year ending in calendar year t. EARN_{it} is earnings (Compustat annual item IB) for the fiscal year ending in t, scaled by the fiscal year-end market equity (from CRSP). dEARN_{it} is the one-year change in earnings scaled by the market equity. For firms with more than one share class, we merge the market equity for all share classes. At the end of June of each year t, we split stocks into deciles on Evr, calculated over the ten-year rolling window up to the fiscal year ending in calendar year $t-1$. Only firms with a complete ten-year history are included. Monthly decile returns are calculated from July of year t to June of $t+1$, and the deciles are rebalanced in June of $t+1$.

A.5.43 Etl and Ecs, Earnings Timeliness, Earnings Conservatism

Following Francis, Lafond, Olsson, and Schipper (2004), we measure earnings timeliness, Etl, and earnings conservatism, Ecs, from the following rolling-window regression:

$$\text{EARN}_{it} = \alpha_{i0} + \alpha_{i1}\,\text{NEG}_{it} + \beta_{i1}R_{it} + \beta_{i2}\text{NEG}_{it}R_{it} + e_{it}, \tag{A33}$$

in which EARN_{it} is earnings (Compustat annual item IB) for the fiscal year ending in calendar year t, scaled by the fiscal year-end market equity. R_{it} is firm i's 15-month stock return ending three months after the end of fiscal year ending in calendar year t. NEG_{it} equals one if $R_{it} < 0$, and zero otherwise. For firms with more than one share class, we merge the market equity for all share classes. We measure Etl as the R^2 and Ecs as $(\beta_{i1} + \beta_{i2})/\beta_{i1}$ from the regression in (A33). At the end of June of each year t, we sort stocks into deciles based on Etl, and separately, on Ecs, both of which are calculated over the ten-year rolling window up to the fiscal year ending in calendar year $t-1$. Only firms with a complete ten-year history are included. Monthly decile returns are calculated from July of year t to June of $t+1$, and the deciles are rebalanced in June of $t+1$.

A.5.44 Frm and Fra, Pension Plan Funding Rate

Following Franzoni and Martin (2006), we define market pension plan funding rates as $(\text{PA} - \text{PO})/\text{ME}$ (denoted Frm) and $(\text{PA} - \text{PO})/\text{AT}$ (denoted Fra), in which PA is the fair value of pension plan assets, PO is the projected benefit obligation, ME is the market equity, and AT is total assets (Compustat annual item AT). Between 1980 and 1997, PA is measured as the sum of overfunded pension plan assets (item PPLAO) and underfunded pension plan assets (item PPLAU), and PO is the sum of overfunded pension obligation (item PBPRO) and underfunded pension obligation (item PBPRU). When the above data are not available, we also measure PA as pension benefits (item PBNAA) and PO as the present value of vested benefits (item PBNVV) from 1980 to 1986. Starting from 1998, firms are not required to report separate items for overfunded and underfunded plans, and Compustat collapses PA and PO into corresponding items reserved previously for overfunded plans (item PPLAO and item PBPRO). ME is from CRSP measured at the end of December. For firms with more than one share class, we merge the market equity for all share classes.

At the end of June of each year t, we split stocks into deciles on Frm, and separately, on Fra, both of which are for the fiscal year ending in calendar year $t-1$. Monthly decile returns are calculated from July of year t to June of $t+1$, and the deciles are rebalanced in June of $t+1$. Because the pension data start in 1980, the Frm and Fra portfolios start in July 1981.

A.5.45 Ala and Alm, Asset Liquidity

Following Ortiz-Molina and Phillips (2014), we measure asset liquidity as cash + 0.75 × noncash current assets + 0.50 × tangible fixed assets. Cash is cash and short-term investments (Compustat annual item CHE). Noncash current assets is current assets (item ACT) minus cash. Tangible fixed assets is total assets (item AT) minus current assets (item ACT), minus goodwill (item GDWL, zero if missing), and minus intangibles (item INTAN, zero if missing). Ala is asset liquidity scaled by one-year-lagged total assets. Alm is asset liquidity scaled by one-year-lagged market value of assets. Market value of assets is total assets plus market equity (item PRCC_F times item CSHO) minus book equity (item CEQ). At the end of June of each year t, we sort stocks into deciles based on Ala, and separately, on Alm, both of which are for the fiscal year ending in calendar year $t-1$.

Monthly decile returns are calculated from July of year t to June of $t+1$, and the deciles are rebalanced in June of $t+1$.

A.5.46 Ala^{q}1, Ala^{q}6, Ala^{q}12, Alm^{q}1, Alm^{q}6, and Alm^{q}12, Quarterly Asset Liquidity

We measure quarterly asset liquidity as cash + 0.75 × noncash current assets + 0.50 × tangible fixed assets. Cash is cash and short-term investments (Compustat quarterly item CHEQ). Noncash current assets is current assets (item ACTQ) minus cash. Tangible fixed assets is total assets (item ATQ) minus current assets (item ACTQ), minus goodwill (item GDWLQ, zero if missing), and minus intangibles (item INTANQ, zero if missing). Ala^{q} is quarterly asset liquidity scaled by one-quarter-lagged total assets. Alm^{q} is quarterly asset liquidity scaled by one-quarter-lagged market value of assets. Market value of assets is total assets plus market equity (item PRCCQ times item CSHOQ) minus book equity (item CEQQ).

At the beginning of each month t, we sort stocks into deciles based on Ala^{q}, and separately, on Alm^{q} for the fiscal quarter ending at least four months ago. Monthly decile returns are calculated for the current month t (Ala^{q}1 and Alm^{q}1), from month t to $t+5$ (Ala^{q}6 and Alm^{q}6), and from month t to $t+11$ (Ala^{q}12 and Alm^{q}12). The deciles are rebalanced at the beginning of month $t+1$. The holding period longer than one month as in Ala^{q}6 means that for a given decile in each month there exist six subdeciles, each of which is initiated in a different month in the prior six months. We take the simple average of the subdecile returns as the monthly return of the Ala^{q}6 decile. For sufficient data coverage, the quarterly asset liquidity portfolios start in January 1976.

A.5.47 Dls1, Dls6, and Dls12, Disparity between Long- and Short-term Earnings Growth Forecasts

Following Da and Warachka (2011), we measure the implied short-term earnings growth forecast as $100 \times (A1_t - A0_t)/|A0_t|$, in which $A1_t$ is analysts' consensus median forecast (IBES unadjusted file, item MEDEST) for the current fiscal year (fiscal period indicator = 1), and $A0_t$ is the actual earnings per share for the latest reported fiscal year (item FY0A, measure indictor ='EPS'). We require both earnings forecasts and actual earnings to be denominated in US dollars (currency code = USD). The disparity between long- and short-term earnings growth forecasts, Dls, is analysts' consensus median forecast of the long-term earnings growth (item MEDEST, fiscal period indictor = 0) minus the implied short-term earnings growth forecast.

At the beginning of each month t, we sort stocks into deciles based on Dls computed with analyst forecasts reported in $t-1$. Monthly decile returns are calculated for the current month t (Dls1), from month t to $t+5$ (Dls6), and from month t to $t+11$ (Dls12), and the deciles are rebalanced at the beginning of $t+1$. The holding period longer than one month as in, for instance, Dls6, means that for a given decile in each month there exist six subdeciles, each of which is initiated in a different month in the prior six months. We take the simple average of the subdecile returns as the monthly return of the Dls6 decile. Because the long-term growth forecast data start in December 1981, the deciles start in January 1982.

A.5.48 Dis1, Dis6, and Dis12, Dispersion in Analyst Forecasts

Following Diether, Malloy, and Scherbina (2002), we measure dispersion in analyst earnings forecasts, Dis, as the ratio of the standard deviation of earnings forecasts (IBES unadjusted file, item STDEV) to the absolute value of the consensus mean forecast (unadjusted file, item MEANEST).

We use the earnings forecasts for the current fiscal year (fiscal period indicator = 1) and we require them to be denominated in US dollars (currency code = USD). Stocks with a mean forecast of zero are assigned to the highest dispersion group. Firms with fewer than two forecasts are excluded. At the beginning of each month t, we sort stocks into deciles based on Dis computed with analyst forecasts reported in month $t-1$. Monthly decile returns are calculated for the current month t (Dis1), from month t to $t+5$ (Dis6), and from month t to $t+11$ (Dis12), and the deciles are rebalanced at the beginning of month $t+1$. The holding period longer than one month as in Dis6 means that for a given decile in each month there exist six subdeciles, each of which is initiated in a different month in the prior six months. We take the simple average of the subdecile returns as the monthly return of the Dis6 decile. Because the analyst forecasts data start in January 1976, the Dis portfolios start in February 1976.

A.5.49 Dlg1, Dlg6, and Dlg12, Dispersion in Analyst Long-term Growth Forecasts

Following Anderson, Ghysels, and Juergens (2005), we measure dispersion in analyst long-term growth forecasts, Dlg, as the standard deviation of the long-term earnings growth rate forecasts from IBES (item STDEV, fiscal period indicator = 0). Firms with fewer than two forecasts are excluded. At the beginning of each month t, we sort stocks into deciles based on Dlg reported in month $t-1$. Monthly decile returns are calculated for the current month t (Dlg1), from month t to $t+5$ (Dlg6), and from month t to $t+11$ (Dlg12), and the deciles are rebalanced at the beginning of month $t+1$. The holding period longer than one month as in Dlg6 means that for a given decile in each month there exist six subdeciles, each of which is initiated in a different month in the prior six months. We take the simple average of the subdecile returns as the monthly return of the Dlg6 decile. Because the long-term growth forecast data start in December 1981, the Dlg portfolios start in January 1982.

A.5.50 $R^1_{\rm a}$, $R^1_{\rm n}$, $R^{[2,5]}_{\rm a}$, $R^{[2,5]}_{\rm n}$, $R^{[6,10]}_{\rm a}$, $R^{[6,10]}_{\rm n}$, $R^{[11,15]}_{\rm a}$, $R^{[11,15]}_{\rm n}$, $R^{[16,20]}_{\rm a}$, and $R^{[16,20]}_{\rm n}$, Seasonality

Following Heston and Sadka (2008), at the beginning of each month t, we sort stocks into deciles based on various measures of past performance, including returns in month $t-12$ ($R^1_{\rm a}$), average returns from month $t-11$ to $t-1$ ($R^1_{\rm n}$), average returns across months $t-24, t-36, t-48$, and $t-60$ ($R^{[2,5]}_{\rm a}$), average returns from month $t-60$ to $t-13$ except for lags 24, 36, 48, and 60 ($R^{[2,5]}_{\rm n}$), average returns across months $t-72, t-84, t-96, t-108$, and $t-120$ ($R^{[6,10]}_{\rm a}$), average returns from month $t-120$ to $t-61$ except for lags 72, 84, 96, 108, and 120 ($R^{[6,10]}_{\rm n}$), average returns across months $t-132, t-144, t-156, t-168$, and $t-180$ ($R^{[11,15]}_{\rm a}$), average returns from month $t-180$ to $t-121$ except for lags 132, 144, 156, 168, and 180 ($R^{[11,15]}_{\rm n}$), average returns across months $t-192, t-204, t-216, t-228$, and $t-240$ ($R^{[16,20]}_{\rm a}$), average returns from month $t-240$ to $t-181$ except for lags 192, 204, 216, 228, and 240 ($R^{[16,20]}_{\rm n}$). Monthly decile returns are calculated for the current month t, and the deciles are rebalanced at the beginning of month $t+1$.

A.5.51 Ob, Order backlog

At the end of June of each year t, we sort stocks into deciles based on order backlog, Ob (Compustat annual item OB) for the fiscal year ending in calendar year $t-1$, scaled by the average of total assets (item AT) from the fiscal years ending in $t-2$ and $t-1$. Firms with no order backlog are excluded (most of them never have any order backlog). Monthly decile returns are calculated from July of year t to June of $t+1$, and the deciles are rebalanced in June of $t+1$. Because the order backlog data start in 1970, the Ob portfolios start in July 1971.

A.6 Trading frictions

A.6.1 Me, Market Equity

Market equity, Me, is price times shares outstanding from CRSP. At the end of June of each year t, we sort stocks into deciles based on the June-end Me. Monthly decile returns are calculated from July of year t to June of $t + 1$, and the deciles are rebalanced in June of $t + 1$.

A.6.2 Iv, Idiosyncratic Volatility

Following Ali, Hwang, and Trombley (2003), at the end of June of each year t, we sort stocks into deciles based on idiosyncratic volatility, Iv, which is the residual volatility from regressing a stock's daily excess returns on the market excess return over the prior one year from July of year $t - 1$ to June of t. We require a minimum of 100 daily returns when estimating Iv. Monthly decile returns are calculated from July of year t to June of $t + 1$, and the deciles are rebalanced at the end of June of year $t + 1$.

A.6.3 Ivff1, Ivff6, and Ivff12, Idiosyncratic Volatility per the FF 3-factor Model

Following Ang, Hodrick, Xing, and Zhang (2006), we calculate idiosyncratic volatility relative to the Fama-French three-factor model, Ivff, as the residual volatility from regressing a stock's excess returns on the Fama-French three factors. At the beginning of each month t, we sort stocks into deciles based on the Ivff estimated with daily returns from month $t - 1$. We require a minimum of 15 daily returns. Monthly decile returns are calculated for the current month t (Ivff1), from month t to $t+5$ (Ivff6), and from month t to $t+11$ (Ivff12), and the deciles are rebalanced at the beginning of month $t + 1$. The holding period that is longer than one month as in, for instance, Ivff6, means that for a given decile in each month there exist six subdeciles, each of which is initiated in a different month in the prior six-month period. We take the simple average of the subdecile returns as the monthly return of the Ivff6 decile.

A.6.4 Ivc1, Ivc6, and Ivc12, Idiosyncratic Volatility per the CAPM

We calculate idiosyncratic volatility per the CAPM, Ivc, as the residual volatility from regressing a stock's excess returns on the value-weighted market excess return. At the beginning of each month t, we sort stocks into deciles based on the Ivc estimated with daily returns from month $t - 1$. We require a minimum of 15 daily returns. Monthly decile returns are calculated for the current month t (Ivc1), from month t to $t + 5$ (Ivc6), and from month t to $t + 11$ (Ivc12), and the deciles are rebalanced at the beginning of month $t + 1$. The holding period that is longer than one month as in, for instance, Ivc6, means that for a given decile in each month there exist six subdeciles, each of which is initiated in a different month in the prior six-month period. We take the simple average of the subdecile returns as the monthly return of the Ivc6 decile.

A.6.5 Ivq1, Ivq6, and Ivq12, Idiosyncratic Volatility per the q-factor Model

We calculate idiosyncratic volatility per the q-factor model, Ivq, as the residual volatility from regressing a stock's excess returns on the q-factors. At the beginning of each month t, we sort stocks into deciles based on the Ivq estimated with daily returns from month $t - 1$. We require a minimum of 15 daily returns. Monthly decile returns are calculated for the current month t (Ivq1), from month t to $t + 5$ (Ivq6), and from month t to $t + 11$ (Ivq12), and the deciles are rebalanced at the beginning of month $t + 1$. The holding period that is longer than one month as in, for instance, Ivq6, means that for a given decile in each month there exist six subdeciles, each of which is initiated in a different month in the prior six-month period. We take the simple average of the subdecile returns as the monthly return of the Ivq6 decile. Because the q-factors start in January 1967, the Ivq portfolios start in February 1967.

A.6.6 Tv1, Tv6, and Tv12, Total Volatility

Following Ang, Hodrick, Xing, and Zhang (2006), at the beginning of each month t, we sort stocks into deciles based on total volatility, Tv, estimated as the volatility of a stock's daily returns from month $t-1$. We require a minimum of 15 daily returns. Monthly decile returns are calculated for the current month t, (Tv1), from month t to $t+5$ (Tv6), and from month t to $t+11$ (Tv12), and the deciles are rebalanced at the beginning of month $t+1$. The holding period that is longer than one month as in, for instance, Tv6, means that for a given decile in each month there exist six subdeciles, each of which is initiated in a different month in the prior six-month period. We take the simple average of the subdeciles returns as the monthly return of the Tv6 decile.

A.6.7 Sv1, Sv6, and Sv12, Systematic Volatility Risk

Following Ang, Hodrick, Xing, and Zhang (2006), we measure systematic volatility risk, Sv, as β^i_{dVXO} from the bivariate regression:

$$r^i_d = \beta^i_0 + \beta^i_{\mathrm{MKT}}\mathrm{MKT}_d + \beta^i_{\mathrm{dVXO}}\mathrm{dVXO}_d + \epsilon^i_d, \tag{A34}$$

in which r^i_d is stock i's excess return on day d, MKT_d is the market factor return, and dVXO_d is the aggregate volatility shock measured as the daily change in the Chicago Board Options Exchange S&P 100 volatility index (VXO). At the beginning of each month t, we sort stocks into deciles based on β^i_{dVXO} estimated with the daily returns from month $t-1$. We require a minimum of 15 daily returns. Monthly decile returns are calculated for the current month t (Sv1), from month t to $t+5$ (Sv6), and from month t to $t+11$ (Sv12), and the deciles are rebalanced at the beginning of month $t+1$. The holding period that is longer than one month as in Sv6 means that for a given decile in each month there exist six subdeciles, each of which is initiated in a different month in the prior six-month period. We take the simple average of the subdecile returns as the monthly return of the Sv6 decile. Because the VXO data start in January 1986, the Sv portfolios start in February 1986.

A.6.8 β1, β6, and β12, Market Beta

At the beginning of each month t, we sort stocks into deciles on their market beta, β, which is estimated with monthly returns from month $t-60$ to $t-1$. We require a minimum of 24 monthly returns. Monthly decile returns are calculated for the current month t (β1), from month t to $t+5$ (β6), and from month t to $t+11$ (β12), and the deciles are rebalanced at the beginning of month $t+1$. The holding period longer than one month as in β6 means that for a given decile in each month there exist six subdeciles, each of which is initiated in a different month in the prior six months. We take the simple average of the subdecile returns as the monthly return of the β6 decile.

A.6.9 β^{FP}1, β^{FP}6, and β^{FP}12, The Frazzini-Pedersen Beta

Following Frazzini and Pedersen (2013), we estimate the market beta for stock i, β^{FP}, as $\hat{\rho}\hat{\sigma}_i/\hat{\sigma}_m$, in which $\hat{\sigma}_i$ and $\hat{\sigma}_m$ are the estimated return volatilities for the stock and the market, and $\hat{\rho}$ is their return correlation. To estimate return volatilities, we compute the standard deviations of daily log returns over a one-year rolling window (with at least 120 daily returns). To estimate return correlations, we use overlapping three-day log returns, $r_{it}^{3d} = \sum_{k=0}^{2} \log(1 + r_{t+k}^{i})$, over a five-year rolling window (with at least 750 daily returns). At the beginning of each month t, we sort stocks into deciles based on β^{FP} estimated at the end of month $t-1$. Monthly decile returns are calculated for the current month t ($\beta^{\mathrm{FP}}1$), from month t to $t+5$ ($\beta^{\mathrm{FP}}6$), and from month t to $t+11$ ($\beta^{\mathrm{FP}}12$), and the deciles are rebalanced at the beginning of month $t+1$. The holding period longer than one month as in $\beta^{\mathrm{FP}}6$ means that for a given decile in each month there exist six subdeciles, each of which is initiated in a different month in the prior six-month period. We take the simple average of the subdecile returns as the monthly return of the $\beta^{\mathrm{FP}}6$ decile.

A.6.10 β^{D}1, β^{D}6, and β^{D}12, The Dimson Beta

Following Dimson (1979), we use the lead and the lag of the market return along with the current market return, when estimating the market beta:

$$r_{id} - r_{fd} = \alpha_i + \beta_{i1}(r_{md-1} - r_{fd-1}) + \beta_{i2}(r_{md} - r_{fd}) + \beta_{i3}(r_{md+1} - r_{fd+1}) + \epsilon_{id}, \tag{A35}$$

in which r_{id} is stock i's return on day d, r_{md} is the market return, and r_{fd} is the risk-free rate. The Dimson beta of stock i, β^{D}, is calculated as $\hat{\beta}_{i1} + \hat{\beta}_{i2} + \hat{\beta}_{i3}$. At the beginning of each month t, we sort stocks into deciles based on β^{D} estimated with the daily returns from month $t-1$. We require a minimum of 15 daily returns. Monthly decile returns are calculated for the current month t ($\beta^{\mathrm{D}}1$), from month t to $t+5$ ($\beta^{\mathrm{D}}6$), and from month t to $t+11$ ($\beta^{\mathrm{D}}12$), and the deciles are rebalanced at the beginning of month $t+1$. The holding period longer than one month as in $\beta^{\mathrm{D}}6$ means that for a given decile in each month there exist six subdeciles, each of which is initiated in a different month in the prior six-month period. We take the simple average of the subdecile returns as the monthly return of the $\beta^{\mathrm{D}}6$ decile.

A.6.11 Tur1, Tur6, and Tur12, Share Turnover

Following Datar, Naik, and Radcliffe (1998), we calculate a stock's share turnover, Tur, as its average daily share turnover over the prior six months. We require a minimum of 50 daily observations. Daily turnover is the number of shares traded on a given day divided by the number of shares outstanding on that day.[11] At the beginning of each month t, we sort stocks into deciles based on Tur over the prior six months from $t-6$ to $t-1$. Monthly decile returns are calculated for the current month t (Tur1), from month t to $t+5$ (Tur6), and from month t to $t+11$ (Tur12), and the deciles are rebalanced at the beginning of month $t+1$. The holding period longer than one month as in, for instance, Tur6, means that for a given decile in each month there exist six subdeciles,

[11] We adjust the NASDAQ trading volume to account for the institutional differences between NASDAQ and NYSE-Amex volumes (Gao and Ritter 2010). Prior to February 1, 2001, we divide NASDAQ volume by two. This procedure adjusts for the practice of counting as trades both trades with market makers and trades among market makers. On February 1, 2001, according to the director of research of NASDAQ and Frank Hathaway (the chief economist of NASDAQ), a "riskless principal" rule goes into effect and results in a reduction of approximately 10% in reported volume. From February 1, 2001 to December 31, 2001, we thus divide NASDAQ volume by 1.8. During 2002, securities firms began to charge institutional investors commissions on NASDAQ trades, rather than the prior practice of marking up or down the net price. This practice results in a further reduction in reported volume of approximately 10%. For 2002 and 2003, we divide NASDAQ volume by 1.6. For 2004 and later years, in which the volume of NASDAQ (and NYSE) stocks has mostly been occurring on crossing networks and other venues, we use a divisor of 1.0.

each of which is initiated in a different month in the prior six months. We take the simple average of the subdecile returns as the monthly return of the Tur6 decile.

A.6.12 Cvt1, Cvt6, and Cvt12, Coefficient of Variation of Share Turnover

Following Chordia, Subrahmanyam, and Anshuman (2001), we calculate a stock's coefficient of variation (the ratio of the standard deviation to the mean) for its daily share turnover, Cvt, over the prior six months. We require a minimum of 50 daily observations. Daily turnover is the number of shares traded on a given day divided by the number of shares outstanding on that day. We adjust the trading volume of NASDAQ stocks per Gao and Ritter (2010) (see footnote 11). At the beginning of each month t, we sort stocks into deciles based on Cvt over the prior six months from $t-6$ to $t-1$. Monthly decile returns are calculated for the current month t (Cvt1), from month t to $t+5$ (Cvt6), and from month t to $t+11$ (Cvt12), and the deciles are rebalanced at the beginning of month $t+1$. The holding period longer than one month as in, for instance, Cvt6, means that for a given decile in each month there exist six subdeciles, each of which is initiated in a different month in the prior six months. We take the simple average of the subdeciles returns as the monthly return of the Cvt6 decile.

A.6.13 Dtv1, Dtv6, and Dtv12, Dollar Trading Volume

At the beginning of each month t, we sort stocks into deciles based on their average daily dollar trading volume, Dtv, over the prior six months from $t-6$ to $t-1$. We require a minimum of 50 daily observations. Dollar trading volume is share price times the number of shares traded. We adjust the trading volume of NASDAQ stocks per Gao and Ritter (2010) (see footnote 11). Monthly decile returns are calculated for the current month t (Dtv1), from month t to $t+5$ (Dtv6), and from month t to $t+11$ (Dtv12), and the deciles are rebalanced at the beginning of month $t+1$. The holding period longer than one month as in, for instance, Dtv6, means that for a given decile in each month there exist six subdeciles, each of which is initiated in a different month in the prior six months. We take the simple average of the subdecile returns as the monthly return of the Dtv6 decile.

A.6.14 Cvd1, Cvd6, and Cvd12, Coefficient of Variation of Dollar Trading Volume

Following Chordia, Subrahmanyam, and Anshuman (2001), we calculate a stock's coefficient of variation (the ratio of the standard deviation to the mean) for its daily dollar trading volume, Cvd, over the prior six months. We require a minimum of 50 daily observations. Dollar trading volume is share price times the number of shares. We adjust the trading volume of NASDAQ stocks per Gao and Ritter (2010) (see footnote 11). At the beginning of each month t, we sort stocks into deciles based on Cvd over the prior six months from $t-6$ to $t-1$. Monthly decile returns are calculated for the current month t (Cvd1), from month t to $t+5$ (Cvd6), and from month t to $t+11$ (Cvd12), and the deciles are rebalanced at the beginning of month $t+1$. The holding period longer than one month as in Cvd6 means that for a given decile in each month there exist six subdeciles, each of which is initiated in a different month in the prior six months. We take the simple average of the subdecile returns as the monthly return of the Cvd6 decile.

A.6.15 Pps1, Pps6, and Pps12, Share Price

At the beginning of each month t, we sort stocks into deciles based on share price, Pps, at the end of month $t-1$. Monthly decile returns are calculated for the current month t (Pps1), from month t to $t+5$ (Pps6), and from month t to $t+11$ (Pps12), and the deciles are rebalanced at the beginning of month $t+1$. The holding period longer than one month as in, for instance, Pps6, means that for a given decile in each month there exist six subdeciles, each of which is initiated in a different month in the prior six months. We take the simple average of the subdeciles returns as the monthly return of the Pps6 decile.

A.6.16 Ami1, Ami6, and Ami12, Absolute Return-to-volume

We calculate the Amihud (2002) illiquidity measure, Ami, as the ratio of absolute daily stock return to daily dollar trading volume, averaged over the prior six months. We require a minimum of 50 daily observations. Dollar trading volume is share price times the number of shares traded. We adjust the trading volume of NASDAQ stocks per Gao and Ritter (2010) (see footnote 11). At the beginning of each month t, we sort stocks into deciles based on Ami over the prior six months from $t-6$ to $t-1$. Monthly decile returns are calculated for the current month t (Ami1), from month t to $t+5$ (Ami6), and from month t to $t+11$ (Ami12), and the deciles are rebalanced at the beginning of month $t+1$. The holding period longer than one month as in, for instance, Ami6, means that for a given decile in each month there exist six subdeciles, each of which is initiated in a different month in the prior six months. We take the simple average of the subdeciles returns as the monthly return of the Ami6 decile.

A.6.17 $\text{Lm}^1 1$, $\text{Lm}^1 6$, $\text{Lm}^1 12$, $\text{Lm}^6 1$, $\text{Lm}^6 6$, $\text{Lm}^6 12$, $\text{Lm}^{12} 1$, $\text{Lm}^{12} 6$, $\text{Lm}^{12} 12$, Turnover-adjusted Number of Zero Daily Volume

Following Liu (2006), we calculate the standardized turnover-adjusted number of zero daily trading volume over the prior x month, Lm^x, as follows:

$$\text{Lm}^x \equiv \left[\text{Number of zero daily volume in prior } x \text{ months} + \frac{1/(x\text{−month TO})}{\text{Deflator}}\right] \frac{21x}{\text{NoTD}}, \quad \text{(A36)}$$

in which x-month TO is the sum of daily turnover over the prior x months ($x = 1, 6$, and 12). Daily turnover is the number of shares traded on a given day divided by the number of shares outstanding on that day. We adjust the trading volume of NASDAQ stocks per Gao and Ritter (2010) (see footnote 11). NoTD is the total number of trading days over the prior x months. We set the deflator to $\max\{1/(x\text{−month TO})\}+1$, in which the maximization is taken across all sample stocks each month. Our choice of the deflator ensures that $(1/(x\text{−month TO}))/\text{Deflator}$ is between zero and one for all stocks. We require a minimum of 15 daily turnover observations when estimating Lm^1, 50 for Lm^6, and 100 for Lm^{12}.

At the beginning of each month t, we sort stocks into deciles based on Lm^x, with $x = 1, 6$, and 12. We calculate decile returns for the current month t ($\text{Lm}^x 1$), from month t to $t+5$ ($\text{Lm}^x 6$), and from month t to $t+11$ ($\text{Lm}^x 12$). The deciles are rebalanced at the beginning of month $t+1$. The holding period longer than one month as in $\text{Lm}^x 6$ means that for a given decile in each month there exist six subdeciles, each initiated in a different month in the prior six months. We take the simple average of the subdecile returns as the monthly return of the $\text{Lm}^x 6$ decile.

A.6.18 Mdr1, Mdr6, and Mdr12, Maximum Daily Return

At the beginning of each month t, we sort stocks into deciles based on maximal daily return, Mdr, in month $t-1$. We require a minimum of 15 daily returns. Monthly decile returns are calculated for the current month t (Mdr1), from month t to $t+5$ (Mdr6), and from month t to $t+11$ (Mdr12), and the deciles are rebalanced at the beginning of month $t+1$. The holding period longer than one month as in, for instance, Mdr6, means that for a given decile in each month there exist six subdeciles, each of which is initiated in a different month in the prior six months. We take the simple average of the subdeciles returns as the monthly return of the Mdr6 decile.

A.6.19 Ts1, Ts6, and Ts12, Total Skewness

At the beginning of each month t, we sort stocks into deciles based on total skewness, Ts, calculated with daily returns from month $t-1$. We require a minimum of 15 daily returns. Monthly decile returns are calculated for the current month t (Ts1), from month t to $t+5$ (Ts6), and from month t to $t+11$ (Ts12), and the deciles are rebalanced at the beginning of month $t+1$. The holding period longer than one month as in Ts6 means that for a given decile in each month there exist six subdeciles, each of which is initiated in a different month in the prior six months. We take the simple average of the subdecile returns as the monthly return of the Ts6 decile.

A.6.20 Isc1, Isc6, and Isc12, Idiosyncratic Skewness per the CAPM

At the beginning of each month t, we sort stocks into deciles based on idiosyncratic skewness, Isc, calculated as the skewness of the residuals from regressing a stock's excess return on the market excess return using daily observations from month $t-1$. We require a minimum of 15 daily returns. Monthly decile returns are calculated for the current month t (Isc1), from month t to $t+5$ (Isc6), and from month t to $t+11$ (Isc12), and the deciles are rebalanced at the beginning of month $t+1$. The holding period longer than one month as in Isc6 means that for a given decile in each month there exist six subdeciles, each of which is initiated in a different month in the prior six months. We take the simple average of the subdecile returns as the monthly return of the Isc6 decile.

A.6.21 Isff1, Isff6, and Isff12, Idiosyncratic Skewness per the FF 3-factor Model

At the beginning of each month t, we sort stocks into deciles based on idiosyncratic skewness, Isff, calculated as the skewness of the residuals from regressing a stock's excess return on the Fama-French three factors using daily observations from month $t-1$. We require a minimum of 15 daily returns. Monthly decile returns are calculated for the current month t (Isff1), from month t to $t+5$ (Isff6), and from month t to $t+11$ (Isff12), and the deciles are rebalanced at the beginning of month $t+1$. The holding period longer than one month as in Isff6 means that for a given decile in each month there exist six subdeciles, each of which is initiated in a different month in the prior six months. We take the simple average of the subdecile returns as the monthly return of the Isff6 decile.

A.6.22 Isq1, Isq6, and Isq12, Idiosyncratic Skewness per the q-factor Model

At the beginning of each month t, we sort stocks into deciles based on idiosyncratic skewness, Isq, calculated as the skewness of the residuals from regressing a stock's excess return on the q-factors using daily observations from month $t-1$. We require a minimum of 15 daily returns. Monthly decile returns are calculated for the current month t (Isq1), from month t to $t+5$ (Isq6), and from month t to $t+11$ (Isq12), and the deciles are rebalanced at the beginning of month $t+1$. The holding period longer than one month as in Isq6 means that for a given decile in each month there exist six subdeciles, each of which is initiated in a different month in the prior six months. We take the simple average of the subdecile returns as the monthly return of the Isq6 decile. Because the q-factors start in January 1967, the Ivq portfolios start in February 1967.

A.6.23 Cs1, Cs6, and Cs12, Coskewness

Following Harvey and Siddique (2000), we measure coskewness, Cs, as:

$$\text{Cs} = \frac{E[\epsilon_i \epsilon_m^2]}{\sqrt{E[\epsilon_i^2]}E[\epsilon_m^2]}, \tag{A37}$$

in which ϵ_i is the residual from regressing stock i's excess return on the market excess return, and ϵ_m is the demeaned market excess return. At the beginning of each month t, we sort stocks into deciles based on Cs calculated with daily returns from month $t-1$. We require a minimum of 15 daily returns. Monthly decile returns are calculated for the current month t (Cs1), from month t to $t+5$ (Cs6), and from month t to $t+11$ (Cs12), and the deciles are rebalanced at the beginning of month $t+1$. The holding period longer than one month as in Cs6 means that for a given decile in each month there exist six subdeciles, each of which is initiated in a different month in the prior six months. We take the simple average of the subdecile returns as the monthly return of the Cs6 decile.

A.6.24 Srev, Short-term Reversal

At the beginning of each month t, we sort stocks into short-term reversal (Srev) deciles based on the return in month $t-1$. To be included in a decile in month t, a stock must have a valid price at the end of month $t-2$ and a valid return for month $t-1$. Monthly decile returns are calculated for the current month t, and the deciles are rebalanced at the beginning of month $t+1$.

A.6.25 β^-1, β^-6, and β^-12, Downside Beta

Following Ang, Chen, and Xing (2006), we define downside beta, β^-, as:

$$\beta^- = \frac{\text{Cov}(r_i, r_m | r_m < \mu_m)}{\text{Var}(r_m | r_m < \mu_m)}, \tag{A38}$$

in which r_i is stock i's excess return r_m is the market excess return, and μ_m is the average market excess return. At the beginning of each month t, we sort stocks into deciles based on β^-, which is estimated with daily returns from prior 12 months from $t-12$ to $t-1$ (we only use daily observations with $r_m < \mu_m$). We require a minimum of 50 daily returns. Monthly decile returns are calculated for the current month t (β^-1), from month t to $t+5$ (β^-6), and from month t to $t+11$ (β^-12), and the deciles are rebalanced at the beginning of month $t+1$. The holding period longer than one month as in β^-6 means that for a given decile in each month there exist six subdeciles, each of which is initiated in a different month in the prior six months. We take the simple average of the subdecile returns as the monthly return of the β^-6 decile.

A.6.26 Tail1, Tail6, and Tail12, Tail Risk

Following Kelly and Jiang (2014), we estimate common tail risk, λ_t, by pooling daily returns for all stocks in month t, as follows:

$$\lambda_t = \frac{1}{K_t}\sum_{k=1}^{K_t} \log \frac{R_{kt}}{\mu_t}, \tag{A39}$$

in which μ_t is the fifth percentile of all daily returns in month t, R_{kt} is the kth daily return that is below μ_t, and K_t is the total number of daily returns that are below μ_t. At the beginning of each month t, we split stocks on tail risk, Tail, estimated as the slope from regressing a stock's excess returns on one-month-lagged common tail risk over the most recent 120 months from $t-120$ to $t-1$. We require a minimum of least 36 monthly observations. Monthly decile returns are calculated for the current month t (Tail1), from month t to $t+5$ (Tail6), and from month t to $t+11$ (Tail12), and the deciles are rebalanced at the beginning of month $t+1$. The holding period longer than one month as in Tail6 means that for a given decile in each month there exist six subdeciles, each of which is initiated in a different month in the prior six months. We take the simple average of the subdecile returns as the monthly return of the Tail6 decile.

A.6.27 $\beta^{\rm ret}$1, $\beta^{\rm ret}$6, $\beta^{\rm ret}$12, $\beta^{\rm lcc}$1, $\beta^{\rm lcc}$6, $\beta^{\rm lcc}$12, $\beta^{\rm lrc}$1, $\beta^{\rm lrc}$6, $\beta^{\rm lrc}$12, $\beta^{\rm lcr}$1, $\beta^{\rm lcr}$6, $\beta^{\rm lcr}$12, $\beta^{\rm net}$1, $\beta^{\rm net}$6, and $\beta^{\rm net}$12, Liquidity Betas (Return-return, Illiquidity-illiquidity, Return-illiquidity, Illiquidity-return, and Net)

Following Acharya and Pedersen (2005), we measure illiquidity using the Amihud (2002) measure, Ami. For stock i in month t, Ami^i_t is the average ratio of absolute daily return to daily dollar trading volume. We require a minimum of 15 daily observations. Dollar trading volume is share price times the number of shares traded. We adjust the trading volume of NASDAQ stocks per Gao and Ritter (2010) (see footnote 11). The Market illiquidity, Ami^M_t, is the value-weighted average of $\min(\text{Ami}^i_t, (30-0.25)/(0.30P^M_{t-1}))$, in which P^M_{t-1} is the ratio of the total market capitalization of S&P 500 at the end of month $t-1$ to its value at the end of July 1962. We measure market illiquidity innovations, ϵ^c_{Mt}, as the residual from the regression below:

$$(0.25+0.30\text{Ami}^M_t P^M_{t-1}) = a_0 + a_1(0.25+0.30\text{Ami}^M_{t-1}P^M_{t-1}) + a_2(0.25+0.30\text{Ami}^M_{t-2}P^M_{t-1}) + \epsilon^c_{Mt} \tag{A40}$$

Innovations to individual stocks' illiquidity, ϵ^c_{it}, are measured analogously by replacing Ami^M with $\min(\text{Ami}^i_t, (30-0.25)/(0.30P^M_{t-1}))$ in equation (A40). Finally, innovations to the market return are measured as the residual, ϵ^r_{Mt}, from the second-order autoregression of the market return. Following Acharya and Pedersen, we define five measures of liquidity betas:

$$\text{Return}-\text{return}: \quad \beta^{\rm ret}_i \equiv \frac{\text{Cov}(r_{it}, \epsilon^r_{Mt})}{\text{var}(\epsilon^r_{Mt} - \epsilon^c_{Mt})} \tag{A41}$$

$$\text{Illiquidity}-\text{illiquidity}: \quad \beta^{\rm lcc}_i \equiv \frac{\text{Cov}(\epsilon^c_{it}, \epsilon^c_{Mt})}{\text{var}(\epsilon^r_{Mt} - \epsilon^c_{Mt})} \tag{A42}$$

$$\text{Return}-\text{illiquidity}: \quad \beta^{\rm lrc}_i \equiv \frac{\text{Cov}(r_{it}, \epsilon^c_{Mt})}{\text{var}(\epsilon^r_{Mt} - \epsilon^c_{Mt})} \tag{A43}$$

$$\text{Illiquidity}-\text{return}: \quad \beta^{\rm lcr}_i \equiv \frac{\text{Cov}(\epsilon^c_{it}, \epsilon^r_{Mt})}{\text{var}(\epsilon^r_{Mt} - \epsilon^c_{Mt})} \tag{A44}$$

$$\text{Net}: \quad \beta^{\rm net}_i \equiv \beta^{\rm ret}_i + \beta^{\rm lcc}_i - \beta^{\rm lrc}_i - \beta^{\rm lcr}_i \tag{A45}$$

At the beginning of each month t, we sort stocks, separately, on β^{ret}, β^{lcc}, β^{lrc}, β^{lcr}, and β^{net}, estimated with the past 60 months (at least 24 months) from $t-60$ to $t-1$. Monthly decile returns are calculated for the current month t ($\beta^{\text{ret}}1$, $\beta^{\text{lcc}}1$, $\beta^{\text{lrc}}1$, $\beta^{\text{lcr}}1$, and $\beta^{\text{net}}1$), from month t to $t+5$ ($\beta^{\text{ret}}6$, $\beta^{\text{lcc}}6$, $\beta^{\text{lrc}}6$, $\beta^{\text{lcr}}6$, and $\beta^{\text{net}}6$), and from month t to $t+11$ ($\beta^{\text{ret}}12$, $\beta^{\text{lcc}}12$, $\beta^{\text{lrc}}12$, $\beta^{\text{lcr}}12$, and $\beta^{\text{net}}12$), and the deciles are rebalanced at the beginning of month $t+1$. The holding period longer than one month as in $\beta^{\text{lcc}}6$ means that for a given decile in each month there exist six subdeciles, each of which is initiated in a different month in the prior six months. We take the simple average of the subdecile returns as the monthly return of the $\beta^{\text{lcc}}6$ decile.

A.6.28 Shl1, Shl6, and Shl12, The High-low Bid-ask Spread Estimator

The monthly Corwin and Shultz (2012) stock-level bid-ask spread estimator, Shl, are obtained from Shane Corwin's Web site. At the beginning of each month t, we sort stocks into deciles based on Shl for month $t-1$. Monthly decile returns are calculated for the current month t (Shl1), from month t to $t+5$ (Shl6), and from month t to $t+11$ (Shl12), and the deciles are rebalanced at the beginning of month $t+1$. The holding period longer than one month as in Shl6 means that for a given decile in each month there exist six subdeciles, each of which is initiated in a different month in the prior six months. We take the simple average of the subdecile returns as the monthly return of the Shl6 decile.

A.6.29 Sba1, Sba6, and Sba12, Bid-ask Spread

The monthly Hou and Loh (2015) stock-level bid-ask spread, Sba, are provided by Roger Loh for the sample period from 1984 to 2012 (excluding 1986 due to missing data). At the beginning of each month t, we sort stocks into deciles based on Sba for month $t-1$. Monthly decile returns are calculated for the current month t (Sba1), from month t to $t+5$ (Sba6), and from month t to $t+11$ (Sba12), and the deciles are rebalanced at the beginning of month $t+1$. The holding period longer than one month as in Sba6 means that for a given decile in each month there exist six subdeciles, each of which is initiated in a different month in the prior six months. We take the simple average of the subdecile returns as the monthly return of the Sba6 decile. The sample period for the Sba portfolios is from February 1984 to January 2013 (excluding February 1986 to January 1987).

A.6.30 β^{lev}1, β^{lev}6, and β^{lev}12, The Intermediary Leverage Beta

At the beginning of each quarter, we estimate a stock's financial intermediary leverage beta, β^{Lev}, from regressing its quarterly returns in excess of the three-month Treasury bill rate on the quarterly non-traded leverage factor during the past 40 quarters (20 quarters minimum). Following Adrian, Etula, and Muir (2014), we construct the leverage of financial intermediary using quarterly aggregate data on total financial assets and liabilities of security broker-dealers from Table L.129 of the Federal Reserve Flow of Funds. To be consistent with the original data used by Adrian et al., we combine the repurchase agreement (repo) liabilities and the reverse repo assets into net repo liabilities. The financial intermediary leverage is measured as total financial assets/(total financial assets − total financial liabilities). The non-traded leverage factor is the seasonally adjusted log change in the level of leverage. The log changes are seasonally adjusted using quarterly seasonal dummies in expanding window regressions. Following Adrian et al., we start using the security broker-dealer data in the first quarter of 1968. The three-month Treasury bill rate data are from the Federal Reserve Bank database.

At the beginning of each month t, we sort stocks into deciles based on β^{Lev} estimated at the beginning of the current quarter. Monthly decile returns are calculated for the current month t

($\beta^{\text{Lev}}1$), from month t to $t+5$ ($\beta^{\text{Lev}}6$), and from month t to $t+11$ ($\beta^{\text{Lev}}12$), and the deciles are rebalanced at the beginning of month $t+1$. The holding period longer than one month as in $\beta^{\text{Lev}}6$ means that for a given decile in each month there exist six subdeciles, each of which is initiated in a different month in the prior six months. We take the simple average of the subdecile returns as the monthly return of the $\beta^{\text{Lev}}6$ decile. Because the financial intermediary leverage data start in 1968 and we need at least 20 quarters to estimate β^{Lev}, the β^{Lev} portfolios start in January 1973.

B Delisting Adjustment

Following Beaver, McNichols, and Price (2007), we adjust monthly stock returns for delisting returns by compounding returns in the month before delisting with delisting returns from CRSP.

As discussed in Beaver, McNichols, and Price (2007), the monthly CRSP delisting returns (file `msedelist`) might not adjust for delisting properly. We follow their procedure to directly construct the delisting-adjusted monthly stock returns. For delisting that occurs before the last trading day in month t, we calculate the delisting-adjusted monthly return, DR_t, as:

$$\text{DR}_t = (1 + \text{pmr}_{dt})(1 + \text{der}_{dt}) - 1, \tag{B1}$$

in which pmr_{dt} is the partial month return from the beginning of the month to the delisting day d, and der_{dt} is the delisting event return from the daily CRSP delisting file (`dsedelist`).

We calculate the partial month return, pmr_{dt}, as follows:

- When the delisting date (item DLSTDT) is the same as the delisting payment date (item DLPDT), the monthly CRSP delisting return, mdr_t, includes only the partial month return:

$$\text{pmr}_{dt} = \text{mdr}_t. \tag{B2}$$

- When the delisting date proceeds the delisting payment date, pmr_{dt} can be computed from the monthly CRSP delisting return and the delisting event return:

$$\text{pmr}_{dt} = \frac{1 + \text{mdr}_t}{1 + \text{der}_{dt}} - 1. \tag{B3}$$

- If pmr_{dt} cannot be computed via the above methods, we construct it by accumulating daily returns from the beginning of month t to the delisting day d:

$$\text{pmr}_{dt} = \prod_{i=1}^{d}(1 + \text{ret}_{it}) - 1, \tag{B4}$$

  in which ret_{it} is the regular stock return on day i.

For delisting that occurs on the last trading day of month t, we include only the regular monthly return for month t, and account for the delisting return at the beginning of the following month: $\text{DR}_t = \text{ret}_t$ and $\text{DR}_{t+1} = \text{der}_{dt}$, in which ret_t is the regular full month return. Differing from Beaver, McNichols, and Price (2007), we do not account for these last-day delistings in the same month, because delisting generally occurs after the market closes. Also, delisting events are often surprises, and their payoffs cannot be determined immediately (Shumway 1997). As such, it might be problematic to incorporate delisting returns immediately on the last trading date in month t.

When delisting event returns are missing, the delisting-adjusted monthly returns cannot be computed. Among nonfinancial firms traded on NYSE, Amex, and Nasdaq, there are 16,326 delistings from 1925 to 2014, with 85.8% of the delisting event returns available. One option is to exclude missing delisting returns. However, previous studies show that omitting these stocks can introduce significant biases in asset pricing tests (Shumway 1997, Shumway and Warther 1999). As such, we replace missing delisting event returns using the average available delisting returns with the same stock exchange and delisting type (one-digit delisting code) during the past 60 months. We condition on stock exchange and delisting type because average delisting returns vary significantly across exchanges and delisting types. We also allow replacement values to vary over time because average delisting returns can vary greatly over time. Our procedure is inspired by prior studies. Shumway (1997) proposes a constant replacement value of -30% for all performance-related delistings on NYSE/Amex. Beaver, McNichols, and Price (2007) construct replacement values conditional on stock exchange and delisting type, but do not allow the replacement values to vary over time.

C Extending the q-factors

Following Hou, Xue, and Zhang (2015), we construct the size, investment, and Roe factors from a triple $2 \times 3 \times 3$ sort on size, investment-to-assets (I/A), and return on equity (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 one-year-lagged total assets, and Roe is income before extraordinary items (Compustat quarterly item IBQ) divided by one-quarter-lagged book equity.[12] At the end of June of each year t, we use the median NYSE size to split NYSE, Amex, and NASDAQ 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 the ranked values of Roe. Earnings data in Compustat quarterly files are used in the months immediately after the most recent public quarterly earnings announcement dates (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 benchmark portfolios. Monthly value-weighted portfolio returns are calculated for the current month, and the portfolios are rebalanced monthly. The size factor 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 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 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.

[12] 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 book value of preferred stock, or total assets (item ATQ) minus total liabilities (item LTQ) in that order as shareholders' equity.

Hou, Xue, and Zhang (2015) start the q-factors sample in January 1972, restricted by the limited coverage of earnings announcement dates and book equity in Compustat quarterly files. We extend 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 the fiscal quarter 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. We first use quarterly book equity from Compustat quarterly files whenever available, and then supplement the coverage for the fourth fiscal quarter with book equity from Compustat annual files.[13] If neither estimate is available, we apply the clean surplus relation to impute the book equity. We first backward impute the beginning-of-quarter book equity as the end-of-quarter book equity minus quarterly earnings plus quarterly dividends.[14] Because we impose a four-month lag between earnings and the holding period month (and the book equity in the denominator of Roe is one-quarter-lagged relative to earnings), all the Compustat data in the backward imputation are at least four-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 BEQ_{t-j}, with $1 \leq j \leq 4$, 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 quarterly dividends from quarter $t-j+1$ to t, respectively. BEQ_t can then 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 to reduce imputation errors ($1 \leq j \leq 4$). We start the sample in January 1967 to ensure that all the 18 benchmark portfolios from the triple sort on size, I/A, and Roe have at least ten firms.

Among the 18 benchmark portfolios underlying the q-factors, the small-low I/A-high Roe portfolio earns the highest average excess return of 1.39% per month, and the small-high I/A-low Roe portfolio the lowest, −0.07%. The largest average return spread between the low and high I/A portfolios, 0.74%, resides in the small-low Roe stocks. In contrast, the spread is only 0.09% in the big-high Roe stocks. The largest average return spread between the high and low Roe portfolios, 1.1%, is in the small-high I/A stocks, and the spread is only 0.1% in the big-low I/A stocks.

[13]Following Davis, Fama, and French (2000), we measure annual book equity 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.

[14]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).