Capital to Labor Growth Ratio and the Cross-Section of Stock Returns

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Abstract

We examine the cross-sectional relation between the ratio of log growth in physical capital to log growth in labor and subsequent stock returns. The ratio is a negative predictor of abnormal returns and the relation strengthens with measures of financing constraint while remaining robust to previously provided determinants of returns. A ratio-based 2-factor model outperforms common asset pricing models explaining various anomalies indicating that anomalies reflect cross-sectional variation in growth ratios. We interpret the findings as outcomes reflecting displacements on the production isoquant, and show the pattern in returns is consistent with an investment-based model in which firms face financing constraints.

JEL Classification: D20, D21, D24, G10, G12, G30, G31

Keywords: cross-section of stock returns, asset pricing, corporate investments, growth options, production technology, factors of production, operating risk, stock return and risk, financial constraints, production flexibility.

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1 Introduction

The empirical evidence from the cross-section of firms supports the view that capital markets price information on real investments. Events associated with corporate expansions (i.e., acquisitions, public equity and debt offerings) tend to precede periods of low returns, whereas events associated with contractions (i.e., spinoffs, share and debt repurchases) tend to precede periods of high returns.[1] Further evidence supports a negative relationship between various forms of corporate investment and subsequent stock returns. For example, capital investments, labor hires, sales growth rates, and capital raising are all negatively correlated with future returns.[2]

In this paper we present new evidence on the implications of real investments for asset pricing by investigating the impact that the relative growth in production inputs has on stock returns in the cross-section of U.S. traded firms. Our measure is motivated by the notion that past production decisions displace firms on the production isoquant, affecting the technical rate of substitution between production inputs. This in turn, affects the operating flexibility and the risk premia of firms if some of the production inputs are subject to adjustment frictions. Difference in average returns emerges from the cross-sectional variation in this measure.

To understand this, consider two identical firms h and l with Cobb-Douglas production technology which accepts physical capital K and labor input L in order to produce output Q, i.e. $Q = L^{\alpha} K^{\nu}$. Both firms are initially located at the same point on the production isoquant.[3] Assume that in the most recent fiscal period firm h, compared to l, meets production with a greater reliance on K than L in response to a positive productivity shock. As a consequence, h experiences a greater leftward displacement from the initial point on the isoquant. The slope at this location is steeper, meaning that h now has a higher technical rate of substitution of labor for physical capital (TRS hereafter) than l.[4] Assume, in accordance with lower adjustment frictions, that L requires less external financing than investments in K.[5,6] A higher TRS has

[1] For evidence from acquisitions see Asquith (1983), Agrawal, Jaffe, and Mandelker (1992) and Loughran and Vijh (1997); from public equity offerings see Ibbotson (1975) and Loughran and Ritter (1995); from public debt offerings see Spiess and Affleck-Graves (1999). For evidence from spinoffs see Cusatis, Miles, and Woolridge (1993); from share repurchase see Lakonishok and Vermaelen (1990) and Ikenberry, Lakonishok, and Vermaelen (1995); and from debt repurchase see Affleck-Graves and Miller (2003).

[2] For evidence from capital investment see Titman, Wei, and Xie (2004) and Polk and Sapienza (2009); from labor hiring see Bazdresch, Belo, and Lin (2014); from sale growth see Broussard, Michayluk, and Neely (2005) and Lamont (2000); and from capital raising see Richarson and Sloan (2003) and Pontiff and Woodgate (2008).

[3] The production isoquant gives all bundles of L and K that produce a fixed amount of output $\overline{Q}$.

[4] The general shape of an isoquant for a Cobb-Douglas production function is convex.

[5] Such could be the case if wages are paid from operating revenue, or internal capital, while the costs of physical capital adjustments, due to their lumpy nature, must be paid with external funds subject to potentially binding financing constraints.

[6] Investments in K are commonly associated with significant adjustment frictions. See for example, Olley and Pakes (1996) and Levinsohn and Petrin (2003), Cooper (2007), Carlson, Fisher, and Giammarino (2004), Zhang (2005) and Livdan, Sapriza, and Zhang (2009). Labor hires, on the other hand, are associated with lower adjustment

implications for risk premia. Firm h, with a larger capital base and therefore a greater production feasibility set, would be better poised to exploit productivity shocks in face of binding financing constraints. In this regard, h will have greater operating flexibility, and hence a lower risk premia, than l. The expected return of a portfolio that is long h and short l, $ER_h - ER_l$, will be negative stemming from a negative difference in risk premium. Since the benefit of a higher TRS hinges on the extent that capital adjustment frictions thwart production flexibility, the difference in risk premia between h and l, and hence the spread between ER_h and ER_l, should widen with the severity that both firms are financially constrained.

Our empirical findings support this explanation. Using the industry-adjusted ratio of log growth in physical capital to log growth in labor (ratio hereafter) as our main test variable and the panel of U.S. traded manufacturing firms over the 1985 to 2010 period, we document a strong negative correlation between annual ratios and subsequent abnormal stock returns. Sorting by previous-year ratio, we find that raw mean annualized returns for firms in the lowest ratio tercile are on average 23%, while mean returns for firms in the highest ratio tercile are on average much lower at 16%. Such large differences in raw returns are hard to explain using traditional measures of expected returns: with standard risk adjustments (relative to the model of Fama and French (1996)) the spread between low ratio and high ratio firms remains highly significant at 6.5% per year.

We also investigate whether firm ratio captures features that relate to TRS in the presence of external financing constraints. In addition to sorting on the ratio, we also sort firms into three financial constraint-groups defined annually in June of year t using a battery of alternate measures for the status of financing constraint proposed in the literature (total asset size, firm age and payout ratio (Hahn and Lee (2009)); KZ Index (Kaplan and Zingales (1988)); SA Index (Hadlock and Pierce (2010)); Z-Score (Altman (1968)); WW Index (Whited and Wu (2006)); and a S&P credit rating indicator (Whited (1992); Kashyap, Lamont, and Stein (1994); Calomiris, Himmelberg, and Wachtel (1995))). Double sorts reveal that the ratio relates positively to labor reliance and negatively to operating risk, and these relations are more pronounced for firms that are more likely to be financially constrained. The findings confirm that the ratio captures important operating features related to TRS.

Next, we repeat the return analysis across three financial constraint-grouped portfolios using each of the alternate measures for the status of financing constraint. The annualized three-factor alpha value-weighted (VW) portfolio spreads between low ratio and high ratio firms for the highest SA Index firms, youngest firms, and firms lacking a S&P credit rating are 11.57%, 16.17% and 8.24% respectively, while the spread is statistically indistinguishable from zero for the lowest SA Index firms, oldest firms, and firms with a S&P

frictions. Using plant-level data, Bai, Carvalho, and Phillips (2015) find support for lower adjustment costs for L than K. Bloom (2009) and Michaels, Page, and Whited (2015) also find production function parameters supportive of lower adjustment costs for L than K in calibrations of structural models.

credit rating.[7] Consistent with the predictions, double sorts reveal the ratio effect is concentrated among the most financially constrained firms.

The ratio effect on returns among financially constrained firms are robust to a host of other adjustments for risk. The portfolio spreads remain sizeable after accounting for the effects of nano and micro-cap stocks (Novy-Marx (2013)), market equity and book-to-market ratio (Fama and French (1993)), operating leverage (Novy-Marx (2011)), investments in physical capital (Anderson and Garcia-Feijóo (2006)), labor hires (Bazdresch, Belo, and Lin (2014)), asset growth (Cooper, Gulen, and Schill (2008)) and equity issuance (Loughran and Ritter (1995)). Firm ratio is also a strong predictor of risk-adjusted returns in cross-sectional regressions that include book-to-market ratio, firm capitalization, stock beta, past six-month returns, trading volume, and separately, the interaction between financial constraints and asset tangibility (Hahn and Lee (2009)), the interaction between financial constraints and the AC Tangibility Index by Almeida and Campello (2007), and industry-peer returns (Fama and French (1997)).

In further tests, we examine to what extent existing asset pricing anomalies are reflections of cross-sectional differences in ratio. Buying high ratio stocks and selling low ratio stocks from the sample of the most financially constrained firms exhibit returns that relate to several asset pricing anomalies. Overall, 2-factor models composed of market excess return and a ratio factor outperform the 3-factor model (Fama and French (1993)) explaining anomalies; and the 2-factor model constructed based on the financing constraint criterion which best captures the explanatory power of the ratio factor does remarkably well explaining the earnings surprise anomaly (Brandt, Kishore, Santa-Clara, and Venkatachalam (2008)), the probability of failure anomaly (Campbell, Hilscher, and Szilagyi (2008)), the distress anomaly (Dichev (1998)), the gross margin anomaly (Novy-Marx (2013)), and the industry-adjusted value momentum profitability anomaly (Novy-Marx (2014)), even outperforming the 4-factor model (Carhart (1997)). The results support the ratio factors proxy for priced risk and that several asset pricing anomalies are partial expressions of ratio effects on returns.

To establish a link between firm ratio and risk premiums more formally, we develop an investment-based model building on the work of Carlson, Fisher, and Giammarino (2004). The novel feature of the model is Cobb-Douglas production with frictionless adjusts in L and irreversible expansions in K (Dixit and Pindyck (1994)) with adjustments paid from external financing subject to a collateral constraint (Almeida and Campello (2007)). Investment irreversibility and the collateral constraint capture respectively downward

[7] Annualized equal-weighted (EW) portfolios yield similar results. The EW spreads between low ratio and high ratio firms for the highest SA Index firms, youngest firms, and firms lacking a S&P credit rating are 10.89%, 13.22% and 7.62% respectively, while being insignificant for the lowest SA Index firms, oldest firms, and firms with a S&P credit rating.

and upward adjustment frictions.[8,9] The assets-in-place associated with capital expansions are assumed to be pledgable for external financing whereas future expansion options and L are not. Hiring and investment decisions are made to maximize firm value, taking as given a stochastic discount factor to value cash flows, and cross-sectional heterogeneity is driven by the stage of firm development, idiosyncratic productivity shocks, and the extent that the external financing constraint may bind.

Based on closed-form expressions for risk premiums, we find that, ceteris paribus, a tighter constraint distorts capital adjusts and increases the risk premia of firms. A higher TRS, however, with a greater substitutability of labor mitigates exposure to systematic risk.[10] Since physical capital adjustments require more upfront financing, the model proposes an inverse relation between TRS and risk premiums to emerge more strongly if the financing constraint is tighter. The analysis reveals a two-dimensional pattern in risk premia across TRS and external financing constraint values in line with our empirical findings.

Relation to Literature. The theoretical literature has focused mostly on studying the implications of physical capital investment frictions (e.g. investment irreversibility) for asset prices.[11] Recently, a new strand of the literature has emerged addressing explicitly or implicitly the role of labor input in this analysis. Merz and Yashiv (2007) and Kuehn, Petrosky-Nadeau, and Zhang (2012) show labor adjustment costs and frictions in labor markets, respectively, affect firm valuation and equity returns at the aggregate level. Bazdresch, Belo, and Lin (2014) show expanding firms experiencing negative shocks to labor adjustment costs contribute to an inverse relation between labor hirings and average returns, while Donangelo (2012) shows labor mobility on the supply-side of the labor market leads to a higher risk premia akin to adjustment frictions.

We contribute to this literature by differentiating between production inputs that pose differing degrees of adjustment frictions. The argument proposed for risk premiums is based on the difference in operating

[8]Financing constraints can arise as a result of asymmetric information or agency problem. Greenwald, Stiglitz, and Weiss (1984) and Myers and Majluf (1984) show how external financing in the equity market can be costly when there is an adverse selection problem. Jensen and Meckling (1976) and Hart and Moore (1995) show how agency problems may generate a wedge between the costs of external financing and internal financing.

[9]The literature commonly views investments in physical capital to be prone to frictions related to external financing constraints and investment irreversibility. In times of positive productivity shocks, external financing constraints hinder the firm's ability to divert profits to capital investments (Livdan, Sapriza, and Zhang (2009) and Whited and Wu (2006)). In times of adverse productivity shocks, costly downward adjustments or irreversibility in physical capital investments leads to idle production capacity and greater operating leverage (Carlson, Fisher, and Giammarino (2004) and Cooper (2007)). In both up and down sides, capital adjustment frictions result in a higher firm risk premium.

[10]During favorable conditions, a larger TRS confers greater production flexibility with increased labor use when the collateral constraint is binding, whereas during unfavorable outcomes, a larger TRS facilitates reduction of labor when installed capital is irreversible.

[11]Berk, Green, and Naik (1999) were among the first to establish a correspondence between corporate investment behavior and systematic risk to explain anomalous regularities in the cross-section of stocks. Since then, the literature has been extended in many directions. See Carlson, Fisher, and Giammarino (2004), Cooper (2007), Zhang (2005) and Sagi and Seasholes (2007), for example. Anderson and Garcia-Feijóo (2006) provide empirical evidence in support of this literature.

flexibility of labor and capital following past production decisions. Frictionless adjustments in labor permit an analytically tractable and parsimonious model, allowing us to focus on a novel mechanism for expected returns which we verify empirically. Our study remains applicable even if labor inflicts adjustment frictions as long as capital adjustment frictions overwhelm those of labor.[12]

Our work is also related to the literature on the impact of financing constraints on stock returns. As investment frictions, it is often hypothesized that financing constraints enhance the risk premia of firms.[13] While Whited and Wu (2006) show empirical support for a positive relation, Lamont, Polk, and Saá-Requejo (2001) offer evidence for a negative return-constraint relation. Given the mixed findings, the literature has progressed to focus on the return-constraint relation in connection to other characteristics such as asset tangibility (Hahn and Lee (2009)) and R&D expenditure (Li (2011)). Our contribution to this literature is to propose past relative growth in production inputs as a novel channel in which to understand the return-constraint relation.

The remainder of the paper is organized as follows. Section 2 briefly motivates our empirical variable as a predictor of returns. Section 3 explains the empirical study and reports the results. Section 4 goes beyond the motivation of Section 2 and develops a formal model linking firm ratios to risk premiums. Section 5 concludes. The Appendix contains all the proofs and other technical details omitted in the main body of the paper.

2 Motivation for the Capital to Labor Growth Ratio

Our main variable of concern is the ratio of log growth in capital to log growth in labor (ratio hereafter). To understand how this ratio affects returns, consider the following Cobb-Douglas production function

$$Q = L^{\alpha} K^{\nu}, \tag{1}$$

where Q, L, K, $0 < \alpha < 1$ and $0 < \nu < 1$ denote, respectively, output quantity, labor input, physical capital input, labor share and physical capital share.

The isoquant curve gives all the bundles of L and K that result in a fixed quantity of output $\overline{Q}$. At a point on the curve, the technical rate of substitution of labor for physical capital (TRS hereafter) measures

[12] There is a growing literature supporting a lower adjustment cost for labor than physical capital, in accordance with our model. Using plant-level data, Bai, Carvalho, and Phillips (2015) find support for lower labor adjustment frictions than physical capital. Bloom (2009) and Michaels, Page, and Whited (2015) find production function parameters supportive of lower adjustment frictions for labor than physical capital in calibrations of structural models. In the other side of the spectrum, Berk, Stanton, and Zechner (2010) theoretically argues that employee entrenchment can lead to bankruptcy costs which would be consistent with the view that labor adjustment frictions can be very high.

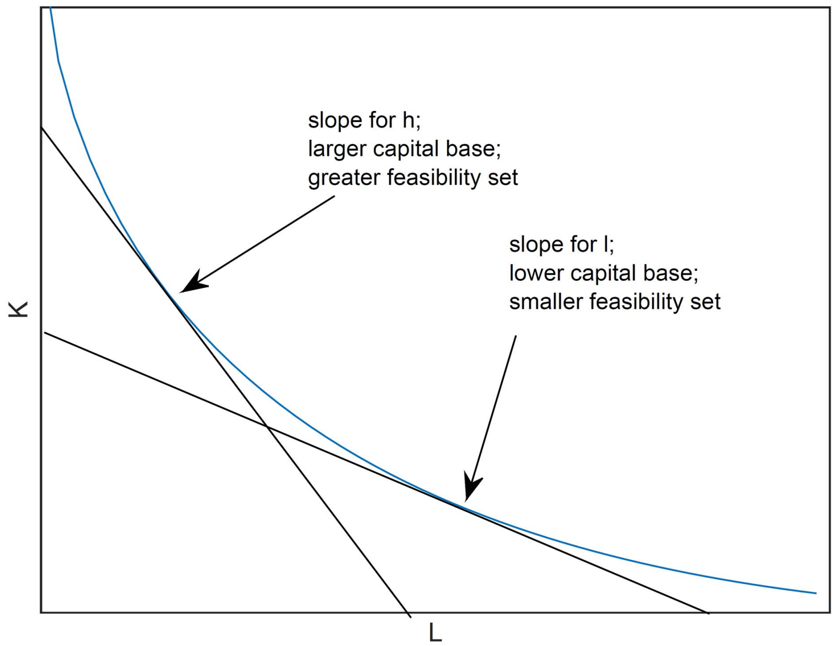
[13] External financing constraints hinder the firm's ability to divert profits to investments. See Livdan, Sapriza, and Zhang (2009) for example.

the slope of the isoquant, or the decrease in K input to keep output at level $\overline{Q}$ when an additional amount of L is increased. Given (1), it follows that

$$|TRS| = \frac{\alpha}{\nu}\frac{K}{L} \tag{2}$$

where $|TRS|$ denotes the absolute value of TRS.

Figure 1. Cobb-Douglas Production Isoquant and Technical Rate of Substitution
The figure depicts the isoquant function and the technical rate of substitution (TRS) at two distinct locations on the isoquant based on the Cobb-Douglas function $Q = L^{\alpha}K^{1-\alpha}$.



Now consider two identical firms h and l initially located at the same point on the isoquant. If in the most recent fiscal period h produces with a greater % increase in K than L in response to a positive productivity shock, h would have experienced a greater leftward displacement on the isoquant than firm l. The slope at this location is steeper, meaning that h now has a higher TRS than l. To illustrate the points, Figure 1 depicts the isoquant for production function (1) and the slopes at two distinct locations. In this sense, ceteris paribus, the ratio of log growth in capital to log growth in labor is an instrument for quantifying the relative displacement of firms on the production isoquant.

Neoclassical theory with frictionless adjustments suggests that the displacements on the isoquant should not affect the operation of neither h nor l. Assume instead, in accordance with lower adjustment frictions, that L requires less external financing than investments in K.[14] An argument could be made for this if wages are paid from operating revenue – which can be viewed as internal capital – whereas physical capital adjustments, due to their lumpy nature, require external funds subject to potentially binding financing constraints.

Following the displacements, consider the ability of h and l to respond to positive systematic productivity shocks if both firms face equally binding financing constraints. h, with a larger capital base and hence a greater production feasibility set, would be better poised to exploit productivity shocks in face of binding financing constraints. In this regard, h would have greater operating flexibility, and hence investors would demand a lower risk premia for holding the stocks of h than l. In asset pricing tests, the expected return of a portfolio that is long h and short l, i.e. $ER_h - ER_l$, would be negative stemming from a negative difference in risk premiums.

In addition, the benefit of a higher TRS relies on the restrictions that the external financing constraint poses to a firm; therefore, the risk premia of h would diverge from that of l with the severity that both firms are financially constrained. In asset pricing tests, the negative $ER_h - ER_l$ spread should widen in the severity that both h and l are financially constrained. Looking ahead to this, we finding empirical evidence in support for this explanation, and Section 4 of the paper develops an investment-based model of firms to formalize the asset pricing implications discussed in this section.

3 Empirical Analysis

In this section, we present new evidence on the implications of real investments for asset pricing by investigating the impact that log change in capital to log change in labor has on stock returns.

3.1 Data Source

We use all NYSE, Amex, and NASDAQ non-utility (four-digit SIC codes between 4900 and 4999) and non-financial firms (four-digit SIC codes between 6000 and 6999) listed on the CRSP monthly stock return files and the Compustat annual and Compustat quarterly industrial files from 1985, the first year Compustat started to keep comprehensive coverage of credit ratings, through the end of 2010. In order to measure operating risk accurately for descriptive analysis, we require firms to have at least 5 years of accounting

[14]Investments in physical capital are commonly associated with significant adjustment frictions. See for example, Olley and Pakes (1996) and Levinsohn and Petrin (2003), Cooper (2007), Carlson, Fisher, and Giammarino (2004), Zhang (2005) and Livdan, Sapriza, and Zhang (2009). Labor hires, on the other hand, are associated with lower adjustment frictions. Using plant-level data, Bai, Carvalho, and Phillips (2015) find support for lower labor adjustment costs than physical capital. Bloom (2009) and Michaels, Page, and Whited (2015) find production function parameters supportive of lower adjustment costs for labor than physical capital in calibrations of structural models.

data. Monthly factor returns, Fama and French (1997) industry classifications and returns, and risk-free rates are from Ken French's website.[15] We eliminate stocks with a share price below $1 and firms with a negative book equity value. To remove biases from the effects of return delistings (Shumway (1997)), we eliminate return observations up to one year from the month of delisting for stocks with a first digit delisting code other than 1.

In accordance with Fama and French (1992), we match CRSP returns from January to June of year t with year $t-2$ Compustat accounting variables, while the returns from July until December are matched with Compustat variables of year $t-1$.[16]

3.2 Variable Description

This section describes the construction of the main variables used in our empirical study.

3.2.1 Capital to Labor Growth Ratio. In accordance with our discussion in Section 2, the main variable in our asset pricing tests is constructed as a ratio of log growth in physical capital to log growth in labor. The ratio is calculated by taking the year-on-year growth in the log of total property plant and equipment (Compustat data item *ppent*) and dividing it by the year-on-year growth in the log of total number of employees (Compustat data item *emp*).

A firm's production technology naturally relates to its industry, hence industry effects can potentially confound our results. To immunize firm ratio from industry effects, we industry-adjust firm-year observations of the ratio (trs hereafter) following the approach in Maksimovic and Zechner (1991) and MacKay and Phillips (2005). For each firm-year observation of the ratio, we calculate the deviation from the firm industry minimum then divide by the industry range as follows:

$$trs_t^{Ind.Adj.} = \frac{trs_t - trs_t^{Ind.Min.}}{trs_t^{Ind.Max.} - trs_t^{Ind.Min.}} \in [0,1] \tag{3}$$

where $trs_t^{Ind.Min.}$ and $trs_t^{Ind.Max.}$ denote respectively the lowest and the highest trs_t values among the peer firms in the same industry. A $trs_t^{Ind.Adj.}$ value close to 0 indicates a trs_t value close to the lowest among the industry-peers whereas a value close to 1 suggest a trs_t value close to the industry maximum. Computing the deviation from the industry minimum references and ranks the firm within its industry. Normalizing by the industry range scales $trs_t^{Ind.Adj.} \in [0,1]$, ensuring the industry-adjusted measure is comparable with similarly ranked firms across industries making it suitable for cross-sectional asset pricing tests.[17]

[15] http:// mba.tuck.dartmouth.edu/ pages/faculty/ken.french/data library.html

[16] This matching scheme is used for all our matches involving Compustat variables and CRSP variables. This is a conservative way of merging data and ensures that our accounting-based variables are contained in the information set of the investors in the stock market prior to the formation of portfolios and observation of stock returns.

[17] To understand this, consider two industries in year t: the first industry has a low variance in the distribution of

When industry-adjusting, each firm-year observation is matched with firms in the same 3-digit SIC with the requirement of a minimum of 30 other industry-peers. Otherwise, firm industry is defined by the 2-digit SIC code conditional on the existence of 30 other industry-peer firms. If this requirement is not met, then the adjustment is done based on the first digit SIC conditional on the existence of 30 other industry-peer firms. Otherwise, the observation is dropped out the sample.[18] This way of industry-adjusting offers a good balance between final sample size and accuracy of industry groupings.

3.2.2 Financial Constraints.

We show the ratio effect on returns depends on the extent that firms are financially constrained. We repeat our investigation for several ready-measures of financing constraint proposed previously in the literature. They are as follows:

Size: Smaller firms tend to face financing constraints because they are typically younger and not as well-established than larger firms. Thus, smaller firms are more vulnerable to financing frictions arising from asymmetric information in capital markets (Gilchrist and Himmelberg (1995); Hahn and Lee (2009)). Size is an inverse measure of financing constraint and measured by sales in our study.

Age: Similarly to smaller firms, younger firms tend to be vulnerable to financing frictions arising from information asymmetry. As an inverse measure of financing constraint, age is defined as the maximum between the firms' age since the first observation recorded in Compustat and since the IPO year, if available.

Payout Ratio: A low payout indicates that the firm is financially constrained (Fazzari, Hubbard, and Petersen (1988)). The justification comes from the notion that severely constrained firms choose lower payout because dividends divert internal funds from investments in physical capital. As an inverse measure of financing constraint, payout ratio is measured as the ratio of total distributions (dividends plus stock repurchases) to net income if net income is positive, or zero if net income is negative.

Kaplan and Zingales Index (KZ Index): In accordance with Lamont, Polk, and Saá-Requejo (2001), among many others, we use the regression coefficients from Kaplan and Zingales (1988) to compute the KZ index for financial constraint. More specifically:

$$\begin{aligned} KZ\ Index = &- 1.002 \times \frac{CashFlow}{TotalAssets} + 0.2826 \times \text{Tobin's Q} + 3.139 \times \frac{TotalDebt}{TotalAssets} \\ &- 39.368 \times \frac{Div}{TotalAssets} - 1.315 \times \frac{CashHoldings}{TotalAssets}, \end{aligned} \tag{4}$$

where higher index values represent more severe financial constraints.

firm trs_t values while the second has a higher variance. If firm trs_t is not scaled, then the highest trs_t firm in the first industry would be grouped with lower ranking firms in the second industry in portfolio assignments. Scaling trs_t overcomes this problem and ensures that the measure is insensitive to differences in the variance of trs_t distribution across industries.

[18] From casual observation, most of the industry adjustments occur at the 3-digit and the 2-digit SIC.

Size and Age Index (SA Index): Hadlock and Pierce (2010) show that their index performs very well discriminating financially constrained firms. The Index is calculated as follows:

$$SA\ Index = -0.737 \times log(TotalAssets) + 0.043 \times log(TotalAssets)^2 - 0.040 \times Age, \tag{5}$$

where Age is defined as the number of years since the first observation in Compustat with non-missing stock price data. Higher index values indicate more severe financial constraints.

Altman's Z-Score (Z-Score): Distressed firms tend to face difficulties raising external financing. Altman's Z-Score (Altman (1968)) proxies for the ex-ante probability of distress (Graham (1996); Graham (2000)). Following Mackie-Mason (1990), we compute Z-Scores as follows:

$$\begin{aligned} Z-Score = 1.2 \times \frac{CurrAssets}{TotalAssets} + 1.4 \times \frac{RetainEarnings}{TotalAssets} + 3.3 \times \frac{OperIncome - Deprec}{TotalAssets} \\ + 0.64 \times \frac{MarketEquity}{LongTermLiab} + \frac{TotalSales}{TotalAssets}, \end{aligned} \tag{6}$$

where higher values indicate more operating and financial strength. Therefore, Z-Score is an inverse measure of financing constraints.

Whited and Wu Index (WW Index): In accordance with Whited and Wu (2006), we rely on the WW Index as an alternative measure of financing constraint. The WW Index is measured as follows:

$$\begin{aligned} WW\ Index = & - 0.091 \times \frac{CashFlow}{TotalAssets} - 0.062 \times (1 \text{ if } Div > 0,\ 0 \text{ otherwise}) \\ & + .021 \times \frac{LongTermDebt}{TotalAssets} - 0.044 \times Log(TotalAssets) \\ & + 0.102 \times IndustrySalesGrowth - 0.035 \times SalesGrowth, \end{aligned} \tag{7}$$

where higher index values imply harsher constraints.[19]

Credit Rating: Possessing a credit rating is as an important indicator of access to public capital markets because firms that do not have a credit rating tend to encounter difficulties rasing external capital (Whited (1992); Kashyap, Lamont, and Stein (1994); Calomiris, Himmelberg, and Wachtel (1995)). We classify firms without a Standard & Poors (S&P) credit rating (bond or commercial paper rating) in any given year as financially constrained, and those with a rating as financially unconstrained. Credit rating is a categorial (dummy) variable that relates inversely with the extent of financial constraints.

3.2.3 Other Firm Characteristics. We require several other firm-characteristics when conducting cross-sectional return regressions. In accordance with many in the literature, they are as follows: log market

[19] Following Whited and Wu (2006), the WW Index values are computed from quarterly Compustat.

equity, log book-to-market, past stock returns, trading volume and stock beta. We follow the approach in Fama and French (1993) when computing market equity and book-to-market variables.[20] We define past returns as the buy-and-hold gross compound returns minus 1 during the six-month period starting from month $t-7$ and ending in month $t-2$ relative to the month t return observation. Following Karpoff (1987), trading volume is measured as actual trading volume normalized by the number of shares outstanding during month t. Stock beta is the estimated coefficient from rolling regressions of monthly stock excess returns on market excess returns.[21] A description of the other firm-characteristics used in robustness checks is given in the respective sections of the paper.

3.3 Firm Characteristics Across $trs_t^{Ind.Adj.}$ Classifications

We begin by investigating some characteristics of the firms sorted by $trs^{Ind.Adj.}$. We compute the time-series mean of the mean stock returns, median size, median book-to-market (B/M), median payout ratio, median KZ Index, median SA Index, median Z-Score, median WW Index, and the proportion of firms with a S&P credit rating for each $trs^{Ind.Adj.}$ classification after sorting by previous-year observation of $trs^{Ind.Adj.}$.

[Insert Table 3 here]

Table 3 reports the results. As shown, mean return is decreasing from low $trs_t^{Ind.Adj.}$ group to high $trs_t^{Ind.Adj.}$ group with a spread of 6.72% per annum and a highly significant test-statistic of -3.3060. The return spread remains sizeable after risk-adjusting relate to the CAPM and the 3-factor model of Fama and French (1993) (FF-3). The results point to an inverse relation between risk premium and $trs_t^{Ind.Adj.}$.

Relative to their lower ratio counterparts, high $trs_t^{Ind.Adj.}$ firms resemble larger firms in return characteristics as evidenced by the negative loading on the SMB factor. The same conclusion does not apply in terms of actual firm size as the average firm size appears to be similar across all $trs_t^{Ind.Adj.}$ terciles. As for book-to-market ratio, higher $trs_t^{Ind.Adj.}$ firms bear a greater resemblance to growth firms, but their returns do not appear to be more growth-related than lower $trs_t^{Ind.Adj.}$ firms.

As for financing constraint characteristics based on our empirical proxies, higher $trs_t^{Ind.Adj.}$ firms on average pay lower dividends, have a higher SA Index, and are slightly less likely to have a credit rating than

[20]Market value of equity is defined as the share price at the end of June times the number of shares outstanding. Book equity is stockholders' equity minus preferred stock plus balance sheet deferred taxes and investment tax credit if available, minus post-retirement benefit asset if available. If missing, stockholders' equity is defined as common equity plus preferred stock par value. If these variables are missing, we use book assets less liabilities. Preferred stock, in order of availability, is preferred stock liquidating value, or preferred stock redemption value, or preferred stock par value. The denominator of the book-to-market ratio is the December closing stock price times the number of shares outstanding.

[21]We use a 60-month window every month requiring at least 24 return observations, and use the procedure suggested in Dimson (1979) with a lag of one month in order to remove biases due to thin trading.

lower $trs_t^{Ind.Adj.}$ firms, with varying levels of significance across differences in these measures. While these results suggest high $trs_t^{Ind.Adj.}$ firms to be more financially constrained, the evidence on KZ Index, Z-Score and WW Index confound this conclusion.

3.4 Labor Input Growth Across $trs_t^{Ind.Adj.}$ and Financing Constraint Classifications

Now we examine whether $trs_t^{Ind.Adj.}$ and financing constraints relate to labor hires. Since the technical rate of substitution of labor (TRS) is a latent characteristic, investigating labor hires across $trs_t^{Ind.Adj.}$ and financing constraint firms sheds light on whether $trs_t^{Ind.Adj.}$ captures features related to TRS.

After double sorting, we investigate the average % change in labor input across each 3-by-3 (3-by-2) classifications of $trs_t^{Ind.Adj.}$ and each of the (dummy) financing constraint criterion. Labor input growth is industry-adjusted in accordance with the method employed to industry-adjust trs_t in order to thwart industry effects.

[Insert Table 1 here]

Table 1 reports the time-series means of the medians. Based on firm size, payout ratio, SA Index and Z-Score as the constraint criteria, higher $trs_t^{Ind.Adj.}$ firms have higher average labor input growth than lower $trs_t^{Ind.Adj.}$ firms, and this relation is stronger for more constrained firms. Similar results apply based on firm age, KZ Index, WW Index and the credit rating indicator as constraint criteria, however the differentials are not statistically significant. Overall, the results are supportive of a stronger positive relation between $trs_t^{Ind.Adj.}$ and labor reliance in face of tighter financing constraints. The findings are in accordance with a greater technical rate of substitutability of labor for physical capital and in line with the argument in Section 2 of the paper.

3.5 Operating Risk Across $trs_t^{Ind.Adj.}$ and Financing Constraint Classifications

The explanation discussed earlier supports a positive relation between $trs_t^{Ind.Adj.}$ and production flexibility which strengthen with the extent that financing constraints are binding. To further confirm this, in this section we investigate whether the operating risk of the firms in our sample exhibit a consistent pattern across $trs_t^{Ind.Adj.}$ and financing constraint measures. We rely on the volatility of the quarter-on-quarter % change in operating cash flow as the measure for operating risk for each firm in the sample.[22]

[22]Quarterly % increase in operating cash flows are regressed on an intercept and the volatility is attained from the standard deviation of the residuals. The regressions are done on a rolling basis with an estimation window of 10 quarters and the requirement of a minimum of 5 non-missing observations. Yearly volatilities are then computed by

[Insert Table 2 here]

Table 2 reports the time-series means of the median volatilities. A clear pattern emerges across $trs_t^{Ind.Adj.}$ and constraint groups. For each financing constraint criterion, operating risk is positively associated with financing constraint across all $trs_t^{Ind.Adj.}$ groups. Importantly, the most constrained firms exhibit an inverse relation between $trs_t^{Ind.Adj.}$ and operating risk in accordance with a positive association between $trs_t^{Ind.Adj.}$ and operating flexibility when faced with binding financing constraints. These findings are also consistent with the explanation presented in Section 2 of the paper and supports that $trs_t^{Ind.Adj.}$ captures features related to TRS. These findings are consistent with the 2-way pattern in risk premia across TRS and the severity of financing constraint generated by the model in Section 4.

3.6 Excess Return Across $trs_t^{Ind.Adj.}$ and Financing Constraint Classifications

Paralleling our discussion on labor adjustability and operating risk, the positive relation between risk premiums and the extent of financing constraint should diminish with $trs_t^{Ind.Adj.}$. Do stocks obey this pattern in average returns across $trs_t^{Ind.Adj.}$ and financing constraint measures? To help address this question, we form portfolios of stocks across $trs^{Ind.Adj.}$ and financial constraint classifications.[23] Then, we compute the time-series means of the portfolio excess returns.

[Insert Table 4 here]

Table 4 reports the results. The means are annualized and expressed in % for easier interpretation of the economic significance of the results. As shown, the 2-way pattern in average returns is analogous to the pattern in operating risk discussed earlier. There is a strong positive return-constraint relation which weakens with $trs_t^{Ind.Adj.}$. This pattern applies to all of the alternate financing constraint measures.

Equal-weighted portfolios are subject to the effects of placing tremendous weight on the nano- and micro-cap stocks, which make up a large proportion of firms by name, but a very small percentage of firms by market capitalization (Novy-Marx (2013)). Consequently, the average investor in the market is not likely to hold a large number of small stocks in his portfolio. Table 4 reveals the results from value-weighted portfolios do not diverge markedly from equal-weighted portfolios, implying that the results are robust to nano- and micro-cap stocks.

averaging across quarters during the fiscal year.

[23]We merge rankings with stock returns the same way accounting variables are merged with stock returns in order to ensure that the rankings are contained in the information set of the investors in the stock market prior to the formation of the portfolios. The merging scheme is described in section 3.1 of the paper.

[Insert Table 5 here]

To summarize, the reported results thus far confirm that $trs_t^{Ind.Adj.}$ captures the features of TRS along several important dimensions – labor adjustability, operating risk and equity returns – consistent with the posited predictions. Section 4 of the paper develops a model that that more formally captures these features of the data.

3.7 $trs^{Ind.Adj.}$ as a Priced Risk

Thus far we have reported evidence supporting $trs_t^{Ind.Adj.}$ dampens the positive association of average return and operating risk with financing constraint. Does risk-adjusted return also exhibit a dependence on $trs_t^{Ind.Adj.}$? Investigating risk-adjusted returns addresses whether differentials in returns arising from the cross-sectional variation in $trs_t^{Ind.Adj.}$ are not mere compensations for exposure to common risk factors.

[Insert Table 6 here]

Table 6 reports the results from equal-weighted (EW) portfolio returns while Table 7 reports the results from value-weighted (VW) portfolios. Qualitatively, EW and VW yield consistent results. The reported figures are annualized, risk-adjusted relative to the FF-3 model (Fama and French (1993)) and expressed in %.

[Insert Table 7 here]

Focusing on the last column of each panel, Table 6 reveals a statistically significant and large spread in risk-adjusted returns between the extreme $trs^{Ind.Adj.}$ portfolios among the most financially constrained firms. This contrasts markedly from the less constrained firms where the spread is much smaller. This pattern in risk-adjusted returns is present for all the alternate financing constraint criteria. The spread ranges from 6.40% to 12.62% per annum for the most constrained, depending on the financial constraint criteria, whereas for the least constrained the spread is much smaller and tends to be insignificant.

Focusing on the last row of each panel, the spread in risk-adjusted returns is positive between portfolios of the most constrained stocks and portfolios of the least constrained stocks; a relation which diminishes from lower $trs^{Ind.Adj.}$ to higher $trs^{Ind.Adj.}$ stocks. The spread ranges from 14.99% to 9.65% per annum for the lowest $trs^{Ind.Adj.}$ stocks, depending on the constraint criteria. By contrast, the spread is much smaller, and based on some of the constraint criteria, the spread is statistically indistinguishable from zero.

Overall, the results confirm that the positive financing constraints-return relation is attenuated by a higher $trs^{Ind.Adj.}$. The findings are orthogonal to traditional measures of expected returns, suggesting that $trs^{Ind.Adj.}$ carries a negative risk premium.

3.8 Return of High $trs^{Ind.Adj.}$ Minus Low $trs^{Ind.Adj.}$ Strategies While Controlling for Other Effects

The relation point to a stronger ratio effect on returns in face of harsher external financing constraints ($fincon$). This suggests that the return spreads attributed to $trs^{Ind.Adj.}$ should be larger for the most constrained stocks. Indeed, the empirical results presented thus far support this claim. In this section, we study the return spreads related to $trs^{Ind.Adj.}$ constructed from the sample of the most constrained stocks. To this end, we construct high $trs^{Ind.Adj.}$ minus low $trs^{Ind.Adj.}$ equal-weighted (EW), and separately, value-weighted (VW) trading strategies from the tercile of the most financially constrained firms separately for each financing constraint criterion and examine the strategy returns. The long-short strategies are rebalanced monthly and constructed from sorting by previous year sort variables.

[Insert Table 8 here]

Table 8 reports the results. The strategies have negative mean EW returns, ranging from -7.62% to -13.22% per annum, and negative mean VW returns ranges from -7.59% to -16.17% per annum, depending on the financing constraint criterion. The strategies mostly hedge out market risk and the size factor as evidenced from the insignificant loadings on $MKTRF$ and SMB. The strategies, however, partly seem to resemble growth returns, reflected in the negative loadings on HML, particularly for the EW strategies. Looking ahead to this, while consistent with Proposition 4 of our model pointing to greater growth-characteristics for higher $trs^{Ind.Adj.}$ firms, the HML factor is not able to fully explain the variation in strategy returns. More importantly, risk-adjusting with the CAPM or the FF-3 factor model is completely ineffective subsuming the negative strategy returns.

3.8.1 Robustness Checks. We conduct a series of robustness checks to ensure that the $trs^{Ind.Adj.}$ effect on returns is robust to alternative explanations.

To this end, we sort and rank stocks into three equally-sized groups by previous-year $trs^{Ind.Adj.}$, and separately, by each of the financing constraint criterion, and each control variable. After computing monthly EW portfolio returns for each of the 3-way classifications,[24] we average each $trs^{Ind.Adj.}$ and financial constraint portfolio returns across the control variable classifications. Thus, each resulting 2-way $trs^{Ind.Adj.}$ $\times$

[24] Value-weighting strategy returns do not markedly change our results. The results using value-weighted strategy returns are available from the author upon request.

financial constraint portfolios are immunized from the return variation attributed to the control variable. Since the return spreads attributed to $trs^{Ind.Adj.}$ is the most pronounced among the most constrained stocks, from the most financially constrained group, we create zero-cost trading strategies by buying the highest $trs^{Ind.Adj.}$ portfolio funded from the proceeds of selling the lowest $trs^{Ind.Adj.}$ portfolio. Then, we regress the strategy returns on the FF-3 factors after repeating the entire procedure for each control variable and each financial constraint criterion. For control variables, we consider previously provided determinants of returns that may confound $trs^{Ind.Adj.}$ effects on returns. The controls are as follows: firm size (by market equity) and, separately, book-to-market ratio (Fama and French (1993)), operating leverage (Novy-Marx (2011)), investment in physical capital (Anderson and Garcia-Feijóo (2006)), labor hires (Bazdresch, Belo, and Lin (2014)), asset growth (Cooper, Gulen, and Schill (2008)) and equity issuance (Loughran and Ritter (1995)). We discuss the motivation for these controls and the results below.

Controlling for Size and Book-to-Market Effects Our first set of robustness checks investigate trading strategy returns by controlling for size and book-to-market effects. Fama and French (1993) show the existence of patterns in average stock returns associated with market equity value (the size effect) and book-to-market ratio (the value premium) in the cross-section. While the FF-3 regressions control for the SML and HML factors, the factors may not completely capture the size and book-to-market effects.

[Insert Table 9 here]

Table 9 reports the results. As shown, the intercept estimates from the FF-3 model are negative and highly statistically significant for all the financial constraint criteria, suggesting that the return spreads attributed to $trs^{Ind.Adj.}$ are robust to size and book-to-market effects.

Controlling for Operating Leverage Carlson, Fisher, and Giammarino (2004) show that operating leverage contributes to the book-to-market effects in the cross-section of stock returns. In line with this view, Novy-Marx (2011) provides empirical support for operating leverage in stock returns. While the regression specification controls for the SML and HML factors, it is possible that these factors may not completely absorb the effects of operating leverage. To dispel concerns of operating leverage effects in $trs^{Ind.Adj.}$, we examine the trading strategy returns after controlling for operating leverage. Following Novy-Marx (2011), we define operating leverage as $OperLever = \frac{CostOfGoodsSold + GeneralSellingAdminCosts}{TotalAssets}$. As additional robustness, we separately control for the degree of operating leverage as defined in standard business finance textbooks (Ross, Westerfield, and Jordan (2010)). The degree of operating leverage (DOL) is defined as $DOL = 1 + \frac{CostOfGoodsSold + GeneralSellingAdminCosts}{CashFlow}$.

[Insert Table 10 here]

Table 10 reports the results. Again, the intercept estimates from the FF-3 model remain negative and highly statistically significant for all the financial constraint criteria even after controlling for operating leverage and DOL. Therefore, differences in operating leverage cannot be the reason for the return spread attributed to $trs^{Ind.Adj.}$.

Controlling for Firm-Level Investments The literature suggests that information on real investments are priced in capital markets. Labor hiring (Bazdresch, Belo, and Lin (2014)), and capital investment (Anderson and Garcia-Feijóo (2006)) have been shown to relate inversely with future stock returns. The construction of $trs^{Ind.Adj.}$ relies on past labor and physical capital input, therefore the reported results may be mere rediscoveries of earlier findings. To dispel this concern, we examine the trading strategy returns after controlling for labor and capital investments. Labor hires and capital investments are defined as a percentage growth, i.e. $\%\Delta Labor_t = \frac{\Delta L_t}{L_{t-1}}$ and $\%\Delta K_t = \frac{\Delta K_t}{K_{t-1}}$, where $\Delta x_t = x_t - x_{t-1}$.

[Insert Table 11 here]

Table 11 reports the results. As shown, the intercept estimates from the FF-3 model remain negative and highly significant for all financial constraint criterion even after controlling for labor hires and physical capital investments. Once again, labor or capital investments cannot account for the $trs^{Ind.Adj.}$ effects.

Controlling for Asset Growth and Equity Issuance Capital raising is associated with lower subsequent returns (Loughran and Ritter (1995)), as is asset growth (Cooper, Gulen, and Schill (2008)). It is possible that $trs^{Ind.Adj.}$ may be capturing cross-sectional variation in asset growth or capital raising, rendering our results mere restatements of previous findings. To dispel this concern, we investigate the spread in returns by controlling for equity issuance, and separately, for asset growth. Net equity issuance is defined as $NetEquityIssue_t = \frac{\Delta BookEquity_t - \Delta RetainedEquity_t}{TotalAssets_{t-1}}$ and asset growth as $AssetGrowth_t = \frac{\Delta TotalAssets_t}{TotalAssets_{t-1}}$.

[Insert Table 12 here]

Table 12 reveals that the negative return spreads attributed to $trs^{Ind.Adj.}$ persist for all the financial constraint criteria even after controlling for asset growth and equity issuances.

Overall, the findings demonstrate that the return spreads attributed to $trs^{Ind.Adj.}$ are robust to several alternative explanations.

3.9 Fama-MacBeth Regressions

Four-way sorts or higher requires assigning stocks very coarsely across groups. This can be problematic when conducting robustness checks involving more than a single control variable or when controlling for the interaction between two variables. Cross-sectional return regressions, on the other hand, are not plagued by this overgranulation problem. In this section, we conduct cross-sectional monthly return regressions following the approach of Fama and MacBeth (1973). The goal is twofold. Firstly, we further examine if $trs^{Ind.Adj.}$ is priced while concurrently controlling for the usual determinants of stock returns, such as size, book-to-market ratio, and equity beta, and additionally controlling for trading volume and industry returns, which do not tend to the basis for common factors in asset pricing models. Secondly, we conduct further robustness checks to dispel alternative explanations involving interactions between possible determinants of stock returns.

For each alternative financial constraint criteria, we estimate separate regressions where the left hand side variable is individual stock return risk-adjusted relative to the FF-3 model.[25] The right hand side variables are: a high $trs^{Ind.Adj.}$ dummy, a high financial constraint dummy, the interaction between the two dummies, and the standard controls for firm-characteristics known to determine stock returns in the cross-section. The regression for month t is

$$r_t^{FF3RiskAdj.} = \gamma_0 \iota + \gamma_1 fincon_{H,t-1} + \gamma_2 trs_{H,t-1}^{Ind.Adj.} + \gamma_3 trs_{H,t-1}^{Ind.Adj.} \times fincon_{H,t-1} + \gamma_4 X_{t-1} + \eta_t \quad (8)$$

where $r_t^{FF3RiskAdj.}$ is the vector of monthly risk-adjusted stock returns, ι is a vector of ones, $fincon_{H,t-1}$ is a vector of ones and zeros indicating a high financing constraint, $trs_{H,t-1}^{Ind.Adj.}$ is a vector of ones and zeros indicating a high $trs^{Ind.Adj.}$ value, and X_{t-1} is a matrix with columns corresponding to vectors of firms' log size, log book-to-market, past returns, trading volume, and stock beta. The construction of these controls is described in section 3.2.3 of the paper.[26] Entries in $trs_{H,t-1}^{Ind.Adj.}$ take the value 1 if firms have a $trs_{t-1}^{Ind.Adj.}$ value in the top tercile, and zero otherwise. Similarly, entries in $fincon_{H,t-1}$ take the value 1 if firms have financial constraint measures among the most constrained tercile, and zero otherwise. For the S&P credit rating dummy, the entries in $fincon_{H,t-1}$ take the value 1 if firms do not have a rating, and zero otherwise.

3.9.1 Regression Results. The posited hypothesis is the positive relation between expected return and the degree of financial constraint to weaken if $trs_{t-1}^{Ind.Adj.}$ larger. Alternatively, the reduction in expected return attributed to a larger $trs_{t-1}^{Ind.Adj.}$ should be more pronounced if the financing constraint is tighter. Thus, from the regression estimates, we examine whether stock returns load negatively on the interaction term between $trs_{H,t-1}^{Ind.Adj.}$ and $fincon_{t-1}$, i.e $\gamma_3 < 0$.

[Insert Table 13 here]

[25]Risk-adjusted returns are measured for each stock-month observation using the slope estimates from rolling regressions of excess returns on the Fama and French 3 factors. Each rolling regression uses the previous 60 months of returns with a minimum of 20 non-missing return observations.

[26]While the vectors of X_{t-1} corresponding to the accounting-based variables are lagged, the vector corresponding to trade volume is contemporaneous with stock returns because trading turnover is a market-based variable.

Table 13 reports the results.[27] Apart from KZ Index, the γ_3 estimates are negative and highly significant for all the regression specifications.[28] These findings corroborate our earlier results from portfolio and strategies returns, suggesting that $trs_t^{Ind.Adj.}$ is a priced risk.

3.9.2 Additional Robustness Checks.

Now we conduct additional robustness checks by controlling for the interaction between determinants of stock returns previously provided in the literature.

Controlling for Debt Capacity and Asset Tangibility: Using asset tangibility as a measure of financing capacity, Hahn and Lee (2009) show that asset tangibility is a significant determinant of stock returns in the cross-section of financially constrained firms. It is possible that $trs_{H,t-1}^{Ind.Adj.}$ may capture variation in asset tangibility because both measures are related to previous investments decisions. For robustness, we re-estimate the coefficients of regression (8) after including the interaction between asset tangibility and financial constraints as an explanatory variable. In accordance with Hahn and Lee (2009), we define asset tangibility as the ratio of property, plant and equipment to total assets. The results are reported in Table 14.

[Insert Tables 14 and 15 here]

Almeida and Campello (2007) propose a different measure of asset tangibility, the AC Index. For additional robustness, we re-estimate the coefficients of regression (8) after including the interaction between *AC* Index and financing constraint as an explanatory variable.[29]

The results are reported in Table 15. Both tables 14 and 15 show that our earlier results are virtually unchanged even after controlling for the joint effects of asset tangibility and financial constraints.

Controlling for Industry Returns: Fama and French (1997) document that the cost of capital of firms is related to firm industry. While $trs^{Ind.Adj.}$ is already industry-adjusted, the financing constraint measures

[27]The estimated coefficients for log size are significantly negative for all of the specifications, and the coefficients on log book-to-market are insignificant for most of the specifications. Similarly, the coefficients for the CAPM beta are not significantly different from zero for all the specifications. These results differ slightly from others in the literature because we use returns already adjusted for the size, book-to-market and market risk factors as the left hand side variable of the regressions. Additionally, the coefficients on trading volume are positive and highly statistically significant, consistent with Karpoff (1987) and Grullon, Lyandres, and Zhdanov (2010). The coefficients on the past six-month cumulative returns are significant and negative in all specifications, and consistent with some specifications reported in Cooper, Gulen, and Schill (2008) and Grullon, Lyandres, and Zhdanov (2010).(Grullon, Lyandres, and Zhdanov show that the coefficient on past returns is sensitive to the set of other independent factors included in Fama Macbeth regressions.)

[28]The estimate of γ_3 when the KZ Index is used as a financing constraint criterion is not statistically significant.

[29]The AC Index is defined as follows:

$$AC\ Index = \frac{CashAndShortTermInvestments}{TotalAssets} + 0.715 \times \frac{AccountsReceivables}{TotalAssets} + 0.547 \times \frac{Inventory}{TotalAssets} + 0.535 \times \frac{NetPropertyPlantAndEquipment}{TotalAssets}. \quad (9)$$

in our empirical study may be industry-dependant and our results may be picking up industry effects. For additional robustness, we re-estimate the coefficients of regression (8) using industry-adjusted returns (Fama and French (1997)) in place of FF-3 risk-adjusted returns.[30]

[Insert Table 16 here]

The results are reported in Table 16. Industry-adjusting returns reduces the γ_3 estimates slightly but the previous findings remain unaltered for most of the regression specifications.

To summarize, corroborating our earlier portfolio findings, the cross-sectional regressions offer results in line with the notion that $trs^{Ind.Adj.}$ is priced while being robust to several alternate determinants of stock returns.

3.10 $trs^{Ind.Adj.}$ Effect and Asset Pricing Anomalies

Given the evidence that $trs^{Ind.Adj.}$ is priced, this section examines whether $trs^{Ind.Adj.}$ relates to a wide range of asset pricing anomalies discovered previously in the literature. The purpose of this exercise is to identify commonalities across some of these seemingly unrelated anomalies, and investigate to what extent they are expressions of $trs^{Ind.Adj.}$ effects disguised as anomalies.

The anomaly strategies we consider are as follows (in alphabetical order): Accruals (Sloan (1996)), Asset Growth (Cooper et al. (2008)), Piotroski's F-Score (Piotroski (2000)), Failure Probability (Campbell et al. (2008)), Gross Margin (Novy-Marx (2013)), Investments (Lyandres, Sun, and Zhang (2008)), Long Run Reversals (DeBondt and Thaler (1987)), Momentum (Jegadeesh and Titman (1993)), Ohlson's O-Score (Dichev (1998)), PEAD CAR3 (Brandt et al. (2008)), Short-term Reversals (Jegadeesh and Titman (1993)), Value Momentum Profitability (Novy-Marx (2014)), Value (Fama and French (1993)) and Size (Fama and French (1993)). The anomaly strategy returns are constructed by Robert Novy-Marx and conveniently made available from his webpage.[31] The strategies are rebalanced either monthly or annually with long and short portfolios constructed after sorting stocks into deciles on the basis of the anomaly variables. The decile breakpoint values are based on NYSE firms, while the long and short portfolios are constructed from the full sample of NYSE, NASDAQ and AMMEX traded firms excluding utility and financial firms. Novy-Marx and Velikov (2014) contains a full description of the construction of these anomaly strategies.

The anomaly returns are regressed on the market risk premium and the zero-cost $trs^{Ind.Adj.}$ strategy returns constructed from the sample of the most financially constrained firms as described previously. More

[30]It is worth noting that industry-adjusting both our main explanatory variable trs and stock returns consists a very stringent robustness check.

[31]http://rnm.simon.rochester.edu/. We thank Robert Novy-Marx for making this data available.

specifically, we fit the following regression:

$$r_t = \gamma_0 + \gamma_1 MKTRF_t + \gamma_2 TRS_t \tag{10}$$

where r_t, $MKTRF_t$ and TRS_t are the time t anomaly strategy return, market excess return and the zero-cost $trs^{ind.Adj.}$ strategy return, respectively. We repeat the regression separately for each anomaly and $trs^{ind.Adj.}$ strategy constructed from each financing constraint criterion, and benchmark the pricing errors (risk-adjusted returns) against the FF-3 model and the 4-factor (FF-4) model of Carhart (1997). The estimated risk-adjusted returns are reported in Table 17, and the estimated loadings on the $trs^{ind.Adj.}$ strategy return are reported in Table 18.

[Insert Table 17 here]

The first two columns of Table 17 report the risk-adjusted returns of the anomalies relative to the FF-3 and FF-4 models. In the sample period, Short Term Reversals, Value and Size are the only strategies to yield negative risk-adjusted returns relative to the factor models, although they are not significant. The remaining columns report the risk-adjusted returns of the anomalies relative to the $trs^{Ind.Adj.}$ 2-factor model. Relative to the 2-factor model, the sign of the risk-adjusted returns of the Value and the Size strategies reverse to become insignificantly positive across all the financing constraint criteria.

Several other anomaly strategies also turn out to be insignificant over the sample period. More specifically, the Accrual, Asset Growth, F-Score, Investments and Long Run Reversal anomalies all had positive risk-adjusted returns relative to the FF-3 and FF-4 models, although none of them are statistically significant. These anomalies, for the most part, remain insignificant relative to the 2-factor model as well in the same sample period.

The standouts pertain to Failure Probability, Gross Margin, Momentum, O-Score, PEAD CAR3, and Value Momentum Profitability anomalies; all of which offer positive risk-adjusted returns relative to the FF-3 and FF-4 models. The exception is the Momentum strategy, which unsurprisingly, turns out to be insignificant relative to the FF-4 model. The 2-factor model partly explains most of these anomalies primarily through the loadings on the TRS factor as shown in Table 18. The financing constraint criteria which best capture the power of TRS explaining these anomalies, in order of importance, are: S&P credit rating dummy, firm age, payout ratio and the SA Index. The explanatory power of the TRS factor is corroborated by the lower overall pricing errors for the 2-factor model against the FF-3 model. The 2-factor models have annualized root mean squared pricing errors of 8.1123%, 8.2339%, 8.6231% and 8.8069% for credit rating, firm age, payout ratio and SA Index as the financing constraint criteria respectively, which fare well against a root mean squared pricing error of 10.4791% for the FF-3 model. Overall, the 2-factor models, however, are inferior to the FF-4 model, which has a root mean squared pricing error of 5.6739%.

[Insert Table 18 here]

Departing from the overall pricing errors, and focusing instead on specific anomalies, the 2-factor model does remarkably well reducing the pricing errors of the Gross Margin and O-Score anomalies; a result that holds across all financing constraint criterion. Based on S&P credit rating, the financing constraint criterion which best captures the explanatory power of the TRS factor, the 2-factor model outperforms the FF-4 model explaining the Failure Probability, the PEAD CAR3 and the Value Momentum Profitability anomalies, and does about as well as the FF-4 model explaining the Gross Margin and the O-Score anomalies. These findings are corroborated by the large and significant loadings on the TRS factor constructed from the sample of firms that do not possess a S&P credit rating.

To summarize, the results suggest that several seemingly unrelated asset pricing anomalies exhibit commonalities which relate to the TRS factor. Long portfolios in anomaly strategies resemble low $trs^{Ind.Adj.}$ stocks, and short anomaly portfolios resemble high $trs^{Ind.Adj.}$ stocks in return characteristics. The findings offer further evidence that TRS proxy for priced risk.

4 Model

In this section, we go beyond the motivation presented in Section 2 and develop an investment-based model of firms. The purpose of the model is to interpret our empirical findings in a simple and straightforward fashion.[32]

4.1 The Environment

We build on the model of Carlson, Fisher, and Giammarino (2004) by introducing reversible labor hirings (Dixit and Pindyck (1994)) and irreversible investments in physical capital subject to collateral constraints (Almeida and Campello (2007)).

Each Firm j, $j \in \{1, ..., J\}$, produces its own output which is sold in the product market at time-t for price $P_{j,t}$. $P_{j,t}$ is composed of an idiosyncratic shock $X_{j,t}$ and a systematic shock Y_t, i.e.,

$$P_{j,t} = X_{j,t} Y_t \tag{11}$$

[32] A more general model capturing the same economic forces is possible, but at a cost of analytical tractability.

with dynamics

$$\begin{aligned}\frac{dX_{j,t}}{X_{j,t}} &= \sigma_j^{id} dB_{j,t}^{id},\\ \frac{dY_t}{Y_t} &= \mu dt + \sigma^{sys} dB_t^{sys},\end{aligned} \tag{12}$$

where μ denotes a fair return for the amount of systematic volatility σ^{sys} in the product market, σ_j^{id} denotes idiosyncratic volatility, and $dB_{j,t}^{id}$ and dB_t^{sys} are increments of independent Brownian motions.

In each stage i, $1 \leq i < M$, each Firm j gains incremental access to the product market through irreversible investments in physical capital $K_{i,j}$ and frictionless adjustments in labor $L_{j,t}$.[33] Investment is required in order to advance physical capital from $K_{i,j}$ to $K_{i+1,j}$, where $K_{i+1,j} > K_{i,j}$. The lumpiness of capital investments is motivated by the fixed adjustment costs $I_i > 0$, which by assumption, are sizeable and hence must be met with external financing.[34]

Output quantity is described by the Cobb-Douglas production function

$$Q(L_{j,t}, K_{i,j}) = L_{j,t}^{\alpha_j} K_{i,j}^{\nu_j}, \qquad 0 < \alpha_j < 1 \quad \text{and} \quad 0 < \nu_j < 1, \tag{13}$$

where $L_{j,t}$, α_j and ν_j denote labor input, labor share and physical capital share, respectively. Without loss of generally, we adopt constant return to scale by assuming $\nu_j = 1 - \alpha_j$ for the remainder of model. It follows then that the absolute value of the technical rate of substitution of labor for physical capital is given by

$$|TRS_{i,j,t}| = \frac{\alpha_j}{1-\alpha_j} \frac{K_{i,j}}{L_{j,t}}. \tag{14}$$

The $|TRS_{i,j,t}|$ captures the steepness of the production isoquant given $K_{i,j}$ and $L_{j,t}$ inputs.

Labor operating cost is c per unit and paid from revenues. Instantaneous profit maximization leads to the following labor input and profit functions:

$$L_{i,j}(P_{j,t}) = \left[\frac{\alpha_j P_{j,t}}{c}\right]^{\gamma_j} K_{i,j}, \quad \text{and} \quad \pi_{i,j}(P_{j,t}) = a_j P_{j,t}^{\gamma_j} K_{i,j}, \tag{15}$$

where $a_j = (1-\alpha_j)\left(\frac{\alpha_j}{c}\right)^{\frac{\alpha_j}{1-\alpha_j}}$, and $\gamma_j = \frac{1}{1-\alpha_j}$. Since $\gamma_j > 1$, $\pi_{i,j}(P_{j,t})$ is a convex function of $P_{j,t}$. Convexity is a property inherited from the adjustability of labor which lends to operating flexibility without irreversible

[33]We assume there are in total M stages until a firm reaches full maturity and depletes all opportunities to increase capital.

[34]Physical capital adjustments are commonly viewed as inflicting significant adjustment costs (Levinsohn and Petrin (2003)), leading firms to require external financing. Other papers with capital adjustment costs include Cooper (2007), Carlson, Fisher, and Giammarino (2004), Zhang (2005) and Livdan, Sapriza, and Zhang (2009), among others.

commitment (Dixit and Pindyck (1994)).[35]

Following Berk, Green, and Naik (1999) and several others (Carlson, Fisher, and Giammarino (2004), Zhang (2005) and Livdan, Sapriza, and Zhang (2009)), we assume a pricing kernel with the following process:

$$\frac{d\xi_t}{\xi_t} = -rdt - \Theta dB_t^{sys}, \tag{16}$$

where $\Theta = \frac{\mu_S - r}{\sigma_S}$ is the constant market price of risk, and r, μ_S and σ_S denote respectively the risk-free rate, the market rate of return, and the market return volatility.[36]

Working under $\mathbb{Q}$ to carry out the valuations changes the dynamics of Y_t to

$$\frac{dY_t}{Y_t} = \hat{\mu}dt + \sigma^{sys}d\hat{B}_t^{sys}, \tag{17}$$

where the risk-neutral drift, $\hat{\mu} = \mu - \sigma^{sys}\Theta$, is by assumption strictly less than the risk-free rate r and $d\hat{B}_t^{sys} = \Theta dt + dB_t^{sys}$ is the increment of a standard Brownian motion under $\mathbb{Q}$.

4.2 The Value of a Mature Firm

For each stage i the expressions that follow are identical for each Firm j. Therefore, for convenience we omit firm subscripts throughout the rest of this section.

The cash flow of a mature firm stems solely from the output produced by the assets-in-place. Denoting $A_M(P_t)$ the value of assets-in-place for a mature firm and $E_t^{\mathbb{Q}}[.]$ the time-t expectation under the $\mathbb{Q}$ measure, the value of the firm is

$$A_{M,t} = A_M(P_t) = E_t^{\mathbb{Q}}\left[\int_t^{\infty} e^{-r(u-t)}\pi_M(P_t)du\right] = \frac{aK_M P_t^{\gamma}}{r - \gamma\hat{\mu} - \frac{1}{2}(\gamma-1)\gamma\sigma^2}. \tag{18}$$

where the last equality is given by the the Gordon growth formula.

4.3 The Value of a Premature Firm

Stage $i < M$ firms derive value from both assets-in-place and a growth option which allows the firm to increase physical capital. Following the same steps as for mature firms, the value of the assets-in place is given by $A_{i,t}$, where $A_{i,t} = A_i(P_t) = E_t^{\mathbb{Q}}\left[\int_t^{\infty} e^{-r(u-t)}\pi_i(P_t)du\right] = \frac{aK_i P_t^{\gamma}}{r-\gamma\hat{\mu}-\frac{1}{2}(\gamma-1)\gamma\sigma^2}$. Denoting $G_{i,t} = G_i(P_t)$

[35]Convexity implies that profits decline less than linearly with P_t and increases more than linearly with P_t.

[36]The existence of the pricing kernel implicitly assumes investors in the market can trade a risk-free asset B_t and a risky security S_t whose price processes are given by $\frac{dB_t}{B_t} = rdt$ and $\frac{dS_t}{S_t} = \mu_S dt + \sigma_S dB_t^{sys}$ respectively.

the value of the growth option and summing together, the firm's total firm value is

$$V_{i,t} = V_i(P_t) = A_{i,t} + G_{i,t}. \tag{19}$$

Subject to satisfying a financing constraint, at time-t_i when the option is exercised the value of the assets-in-place of the firm increases by $A_{i+1,t_i} - A_{i,t_i}$; and if $i < M-1$, the firm acquires another expansion option worth G_{i+1,t_i}. After exercising the option, $t > t_i$, the growth option value is merely the value of the incremental increase in assets-in-place plus the value of the new option. That is, $G_{i,t} = A_{i+1,t} - A_{i,t} + G_{i+1,t}$, and therefore $V_{i,t} = A_{i,t} + (A_{i+1,t} - A_{i,t}) + G_{i+1,t} = A_{i+1,t} + G_{i+1,t} = V_{i+1,t}$.

Prior to exercising the option, $t < t_i$, the expected present-value of the payoff $A_{i+1,t_i} - A_{i,t_i} + G_{i+1,t_i} - I_i$ gives the value of the growth option

$$G_{i,t} = G_i(P_t) = E_t^{\mathbb{Q}}\Big[e^{-r(t_i-t)}\big(A_{i+1,t_i} - A_{i,t_i} + G_{i+1,t_i} - I_i\big)\Big],\ t \leq t_i. \tag{20}$$

Expansions occur conditional on satisfying a financing constraint.[37] Asymmetric information (Greenwald et al. (1984), Myers and Majluf (1984)) or agency problem (Jensen and Meckling (1976), Hart and Moore (1995)) ensures that only a fraction ω_i, $0 < \omega_i < 1$, of the value of the assets $A_{i+1,t_i} - A_{i,t_i}$ acquired with financing I_i is pledgable as collateral at time-t_i. G_{i+1,t_i}, the new option, is not pledgable and hence does not contribute to financing capacity.[38] Ceteris paribus, a higher ω_i means the collateral is more valuable to investors and the product $\omega_i \times \big(A_{i+1,t_i} - A_{i,t_i}\big)$ determines the financing capacity of the firm.

Given the model setup, the value function of a stage $i < M-1$ Firm under the optimal investment rule t_i obeys the following Bellman equation and external financing constraint:

$$V_{i,t} = V_i(P_t) = \underset{t_i \geq t}{Max} E_t^{\mathbb{Q}}\left[\int_t^{\infty} e^{-r(u-t)}\pi_i(P_t)du + e^{-r(t_i-t)}\Big(A_{i+1,t_i} - A_{i,t_i} + G_{i+1,t_i} - I_i\Big)\right] \tag{21}$$

$$\text{s.t.} \qquad I_i \leq \omega_i \times \big(A_{i+1,t_i} - A_{i,t_i}\big), \tag{22}$$

while the solution with $G_{i+1,t_i} = 0$ gives the value of a stage $i = M-1$ firm. We prove the following in the Appendix:

Proposition 1. *The value of the growth option for a stage $i < M-1$ firm is given by*

$$G_{i,t} = \left(\frac{P_t}{P_{t_i}}\right)^{\phi}\big[V_{i+1}(P_{t_i}) - A_i P_{t_i}^{\gamma} - I_i\big] = B_i P_t^{\phi}, \tag{23}$$

[37] Similarly to Almeida and Campello (2007) and for analytical tractability, we do not differentiate between debt and equity financing.

[38] This implicitly assumes that only tangible assets are pledgable and hence options are not contractible for external financing.

where B_i is the constant of integration which takes on the recursive form

$$B_i = \begin{cases} B_{i+1} + P_{t_i}^{-\phi}\left[\left(A_{i+1} - A_i\right) P_{t_i}^{\gamma} - I_i\right] & , \text{ if } P_t^{\max} < P_{t_i}^{FU} \\ \\ B_{i+1} + \frac{P_{t_i}^{-\phi} I_i (1-\omega_i)}{\omega_i} & , \text{ if } P_{t_i}^{FU} < P_t^{\max} < P_{t_i}^{FC}, \end{cases} \tag{24}$$

$P_t^{\max} = \sup_{t \geq 0}\{P_u : u \in [0,t)\}$ is the firm's maximum output price, and $P_{t_i} = Max(P_{t_i}^{FU}, P_{t_i}^{FC})$ is the optimal threshold for P_t where the advancement to the next stage $i+1$ occurs.

$$\begin{aligned} P_{t_i}^{FU} &= \left[\left(\frac{\phi}{\phi - \gamma}\right) \frac{I_i}{A_{i+1} - A_i}\right]^{1/\gamma} \quad \text{and} \\ P_{t_i}^{FC} &= \left[\left(\frac{\phi}{\gamma}\right)\left(\frac{1-\omega_i}{\omega_i}\right) \frac{I_i}{A_{i+1} - A_i}\right]^{1/\gamma} \end{aligned} \tag{25}$$

refer to P_{t_i} if the firm is collateral unconstraint and collateral constrained, respectively, and $A_i = \frac{aK_i}{r - \gamma\hat{\mu} - \frac{1}{2}(\gamma-1)\gamma\sigma^2}$, $r - \gamma\hat{\mu} - \frac{1}{2}(\gamma-1)\gamma\sigma^2 > 0$, $\phi = \frac{1}{2} - \frac{\hat{\mu}}{\sigma^2} + \sqrt{\left(\frac{1}{2} - \frac{\hat{\mu}}{\sigma^2}\right)^2 + \frac{2r}{\sigma^2}} > \gamma$, and $\sigma = \sqrt{(\sigma^{id})^2 + (\sigma^{sys})^2}$.

The value of the growth option for a stage $i = M-1$ firm satisfies the same solution with $B_{i+1} = 0$.

Proof: *See Appendix.* □

Proposition 1 shows that for any stage i, the model solution is expressed in closed-form. Even though the expansion opportunities are compound options – for $1 \leq i < M-1$, expanding capital buys the firm another expansion opportunity in the future – the model remains tractable when generalized to any i and M.

The proposition also shows that labor adjustability affects firm value. Akin to profits, the value of assets-in-place is convex in P_t which also characterizes the value of the assets acquired when expansions occur. This in turn bears on the value of growth options and, hence, on the optimal exercise policy P_{t_i}.

The solution also depends on ω_i, or the severity which the external financing constraint can bind, leading to two sets of valuations. The first solution pertains to the case the constraint is non-binding and $P_{t_i}^{FU}$ is the optimal threshold for P_t where the expansion happens. The second solution relates to the binding constraint scenario and the expansion is delayed until P_t reaches a higher threshold $P_{t_i}^{FC}$. As seen from (22) and (25), physical capital investment is delayed if ω_i takes on a lower value since the condition equates to a tighter constraint. More generally, the largest between $P_{t_i}^{FC}$ and $P_{t_i}^{FU}$ characterizes the optimal investment policy, and the growth option value – as well as the firm value – accounts for the difference in policies across constraint-scenarios. These features of the model, coupled with labor adjustability, offer additional implications for returns in the cross-section of firms. We explore these novel features of the model below.

4.4 Implications for Returns

Having discussed the valuation, we turn our attention to the model-implied returns.

The return of a mature firm is independent of physical capital since the firm value exhibits constant returns with respect to physical capital. The assets-in-place of a stage $i < n$ firm exhibits the same property, thus WLOG we refer to the return on both mature firms and assets-in-place as $dR_{A,t}$. Applying Ito's Lemma to (18) gives

$$dR_{A_i,t} = \mu_{A_i,t} dt + \gamma \sigma^{sys} dB_t^{sys} + \gamma \sigma_t^{id} dB_t^{id}. \tag{26}$$

where

$$\mu_{A_i,t} = \gamma \mu + \frac{1}{2} \frac{P_t^2}{A_{i,t}} \frac{\partial^2 A_{i,t}}{\partial P_t^2} \left((\sigma^{sys})^2 + (\sigma^{id})^2 \right), \tag{27}$$

Equation (26) is intuitive. σ^{sys} denotes the systematic risk of the product market, a constant by assumption. $\gamma > 1$ is a multiplier that captures the convexity of assets-in-place and due to the Jensen-Ito effect the drift $\mu_{A_i,t}$ contains $\frac{1}{2} \frac{P_t^2}{A_{i,t}} \frac{\partial^2 A_{i,t}}{\partial P_t^2} \left((\sigma^{sys})^2 + (\sigma^{id})^2 \right)$.[39]

Now we investigate the return of a pre-mature firm $dR_{i,t}$, which is a weighted average of the return on assets-in-place and growth option

$$dR_{i,t} = \left(1 - \frac{G_{i,t}}{V_{i,t}} \right) dR_{A_i,t} + \frac{G_{i,t}}{V_{i,t}} dR_{G_i,t}. \tag{28}$$

$dR_{G_i,t}$ is the return on the firm's growth option attained by applying Ito's Lemma, i.e.

$$dR_{G_i,t} = \mu_{G_i,t} dt + \Omega_{i,t} \big(\sigma^{sys} dB_t^{sys} + \sigma^{id} dB_t^{id} \big), \tag{29}$$

where

$$\mu_{G_i,t} = \Omega_{i,t} \mu + \frac{1}{2} \frac{P_t^2}{G_{i,t}} \frac{\partial^2 G_{i,t}}{\partial P_t^2} \left((\sigma^{sys})^2 + (\sigma^{id})^2 \right), \tag{30}$$

and $\Omega_{i,t} = \frac{P_t}{G_{i,t}} \frac{\partial G_{i,t}}{\partial P_t}$ is the elasticity of $G_{i,t}$ with respect to P_t. Given the returns, we prove the following in the Appendix:

Proposition 2. *A stage $i < M$ firm has a conditional systematic return volatility of*

$$\sigma_{R_{i,t}}^{sys} = \left[\left(1 - \frac{G_{i,t}}{V_{i,t}} \right) \gamma + \frac{G_{i,t}}{V_{i,t}} \Omega_{i,t} \right] \sigma^{sys}, \tag{31}$$

[39]See Dixit (1993) for an explanation of the Jensen-Ito effect.

and a conditional expected return $E_t[dR_{i,t}]$ that relates inversely with $|TRS_{i,t}|$, i.e.

$$\frac{\partial E_t[dR_{i,t}]}{\partial |TRS_{i,t}|} < 0. \tag{32}$$

Proof: *See Appendix.* □

Proposition 2 states the systematic risk for stage $i < M$ firms in the model. As a portfolio of two assets, a firm's conditional systematic risk is a weighted average of the systematic risk of assets-in-place and the expansion option. The option plays an important role on the systematic risk of the firm. As levered positions in underlying assets, options are riskier than assets-in-place, i.e. $\Omega_{i,t} > \gamma$. Consequently, ceteris paribus, a greater prominence of the expansion option $\frac{G_{i,t}}{V_{i,t}}$ (option leverage hereafter) amplifies systematic risk.

Applying the basic asset pricing equation, the proposition extends to risk premia as $\sigma^{sys}_{R_{i,t}}\Theta$, or to expected return as follows:

$$E_t[dR_{i,t}] = \left(r + \sigma^{sys}_{R_{i,t}}\Theta\right) dt. \tag{33}$$

The novel feature of the model is the inverse relation between expected return $E_t[dR_{i,t}]$ and $|TRS_{i,t}|$ through their dependence on P_t. In the inaction region of P_t where investing in capital is suboptimal, i.e. when $P_t < P_i$, $\sigma^{sys}_{R_{i,t}}$ is rising in P_t because option leverage $\frac{G_{i,t}}{V_{i,t}}$ is also rising with P_t. $|TRS_{i,t}|$, on the other hand, is decreasing in P_t solely from upward adjustments in labor. This in turn establishes an inverse correspondence between $E_t[dR_{i,t}]$ and $|TRS_{i,t}|$, i.e. $\frac{\partial E_t[dR_{i,t}]}{\partial P_t} > 0$ and $\frac{\partial |TRS_{i,t}|}{\partial P_t} < 0$ which implies $\frac{\frac{\partial E_t[dR_{i,t}]}{\partial P_t}}{\frac{\partial |TRS_{i,t}|}{\partial P_t}} = \frac{\partial E_t[dR_{i,t}]}{\partial |TRS_{i,t}|} < 0$.

In the Appendix we also show that the inverse relation between $E_t[dR_{i,t}]$ and $|TRS_{i,t}|$ holds at the exercise boundary $P_t = P_i$ where capital expansion occurs optimally. As P_t approaches the exercise boundary, $|TRS_{i,t}|$ rises from capital expansion simultaneously with a decrease in $\sigma^{sys}_{R_{i,t}}$ due to a drop in option leverage steaming from the conversion of growth option to assets-in-place. The new assets are less risky than the option they replace, establishing an inverse relation between $E_t[dR_{i,t}]$ and $|TRS_{i,t}|$.

While the correspondence between $E_t[dR_{i,t}]$ and $|TRS_{i,t}|$ goes in the same direction both in the inaction region and at the exercise boundary, the underlying mechanisms are different. In the inaction region, given a certain level of capital accumulation K_i, $|TRS_{i,t}|$ decreases with increasingly greater reliance on labor as the firm value simultaneously experiences greater option leverage. At the exercise boundary, by contrast, the change in $|TRS_{i,t}|$ is positive rather than negative due to the capital expansion while the firm value experiences a simultaneous drop in option leverage. While the mechanisms are different, $E_t[dR_{i,t}]$ and $|TRS_{i,t}|$ have an inverse relation both in the inaction region and at the exercise boundary.

Another novel feature of the model is the dependence of the negative relation between $E_t[dR_{i,t}]$ and $TRS_{i,t}$ on the severity that the external financing constraint binds, or ω_i. We summarize this feature of the model in the next proposition.

Proposition 3. *If the external financing constraint is binding, then a stage $i < M$ firm has an inverse relation between expected return $E_t[dR_{i,t}]$ and $|TRS_{i,t}|$ that strengthens in the severity that the constraint binds. I.e.,*

$$\frac{\partial}{\partial \omega_i} \frac{\partial E_t[dR_{i,t}]}{\partial |TRS_{i,t}|} > 0. \tag{34}$$

Proof: *See Appendix.* □

If the external financing constraint is non-binding then the risk premia is insensitive to changes in ω_i insofar as the constraint remains non-binding. This is so because the scenario equates to one with no constraint at all. A binding constraint, on the other hand, distorts capital expansions and increases the risk premium. It is easy to see that $\frac{\partial P_{t_i}^{FC}}{\partial \omega_i} < 0$; i.e., P_t must reach a higher investment threshold to confer capital expansion if the constraint binds more tightly. Higher values of $P_{t_i}^{FC}$, in turn, implies a larger region in the inaction space where higher option leverage impacts the risk premium.

Proposition 3 highlights the importance of the severity of a binding constraint on the relation between $E_t[dR_{i,t}]$ and $|TRS_{i,t}|$. The same mechanisms discussed in Proposition 2 apply for the relation between $E_t[dR_{i,t}]$ and $|TRS_{i,t}|$ if the financing constraint is binding. A binding constraint additionally leads to a stronger inverse relation for lower values of ω_i resulting from a greater reduction in option leverage $\frac{G_{i+1,t_i}}{V_{i+1,t_i}} - \frac{G_{i,t}}{V_{i,t}} < 0$ at the boundary $P_{t_i}^{FC}$. This is so because a greater distortion in capital investment, i.e. a higher $P_{t_i}^{FC}$, leads to a greater reduction in option leverage when the expansion occurs. As a consequence, a lower value of ω_i has the effect of strengthening the inverse relation between $E_t[dR_{i,t}]$ and $|TRS_{i,t}|$; looked another way, the inverse relation between $E_t[R_{i,t_i}]$ and $|TRS_{i,t}|$ weakens from a financing constraint that binds less severely.

Proposition 3 together with Proposition 2 form the basis for a novel prediction in mean returns that relate to observable characteristics across firms. $|TRS|$ is a latent variable but to the extent that the relative growth in production inputs observed empirically captures shifts in $|TRS|$, the model is consistent with capital to labor growth ratios as predictors of lower future returns with more pronounced effects in the subsample of firms facing tighter financing constraints. These results are consistent with the empirical findings reported in Section 3 of the paper.

5 Conclusion

The ratio of log growth in physical capital to log growth in labor input predicts lower future stock returns. This return relation becomes more pronounced with the severity of the empirical measures for financing constraint. We provide an interpretation of this predictability as an outcome reflecting differences in risk premiums based on displacements on the production isoquant with supporting empirical findings. Cross-sectional differences in the growth of physical capital to labor input can thus be useful sources of information for quantifying risk premiums in capital markets. A dynamic investment-based asset pricing model with adjustable labor and irreversible capital investments subject to an external financing constraint is able to produce a consistent pattern in conditional expected returns.

Our work is part of a growing literature that recognizes the importance of the operating environment and corporate decisions of firms in understanding cross-sectional returns.

Proof of Proposition 1

Consider the Bellman equation (21). Subtracting $E_t^{\mathbb{Q}}\left[\int_t^{\infty} e^{-r(u-t)}\pi_i(P_t)du\right]$ from both sides of the equation results in the following optimization problem:

$$G_{i,t} = G_i(P_t) = \underset{t_i \geq t}{Max}\, E_t^{\mathbb{Q}}\left[e^{-r(t_i-t)}\Big(A_{i+1,t_i} - A_{i,t_i} + G_{i+1,t_i} - I_i\Big)\right] \tag{35}$$

$$\text{s.t.} \qquad I_i \leq \omega_i \times \big(A_{i+1,t_i} - A_{i,t_i}\big), \tag{36}$$

The basic asset pricing equation states that

$$E_t^{\mathbb{Q}}\big[dG_{i,t} - G_{i,t}rdt\big] = 0, t \leq \tau. \tag{37}$$

We have under $\mathbb{Q}$,

$$\frac{dP_t}{P_t} = \hat{\mu}dt + \sigma d\hat{B}_t, \tag{38}$$

where $\sigma = \sqrt{(\sigma^{id})^2 + (\sigma^{sys})^2}$ and $d\hat{B}_t = \frac{\sigma^{id}}{\sigma}dB_t^{id} + \frac{\sigma^{sys}}{\sigma}d\hat{B}_t^{sys}$.

Applying Ito's Lemma to $G_{i,t}$ we have (29).

Following Stokey (2008), the optimization problem has the following Hamilton Jacobi Bellman equation:

$$rG_{i,t} = \underset{t_i \geq t}{Max}\left[\frac{1}{2}\sigma^2 P_t^2 \partial_{P_t}^2 G_{i,t} + \hat{\mu}P_t\partial_{P_t}G_{i,t}\right], t \leq t_i, \tag{39}$$

where $\partial_{P_t} = \frac{\partial}{\partial P_t}$.

To solve the optimization problem, first consider the scenario where the constraint does not bind. The scenario translates to the case in which there is no constraint at all. Denoting $G_{i,t_i} = G_i(P_{t_i})$, $A_{i,t_i} = A_i(P_{t_i})$, and $V_{i,t_i} = V_i(P_{t_i})$, the value matching condition at the optimal threshold $P_t = P_{t_i}$ is given by

$$G_{i,t_i} = V_{i+1,t_i} - A_{i,t_i} - I_i = A_{i+1,t_i} + G_{i+1,t_i} - A_{i,t_i} - I_i. \tag{40}$$

The solution is $G_{i,t} = B_i P_t^{\phi}$, where $\phi = \frac{1}{2} - \frac{\mu^{\mathbb{Q}}}{\sigma^2} + \sqrt{\left(\frac{1}{2} - \frac{\mu^{\mathbb{Q}}}{\sigma^2}\right)^2 + \frac{2r}{\sigma^2}}$.[40] Solving for B_i using (40) and substituting it into $G_{i,t} = B_i P_t^{\phi}$ gives

$$G_{i,t} = \left(\frac{P_t}{P_{t_i}}\right)^{\phi}(V_{i+1,t_i} - AP_{i,t_i} - I_i) = B_i P_t^{\phi} \tag{41}$$

[40] See Dixit and Pindyck (1994)

where

$$B_i = B_{i+1} + P_{t_i}^{-\phi} \left[\left(A_{i+1} - A_i \right) P_{t_i}^{\gamma} - I_i \right] \tag{42}$$

and $A_i = \frac{aK_i}{r - \gamma\hat{\mu} - \frac{1}{2}(\gamma-1)\gamma\sigma^2}$.

The smooth pasting condition at $P_t = P_{t_i}$ allows us to solve for the optimal exercise threshold P_{t_i}. The condition is

$$\partial_{P_t} G_{i,t_i} = \partial_{P_t} V_{i+1,t_i} - \partial_{P_t} A_{i,t_i} \tag{43}$$

and solving for P_{t_i} gives the closed-form expression

$$P_{t_i}^{FU} = \left[\left(\frac{\phi}{\phi - \gamma} \right) \frac{I_i}{A_{i+1} - A_i} \right]^{1/\gamma} \tag{44}$$

where $P_{t_i}^{FU}$ denotes the optimal threshold P_{t_i} if the constraint is non-binding.

Now consider the binding constraint scenario. The solution for $G_{i,t}$ must simultaneously satisfy the value matching, smooth pasting, and the financing constraint conditions. By the complementary slackness condition, at the optimal policy $P_t = P_{t_i}$ the Lagrangian multiplier with respect to the constraint is non-negative. This implies that constraint (36) must hold as an equality. Substituting the constraint into the value matching condition leads to $\left(B_{i+1} - B_i \right) P_{t_i}^{\phi} = I_i \left(1 - \frac{1}{\omega_i} \right)$, and solving for B_i gives

$$B_i = B_{i+1} + \frac{P_{t_i}^{-\phi} I_i \left(1 - \omega_i \right)}{\omega_i}. \tag{45}$$

Substituting this into the smooth pasting condition and solving for P_{t_i} gives

$$P_{t_i}^{FC} = \left[\left(\frac{\phi}{\gamma} \right) \left(\frac{1 - \omega_i}{\omega_i} \right) \frac{I_i}{A_{i+1} - A_i} \right]^{1/\gamma}. \tag{46}$$

$P_{t_i}^{FC}$ denotes the optimal investment threshold for P_t in the presence of a binding constraint. The constraint is a hindrance to capital investment, hence if the constraint is binding $P_{t_i}^{FC} > P_{t_i}^{FU}$, otherwise $P_{t_i}^{FC} \leq P_{t_i}^{FU}$.

To summarize, the optimal investment policy is $P_{t_i} = Max(P_{t_i}^{FC}, P_{t_i}^{FU})$ and B_i is given by (45) and (42) for the constrained and unconstrained scenarios, respectively. The value of the growth option for a stage $i = M - 1$ firm satisfies the same solution with $B_{i+1} = 0$. This completes the proof. □

Proof of Proposition 2

The derivation of (31) is trivial: it merely states that a firm's systematic volatility is a weighted average of the systematic volatility of its assets-in-place and growth option.

To prove (32) two cases must be considered: the inaction region $P_t < P_{t_i}$ where labor is continuously adjusted but physical capital is fixed; and at the boundary $P_t = P_{t_i}$ where investment in physical capital occurs optimally.

In the first case, observe that

$$|TRS_{i,t}| = \frac{\alpha}{1-\alpha}\left(\frac{\alpha P_t}{c}\right)^{-\gamma}. \tag{47}$$

after substituting labor demand $L_{i,t} = L_i(P_t) = \left[\frac{\alpha P_t}{c}\right]^{\gamma} K_i$ into $|TRS_{i,t}| = \frac{\alpha}{1-\alpha}\frac{K_i}{L_{i,t}}$. From (47) it is easy to see that

$$\frac{\partial |TRS_{i,t}|}{\partial P_t} < 0. \tag{48}$$

Applying the basic asset pricing equation, (31) extends to risk premia as $\sigma^{sys}_{R_{i,t}}\Theta$, or to expected return as follows:

$$E_t[dR_{i,t}] = \left(r + \sigma^{sys}_{R_{i,t}}\Theta\right) dt. \tag{49}$$

Thus it suffices to show that $\frac{\partial \sigma_{R_{i,t}}}{\partial P_t} > 0$ to prove an inverse relationship between $E_t[dR_{i,t}]$ and $|TRS_{i,t}|$.

Taking the derivative of (31) gives

$$\frac{\partial \sigma^{sys}_{R_{i,t}}}{\partial P_t} = \frac{\partial}{\partial P_t}\left[\frac{G_{i,t}}{V_{i,t}}\right](\Omega_{i,t} - \gamma) + \frac{G_{i,t}}{V_{i,t}}\frac{\partial \Omega_{i,t}}{\partial P_t} \tag{50}$$

The first term of (50) is positive since $\frac{\partial}{\partial P_t}\left[\frac{G_{i,t}}{V_{i,t}}\right] > 0$ and $\Omega_{i,t} > \gamma$. The second term vanishes because $\Omega_{i,t} = \frac{P_i}{G_{i,t}}\frac{\partial G_{i,t}}{\partial P_t} = \frac{P_t}{G_{i,t}} B_i \phi_i P_t^{\phi_i - 1} = \phi_i$, and $\frac{\partial \phi_i}{\partial P_t} = 0$. Hence $\frac{\partial E_t[dR_{i,t}]}{\partial |TRS_{i,t}|} < 0$ in the inaction region.

Now to prove that $\frac{\partial E_t[dR_{i,t}]}{\partial |TRS_{i,t}|} < 0$ at the investment boundary $P_t = P_{t_i}$, consider the difference in $|TRS_{i,t}|$ at the boundary P_{t_i} and at $P_t = P_{t_i} - \Delta P$ for some small ΔP just before P_t reaches the boundary. $\frac{\partial |TRS_{i,t}|}{\partial P_t}$ is approximated as follows

$$\frac{\partial |TRS_{i,t}|}{\partial P_t} \approx \frac{\Delta |TRS_{i,t}|}{P_{t_i} - P_t} = \frac{|TRS_{i,t_i}| - |TRS_{i,t}|}{P_{t_i} - (P_{t_i} + \Delta P)} = \frac{\frac{\alpha}{1-\alpha}\left(\frac{K_{i+1}}{L_i(P_{t_i})} - \frac{K_i}{L_i(P_t)}\right)}{\Delta P}. \tag{51}$$

Letting $\Delta P \to 0$ gives

$$\frac{\partial |TRS_{i,t}|}{\partial P_t} \to \frac{\alpha}{1-\alpha}\frac{K_{i+1} - K_i}{L_i(P_{t_i})} > 0. \tag{52}$$

Thus it suffices to show that $\frac{\partial \sigma_{R_{i,t}}}{\partial P_t} < 0$ to prove an inverse relationship between $E_t[dR_{i,t}]$ and $|TRS_{i,t}|$ at the boundary $P_t = P_{t_i}$.

To prove this, consider the difference in $\sigma^{sys}_{R_{i,t}}$ at the boundary P_{t_i} and at $P_t = P_{t_i} - \Delta P$ for some small

ΔP just before P_t reaches the boundary. The difference is negative, i.e.

$$\frac{\Delta\sigma_{R_{i,t}}^{sys}}{\Delta P} = \frac{\sigma_{R_{i,t_i}}^{sys} - \sigma_{R_{i,t}}^{sys}}{\Delta P} < 0 \tag{53}$$

since $\frac{G_{i+1,t_i}}{V_{i+1,t_i}} < \frac{G_{i,t}}{V_{i,t}}$ and $\Omega_{i,t} > \gamma$. This completes the proof.

□

Proof of Proposition 3

The proof that $E_t[dR_{i,t}]$ relates inversely to $|TRS_{i,t}|$ in Proposition 2 also applies if the external financing constraint binds. To prove a stronger inverse relation between $E_t[dR_{i,t}]$ and $|TRS_{i,t}|$ for lower values of ω_i consider the reduction in option leverage $\frac{G_{i+1,t_i}}{V_{i+1,t_i}} - \frac{G_{i,t}}{V_{i,t}} < 0$ at the boundary $P_{t_i}^{FC}$. From (25), $\frac{\partial P_{t_i}^{FC}}{\partial \omega_i} < 0$, i.e. P_t must reach a higher threshold to confer capital expansion if the constraint binds more severely – if ω_i is lower. Higher values of $P_{t_i}^{FC}$ implies greater declines in option leverage at the time of capital expansion and thus $\frac{\partial \sigma_{R_{i,t_i}}}{\partial \omega_i} < 0$. Therefore, a higher value of ω_i has the effect of weakening the inverse relation between $\sigma_{R_{i,t}}^{sys}$ and $|TRS_{i,t}|$; or looked another way, the inverse relation between $E_t[R_{i,t_i}]$ and $|TRS_{i,t}|$ strengthens from a financing constraint that binds more severely. This completes the proof.

□

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Table 1. Labor Input of $trs^{Ind.Adj.}$ and $fincon$-Sorted Firms

The table reports the time-series means of the median industry-adjusted % increase in labor input for each of the two-way rank classifications of $trs^{Ind.Adj.}$ and financial constraint. At the end of each June, we sort and rank firms into three equally-sized groups based on $trs^{Ind.Adj.}$, and separately, based on each financing constraint criterion. For the categorical variable, firms are separated into two groups depending on the value of the dummy. Then the median % increase in labor input is computed for each group. Each panel corresponds to the results for a different financial constraint criterion.

$fincon$ Tercile	1	2	3	3-1	1	2	3	3-1	1	2	3	3-1
	(a) Size				(b) Age				(c) Payout Ratio			
1	0.2878***	0.3073***	0.3098***	0.0220**	0.3263***	0.3492***	0.3271***	0.0008	0.2851***	0.3133***	0.3075***	0.0224**
	[21.6444]	[29.7897]	[31.2784]	[2.0404]	[28.4973]	[34.8580]	[36.5984]	[0.0702]	[24.9379]	[37.6445]	[32.9228]	[2.4474]
2	0.3561***	0.3638***	0.3270***	-0.0291***	0.3053***	0.3356***	0.3126***	0.0073	0.4193***	0.3835***	0.3143***	-0.1050***
	[41.3998]	[39.0899]	[36.1080]	[-2.6711]	[28.0880]	[32.6160]	[31.8075]	[0.6567]	[34.8853]	[37.3981]	[29.4164]	[-7.4510]
3	0.3440***	0.3724***	0.3326***	-0.0114	0.3124***	0.3399***	0.3044***	-0.008	0.3295***	0.3637***	0.3412***	0.0117
	[46.7856]	[48.8489]	[42.3222]	[-1.2137]	[46.2104]	[53.4675]	[35.9945]	[-0.9434]	[40.8244]	[40.1043]	[38.5683]	[1.2060]
3-1	0.0562***	0.0650***	0.0227***		-0.0139	-0.0093	-0.0227***		0.0445***	0.0504***	0.0337***	
	[4.5628]	[8.4647]	[3.0308]		[-1.6051]	[-1.0512]	[-3.6478]		[4.2782]	[6.8314]	[4.3101]	
	(d) KZ Index				(e) SA Index				(f) Z-Score			
1	0.3409***	0.3683***	0.3320***	-0.009	0.3252***	0.3483***	0.3126***	-0.0126	0.2707***	0.2886***	0.2950***	0.0243***
	[26.2325]	[36.4405]	[33.7821]	[-0.6479]	[46.0100]	[49.8481]	[33.4043]	[-1.3328]	[33.1349]	[36.6453]	[31.3925]	[2.9761]
2	0.3290***	0.3583***	0.3217***	-0.0074	0.3528***	0.3797***	0.3236***	-0.0292***	0.3379***	0.3725***	0.3171***	-0.0208**
	[36.4734]	[34.1786]	[33.3021]	[-0.8473]	[39.6683]	[36.9814]	[39.6703]	[-2.8253]	[42.6887]	[42.5772]	[36.2911]	[-2.1180]
3	0.2909***	0.3005***	0.2939***	0.0029	0.2908***	0.3116***	0.3171***	0.0263**	0.3489***	0.3537***	0.3287***	-0.0202*
	[39.8846]	[38.8652]	[32.4558]	[0.3235]	[22.5721]	[29.4374]	[33.6707]	[2.5018]	[27.2795]	[34.5041]	[31.9639]	[-1.7033]
3-1	-0.0500***	-0.0679***	-0.0381***		-0.0344***	-0.0367***	0.0045		0.0782***	0.0650***	0.0337***	
	[-4.7877]	[-6.5277]	[-4.0840]		[-3.3707]	[-4.6961]	[0.8294]		[8.1691]	[7.2482]	[4.0858]	
	(g) WW Index				(h) Credit Rating							
1	0.3445***	0.3606***	0.3260***	-0.0186*								
	[34.3902]	[37.8381]	[39.0090]	[-1.6952]								
2 (0)	0.3214***	0.3410***	0.3161***	-0.0053	0.3122***	0.3367***	0.3144***	0.0021				
	[31.6286]	[35.0011]	[33.0139]	[-0.5387]	[29.1795]	[38.8330]	[35.9958]	[0.1976]				
3 (1)	0.3016***	0.3291***	0.3113***	0.0097	0.3322***	0.3551***	0.3181***	-0.014				
	[35.0481]	[38.3496]	[34.7744]	[0.9676]	[41.0303]	[47.5310]	[33.2739]	[-1.2830]				
3-1 (1-0)	-0.0429***	-0.0315***	-0.0147***		0.0200**	0.0185***	0.0038					
	[-5.0399]	[-3.9912]	[-2.6082]		[2.3185]	[3.3971]	[0.6772]					

Table 2. Operating Risk of $trs^{Ind.Adj.}$ and $fincon$-Sorted Firms

The table reports the time-series means of the median volatility of the % increase in operating earnings for each of the two-way rank classifications of $trs^{Ind.Adj.}$ and financial constraint. At the end of each June, we sort and rank firms into three equally-sized groups based on $trs^{Ind.Adj.}$, and separately, based on each financing constraint criterion. For the categorical variable, firms are separated into two groups depending on the value of the dummy. Then the median volatility of the firms' % increase in operating earnings is computed for each group. The volatilities are estimated for each firm and each quarter using rolling regressions with a window of 10 quarters (2.5 year window) and the requirement of at least 5 quarters of non-missing observations. Then quarterly volatilities are averaged for each firm and each fiscal year. Each panel corresponds to the results for a different financial constraint criterion.

$fincon$ Tercile	1	2	3	3-1	1	2	3	3-1	1	2	3	3-1
	(a) Size				(b) Age				(c) Payout Ratio			
1	139.2221***	117.5093***	121.1509***	-18.0712***	88.0607***	66.6909***	80.6350***	-7.4257*	120.4002***	98.6500***	108.5793***	-11.8209**
	[34.6613]	[59.2944]	[45.7536]	[-3.7915]	[19.2630]	[29.6535]	[29.2319]	[-1.9182]	[27.6828]	[40.4250]	[35.6062]	[-2.3884]
2	43.4030***	38.7057***	38.3944***	-5.0086***	68.4008***	50.7601***	55.6317***	-12.7691***	33.6132***	32.2676***	30.8973***	-2.7159***
	[25.4289]	[36.9571]	[28.8177]	[-2.7691]	[26.6232]	[33.1538]	[26.8463]	[-3.7427]	[34.6801]	[41.9259]	[38.2800]	[-2.6837]
3	24.7836***	23.7474***	22.4510***	-2.3326***	31.3440***	30.4587***	28.3279***	-3.0161***	29.4001***	27.0354***	26.7166***	-2.6836***
	[39.3642]	[46.8018]	[43.6073]	[-2.9615]	[37.8652]	[24.4008]	[54.1818]	[-3.5859]	[37.8788]	[39.3744]	[69.6264]	[-4.7897]
3-1	-114.4385***	-93.7619***	-98.6999***		-56.7167***	-36.2322***	-52.3071***		-91.0001***	-71.6146***	-81.8627***	
	[-30.015]	[-47.126]	[-37.718]		[-13.880]	[-14.931]	[-21.157]		[-23.260]	[-31.418]	[-27.721]	
	(d) KZ Index				(e) SA Index				(f) Z-Score			
1	44.4851***	38.6804***	47.9608***	3.4756	26.9983***	26.0850***	24.5746***	-2.4237***	77.6866***	65.6953***	69.7613***	-7.9252**
	[23.2265]	[29.1380]	[20.6119]	[1.3735]	[43.6980]	[32.8631]	[62.2939]	[-3.1290]	[22.4657]	[25.0583]	[20.8539]	[-1.9706]
2	47.5000***	38.8255***	44.0630***	-3.437	45.9672***	41.7334***	37.8868***	-8.0804***	51.5902***	40.6713***	46.9558***	-4.6344
	[16.3530]	[33.9586]	[27.6951]	[-1.1250]	[26.2838]	[27.0976]	[37.5664]	[-4.9907]	[16.1067]	[29.9190]	[27.3899]	[-1.5090]
3	85.8557***	69.7443***	66.7166***	-19.1391***	133.5758***	102.8836***	118.0767***	-15.4991***	43.2209***	34.7535***	36.4695***	-6.7514***
	[19.0891]	[15.5314]	[15.1932]	[-4.7374]	[30.4070]	[38.1625]	[41.3314]	[-3.2266]	[21.7388]	[41.1963]	[42.0364]	[-3.2787]
3-1	41.3706***	31.0638***	18.7559***		106.5775***	76.7986***	93.5021***		-34.4656***	-30.9418***	-33.2918***	
	[8.6682]	[6.2292]	[3.3121]		[25.7644]	[27.4484]	[33.0926]		[-8.9372]	[-11.482]	[-10.090]	
	(g) WW Index				(h) Credit Rating							
1	40.0793***	35.0767***	35.7173***	-4.3620**								
	[24.4074]	[30.4214]	[27.5761]	[-2.5146]								
2 (0)	61.6827***	50.0585***	57.9015***	-3.7812	78.6557***	59.2890***	68.3303***	-10.3253***				
	[19.1780]	[25.4695]	[22.9240]	[-1.2056]	[29.8743]	[38.8446]	[32.1357]	[-3.4082]				
3 (1)	77.4174***	61.9451***	63.3067***	-14.1107***	26.7461***	26.1411***	25.1849***	-1.5612**				
	[19.8689]	[23.4298]	[25.2337]	[-3.7060]	[40.3778]	[35.8850]	[38.0502]	[-2.2866]				
3-1 (1-0)	37.3381***	26.8685***	27.5894***		-51.9096***	-33.1478***	-43.1455***					
	[8.9957]	[8.9649]	[11.0158]		[-23.915]	[-22.790]	[-19.529]					

Table 3. Characteristics and Returns of $trs^{Ind.Adj.}$-Sorted Firms
The table reports mean raw returns, mean abnormal returns relative to the CAPM, mean abnormal returns relative to the FF 3-factor model, estimates of the FF 3-factor loadings, and the financing constraint characteristics for each of the $trs^{Ind.Adj.}$ tercile portfolios. At the end of each June, we sort and rank firms into three equally-sized groups based on $trs^{Ind.Adj.}$. Then median size, book-to-market (B/M), payout ratio, KZ Index, SA Index, Z-Score, WW Index and the proportions of firms with a credit rating are computed for each portfolio. The reported characteristics are the means of the medians observed monthly. $trs^{Ind.Adj.}$ terciles are reported down the rows. The reported portfolio returns are annualized and expressed in %. Newey and West (1987) robust t-statistics are reported in square brackets.

			FF 3-Factor Loadings				Portfolio Characteristics							
$trs^{Ind.Adj.}$ Tercile	raw ret	α^{CAPM}	α^{FF3}	$MKTRF$	SMB	HML	Size	B/M	Payout	KZ Index	SA Index	Z-Score	WW Index	Proportion with credit rating
1	23.0721***	12.2615***	10.1364***	0.9930***	0.9462***	0.2356***	5.4366	0.7882	88.2999	-8.0127	-3.3488	5.7732	2.682	0.2657
	[4.2227]	[3.7288]	[5.5775]	[33.2450]	[9.3538]	[2.9893]								
2	19.2957***	8.6221***	6.6256***	1.0182***	0.7183***	0.2685***	5.5655	0.7175	78.6672	-5.7837	-3.3756	5.9742	2.3738	0.2778
	[3.7324]	[3.1462]	[3.7206]	[26.7016]	[10.6724]	[4.5415]								
3	16.3536***	5.4332**	3.6726**	1.0588***	0.6647***	0.2282***	5.4057	0.7112	61.798	-11.1917	-3.3228	6.746	2.3912	0.2515
	[3.2742]	[2.1514]	[2.2231]	[29.5654]	[8.9414]	[3.4268]								
3-1	-6.7185***	-6.8283***	-6.4638***	0.0659**	-0.2816***	-0.0074	-0.0309	-0.0770***	-26.5020**	-3.1790***	0.0260*	0.9727	-0.2908	-0.0142*
	[-3.3060]	[-3.4078]	[-3.7346]	[2.0347]	[-2.8503]	[-0.0881]	[-0.6785]	[-4.4280]	[-2.5152]	[-2.6091]	[1.7562]	[4.3422]	[-0.6277]	[-1.7260]

Table 4. Equal-Weighted Excess Returns of Portfolios Sorted on $trs^{Ind.Adj.}$ and $fincon$

The table reports the time-series mean excess returns to equal-weighted $trs^{Ind.Adj.}$ and financial constraint portfolios. At the end of each June, we sort and rank firms into three equally-sized groups based on $trs^{Ind.Adj.}$, and separately, based on each financing constraint criterion. For the categorical variable, firms are separated into two groups depending on the value of the dummy. Then the time-series mean of the monthly equal-weighted excess portfolio returns are computed for each portfolio. Each panel reports mean returns when a different variable is used as the financial constraint criterion. The reported means are annualized and expressed in %. Newey and West (1987) robust t-statistics are reported in square brackets.

$fincon$ Tercile	1	2	3	3-1	1	2	3	3-1	1	2	3	3-1
	(a) Size				(b) Age				(c) Payout Ratio			
1	24.8917***	20.7590***	15.9111***	-8.9806***	25.8916***	19.4199***	12.6724**	-13.2192***	25.4101***	19.6190***	17.3384***	-8.0717***
	[3.6963]	[3.3099]	[2.7063]	[-3.1221]	[3.6691]	[3.1283]	[2.1207]	[-3.9829]	[3.5730]	[2.9468]	[2.6862]	[-2.6771]
2	16.8396***	14.6058***	11.9184**	-4.9212**	18.6005***	14.3630***	14.7721***	-3.8284	14.1375***	10.9771**	6.7924	-7.3451***
	[3.0672]	[2.7056]	[2.1364]	[-2.3636]	[3.4680]	[2.7322]	[2.7985]	[-1.4862]	[3.0212]	[2.2053]	[1.3675]	[-2.7072]
3	12.0147***	10.5332**	9.8272**	-2.1875	11.4254***	12.4033***	11.0171**	-0.4083	12.4311***	10.9110***	9.0139**	-3.4171*
	[2.7096]	[2.2085]	[2.4793]	[-1.1485]	[2.6678]	[2.6436]	[2.5728]	[-0.2313]	[2.9785]	[2.7674]	[2.4423]	[-1.8097]
3-1	-12.8769***	-10.2258***	-6.0839*		-14.4662***	-7.0165**	-1.6553		-12.9790***	-8.7080**	-8.3245**	
	[-2.9615]	[-2.6908]	[-1.6626]		[-3.3157]	[-2.1117]	[-0.5198]		[-3.1104]	[-2.1812]	[-2.1052]	
	(d) KZ Index				(e) SA Index				(f) Z-Score			
1	13.9373***	13.1999***	10.5866**	-3.3507	11.7531***	11.0582**	9.4089**	-2.3442	27.8800***	21.7063***	17.3196***	-10.5604***
	[2.7590]	[2.7632]	[2.2900]	[-1.3889]	[2.7409]	[2.3564]	[2.1551]	[-1.3515]	[3.8721]	[3.1617]	[2.8676]	[-2.8771]
2	17.3904***	13.8424***	12.7320**	-4.6583**	16.1466***	12.6621**	11.8631**	-4.2835*	17.4702***	14.7022***	13.6602***	-3.8100*
	[3.3382]	[2.7000]	[2.5763]	[-2.1046]	[3.0533]	[2.4079]	[2.2563]	[-1.7385]	[3.5881]	[2.9673]	[2.8562]	[-1.6546]
3	26.9295***	20.5393***	15.2576**	-11.6719***	26.9700***	22.8523***	16.0757***	-10.8943***	11.6183**	10.3297**	7.7087	-3.9096**
	[3.7630]	[3.0355]	[2.4931]	[-3.1844]	[3.7652]	[3.5563]	[2.6525]	[-3.7107]	[2.3721]	[2.2616]	[1.5886]	[-2.1549]
3-1	12.9922***	7.3394**	4.671		15.2168***	11.7941***	6.6668*		-16.2617***	-11.3766***	-9.6109***	
	[3.0182]	[2.0195]	[1.5300]		[3.1635]	[3.0713]	[1.7863]		[-3.9524]	[-3.0646]	[-3.4574]	
	(g) WW Index				(h) Credit Rating							
1	21.6041***	18.5050***	17.5369***	-4.0672								
	[3.9729]	[3.7373]	[3.5669]	[-1.5423]								
2 (0)	17.2628***	15.2213***	11.4976**	-5.7652***	20.9147***	17.6767***	13.2960**	-7.6187***				
	[3.2297]	[2.6122]	[2.1556]	[-2.7705]	[3.5512]	[3.2151]	[2.5245]	[-3.4696]				
3 (1)	18.5739***	12.9212**	9.8697*	-8.7041***	13.7279***	10.3413**	10.8781**	-2.8498				
	[2.9790]	[2.3270]	[1.8617]	[-2.9867]	[2.9528]	[2.0377]	[2.2812]	[-1.2146]				
3-1 (1-0)	-3.0302	-5.5838**	-7.6671***		-7.1868**	-7.3355***	-2.418					
	[-1.0547]	[-2.2518]	[-3.2034]		[-2.2435]	[-2.9956]	[-0.9557]					

Table 5. Value-Weighted Excess Returns of Portfolios Sorted on $trs^{Ind.Adj.}$ and $fincon$

The table reports the time-series mean excess returns to value-weighted $trs^{Ind.Adj.}$ and financial constraint portfolios. At the end of each June, we sort and rank firms into three equally-sized groups based on $trs^{Ind.Adj.}$, and separately, based on each financing constraint criterion. For the categorical variable, firms are separated into two groups depending on the value of the dummy. Then the time-series mean of the monthly value-weighted excess portfolio returns are computed for each portfolio. Each panel reports mean returns when a different variable is used as the financial constraint criterion. The reported means are annualized and expressed in %. Newey and West (1987) robust t-statistics are reported in square brackets.

	1	2	3	3-1	1	2	3	3-1	1	2	3	3-1
$fincon$ Tercile	(a) Size				(b) Age				(c) Payout Ratio			
1	12.2798*	3.2772	2.3582	-9.9216**	21.7313***	14.7986**	5.5573	-16.1740***	5.219	6.618	8.9057	-8.2623*
	[1.8174]	[0.4978]	[0.3304]	[-2.5675]	[3.4149]	[2.2814]	[0.9051]	[-3.0175]	[0.7321]	[0.9039]	[1.4170]	[-1.6815]
2	13.0252**	11.7642**	7.6972	-5.328	11.0395**	8.3184*	16.4290***	5.3895	9.9633**	5.0367	9.4051**	-8.1786**
	[2.4174]	[2.1194]	[1.2668]	[-1.4085]	[2.4401]	[1.6691]	[2.6497]	[1.2165]	[2.0851]	[0.9801]	[2.0997]	[-2.0884]
3	7.9510**	7.7920**	7.0277*	-0.9232	11.5696***	11.7614***	11.0156***	-0.5539	7.1456**	7.9214**	6.9320**	2.1925
	[2.0124]	[2.1172]	[1.7984]	[-0.3782]	[2.9725]	[3.4463]	[3.1900]	[-0.2282]	[2.1617]	[2.4107]	[2.1483]	[0.8047]
3-1	-4.3288	4.5149	4.6695		-10.1617**	-3.0372	5.4584		1.9266	1.3034	-1.9738	
	[-0.8559]	[0.8912]	[0.8653]		[-2.3191]	[-0.5784]	[1.1595]		[0.3436]	[0.2297]	[-0.4654]	
	(d) KZ Index				(e) SA Index				(f) Z-Score			
1	7.0113*	8.8771**	7.5850*	0.5736	7.3564*	7.6173**	8.1552**	0.7988	15.0370***	9.8965**	7.45	-7.5870**
	[1.8112]	[2.5590]	[1.9068]	[0.1865]	[1.9104]	[2.2139]	[2.2859]	[0.3320]	[3.5067]	[2.0138]	[1.5963]	[-2.2991]
2	10.4652**	7.155	7.5424	-2.9228	14.4185***	7.9432	4.4946	-9.9239**	8.9404**	5.7684	8.2425**	-0.6979
	[2.0260]	[1.5594]	[1.3387]	[-0.7872]	[2.7409]	[1.3747]	[0.7307]	[-2.3693]	[2.4131]	[1.5228]	[2.1430]	[-0.2446]
3	14.5669***	3.9037	5.1621	-9.4048**	17.1938**	8.9646	5.6192	-11.5746**	5.8199	9.3617**	7.7368*	1.9169
	[2.7171]	[0.6034]	[0.9645]	[-2.5126]	[2.0815]	[1.3283]	[0.8385]	[-2.4262]	[1.2130]	[2.2384]	[1.7740]	[0.5541]
3-1	7.5556*	-4.9734	-2.4229		9.8374	1.3473	-2.5359		-9.2171**	-0.5348	0.2868	
	[1.7690]	[-0.9829]	[-0.4954]		[1.4414]	[0.2492]	[-0.4468]		[-2.1961]	[-0.1242]	[0.0670]	
	(g) WW Index				(h) Commercial Paper Rating							
1	10.5764***	8.4240**	10.0732***	-0.5032								
	[2.7356]	[2.0258]	[2.6680]	[-0.1740]								
2 (0)	8.4188*	4.6811	6.3612	-2.0576	13.4722**	12.2282**	5.2367	-8.2355**				
	[1.6708]	[0.9685]	[1.3373]	[-0.5723]	[2.5299]	[2.3205]	[0.8788]	[-2.1716]				
3 (1)	10.1975**	6.7087	1.6785	-8.5190**	7.6980*	6.8252*	7.7711**	0.0731				
	[2.3249]	[1.5168]	[0.3498]	[-2.1080]	[1.9450]	[1.9419]	[2.1616]	[0.0277]				
3-1 (1-0)	-0.3789	-1.7153	-8.3948**		-5.7742	-5.403	2.5345					
	[-0.1199]	[-0.6044]	[-2.2893]		[-1.6007]	[-1.5803]	[0.5757]					

Table 6. Equal-Weighted Abnormal Returns Relative to FF 3-Factor Model of Portfolios Sorted on $trs^{Ind.Adj.}$ and $fincon$

The table reports abnormal returns relative to the Fama and French 3-factor model for each $trs^{Ind.Adj.}$ and $fincon$ portfolio. At the end of each June, we sort and rank firms into three equally-sized groups based on $trs^{Ind.Adj.}$, and separately based on each financing constraint criterion. For the categorical variable, firms are separated into two groups depending on the value of the dummy. Then monthly equal-weighted portfolio returns are computed for each of the two-way rank classifications. Each panel reports estimates when a different variable is used as the financial constraint criterion. The reported estimates are annualized and expressed in %. Newey and West (1987) robust t-statistics are reported in square brackets.

$fincon$ Tercile	1	2	3	3-1	1	2	3	3-1	1	2	3	3-1
	(a) Size				(b) Age				(c) Payout Ratio			
1	16.0264***	12.3267***	7.2832***	-8.7431***	15.6778***	10.0484***	3.0567	-12.6211***	15.2673***	9.7288***	7.1805***	-8.0868***
	[5.1930]	[4.8721]	[3.0738]	[-3.6407]	[5.2885]	[4.0829]	[1.3384]	[-4.3733]	[4.9931]	[3.7799]	[2.8677]	[-3.1404]
2	6.6468***	4.9592**	1.5862	-5.0606**	10.0352***	5.8331***	5.6081**	-4.4271**	6.4166***	2.9027	-0.943	-7.3596***
	[3.4685]	[2.3096]	[0.7566]	[-2.4459]	[4.3985]	[3.0295]	[2.3938]	[-1.9819]	[3.1597]	[1.3391]	[-0.4226]	[-2.8295]
3	3.1749*	1.7463	2.051	-1.124	2.7367*	3.5045*	3.0459*	0.3092	4.4248***	3.6663**	1.8868	-2.538
	[1.7430]	[0.8251]	[1.0575]	[-0.6211]	[1.7418]	[1.7653]	[1.7771]	[0.1762]	[2.9892]	[2.0316]	[1.1675]	[-1.3845]
3-1	-12.8515***	-10.5803***	-5.2323*		-12.9410***	-6.5440***	-0.0108		-10.8425***	-6.0625**	-5.2937**	
	[-3.9713]	[-3.7810]	[-1.9530]		[-4.2118]	[-2.8977]	[-0.0047]		[-3.9678]	[-2.4680]	[-2.0942]	
	(d) KZ Index				(e) SA Index				(f) Z-Score			
1	6.1353***	5.6160***	2.9486	-3.1867	2.8372*	1.9255	0.9203	-1.9169	16.6498***	10.3380***	6.6335***	-10.0162***
	[2.7771]	[3.0245]	[1.4750]	[-1.4004]	[1.6517]	[0.9806]	[0.5197]	[-1.0673]	[5.4028]	[3.8248]	[2.6364]	[-3.3092]
2	8.3902***	4.9088**	3.8765**	-4.5138**	6.5742***	3.4824*	2.509	-4.0652*	8.9667***	6.1498***	5.3260**	-3.6407
	[4.3281]	[2.4248]	[2.0240]	[-1.9856]	[3.6464]	[1.7016]	[1.1482]	[-1.7548]	[4.4949]	[2.9629]	[2.4069]	[-1.6341]
3	15.7873***	9.6451***	4.5707*	-11.2166***	17.8250***	14.3210***	7.0281***	-10.7970***	3.9600**	3.2804*	-0.2899	-4.2499**
	[4.9059]	[3.2017]	[1.8279]	[-3.5116]	[5.2494]	[5.3936]	[2.8556]	[-4.2337]	[2.0394]	[1.7279]	[-0.1703]	[-2.4497]
3-1	9.6521***	4.0291	1.6222		14.9878***	12.3955***	6.1077**		-12.6898***	-7.0576***	-6.9234***	
	[2.8001]	[1.3819]	[0.6176]		[4.0720]	[4.6196]	[2.2958]		[-4.1705]	[-2.7514]	[-2.8769]	
	(g) WW Index				(h) Commercial Paper Rating							
1	12.6374***	10.2661***	8.7762***	-3.8612								
	[5.3980]	[4.4990]	[3.9223]	[-1.6102]								
2 (0)	8.1098***	5.5785**	2.1375	-5.9723***	11.6736***	8.8415***	4.3185**	-7.3550***				
	[4.3812]	[2.4546]	[1.0244]	[-2.9449]	[5.3112]	[4.5826]	[2.3525]	[-3.7845]				
3 (1)	8.8708***	3.7436*	1.1022	-7.7686***	4.4354**	1.0789	1.9831	-2.4522				
	[3.1639]	[1.6540]	[0.5485]	[-3.0827]	[2.2127]	[0.4898]	[0.8954]	[-1.0590]				
3-1 (1-0)	-3.7665	-6.5225***	-7.6740***		-7.2382***	-7.7626***	-2.3354					
	[-1.3553]	[-2.6592]	[-3.5247]		[-2.8219]	[-4.4663]	[-1.1601]					

Table 7. Value-Weighted Abnormal Returns Relative to FF 3-Factor Model of Portfolios Sorted on $trs^{Ind.Adj.}$ and $fincon$

The table reports abnormal returns relative to the Fama and French 3-factor model to each $trs^{Ind.Adj.}$ and $fincon$ portfolio. At the end of each June, we sort and rank firms into three equally-sized groups based on $trs^{Ind.Adj.}$, and separately based on each financing constraint criterion. For the categorical variable, firms are separated into two groups depending on the value of the dummy. Then monthly value-weighted portfolio returns are computed for each of the two-way rank classifications. Each panel reports estimates when a different variable is used as the financial constraint criterion. The reported estimates are annualized and expressed in %. Newey and West (1987) robust t-statistics are reported in square brackets.

$fincon$ Tercile	1	2	3	3-1	1	2	3	3-1	1	2	3	3-1
	(a) Size				(b) Age				(c) Payout Ratio			
1	3.9362	-3.3965	-5.8103	-9.7465**	10.2557***	4.1221	-5.371	-15.6267***	7.4028**	-3.1033	-2.5142	-9.9170**
	[1.0066]	[-0.9627]	[-1.5107]	[-2.4934]	[2.6653]	[1.1102]	[-1.6152]	[-2.9091]	[2.1358]	[-0.8646]	[-0.7336]	[-2.2074]
2	5.4984*	3.577	-0.1032	-5.6016	0.5852	-0.4069	5.4532	4.868	7.6525**	4.1378	-1.145	-8.7975**
	[1.8491]	[1.4032]	[-0.0369]	[-1.5242]	[0.2244]	[-0.1537]	[1.4668]	[1.1156]	[2.4556]	[1.3783]	[-0.3771]	[-2.1876]
3	2.036	2.8384*	2.2267	0.1907	2.0568	2.9597*	2.7863	0.7295	-0.2618	2.5187	3.7966*	4.0584
	[1.1980]	[1.7670]	[1.1686]	[0.0764]	[1.1535]	[1.6782]	[1.4712]	[0.3055]	[-0.1386]	[1.3081]	[1.9374]	[1.5490]
3-1	-1.9002	6.235	8.0370*		-8.1988**	-1.1623	8.1573**		-7.6645**	5.622	6.3109	
	[-0.5229]	[1.5749]	[1.9468]		[-2.1299]	[-0.2874]	[2.2570]		[-2.2987]	[1.4365]	[1.6268]	
	(d) KZ Index				(e) SA Index				(f) Z-Score			
1	1.1266	4.3883**	3.5165	2.3899	1.4989	2.5952	3.4266*	1.9277	7.3007**	1.0916	-0.1471	-7.4479**
	[0.5516]	[2.4147]	[1.4710]	[0.7960]	[0.8780]	[1.4587]	[1.7703]	[0.7980]	[2.5122]	[0.4811]	[-0.0516]	[-2.1648]
2	4.3424	0.806	1.0953	-3.2471	7.4628***	2.0394	-2.8218	-10.2846***	2.2986	0.0198	2.5056	0.2071
	[1.5193]	[0.3322]	[0.3333]	[-0.8576]	[2.6309]	[0.6261]	[-1.0099]	[-2.6351]	[0.9612]	[0.0099]	[1.0366]	[0.0733]
3	5.7507	-4.2641	-3.0767	-8.8273**	9.0834*	0.8897	-1.7008	-10.7841**	0.4872	5.2210**	3.4695	2.9823
	[1.5169]	[-1.0540]	[-1.1194]	[-2.2265]	[1.7424]	[0.2673]	[-0.4848]	[-2.2507]	[0.1832]	[2.2372]	[1.5405]	[0.8134]
3-1	4.6241	-8.6524**	-6.5931*		7.5844	-1.7055	-5.1274		-6.8135*	4.1294	3.6166	
	[1.0762]	[-2.0040]	[-1.7731]		[1.5377]	[-0.4750]	[-1.3306]		[-1.7675]	[1.3114]	[1.0508]	
	(g) WW Index				(h) Commercial Paper Rating							
1	4.2551*	3.6852**	5.2716**	1.0165								
	[1.8764]	[2.0377]	[2.3622]	[0.3398]								
2 (0)	1.756	-2.3998	-0.8941	-2.6501	6.3222**	5.3568**	-1.2295	-7.5517**				
	[0.5529]	[-0.7926]	[-0.4345]	[-0.7483]	[2.2231]	[1.9988]	[-0.5380]	[-2.2028]				
3 (1)	3.6562	0.7586	-3.8995	-7.5557*	1.7743	1.8111	2.842	1.0677				
	[1.4804]	[0.2620]	[-1.2528]	[-1.7903]	[0.9951]	[1.2151]	[1.4467]	[0.4192]				
3-1 (1-0)	-0.5989	-2.9266	-9.1710**		-4.5479	-3.5456	4.0715					
	[-0.1777]	[-1.0706]	[-2.4162]		[-1.5575]	[-1.3163]	[1.3997]					

Table 8. High $trs^{Ind.Adj.}$ minus Low $trs^{Ind.Adj.}$ Trading Strategy Returns

This table reports the coefficient estimates from the time-series regressions on the Fama and French 3-factors for the trading strategies formed by buying the top $trs^{Ind.Adj.}$ portfolio and selling the bottom $trs^{Ind.Adj.}$ portfolio within the sample of the most financially constrained firms. Portfolio abnormal returns are reported relative to CAPM and the Fama French three-factor model, where r_t is the portfolio return,$MKTRF$, SMB, and HML are the Fama and French (1993) three- factors that proxy for market excess return, size and book-to-market, respectively. At the end of each June, we sort and rank firms into three equally-sized groups based on $trs^{Ind.Adj.}$, and separately, based on each of the financing constraint variables. Then, we compute monthly equal-weighted and value-weighted portfolio returns for each of the 3×3 rank classifications of $trs^{Ind.Adj.}$ and financial constraint, and trading strategy returns are computed by buying the highest $trs^{Ind.Adj.}$ portfolio and selling the lowest $trs^{Ind.Adj.}$ portfolio from the most financially constrained group. The intercept estimates are annualized and expressed in %. Newey and West (1987) robust t-stats are reported in square brackets.

	(a) Equal-Weighted						(b) Value-Weighted					
financial constraint	r	α^{CAPM}	α^{FF3}	$MKTRF$	SMB	HML	r	α^{CAPM}	α^{FF3}	$MKTRF$	SMB	HML
Size	-8.9806***	-9.4098***	-8.7431***	0.1292***	-0.0462	-0.3970**	-9.9216**	-10.2845***	-9.7465**	0.0664	-0.0859	-0.1445
	[-3.1282]	[-3.3204]	[-3.6692]	[3.0613]	[-0.3453]	[-2.3176]	[-2.5725]	[-2.6740]	[-2.5130]	[0.5956]	[-0.6344]	[-1.1326]
Age	-13.2192***	-13.3123***	-12.6211***	0.0605	-0.0698	-0.3324**	-16.1740***	-16.0793***	-15.6267***	0.0419	-0.0135	-0.3340*
	[-3.9906]	[-4.0999]	[-4.4076]	[1.2816]	[-0.4854]	[-1.9890]	[-3.0175]	[-2.9217]	[-2.9319]	[0.4071]	[-0.0536]	[-1.7608]
Payout Ratio	-8.0717***	-8.5564***	-8.0868***	0.1209***	-0.0311	-0.2850*	-8.2623*	-9.9371**	-9.9170**	0.3212***	0.0663	-0.2566
	[-2.6823]	[-2.9198]	[-3.1650]	[2.6879]	[-0.2420]	[-1.9028]	[-1.6848]	[-2.0553]	[-2.2248]	[2.7667]	[0.2748]	[-1.4512]
KZ Index	-11.6719***	-11.6172***	-11.2166***	0.0408	-0.0131	-0.2917	-9.4048**	-9.6770**	-8.8273**	-0.0431	-0.2568*	0.2096
	[-3.1906]	[-3.1800]	[-3.5391]	[0.9290]	[-0.0921]	[-1.5969]	[-2.5174]	[-2.5497]	[-2.2439]	[-0.5652]	[-1.6831]	[1.3177]
SA Index	-10.8943***	-11.2584***	-10.7970***	0.1290***	0.0029	-0.4007**	-11.5746**	-11.4516**	-10.7841**	-0.0036	-0.1018	-0.1968
	[-3.7179]	[-3.9166]	[-4.2669]	[2.7751]	[0.0217]	[-2.4366]	[-2.4309]	[-2.4392]	[-2.2683]	[-0.0301]	[-0.4395]	[-1.0354]
Z-Score	-10.5604***	-10.4175***	-10.0162***	0.0646	0.0322	-0.4558***	-7.5870**	-7.2738**	-7.4479**	-0.0849	-0.0115	0.1889
	[-2.8827]	[-2.9284]	[-3.3351]	[1.5029]	[0.2293]	[-2.7430]	[-2.3036]	[-2.1494]	[-2.1818]	[-1.2563]	[-0.0968]	[1.1731]
WW Index	-8.7041***	-8.6308***	-7.7686***	0.0115	-0.1283	-0.2659	-8.5190**	-8.4167**	-7.5557*	-0.0417	-0.1865	-0.0542
	[-2.9925]	[-2.9600]	[-3.1068]	[0.2338]	[-0.9691]	[-1.4592]	[-2.1121]	[-2.0014]	[-1.8043]	[-0.4470]	[-1.4418]	[-0.6064]
Credit	-7.6187***	-7.8262***	-7.3550***	0.0867**	-0.0201	-0.3260***	-8.2355**	-9.1414**	-7.5517**	0.1405*	-0.2896	-0.2981***
Rating	[-3.4763]	[-3.6558]	[-3.8142]	[2.5297]	[-0.2183]	[-3.1533]	[-2.1758]	[-2.3649]	[-2.2028]	[1.6541]	[-1.5990]	[-2.6727]

Table 9. High $trs^{Ind.Adj.}$ minus Low $trs^{Ind.Adj.}$ Trading Strategy Returns Controlling for Market Equity and Book-to-Market

This table reports the coefficient estimates from the time-series return regressions on the Fama and French 3-factors for the size (market equity value) and book-to-market-controlled trading strategies formed by buying the top $trs^{Ind.Adj.}$ portfolio and selling the bottom $trs^{Ind.Adj.}$ portfolio from the sample of the most financially constrained firms. Portfolio abnormal returns are reported relative to the Fama French three-factor model, where $MKTRF$, SMB, and HML are the Fama and French (1993) three-factors that proxy for market excess return, size and book-to-market, respectively. At the end of each June, we sort and rank firms into three equally-sized groups based on $trs^{Ind.Adj.}$, and separately based on each of the financing constraint variables, market equity and book-to-market. For the categorical variable, firms are separated into two groups depending on the value of the dummy. Then, we compute monthly equally-weighted portfolio returns for each of the $3 \times 3(2) \times 3$ rank classifications of $trs^{Ind.Adj.}$, financial constraint, size, and separately, book-to-market. Then, for each month we average the returns of each of the $3 \times 3(2)$ $trs^{Ind.Adj.}$ and financial constraint portfolios across the market equity portfolios, and separately, across the book-to-market portfolios, and trading strategy returns are computed by buying the highest $trs^{Ind.Adj.}$ portfolio and selling the lowest $trs^{Ind.Adj.}$ portfolio from the most financially constrained group. The intercept estimates are annualized and expressed in %. Newey and West (1987) robust t-stats are reported in square brackets.

financial constraint	(a) Controlling for Market Equity					(b) Controlling for Book-to-Market				
	γ_0	$MKTRF$	SMB	HML	RSq	γ_0	$MKTRF$	SMB	HML	RSq
Size	-9.5451***	0.1245	-0.3208**	0.0042	0.0452	-7.6420***	0.1236***	-0.4437**	-0.0907	0.0941
	[-2.7804]	[1.4694]	[-2.2964]	[0.0289]		[-2.9199]	[2.6981]	[-2.1337]	[-0.5685]	
Age	-12.8741***	0.0488	-0.2424**	-0.0204	0.0476	-12.3828***	0.0511	-0.3456*	-0.0898	0.0543
	[-4.4819]	[0.9645]	[-2.1992]	[-0.1721]		[-4.0709]	[1.0173]	[-1.6875]	[-0.5428]	
Payout Ratio	-7.1416***	0.1435**	-0.2088*	0.0312	0.0601	-8.2464***	0.1323***	-0.3734*	-0.0547	0.0687
	[-3.0357]	[2.4568]	[-1.9143]	[0.2757]		[-2.9024]	[2.6783]	[-1.7852]	[-0.3339]	
KZ Index	-8.2409***	0.0189	-0.1052	0.0206	0.0097	-11.4879***	0.051	-0.4626*	-0.1421	0.0597
	[-2.9226]	[0.4051]	[-0.7892]	[0.1766]		[-2.8336]	[0.9359]	[-1.7206]	[-0.7356]	
SA Index	-11.4524***	0.0866	-0.3238	0.1466	0.0557	-9.2847***	0.1068**	-0.4214**	-0.0458	0.0928
	[-2.8760]	[1.0950]	[-1.5340]	[0.7863]		[-3.5080]	[2.2387]	[-2.2216]	[-0.3126]	
Z-Score	-7.7565***	0.0486	-0.2921**	-0.0007	0.0662	-10.4175**	0.1153**	-0.6818*	-0.171	0.0799
	[-2.9353]	[1.2401]	[-2.3421]	[-0.0063]		[-2.4521]	[2.0025]	[-1.8976]	[-0.6604]	
WW Index	-5.8344***	-0.005	-0.1238	-0.0874	0.018	-8.0263***	-0.0015	-0.2923	-0.1758	0.0425
	[-2.8018]	[-0.1069]	[-1.1658]	[-1.0396]		[-2.9218]	[-0.0325]	[-1.3418]	[-1.1378]	
Credit Rating	-6.6556***	0.0891**	-0.2604***	-0.0242	0.1285	-7.1535***	0.0717**	-0.3460***	-0.0585	0.1236
	[-4.0769]	[2.2426]	[-3.6567]	[-0.3187]		[-3.5545]	[2.0431]	[-2.6702]	[-0.5417]	

Table 10. High $trs^{Ind.Adj.}$ minus Low $trs^{Ind.Adj.}$ Trading Strategy Returns Controlling for Operating Leverage

This table reports the coefficient estimates from the time-series return regressions on the Fama and French 3-factors for the operating leverage and DOL-controlled trading strategies formed by buying the top $trs^{Ind.Adj.}$ stock portfolio and selling the bottom $trs^{Ind.Adj.}$ portfolio from the sample of the most financially constrained firms. Portfolio abnormal returns are reported relative to the Fama French three-factor model, where $MKTRF$, SMB, and HML are the Fama and French (1993) three-factors that proxy for market excess return, size and book-to-market, respectively. At the end of each June, we sort and rank firms into three equally-sized groups based on $trs^{Ind.Adj.}$, and separately based on each of the financing constraint variables, market equity and book-to-market. For the categorical variable, firms are separated into two groups depending on the value of the dummy. Then, we compute monthly equally-weighted portfolio returns for each of the $3\times3(2)\times3$ rank classifications of $trs^{Ind.Adj.}$, financial constraint, operating leverage, and separately, DOL. Then, for each month we average the returns of each of the $3\times3(2)$ $trs^{Ind.Adj.}$ and financial constraint portfolios across the operating leverage portfolios, and separately, across the DOL portfolios, and trading strategy returns are computed by buying the highest $trs^{Ind.Adj.}$ portfolio and selling the lowest $trs^{Ind.Adj.}$ portfolio from the most financially constrained group. The intercept estimates are annualized and expressed in %. Newey and West (1987) robust t-stats are reported in square brackets.

financial constraint	(a) Controlling for operating leverage α^{FF3}	$MKTRF$	SMB	HML	RSq	(b) Controlling for DOL α^{FF3}	$MKTRF$	SMB	HML	RSq
Size	-7.6466***	0.1120**	-0.4694**	-0.1031	0.0967	-8.1753***	0.1554***	-0.4343**	-0.0008	0.1427
	[-2.9249]	[2.4088]	[-2.1267]	[-0.6354]		[-3.3055]	[3.5378]	[-2.5939]	[-0.0062]	
Age	-11.1958***	0.0409	-0.3510*	-0.1033	0.0597	-9.3297***	0.0509	-0.3574**	-0.0861	0.0701
	[-3.8633]	[0.9354]	[-1.8149]	[-0.6845]		[-3.2531]	[1.1992]	[-2.0376]	[-0.6092]	
Payout Ratio	-7.4524***	0.0692	-0.3213*	-0.1027	0.0546	-6.4402***	0.1298***	-0.2616**	-0.0018	0.0733
	[-2.7096]	[1.6169]	[-1.6540]	[-0.6770]		[-2.6429]	[2.9685]	[-2.0136]	[-0.0160]	
KZ Index	-9.1044***	-0.0162	-0.2419	-0.0456	0.0362	-9.2678***	-0.0084	-0.3164*	-0.0634	0.0539
	[-3.2635]	[-0.3902]	[-1.4988]	[-0.3755]		[-3.2473]	[-0.2098]	[-1.6809]	[-0.4384]	
SA Index	-10.9162***	0.1046**	-0.5137**	-0.0975	0.0954	-9.5170***	0.1321***	-0.4436***	0.0659	0.1499
	[-3.6393]	[2.1558]	[-2.1185]	[-0.5403]		[-3.4614]	[2.8716]	[-2.6045]	[0.5254]	
Z-Score	-7.5292**	-0.0394	-0.4517***	0.0155	0.1183	-7.8668***	0.0303	-0.4530**	-0.0043	0.1139
	[-2.1669]	[-0.6939]	[-2.8416]	[0.0972]		[-2.7095]	[0.7578]	[-2.5285]	[-0.0286]	
WW Index	-8.1560***	0.0053	-0.3129	-0.1757	0.0444	-7.6230***	0.0261	-0.2217	-0.132	0.0303
	[-2.9607]	[0.1099]	[-1.3541]	[-1.0753]		[-2.9924]	[0.5245]	[-1.2976]	[-1.1225]	
Credit Rating	-7.1833***	0.0643*	-0.3341***	-0.0423	0.1402	-6.7392***	0.0803**	-0.3380***	-0.0273	0.1447
	[-3.7255]	[1.9622]	[-2.9018]	[-0.4428]		[-3.4188]	[2.3475]	[-2.8923]	[-0.2812]	

Table 11. High $trs^{Ind.Adj.}$ minus Low $trs^{Ind.Adj.}$ Trading Strategy Returns Controlling for Firm-Level Investments in Physical Capital and Labor

This table reports the coefficient estimates from the time-series return regressions on the Fama and French 3-factors for the firm-level investment-controlled trading strategies formed by buying the top $trs^{Ind.Adj.}$ stock portfolio and selling the bottom $trs^{Ind.Adj.}$ portfolio from the sample of the most financially constrained firms. Portfolio abnormal returns are reported relative to the Fama French three-factor model, where $MKTRF$, SMB, and HML are the Fama and French (1993) three-factors that proxy for market excess return, size and book-to-market, respectively. At the end of each June, we sort and rank firms into three equally-sized groups based on $trs^{Ind.Adj.}$, and separately based on each of the financing constraint variables, physical capital investment rate and labor input growth rate. For the categorical variable, firms are separated into two groups depending on the value of the dummy. Then, we compute monthly equally-weighted portfolio returns for each of the $3 \times 3(2) \times 3$ rank classifications of $trs^{Ind.Adj.}$, financial constraint, physical capital investment rate, and separately, labor input growth rate. Then, for each month we average the returns of each of the $3 \times 3(2)$ $trs^{Ind.Adj.}$ and financial constraint portfolios across the physical capital investment rate portfolios, and separately, acrosss the labor input growth rate portfolios, and trading strategy returns are computed by buying the highest $trs^{Ind.Adj.}$ portfolio and selling the lowest $trs^{Ind.Adj.}$ portfolio from the most financially constrained group. The intercept estimates are annualized and expressed in %. Newey and West (1987) robust t-stats are reported in square brackets.

	(a) Controlling for capital investment rate					(b) Controlling for labor input growth rate				
financial constraint	α^{FF3}	$MKTRF$	SMB	HML	RSq	α^{FF3}	$MKTRF$	SMB	HML	RSq
Size	-5.5846**	0.0840*	-0.3266**	0.0233	0.0741	-7.1658***	0.1254***	-0.3288**	-0.0138	0.0959
	[-1.9975]	[1.7675]	[-2.3995]	[0.2041]		[-3.2557]	[2.8845]	[-2.3719]	[-0.1221]	
Age	-9.8898***	0.0121	-0.2294*	-0.0189	0.0367	-11.0592***	0.0791	-0.2183*	-0.0399	0.0402
	[-3.4489]	[0.2190]	[-1.7486]	[-0.1557]		[-4.2617]	[1.5887]	[-1.8589]	[-0.3472]	
Payout Ratio	-5.8288**	0.062	-0.1804	0.0404	0.0334	-6.4770***	0.1247***	-0.2133**	-0.0195	0.0562
	[-2.3068]	[1.4086]	[-1.5927]	[0.3829]		[-2.8061]	[2.6934]	[-2.0278]	[-0.1929]	
KZ Index	-9.1016***	-0.0037	-0.1665	0.0485	0.0255	-8.7162***	0.061	-0.0837	0.0455	0.0099
	[-2.9903]	[-0.0816]	[-1.3387]	[0.4418]		[-3.0777]	[1.1951]	[-0.7097]	[0.4233]	
SA Index	-6.2620**	0.0595	-0.3056**	0.0229	0.0579	-8.7662***	0.1374***	-0.3206**	0.029	0.093
	[-2.1257]	[1.2048]	[-2.4629]	[0.2040]		[-3.4678]	[2.8008]	[-2.3085]	[0.2465]	
Z-Score	-9.0803***	0.0097	-0.3065***	-0.0009	0.0744	-6.8376**	0.0848*	-0.2941***	0.0548	0.0736
	[-3.3532]	[0.2063]	[-2.8594]	[-0.0091]		[-2.4901]	[1.7517]	[-2.8856]	[0.5420]	
WW Index	-5.5328**	-0.0039	-0.1931	-0.0921	0.0266	-6.2108**	0.0336	-0.1527	-0.0954	0.0202
	[-2.3501]	[-0.0741]	[-1.2793]	[-0.8277]		[-2.5514]	[0.7399]	[-1.2621]	[-0.9647]	
Credit Rating	-5.5328***	0.0469	-0.2778***	0.0122	0.1187	-5.8533***	0.1146***	-0.2513***	-0.0133	0.1153
	[-2.6835]	[1.2757]	[-3.4070]	[0.1510]		[-3.0075]	[3.1057]	[-2.8054]	[-0.1594]	

Table 12. High $trs^{Ind.Adj.}$ minus Low $trs^{Ind.Adj.}$ Trading Strategy Returns Controlling for Asset Growth and Equity Issues

This table reports the coefficient estimates from the time-series return regressions on the Fama and French 3-factors for the asset growth and equity issuance-controlled trading strategies formed by buying the top $trs^{Ind.Adj.}$ stock portfolio and selling the bottom $trs^{Ind.Adj.}$ portfolio from the sample of the most financially constrained firms. Portfolio abnormal returns are reported relative to the Fama French three-factor model, where $MKTRF$, SMB, and HML are the Fama and French (1993) three-factors that proxy for market excess return, size and book-to-market, respectively. At the end of each June, we sort and rank firms into three equally-sized groups based on $trs^{Ind.Adj.}$, and separately based on each of the financing constraint variables, equity issues and asset growth. For the categorical variable, firms are separated into two groups depending on the value of the dummy. Then, we compute monthly equally-weighted portfolio returns for each of the $3 \times 3(2) \times 3$ rank classifications of $trs^{Ind.Adj.}$, financial constraint, equity issues, and separately, asset growth. Then, for each month we average the returns of each of the $3 \times 3(2)$ $trs^{Ind.Adj.}$ and financial constraint portfolios across the equity issue portfolios, and separately, across the asset growth portfolios, and trading strategy returns are computed by buying the highest $trs^{Ind.Adj.}$ portfolio and selling the lowest $trs^{Ind.Adj.}$ portfolio from the most financially constrained group. The intercept estimates are annualized and expressed in %. Newey and West (1987) robust t-stats are reported in square brackets.

	(a) Controlling for asset growth					(b) Controlling for equity issuance				
financial constraint	α^{FF3}	$MKTRF$	SMB	HML	RSq	α^{FF3}	$MKTRF$	SMB	HML	RSq
Size	-13.2838***	0.0234	-0.3328**	0.1591	0.0588	-8.0967***	0.1391***	-0.4242**	0.01	0.1044
	[-3.1617]	[0.3223]	[-2.1179]	[1.2080]		[-3.1081]	[2.9660]	[-2.1245]	[0.0652]	
Age	-11.4389***	0.0604	-0.1807	-0.0714	0.0148	-11.5487***	0.0367	-0.3312**	-0.0387	0.065
	[-2.9800]	[1.0552]	[-1.4226]	[-0.5544]		[-3.9826]	[0.7331]	[-2.0200]	[-0.2777]	
Payout Ratio	-5.4416*	0.1356**	-0.156	0.0713	0.0367	-6.9758**	0.1396**	-0.2597*	0.0174	0.0549
	[-1.9466]	[2.1999]	[-1.4128]	[0.6254]		[-2.5362]	[2.1125]	[-1.6854]	[0.1213]	
KZ Index	-9.4928***	0.0142	-0.1705	-0.0215	0.0147	-10.3333***	0.029	-0.2816	0.0036	0.0429
	[-2.7848]	[0.2733]	[-0.9928]	[-0.1543]		[-3.3826]	[0.6134]	[-1.5548]	[0.0246]	
SA Index	-13.6176***	0.0919	-0.4831**	0.04	0.1179	-10.3227***	0.1179**	-0.4492**	0.0351	0.1244
	[-3.9773]	[1.5199]	[-2.3892]	[0.2619]		[-3.8908]	[2.5024]	[-2.4801]	[0.2520]	
Z-Score	-8.9907***	0.0718*	-0.3544**	-0.0046	0.0761	-10.0588***	0.041	-0.4710**	-0.0027	0.1035
	[-3.2317]	[1.6591]	[-2.3416]	[-0.0361]		[-3.2083]	[0.9513]	[-2.4376]	[-0.0168]	
WW Index	-6.3080***	-0.0017	-0.1521	-0.1196	0.0251	-7.6979***	0.0061	-0.2601	-0.1172	0.0423
	[-2.8682]	[-0.0372]	[-1.1786]	[-1.2534]		[-3.0145]	[0.1298]	[-1.5588]	[-0.9499]	
Credit Rating	-6.5115***	0.0472	-0.2433***	-0.0263	0.0976	-7.3894***	0.0705**	-0.3337***	-0.0137	0.1435
	[-3.4333]	[1.2197]	[-3.3065]	[-0.3030]		[-3.7493]	[2.1368]	[-2.9118]	[-0.1403]	

Table 13. Fama MacBeth Regressions

This table reports the coefficient estimates from running Fama and MacBeth (1973) cross-sectional regressions of risk-adjusted stock returns relative to the Fama and French 3-factors on the loading on the market factor (β_{CAPM}), log book to market ($Log(BM)$), log market equity ($Log(ME)$), six-month lagged return from months -7 to -2 relative to the month of observation (r_{6mo}), monthly trading volume normalized by the number of shares outstanding ($trade$), the high $trs^{Ind.Adj.}$ dummy ($trs_H^{Ind.Adj.}$), the high financial constraint dummy ($fincon_H$), the interaction between $fincon_H$ and $trs_H^{Ind.Adj.}$. The regression model is given by equation (8) on page 18 of the paper. Each column corresponds to the regressions results using a different proxy for the status of financing constraint. Newey and West (1987) robust t-statistics are reported in square brackets. R^2 refers to the time-series average of the monthly R squared.

	Size	Age	Payout Ratio	KZ Index	SA Index	Z-Score	WW Index	Credit Rating
β_{CAPM}	-0.0022	-0.0022	-0.002	-0.0022	-0.0022	-0.0022	-0.0022	-0.0022
	[-0.7609]	[-0.7532]	[-0.7013]	[-0.7509]	[-0.7772]	[-0.7388]	[-0.7611]	[-0.7454]
$log(ME)$	-0.0062***	-0.0073***	-0.0073***	-0.0070***	-0.0062***	-0.0070***	-0.0070***	-0.0080***
	[-8.0469]	[-9.0147]	[-9.9386]	[-8.7883]	[-8.7090]	[-8.7405]	[-8.7282]	[-8.5995]
$log(BM)$	0.0018**	0.0008	0.0009	0.0011	0.0018**	0.0005	0.001	0.0003
	[2.0934]	[0.8445]	[0.9443]	[1.1903]	[1.9948]	[0.4772]	[1.0774]	[0.3234]
r_{6mo}	-0.0081**	-0.0079**	-0.0078**	-0.0078**	-0.0081**	-0.0076**	-0.0078**	-0.0078**
	[-2.2096]	[-2.1671]	[-2.1436]	[-2.1356]	[-2.1935]	[-2.1098]	[-2.1477]	[-2.1427]
$trade$	0.0131***	0.0134***	0.0133***	0.0131***	0.0130***	0.0130***	0.0131***	0.0132***
	[8.0318]	[8.0216]	[8.2615]	[7.8949]	[7.9083]	[7.9074]	[7.8205]	[7.8192]
$trs_H^{Ind.Adj.}$	0	0.0001	-0.0004	-0.0019*	-0.0002	-0.0017*	-0.0027**	0.0034**
	[-0.0500]	[0.1030]	[-0.4170]	[-1.7664]	[-0.1580]	[-1.6745]	[-2.4529]	[2.0616]
$fincon_H$	0.0068***	-0.0016*	-0.001	0.0002	0.0065***	0.0046***	-0.0030***	-0.0049***
	[2.9669]	[-1.7218]	[-0.7715]	[0.2017]	[3.4616]	[3.4492]	[-2.9420]	[-3.0986]
$fincon_H \times trs_H^{Ind.Adj.}$	-0.0075***	-0.0074***	-0.0048***	-0.0028	-0.0072***	-0.0033*	-0.0002	-0.0079***
	[-4.0354]	[-3.6269]	[-3.1545]	[-1.3444]	[-4.0845]	[-1.9098]	[-0.1234]	[-3.6232]
R^2	0.0934	0.0923	0.0929	0.0926	0.0928	0.0927	0.0921	0.0922

Table 14. Fama MacBeth Regressions Controlling for the Interaction Between Financial Constraint and Asset Tangibility using the Ratio of Property Plant and Equipment to Total Asset for Tangibility

This table reports the coefficient estimates from running Fama and MacBeth (1973) cross-sectional regressions of risk-adjusted stock returns relative to the Fama and French 3-factors on the loading on the market factor (β_{CAPM}), log book to market ($Log(BM)$), log market equity ($Log(ME)$), six-month lagged return from months -7 to -2 relative to the month of observation (r_{6mo}), monthly trading volume normalized by the number of shares outstanding ($trade$), the high $trs^{Ind.Adj.}$ dummy ($trs_H^{Ind.Adj.}$), the high financial constraint dummy ($fincon_H$), the interaction between $fincon_H$ and $trs_H^{Ind.Adj.}$, and the interaction between the ratio of Property Plant and Equipment to Total Asset and $fincon$. Separate regressions are estimated for each financial constraint criterion. The regression model is given by equation (8) on page 18 of the paper. Each column corresponds to the regressions results using a different proxy for the status of financing constraint Newey and West (1987) robust t-statistics are reported in square brackets. R^2 refers to the time-series average of the monthly R squared.

	Size	Age	Payout Ratio	KZ Index	SA Index	Z-Score	WW Index	Credit Rating
β_{CAPM}	-0.0021	-0.0021	-0.002	-0.0022	-0.0021	-0.0021	-0.0021	-0.0022
	[-0.7089]	[-0.7071]	[-0.7024]	[-0.7509]	[-0.7309]	[-0.7356]	[-0.7308]	[-0.7501]
$log(ME)$	-0.0065***	-0.0074***	-0.0073***	-0.0070***	-0.0063***	-0.0070***	-0.0072***	-0.0081***
	[-8.5169]	[-9.2946]	[-9.9579]	[-8.7652]	[-8.8706]	[-8.8024]	[-9.0348]	[-8.6332]
$log(BM)$	0.0015*	0.0006	0.0009	0.0013	0.0017*	0.0005	0.0008	0.0003
	[1.7563]	[0.6767]	[0.9707]	[1.3411]	[1.8410]	[0.5250]	[0.8864]	[0.3088]
r_{6mo}	-0.0083**	-0.0081**	-0.0078**	-0.0077**	-0.0083**	-0.0077**	-0.0077**	-0.0079**
	[-2.2873]	[-2.2404]	[-2.1443]	[-2.1189]	[-2.2629]	[-2.1346]	[-2.1431]	[-2.1778]
$trade$	0.0131***	0.0135***	0.0133***	0.0132***	0.0130***	0.0130***	0.0132***	0.0132***
	[8.2477]	[8.0625]	[8.2891]	[7.8798]	[7.9578]	[7.9532]	[7.8235]	[7.8379]
$fincon\times$ Tangibility	0.0000**	0	0	0	0	0	-0.0000*	0
	[2.3926]	[1.4107]	[-0.7374]	[-0.9395]	[-1.0073]	[-0.1250]	[-1.9363]	[-0.1486]
$trs_H^{Ind.Adj.}$	0.0003	0.0003	-0.0004	-0.0018*	0.0002	-0.0017*	-0.0022**	0.0039**
	[0.3684]	[0.3172]	[-0.4021]	[-1.6982]	[0.1808]	[-1.7418]	[-2.0897]	[2.4883]
$fincon_H$	0.0073***	-0.0013	-0.0011	0.0005	0.0067***	0.0045***	-0.0026**	-0.0052**
	[3.0587]	[-1.3380]	[-0.8381]	[0.5242]	[3.6526]	[3.4521]	[-2.3718]	[-2.0772]
$fincon_H \times trs_H^{Ind.Adj.}$	-0.0077***	-0.0074***	-0.0048***	-0.0028	-0.0074***	-0.0032*	-0.0005	-0.0084***
	[-4.2107]	[-3.6585]	[-3.1595]	[-1.3604]	[-4.2801]	[-1.8568]	[-0.2896]	[-4.0442]
R^2	0.0963	0.0957	0.0935	0.0937	0.0962	0.0945	0.0936	0.0945

Table 15. Fama MacBeth Regressions Controlling for the Interaction Between Financial Constraint and Asset Tangibility using the Almeida and Campello (2007) AC Index for Tangibility

This table reports the coefficient estimates from running Fama and MacBeth (1973) cross-sectional regressions of risk-adjusted stock returns relative to the Fama and French 3-factors on the loading on the market factor (β_{CAPM}), log book to market ($Log(BM)$), log market equity ($Log(ME)$), six-month lagged return from months -7 to -2 relative to the month of observation (r_{6mo}), monthly trading volume normalized by the number of shares outstanding ($trade$), the high $trs^{Ind.Adj.}$ dummy ($trs_H^{Ind.Adj.}$), the high financial constraint dummy ($fincon_H$), the interaction between $fincon_H$ and $trs_H^{Ind.Adj.}$, and the interaction between the tangibility measure of Almeida and Campello (2007), the AC Index, and $fincon$. Separate regressions are estimated for each financial constraint criterion. The regression model is given by equation (8) on page 18 of the paper. Each column corresponds to the regressions results using a different proxy for the status of financing constraint Newey and West (1987) robust t-statistics are reported in square brackets. R^2 refers to the time-series average of the monthly R squared.

	Size	Age	Payout Ratio	KZ Index	SA Index	Z-Score	WW Index	Credit Rating
β_{CAPM}	-0.0021	-0.0021	-0.002	-0.0022	-0.0021	-0.0021	-0.0021	-0.0021
	[-0.7331]	[-0.7282]	[-0.6790]	[-0.7381]	[-0.7436]	[-0.7053]	[-0.7420]	[-0.7194]
$log(ME)$	-0.0062***	-0.0073***	-0.0072***	-0.0070***	-0.0059***	-0.0070***	-0.0072***	-0.0081***
	[-8.1467]	[-8.8791]	[-9.9600]	[-8.8476]	[-8.1064]	[-8.6386]	[-8.8260]	[-8.4957]
$log(BM)$	0.0018**	0.0007	0.0009	0.0011	0.0021**	0.0001	0.0009	0.0003
	[2.0727]	[0.7503]	[0.9771]	[1.1501]	[2.3038]	[0.0845]	[0.9681]	[0.3569]
r_{6mo}	-0.0082**	-0.0081**	-0.0079**	-0.0080**	-0.0083**	-0.0077**	-0.0077**	-0.0080**
	[-2.2469]	[-2.2222]	[-2.1773]	[-2.1857]	[-2.2867]	[-2.1443]	[-2.1369]	[-2.2213]
$trade$	0.0130***	0.0135***	0.0132***	0.0132***	0.0130***	0.0131***	0.0132***	0.0133***
	[8.0772]	[8.0302]	[8.2571]	[7.8698]	[7.8768]	[7.8818]	[7.7859]	[7.8604]
$fincon\times$ AC Index	0.0004	-0.0017	-0.0000**	0.0001***	0.0044***	-0.0002**	-0.0002**	-0.0180**
	[0.7260]	[-1.0892]	[-2.2846]	[3.1279]	[3.1134]	[-2.0413]	[-2.4791]	[-2.2354]
$trs_H^{Ind.Adj.}$	0.0001	0.0002	-0.0002	-0.0014	0	-0.0013	-0.0022**	0.0037**
	[0.1420]	[0.2086]	[-0.2533]	[-1.3194]	[-0.0486]	[-1.3565]	[-2.0755]	[2.2299]
$fincon_H$	0.0073***	-0.0024*	-0.0012	0	0.0053***	0.0038***	-0.002	-0.0137***
	[3.2101]	[-1.9057]	[-0.8775]	[0.0317]	[2.8581]	[3.1453]	[-1.5325]	[-2.9301]
$fincon_H \times trs_H^{Ind.Adj.}$	-0.0074***	-0.0071***	-0.0049***	-0.0033	-0.0068***	-0.0037**	-0.0004	-0.0080***
	[-4.0915]	[-3.4220]	[-3.2012]	[-1.6299]	[-3.8515]	[-2.1405]	[-0.2709]	[-3.7299]
R^2	0.0955	0.0941	0.0937	0.0942	0.0948	0.0952	0.0932	0.0939

Table 16. Fama MacBeth Regressions with Fama and French (1997) Industry-Adjusted Returns

This table reports the coefficient estimates from the Fama and MacBeth (1973) cross-sectional regressions of industry-adjusted stock returns on the loading on the market factor (β_{CAPM}), log book to market ($Log(BM)$), log market equity ($Log(ME)$), six-month lagged return from months -7 to -2 relative to the month of observation (r_{6mo}), monthly trading volume normalized by the number of shares outstanding ($trade$), the high $trs^{Ind.Adj.}$ dummy ($trs_H^{Ind.Adj.}$), the high financial constraint dummy ($fincon_H$), and the interaction between $fincon_H$ and $trs_H^{Ind.Adj.}$. Separate regressions are estimated for each financial constraint criterion. The regression model is given by equation (8) on page 18 of the paper. Each column corresponds to the regressions results using a different proxy for the status of financing constraint. Newey and West (1987) robust t-statistics are reported in square brackets. R^2 refers to the time-series average of the monthly R squared.

	Size	Age	Payout Ratio	KZ Index	SA Index	Z-Score	WW Index	Credit Rating
β_{CAPM}	0.0015	0.0015	0.0018	0.0015	0.0015	0.0016	0.0015	0.0015
	[0.9377]	[0.9436]	[1.0816]	[0.9551]	[0.9071]	[0.9762]	[0.9229]	[0.9440]
$log(ME)$	-0.0054***	-0.0056***	-0.0058***	-0.0052***	-0.0055***	-0.0051***	-0.0052***	-0.0059***
	[-5.7854]	[-5.9379]	[-6.6133]	[-5.5539]	[-6.4118]	[-5.4226]	[-5.5341]	[-5.4140]
$log(BM)$	0.0028***	0.0026**	0.0028***	0.0031***	0.0027***	0.0026**	0.0030***	0.0026**
	[2.9112]	[2.5179]	[2.6524]	[3.0366]	[2.7663]	[2.4423]	[2.8633]	[2.5174]
r_{6mo}	-0.0087**	-0.0088**	-0.0086**	-0.0085**	-0.0086**	-0.0085**	-0.0087**	-0.0086**
	[-2.2630]	[-2.2845]	[-2.2527]	[-2.2330]	[-2.2368]	[-2.2872]	[-2.2674]	[-2.2575]
$trade$	0.0149***	0.0155***	0.0154***	0.0149***	0.0150***	0.0148***	0.0149***	0.0150***
	[7.9592]	[8.2818]	[8.4489]	[7.9205]	[7.9561]	[7.9265]	[7.8645]	[7.8604]
$trs_H^{Ind.Adj.}$	-0.0007	0.0001	-0.001	-0.0026***	-0.0003	-0.0024***	-0.0025***	0.0028**
	[-0.9420]	[0.1252]	[-1.3493]	[-3.2358]	[-0.3642]	[-2.8972]	[-2.8943]	[2.1402]
$fincon_H$	-0.0005	-0.0038***	-0.0048***	-0.0004	-0.0003	0.0034**	-0.0045***	-0.0031**
	[-0.2864]	[-3.5748]	[-3.7191]	[-0.3930]	[-0.2336]	[2.0497]	[-4.8359]	[-2.3472]
$fincon_H \times trs_H^{Ind.Adj.}$	-0.0043***	-0.0068***	-0.0026*	0.0002	-0.0058***	-0.0004	0.0003	-0.0069***
	[-3.2302]	[-4.4791]	[-1.8417]	[0.0805]	[-3.8044]	[-0.2040]	[0.1931]	[-4.0901]
R^2	0.0662***	0.0659***	0.0663***	0.0663***	0.0657***	0.0666***	0.0658***	0.0652***

Table 17. Anomaly Excess Returns Relative to TRS 2-Factor Model

This table reports the pricing errors relative to the Fama and French three-factor model, and separately, relative to the Fama and French four-factor model, and the two-factor models made up of the market risk premium and a factor constructed by buying the top $trs^{Ind.Adj.}$ portfolio and selling the bottom $trs^{Ind.Adj.}$ portfolio from the sample of the most financially constrained stocks for various anomaly trading strategy returns and various financing constraint measures. The regression model is: $r_t = \gamma_0 + \gamma_1 MKTRF_t + \gamma_2 TRS_t$, where r_t, $MKTRF_t$ and TRS_t are the time t anomaly return, market risk premium and the $trs^{Ind.Adj.}$ strategy return, respectively. The construction of the anomaly trading strategies and the $trs^{Ind.Adj.}$ factors is further described on page 20 of the paper. The intercept estimates are annualized and expressed in %. Newey and West (1987) robust t-stats are reported in square brackets. The sample covers from July 1989 through December 2010, and is determined by the availability of S&P credit ratings from COMPUSTAT for firms with at least five years of accounting information.

Trading Strategy	α^{FF3}	α^{FF4}	Size	Age	Payout Ratio	KZ Index	SA Index	Z-Score	WW Index	Credit Rating
Accruals	1.9419	2.489	2.1912	2.553	2.8822	2.808	2.272	1.2354	1.2066	3.6028
	[0.8156]	[0.9656]	[0.8915]	[1.0676]	[1.1834]	[1.1464]	[0.9087]	[0.5360]	[0.4982]	[1.4621]
AssetGrowth	2.6039	1.7901	5.2029	4.6228	4.7919	4.8881	5.2991*	4.9031	5.0289	4.0519
	[1.0005]	[0.6627]	[1.5880]	[1.4246]	[1.5411]	[1.5780]	[1.6649]	[1.5201]	[1.5519]	[1.3132]
FScore	5.11	3.8193	5.4977	7.9658**	5.5762	4.3448	6.7439**	3.7349	4.3099	5.7788*
	[1.4660]	[1.1742]	[1.6226]	[2.4115]	[1.6044]	[1.1182]	[1.9962]	[1.0504]	[1.1716]	[1.6965]
FailProb	22.5267***	11.7914***	18.9364***	17.9464***	18.2193***	19.3441***	17.6492***	18.6480***	20.1023***	6.8773***
	[4.8164]	[3.2085]	[3.6337]	[3.3355]	[3.3998]	[3.7155]	[3.3630]	[3.6507]	[3.8580]	[3.0315]
GrossMargin	6.5410***	6.5897***	3.3851	4.3371	4.1491	3.0192	4.0199	2.7277	3.6346	4.8936*
	[2.9696]	[2.8175]	[1.2241]	[1.6221]	[1.5371]	[1.0983]	[1.4673]	[1.0170]	[1.3308]	[1.8809]
Investment	3.8395	3.4236	4.9165*	3.8792	4.1855	4.6931*	5.0595*	4.8984*	5.0312*	4.0518
	[1.4901]	[1.2927]	[1.8471]	[1.4356]	[1.5567]	[1.7620]	[1.8609]	[1.8271]	[1.8195]	[1.4977]
LRReversal	0.8033	1.294	3.9871	2.16	3.2348	5.1205	3.7103	5.4658	4.3993	2.3677
	[0.2991]	[0.4766]	[0.9967]	[0.5638]	[0.8430]	[1.1885]	[0.9269]	[1.2817]	[1.0730]	[0.6481]
Momentum	18.9335***	2.7268	15.4946***	11.3272**	13.5037**	16.7442***	14.1296**	15.8271***	17.2939***	12.1434*
	[3.4551]	[1.3366]	[2.7279]	[2.0125]	[2.1971]	[2.7913]	[2.5817]	[2.8644]	[3.1319]	[1.9522]
OScore	10.8555***	7.3746***	8.2332**	10.1179***	8.3555**	7.3214*	8.8530**	7.0095*	8.6771**	8.8742**
	[3.9533]	[2.8617]	[2.1713]	[2.7065]	[2.1824]	[1.8640]	[2.4313]	[1.8215]	[2.3336]	[2.2956]
PEADCAR3	12.6624***	9.9763***	11.9395***	9.7806***	10.8949***	11.9974***	11.2924***	11.8659***	12.2683***	9.9541***
	[5.2885]	[3.9320]	[5.1712]	[3.7303]	[4.3588]	[4.8166]	[4.6862]	[4.9043]	[5.3493]	[3.9688]
SRReversal	-3.7789	-0.4561	-4.4155	-0.103	-2.9423	-2.6687	-2.036	-3.6595	-3.8169	-1.2093
	[-0.9588]	[-0.1177]	[-1.1334]	[-0.0265]	[-0.7525]	[-0.6636]	[-0.5413]	[-0.9611]	[-1.0387]	[-0.3072]
ValMomProf	16.6325***	8.0510***	15.5312***	12.8792***	14.5485***	16.9540***	14.8978***	16.4642***	16.7285***	3.9372***
	[4.8103]	[3.3003]	[4.1152]	[3.2267]	[3.8621]	[3.9953]	[4.0576]	[3.9887]	[4.2042]	[3.7843]
Value	-2.7356	-2.1176	2.3339	2.1207	2.5315	2.042	2.603	2.8285	1.7769	1.5521
	[-1.3857]	[-1.0346]	[0.5793]	[0.5284]	[0.6235]	[0.5048]	[0.6579]	[0.6929]	[0.4540]	[0.3916]
Size	-0.1346	-0.1033	1.8115	0.7156	1.9802	4.177	1.3139	3.901	2.5703	2.0803
	[-0.0764]	[-0.0535]	[0.4474]	[0.1759]	[0.4988]	[0.9381]	[0.3350]	[0.9098]	[0.6331]	[0.5195]
Root Mean Squared Pricing Error	10.4791	5.6739	9.2275	8.2339	8.6231	9.5479	8.8069	9.2453	9.7700	8.1123

Table 18. Anomaly Loadings on TRS Factor

This table reports the estimated loadings of the anomaly trading strategy returns on the factor returns constructed by buying the top $trs^{Ind.Adj.}$ portfolio and selling the bottom $trs^{Ind.Adj.}$ portfolio from the sample of the most financially constrained stocks for various anomaly trading strategies and various financing constraint measures. The regression model is: $r_t = \gamma_0 + \gamma_1 MKTRF_t + \gamma_2 TRS_t$, where r_t, $MKTRF_t$ and TRS_t are the time t anomaly return, market risk premium and the $trs^{Ind.Adj.}$ strategy return, respectively. The construction of the anomaly trading strategies and the $trs^{Ind.Adj.}$ factors is further described on page 20 of the paper. Newey and West (1987) robust t-stats are reported in square brackets. The sample covers from July 1989 through December 2010, and is determined by the availability of S&P credit ratings from COMPUSTAT for firms with at least five years of accounting information.

Trading Strategy	Size	Age	Payout Ratio	KZ Index	SA Index	Z-Score	WW Index	Credit Rating
Accruals	-0.0032	0.0204	0.0662	0.0603*	0.0042	-0.1359**	-0.1209***	0.1508***
	[-0.0725]	[0.4570]	[1.2597]	[1.7564]	[0.0982]	[-2.0483]	[-2.7399]	[2.6064]
AssetGrowth	-0.0367	-0.0596	-0.0794	-0.0716	-0.0246	-0.0932	-0.0656	-0.1672*
	[-0.5261]	[-0.9486]	[-1.1917]	[-1.2672]	[-0.3072]	[-1.2500]	[-1.2174]	[-1.9434]
FScore	0.0212	0.1670*	0.0298	-0.0966	0.1278	-0.2124**	-0.1152	0.0546
	[0.2963]	[1.8988]	[0.3487]	[-1.2038]	[1.4613]	[-2.0787]	[-1.5480]	[0.5363]
FailProb	-0.1297	-0.1446**	-0.2064*	-0.0958	-0.2289***	-0.2231	-0.02	-0.3712***
	[-1.4752]	[-2.0208]	[-1.8289]	[-0.9584]	[-2.7300]	[-1.2574]	[-0.2091]	[-3.0497]
GrossMargin	-0.0282	0.0412	0.0477	-0.0677	0.0301	-0.1302*	-0.0048	0.1333**
	[-0.6188]	[0.7645]	[0.9735]	[-1.4345]	[0.7840]	[-1.7222]	[-0.0917]	[2.3853]
Investment	0.0022	-0.0631**	-0.0713*	-0.0208	0.0145	0.0006	0.0163	-0.0921*
	[0.0523]	[-2.0762]	[-1.9511]	[-0.4449]	[0.4107]	[0.0107]	[0.3337]	[-1.7358]
LRReversal	-0.0939	-0.1737*	-0.1729*	0.0174	-0.1085	0.0706	-0.0657	-0.2828***
	[-1.1286]	[-1.7789]	[-1.7041]	[0.1576]	[-1.0384]	[0.4149]	[-0.8036]	[-2.8252]
Momentum	-0.1346	-0.3453***	-0.3397***	-0.0139	-0.2401**	-0.1446	0.0493	-0.5180***
	[-1.6432]	[-4.2678]	[-2.8517]	[-0.0916]	[-2.3557]	[-1.0475]	[0.3765]	[-3.8252]
OScore	-0.0165	0.1067*	-0.0048	-0.1118	0.0393	-0.1916	0.0326	0.0516
	[-0.3060]	[1.8079]	[-0.0666]	[-1.4061]	[0.6098]	[-1.5310]	[0.4854]	[0.8169]
PEADCAR3	0.0273	-0.1168***	-0.0769	0.035	-0.032	0.0285	0.0724	-0.1865***
	[0.6438]	[-2.8348]	[-1.5384]	[0.6883]	[-0.6897]	[0.5453]	[1.5495]	[-3.2369]
SRReversal	-0.1183	0.1925**	0.0258	0.0548	0.1016	-0.0633	-0.0734	0.2177**
	[-1.3378]	[2.1179]	[0.3004]	[0.5753]	[1.1675]	[-0.6999]	[-0.6844]	[2.2339]
ValMomProf	-0.1630**	-0.2692***	-0.2676***	-0.0262	-0.2017**	-0.1021	-0.0569	-0.3577***
	[-2.3896]	[-3.1916]	[-2.8248]	[-0.1957]	[-2.2021]	[-1.0344]	[-0.7781]	[-3.8042]
Value	-0.0536	-0.0476	-0.0356	-0.0871	-0.0247	-0.0078	-0.1317*	-0.1458*
	[-0.7621]	[-0.5809]	[-0.4417]	[-1.5749]	[-0.3108]	[-0.0769]	[-1.7185]	[-1.8177]
Size	-0.0989	-0.1314	-0.0853	0.1394	-0.1322	0.1475	-0.0306	-0.0818
	[-1.3805]	[-1.3467]	[-0.9435]	[0.9981]	[-1.4320]	[0.8817]	[-0.4056]	[-0.9495]