A Unified Explanation of Value and Momentum Premia

Elisa Pazaj *

Abstract

This paper shows that both value and momentum premia arise in a dynamic q-theoretic framework that considers optimal corporate policies under uncertain financing conditions. Equity market timing lowers the financing risk of recent losers, giving rise to a momentum premium during times of overall easy financing conditions. The value premium captures differences in financial slack, that increase during tight financing markets. These dynamics imply a procyclical momentum premium, a countercyclical value premium and a negative correlation between the two premia. Empirical evidence on observed financing choices and relative measures of constraints confirm model predictions.

Keywords: Momentum, value, investment, financing constraints.

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*University of Amsterdam. E-mail: e.pazaj@uva.nl

I. Introduction

Extensive empirical work documents predictability of stock returns based on the ratio of the stock's book value relative to its market value, known as the value effect, and predictability based on recent past performance, known as the momentum effect[1]. The question of why we observe these regularities in the data is still unsettled despite the vast literature devoted to this purpose. Existing explanations typically focus on either premium in isolation, and those that consider both cannot reproduce their significant negative correlation (e.g., Asness, Moskowitz & Pedersen 2013, Liu & Zhang 2014). The significance of the correlation implies that value and momentum premia cannot be independent. A satisfactory explanation, therefore, needs to account for the co-movement.

This paper takes a step in this direction by providing an explanation for the two premia that also reproduces the negative relationship. Value and momentum arise simultaneously within a framework that considers joint decisions regarding firm investment, financing and liquidity management under uncertainty about financing conditions. I show this using a flexible and tractable set up based on Bolton, Chen & Wang (2013). Uncertain financing costs represent the key market friction that induces changes in investment and asset prices that, in the cross-section, imply return differentials based on book-to-market and recent past performance consistent with the presence of the two premia.

The main idea is as follows. Take a neoclassical model in which the firm's cash flow is stochastic. Suppose issuing equity is costly [2]. With a financing pecking order, equity

[1] Stattman (1980) and Rosenberg, Reid & Lanstein (1985) provide the first evidence on the value premium in US equities. Fama & French (1992) show that, along with a size factor, book-to-market subsumes the ability of leverage and earnings-to-price ratio to predict returns. Chan, Hamao & Lakonishok (1991) show that book-to-market predicts returns of Japanese equities as well. Fama & French (1998) document a strong value premium in global stock markets. Jegadeesh & Titman (1993) document positive and significant returns to momentum strategies. Rouwenhorst (1998) shows that there is persistence in returns over the medium-term horizon not only in the US, but also in international equity markets. Moskowitz & Grinblatt (1999) show that there is a strong momentum effect in industry portfolios.

[2] Equity issuance can be costly because of direct floatation costs (e.g. Smith (1977), Altinkilic & Hansen (2000), Eckbo & Masulis (1992)) and indirect costs such as agency costs (Jensen & Meckling 1976) and

issuances will be used infrequently. The value of issuing equity becomes a delay option, whose value depends on the distance to issuance. Following negative cash-flow shocks, issuance becomes more likely and the risk premium of the firm increases. Firm value becomes more sensitive to productivity shocks as negative cash-flow realizations increase the possibility of having to resort to costly external financing or liquidation. When the cost of issuing equity is random, firm value is exposed to an additional source of risk: financing shocks [3] . This risk also increases as the firm moves closer to issuance. Firms that are more financially constrained are more likely to have to pay the higher issuance costs in the event they materialize.

The financially constained firms, given their high sensitivity to cash-flow shocks, are the ones that end up in the extreme past performance portfolios. Winners are the constrained firms with high expected returns that in the recent past have received a string of large positive cash-flow shocks. The large negative returns to the losers imply a string of negative cash-flow shocks for firms that are financially constrained and, at the same time, have low expected returns. Differences in risk premia thus derive from both heterogeneity in fundamentals and heterogeneity in financial slack. Fundamental differences that drive the momentum premium include higher equity issuance costs and more procyclical productivity for winners compared to losers. These risk differentials diminish during times of tight financing conditions whereby issuance is prohibitively costly for all firms. The model thus imparts a dependence of momentum profitability on market states, in line with Cooper, Gutierrez & Hameed (2004).

The value premium in the model captures the risk differential between financially

adverse selection costs (Myers & Majluf 1984).

[3] Choe & Nanda (1993) present evidence of firms issuing more equity during expansionary periods. Erel, Julio, Kim & Weisbach (2012) show that changes in macroeconomic conditions affect the ability of firms to obtain external equity financing. Kale & Stulz (2013) show that the decrease in equity issuance during the Great Recession was greater than the decrease in debt issuance. McLean & Zhao (2014) also provide evidence supportive of time-variation in the costs of equity issuance and show that this variation has real effects on firm investment and employment.

constrained and unconstrained firms and arises even without differences in fundamental parameters. Financially constrained firms invest less because they face a higher marginal cost of financing. Low investment implies low future profitability and greater exposure to systematic risks. This is reflected in a lower valuation relative to capital, i.e. a higher book-to-market ratio. When financing costs are low, the risk differential between constrained and unconstrained firms is positive but small. The value premium is amplified during periods of high financing costs, as the financially constrained firms face an even greater liquidation risk and may even engage in asset sales to avoid the high equity issuance costs.

Eisfeldt & Muir (2016) provide time-series estimates of the cost of external financing and show that the cost is higher during recessions. Given higher issuance costs in these periods, the model predicts a procyclical momentum premium and a countercyclical value premium. Such behaviour can simultaneously explain the presence of unconditional value and momentum premia and an overall negative correlation between the two.

Several new testable predictions arise in this setting that link the two premia to fundamentals. First, the model predicts a lower level of external financing for winners compared to losers. To see this, consider that winners face higher issunace costs than losers in good times, prompting them to delay issuance more than losers. Winners also use the recent positive cash-flow shocks to reduce debt and increase their cash balance, moving further away from their issuance boundary, implying both lower debt and lower equity issuance compared to loser firms. Portfolio statistics are consistent with this reasoning and show that losers issue more debt and equity during portfolio formation. These patterns reverse the year after, consistent with the temporary nature of momentum profits. Spanning tests show that the momentum alpha becomes insignificant once accounting for low-minus-high debt and equity issuance factors in addition to the Fama & French (1992) three or Fama & French (2015) five factors.

To empirically examine the model-implied role of financial constraints and market timing, I refer to both firm-level measures of constraints as well as market-wide proxies for the overall state of the financing markets in the US. For the firm-level measures I rely on Hoberg & Maksimovic (2015), constructed from textual analysis of the Mangement Discussion and Analysis (MD&A) section in 10-Ks. As market-wide proxies I consider the St. Louis Fed Financial Stress Index (STLFSI); Moody's Seasoned Baa Corporate Bond Yield Relative to Yield on 10-Year Treasury (BAA10Y); and the Chicago Fed National Financial Conditions Index (CNFCI). The performance of value and momentum factors changes significantly with the overall state of the financing markets. Momentum returns are higher during eased financing conditions, while value returns are higher when conditions are tight. The Hoberg & Maksimovic (2015) measures at the portfolio level are generally higher for the winner portfolio during eased conditions, while during tight conditions losers become more constrained.

The time-variation in financing conditions has important implications for firm investment choices, especially when most constrained. During eased financing conditions, firms issue equity sooner than necessary to take advantage of the relatively lower issuance costs. As the cash balance declines and the firm moves closer to issuance, it also increases investment so as to reach the boundary sooner. Winners and losers in a momentum sort, being close to their respective issuance boundaries, would be expected to have high levels of investment. The model dynamics predict decreasing investment for winners during portfolio formation and increasing investment for losers. The data confirms both predictions. The investment of the winner portfolio declines during the year before formation, while the investment of the loser portfolio increases. Both winners and losers, however, invest more than the average firm, which explains why the investment factor (CMA) does not subsume momentum. The investment factor, however, prices the value strategy. The lower investment of value firms can be driven by asymmetric capital adjustment costs as in Zhang (2005). I provide supporting evidence for financial constraints also playing a role. The Hoberg & Maksimovic (2015) constraints measures are higher for value firms, with differences being larger during tight financing conditions.

The paper is organised as follows. Section II provides a review of the relevant literature on the two premia. Section III describes the model and develops the testable hypotheses. Section IV presents the empirical results on the dynamics of investment, external financing and financial costraints for value and momentum portfolios. Section V provides a discussion of the model implications and empirical results. Section VI concludes.

II. Related literature

This paper relates to the large body of theoretical work that aims to explain value and momentum premia, but is one of the few that focuses on both simultaneously. Similar to Berk, Green & Naik (1999), the framework considers an exogenous stochastic discount factor and models the evolution of firm risk given optimal investment decisions. Unlike Berk et al. (1999), investment is chosen within a Hayashi (1982) q-theory framework rather than a real options framework and financing conditions that are stochastic. Stochastic financing conditions drive the cyclicality of the two premia and their negative comovement, features that Berk et al. (1999) cannot reproduce.

A large number of existing explanations for the value premium rely on operating leverage, induced by labor costs (Donangelo 2021) or capital adjustment costs (Cooper 2006, Zhang 2005). These models consider a single source of priced risk in the economy, implying the conditional CAPM holds. However, empirical evidence in Petkova & Zhang (2005) and Lewellen & Nagel (2006) shows that the conditional CAPM fails to explain the value premium. The model here specifies two sources of priced risk and thus does not collapse to the conditional CAPM. Importantly, this paper relates the value premium to financial rather than operating leverage, consistent with evidence in Doshi, Jacobs, Kumar & Rabinovitch (2019) that the value premium disappears in unlevered stock returns.

This paper provides a novel mechanism for the momentum premium where financing options play a key role, in contrast to existing explanations that rely only on cash flow growth differentials (Johnson 2002, Sagi & Seasholes 2007). The moneyness of the financing options changes with the market state. This imparts a depence of the profitability of momentum strategies on the overall state of the market, in a similar spirit to Cooper et al. (2004). Liu & Zhang (2014) represents a closely related paper that also builds on the neoclassical theory of investment to explain returns to momentum strategies. The model does not incorporate stochastic financing conditions and thus cannot reproduce the procyclicality of momentum and its negative interaction with value.

A series of papers link momentum and value to behavioural biases. Lakonishok, Shleifer & Vishny (1994) and Haugen & Baker (1996) believe that value strategies work because investors systematically make errors in their forecasts or because investors are uncomfortable holding value stocks. Barberis, Shleifer & Vishny (1998) combine conservatism bias and representative heuristic to explain the timing of the profitability of the momentum strategy. Daniel, Hirshleifer & Subrahmanyam (1998) link momentum to traders exhibiting a self-attribution bias. The exogenous specification of the stochastic discount factor in this paper does not rule out the SDF representing the discounting process of a biased investor.

This paper inherently relates to the literature that examines the relationship between financing constraints and stock returns (Lamont, Polk & Saa-Requejo 2001, Whited & Wu 2006, Livdan, Sapriza & Zhang 2009, Buehlmaier & Whited 2018). The evidence on whether more constrained firms earn higher returns is mixed in the early literature, but measures that do not suffer from the disadvantages of accounting based indicators of financial constraints (Farre-Mensa & Ljungqvist 2016) do confirm that more constrained firms are riskier. This paper highlights that exposure to financial constraints risk depends not only on financial slack but also firm characteristics. The value premium in the model generally captures the effect of financial slack on stock returns, while the mometum premium is driven by the interaction between financial slack and fundamental characteristics.

While closely related to Bolton et al. (2013) and Eisfeldt & Muir (2016) that consider investment, financing, payout and cash savings decisions jointly within a dynamic framework where financing conditions are stochastic, this paper focuses on the cross-sectional asset pricing implications, similar to Belo, Lin & Yang (2019). In contrast to Belo et al. (2019) where cross-sectional return differences in the model that capture the value premium emerge from differences in productivity, the value premium in this paper arises from differences in financial slack when holding productivity constant. Differences in financial slack, conditional on the state of the macroeconomy, underpin also the momentum premium, its negative relationship to value and momentum crashes. These are not considered in Belo et al. (2019), making the two papers complementary.

III. The model

This section outlines a dynamic corporate financing model, in the spirit of Bolton et al. (2013), with a focus on the asset pricing implications[4]. The framework provides a set of predictions on the relationship between book-to-market and past performance with future returns and firm financing and investment choices. These predictions guide the empirical work in section IV. Appendix A contains a detailed description of the model set up and solution. This section provides a brief overview.

[4]I add credit lines as an alternative source of external financing, following the extension to Bolton, Chen & Wang (2011).

A. Mode overview

The model considers a financially constrained firm that faces stochastic financing opportunities. The firm can be in one of two possible states of the world, denoted by $s_t = G, B$. Investment and external financing opportunities are better in the good state, G, and worse in the bad state, B. There is a constant probability, ζ_s, that the economy switches from the current state s to state s^-, where s^- denotes a state different from s.

Production requires two inputs, cash W, and capital K. The firm buys and sells capital at the price of one. The following accounting identity applies to the capital stock of the firm:

$$dK_t = (I_t - \delta\, K_t)\, dt, \quad t \geq 0, \tag{1}$$

where I denotes investment and $\delta \geq 0$ the rate of capital depreciation. Firm revenues, $K_t\, dA_t$, are proportional to the capital stock, K_t, and depend on the cash-flow shock, dA_t. Cash-flow shocks, dA_t, follow an arithmetic Brownian motion:

$$dA_t = \mu_s\, dt + \sigma_s\, dZ_t^A, \tag{2}$$

where Z_t^A is a standard Brownian motion, and μ_s and σ_s represent the drift and volatility of the cash-flow process in state s. This specification of the cash-flow process means the firm faces potential losses. Potential losses coupled with costly external financing provide a motive for saving cash. Cash within the firm earns a lower rate of return compared to the risk-free rate r_s, making it costly.

The firm can alternatively use external financing to cover potential losses and finance investment. External financing involves credit lines and new equity issues [5]. Only a fixed portion of the capital of the firm, $c_s > 0$, is posted as collateral for the credit line. This limits the credit line draw-down to an amount of $c_s K$. Credit line access involves a cost in the form of a spread, α_s, over the risk-free rate on the amount borrowed. Equity issuance is also costly. The costs include a fixed component, $\phi_s K$, where ϕ_s is the fixed cost parameter in state s, and a proportional component $\gamma_s > 0$, where γ_s is the marginal cost parameter in state s.

There are two state variables in the firm's optimization problem: firm size, K, and the cash balance, W, in each state of the economy, s. Management chooses investment, external financing, cash savings, payout policies and liquidation time that maximize shareholder value. Optimal policies result in the cash balance evolving between two barriers: an upper payout boundary, $\overline{W_s}$, and a lower equity issuance boundary, $\underline{W_s}$. To solve the model, it is useful to note that firm value is homogeneous of degree one in capital, K, and cash, W, in each state, s. This allows to define the problem as a function of only one state variable, the ratio of cash-to-capital: $w = W/K$.

Let $P(K, W, s)$ denote the state-dependent firm value function. The homogeneity property allows the value function to be written as $P(K, W, s) = p_s(w)\, K$, where $p_s(w)$ represents the scaled value function in state s. This makes it possible to write the Hamilton-Jakobi-Bellman equation of the shareholders' maximisation problem in $(\underline{w}_s, \overline{w}_s)$ as:

$$
\begin{aligned}
r_s p_s(w) = \max_{i_s} \; & \left[(r_s + \Phi_s)\, w + \hat{\mu}_s - i_s - g_s(i_s)\right] p_s'(w) + \frac{\sigma_s^2}{2}\, p_s''(w) \\
& + (i_s - \delta)\; (p_s(w) - w\, p_s'(w)) + \hat{\zeta}_s\; (p_{s^-}(w) - p_s(w))\,,
\end{aligned} \tag{3}
$$

[5] The relative costs of the credit line and equity issuance will determine which source of funding is used first. Throughout this analysis, the cost of issuing equity is assumed to be higher. The model thus generates a pecking order between the three sources of financing: the firm issues equity only after exhausting its cash balance, and then drawing down its credit line.

where

$$\Phi_s = \begin{cases} +\alpha_s, & \text{if } w \leq 0, \\ -\lambda_s, & \text{if } w > 0, \end{cases}$$

and where i_s is the investment-to-capital ratio, I/K, and $g_s(i_s)$ represents the investment adjustment cost function, which is increasing and convex [6].

The left-hand side of equation (3) represents the required return for investing in the firm. Under the risk-neutral measure, $\mathbb{Q}$, this is determined by the risk-free rate. The first and the second terms on the right-hand side of (3) represent the effects of productivity shocks on firm value. In the region $(0, \overline{w}_s)$, the firm funds investment using cash reserves that earn interest lower than the risk-free rate, $(r_s - \lambda_s)$. In $(\underline{w}_s, 0)$, the firm uses the credit line. Firm value decreases following a negative productivity shock, with the decrease reflecting the additional interest it needs to pay on the credit line $(r_s + \alpha_s)$. The third term captures the marginal effects of investment. The last term represents the expected change in firm value when the state changes from s to s^-.

The ODE in (3) is solved using value matching and smooth pasting conditions at the boundaries as well as continuity and smoothness conditions at zero.

B. Risk premia

The model incorporates two types of priced shocks: shocks to productivity and shocks to the state of the economy. Productivity shocks, dZ_t^A, affect firm risk by changing its *level* of financial slack, as measured by the cash-to-capital ratio, w. Shocks to the state of the economy, s, affect firm risk by changing the *value* of financial slack. The marginal value of

[6] The detailed specification of the investment adjustment cost function is given in Appendix A.

cash is higher during bad times, making financial slack more valuable and the firm riskier.

The existence of two sources of aggregate uncertainty implies the CAPM no longer applies. Let $\mu_s^R(w)$ denote the expected excess return on the firm. Matching terms in the Hamilton-Jakobi-Bellman equations under the risk-neutral probability measure $\mathbb{Q}$ and the physical probability measure $\mathbb{P}$, the following obtains for the expected excess return, $\mu_s^R(w)$:

$$\mu_s^R(w) = -(e^{\kappa_s} - 1)\, \zeta_s\, \frac{p_{s^-}(w) - p_s(w)}{p_s(w)} + \eta_s\, \rho_s\, \sigma_s\, \frac{p_s^{'}(w)}{p_s(w)}. \tag{4}$$

The first term in equation (4) represents the state risk premium. This is given by the market price of the risk of the economy switching states, κ_s, the probability of the economy switching states, ζ_s, and the percentage change in firm value, at the current cash-to-capital ratio, if the economy switches to a different state (from s to s^-). Firms whose prices drop more when the economy switches to a state of higher marginal utility require a greater risk premium in the current state. Conversely, firms whose prices increase more when the economy switched to a state of lower marginal utility require a lower risk premium in the current state. The second term in equation (4) represents the productivity risk premium, given by the market price of productivity risk, η_s, and the firm's exposure to this risk, $\rho_s\, \sigma_s\, p_s^{'}(w)/p_s(w)$. The higher the marginal cost of financing, $p_s^{'}(w)$, the greater the risk premium.

C. Calibration

The parameters in the baseline case of Bolton et al. (2013) serve as a starting point in calibrating the model. I use different values for the equity issuance cost parameters from Bolton et al. (2013) who rely on estimates from Eckbo, Masulis & Norli (2007) and Altinkilic & Hansen (2000). These studies base their estimates on Seasoned Equity Offerings

(SEOs), which are infrequent. Fama & French (2005) show that firms issue equity much more frequently and at smaller amounts compared to SEOs. Issuances under this model are liquidity motivated and hence, likely smaller and more frequent than SEOs. The higher frequency implies a lower fixed cost of equity issuance compared to estimates based on SEO samples. The smaller size implies a higher marginal cost. Although the costs of equity issuance that take this evidence into account are yet to be estimated, I intuitively adjust the parameter values. I set the fixed cost of equity issuance at 0.1% in the good state to allow for greater frequency of issuance during good times. I set the marginal cost of equity issuance at 10% in both states. Although both fixed and marginal costs may increase in bad states of the world, I only change the fixed cost as that is what determines access to the external equity market.

Assuming an average duration of ten years for good times and an average duration of two years for bad times, the transition intensities are set to $\zeta_G = 0.1$ out of the good state and $\zeta_B = 0.5$ out of the bad state. Similar to Bolton et al. (2013), the model assumes exogenous risk adjustments. The spread paid for the credit line is set to 1.5%, based on the estimates of Sufi (2007). The remaining parameters in the baseline calibration, listed in Appendix B, are set at the same levels as in Bolton et al. (2013).

D. *Momentum effects*

This subsection shows that stochastic financing and investment opportunities give rise to a positive momentum premium. Consistent with the empirical evidence on the procyclicality of momentum, the premium is present only in good states of the market.

To examine momentum effects in the model, bearing in mind that it is a cross-sectional result, it is instructive to conider the cumulative excess return process, $dcer_t(w, s)$, which is given by:

$$d\,cer_t(w,s) = EER_t\,dt + \sigma_s \frac{p_t^{'}(w,s)}{p_t(w,s)}\,dZ_t^A + \frac{p_t(w,s) - p_{t-1}(w,s^-)}{p_{t-1}(w,s^-)}\,\epsilon_t, \tag{5}$$

where ϵ_t is the realised state shock:

$$\epsilon_t = \begin{cases} 0, & \text{if } s_{t-1} = s_t \\ 1, & \text{otherwise.} \end{cases}$$

In the good state ($s_{t-1} = s_t = s_G$), the firms with the highest recent cumulative returns are the financially constrained high mean firms (high EER_t) that have recently received large positive cash-flow shocks. The firms with the largest negative cumulative returns are the financially constrained low mean firms (low EER_t) that have recently received negative cash-flow shocks. Both winners and losers are financially constrained because it is these firms that are the most sensitive to any cash-flow shock realizations. The differences in fundamentals between winners and losers that drive differences in their mean returns imply persistence of the risk differential between the two in the short-term. In the steady state, firms keep the cash balance close to their respective targets, implying periods of a high degree of financial constraints do not persist indefinitely and therefore momentum returns decrease with the portfolio holding period over long time horizons.

Figure 1 provides a numerical example showing how the relative riskiness and investment levels between winner (W) and loser (L) firms change with their respective capitalizations[7]. The firm labelled as winner has a higher expected cash-flow growth in the good state relative to the bad state ($\alpha_G^W = 24\%$ and $\alpha_B^W = 18\%$). Differences in expected growth

[7] To highlight the key effects, I consider here a simplified version whereby no credit lines are available. The results in the credit line case are similar, with debt being cosidered as negative cash, and the resulting implied changes in debt levels being of opposite sign to changes in cash.

between the two states are smaller for the loser firm ($\alpha_G^L = 22\%$ and $\alpha_B^L = 20\%$). The winner firm also faces a larger fixed cost of issuing equity in the good state ($\phi_G^W = 0.5\%$ and $\phi_G^L = 0.1\%$). The higher cost of external financing coupled with the lower cash-flow growth rate in the bad state make cash within the winner firm even more valuable during good times. The expected return on the winner when financially constrained will still be higher than that of the financially constrained loser even following a positive cash-flow shock that increases the cash balance. In bad times, both firms are riskier when constrained, but the risk differentials diminish significantly for the most constrained firms, which are the ones that would end up in extreme past performance portfolios. Momentum strategies would therefore no longer be profitable during bad times, consistent with the procyclical nature of momentum profits documented in the data.

Panels C and D in Figure 1 show the respective investment levels of the two firms. In good times, both financially constrained winners and losers are close to their respective issuance boundaries, which are positive, implying both types of firms engaging in market timing behavior. Both winners and losers increase investment in order to reach the lower boundary sooner than necessary so as to take advantage of the lower external financing costs. The resulting investment levels of both firms, because of market timing, are high on average. Notably, the issuance boundary is higher for the loser firm, implying losers issue equity sooner and more often than winners. The latter, following recent positive cash-flow shocks move further away from their boundary, implying less reliance on external financing (higher levels of cash and lower levels of debt).

The model also predicts large losses to momentum strategies when the state switches from bad to good, consistent with the evidence of momentum crashes in the data (Daniel & Moskowitz 2016). In bad states of the world, extreme past performance sorts still focus on the most financially constrained firms, being the subset of firms where productivity shocks have the largest price impact. Given similar levels of riskiness, positive cash-flow shocks for recent winners and negative cash-flow shocks for recent losers imply higher betas for losers compared to winners. When the state switches to a good one, because of the higher betas, the prices of loser firms increase the most. This translates to large positive returns to the loser leg. Momentum strategies, being short the losers, incur large losses. The model predictions with regards to the momentum premium can be summarized as follows:

Prediction 1. Losers issue more equity and debt than winners during portfolio formation.

Prediction 2. Winners are more financially constrainted than losers in good times.

Prediction 3. Winners and losers are both high investment firms.

Prediction 4. Winners and losers face greater uncertainty regarding equity issuance costs.

E. Value effects

In this subsection, I show that the model produces a positive unconditional value premium. Stochastic investment and financing opportunities produce a higher value premium in bad states of the economy.

Capital-to-value serves as the model-equivalent of book-to-market. In the model, high book-to-market firms are more financially constrained and generally invest less. Figure 2 shows numerically how investment changes with book-to-market. Panel A shows that the relationship between investment and book-to-market is non-monotonic in good times. Investment, however, generally decreases with the book-to-market ratio. Panel B shows that investment is strictly decreasing in the book-to-market ratio in bad times. High book-to-market firms engage in asset sales, while low book-to-market firms continue to expand capital.

Differences in the marginal cost of financing drive the differences in investment levels in the two states. High book-to-market firms in the model rely on external funds to finance investment, while low book-to-market firms rely on cash savings. The wedge in the marginal costs of financing between internal and external funds is positive but small in good times. The possibility to time the equity market lowers the overall effective costs of financing further for the financially constrained firm, allowing it to invest more. This makes the difference between the investment levels of high and low book-to-market firms even smaller. The difference in marginal costs is amplified in bad times because of the much higher external financing costs. Financially constrained firms (high book-to-market) engage in asset sales to avoid the large costs of external financing. Well-capitalised firms (low book-to-market) fare much better. The resulting difference in expected returns becomes larger.

Panels C and D in Figure 2 show numerically how the risk premium changes with book-to-market. In good times (Panel C) small differences in investment levels justify a small difference in risk premia between high and low book-to-market firms. In bad times (Panel D), large differences in investment levels, driven by large differences in the marginal cost of financing, justify a large value premium. The model produces a positive value premium even without time-variation in investment and financing opportunities. Accounting for stochastic financing conditions, however, brings the model closer to the data. The key predictions of this framework with regards to the value premium are as follows:

Prediction 5. High book-to-market firms are more financially constrained than low book-to-market firms, more so during bad times.

Prediction 6. Value strategies deliver larger returns during tight financing conditions.

IV. Empirical results

This section empirically investigates the dynamics of the investment and external financing choices of firms in value and momentum portfolios.

A. *Momentum and external financing*

The analysis is based on U.S. stocks included in the CRSP and Compustat databases, merged using 6-digit CUSIP identifiers. The sample covers the period January 1975 to December 2019[8]. Momentum strategies buy firms with the highest cumulative returns over the previous year and sell firms with the lowest. Because of reversal, momentum does not include the performance of the most recent month in the computation of cumulative returns. Value strategies buy stocks with the highest book-to-market ratio and sell the ones with the lowest. I follow the same methodology as Fama & French (1992) in calculating and lagging the book-to-market ratio. Value and momentum portfolios use NYSE breakpoints and value-weighted returns.

Debt and equity issuance data is obtained from Compustat files. Debt is the sum of long term debt and debt in current liabilities (Compustat quarterly variables DLTTQ and DLCQ). I lag the debt variable by one quarter. Equity issuance is measured by cash proceeds from the issuance of common and preferred stock (Compustat item SSTK from the Statement of Cash Flows). I obtain cash proceeds from equity issuance from the annual statements. Because these proceeds represent a flow variable, observation over a longer period provides a better picture of relative firm issuance activity and financial position at a given point in time.

Figure 3 shows the dynamics of average debt and equity issuance around momen-

[8] January 1975 serves as the starting point for the regressions due to limited data availability on external financing.

tum portfolio formation. The statstics are presented separately for ten past performance portfolios. With monthly rebalancing, there are 574 cross-sections of firms sorted on past performance over the period January 1975 to December 2019. I compute the value-weighted average debt and equity issuance for each decile in each cross-section, starting from 24 months before the respective portfolio formation up to 24 months after. The plots show the time-series average of debt and equity issuance levels for a given month relative to formation for each past performance decile over the 574 portfolios. The plots show that losers issue more debt and equity during portfolio formation compared to winners[9]. The patterns reverse during the year after formation, consistent with the time when momentum strategies cease to be profitable.

Conditional double-sorts on debt and equity issuance and momentum, shown in Table I, confirm these patterns around formation. Firms are first sorted in three portfolios based on their debt or equity issuance levels. Within each tercile, firms are then sorted into quintiles based on past performance. Results show that momentum strategies work only among high equity issuers and extreme debt portfolios.

Motivated by the observed financing dynamics, I next conduct spanning tests on momentum that consider two financing factors, one based on debt and one on equity issuance. I follow a similar methodology to Fama & French (1992), using 2×3 sorts on each factor and size. The long debt portfolio return represents the (simple) average of the returns to small and large firms in the low debt tercile. The short debt portfolio return represents the (simple) average of the returns to small and large firms in the high debt tercile. I construct the equity issuance factor similarly. Portfolios use value-weights and NYSE breakpoints. The debt factor delivers a positive premium of 0.33% per month, with a test statistic of 3.34[10]. The average equity issuance factor premium is also positive, 0.14% per month, but

[9] Results are similar when scaling by beginning-of-period total assets to remove any denominator effects.

[10] Unreported regressions of the debt factor returns on the Fama and French three and five factors show that neither of the models can explain its returns (even when adding momentum to the regressors). The intercepts of the regressions are in the range 0.40 - 0.60% per month, with t-statistics greater than 4.

statistically insignificant. The purpose here is not to propose new asset pricing factors, but to show the presence of a relationship between value and momentum and underlying firm fundamentals.

Table II presents spanning test results. The dependent variable in Panel A is the return to the momentum factor constructed using 2×3 sorts on past performance and size. Regressors include the Fama and French five factors: the market factor (MKT), the size factor (SMB), the investment factor (CMA) and the profitability factor (RMW), as well as two additional external financing factors, DEBT and SSTK (equity issuance). Over the period January 1975 to December 2019 the momentum factor earns an unconditional risk premium of 60 basis points, with a test statistic of 3.26. The second and third specifications regress returns to momentum on the Fama and French three and five factors. The alpha on momentum is high and significant against the Fama and French three factors. It is lower but still positive and significant against the Fama and French five factors.

The alpha on momentum disappears when adding the debt and equity issuance factors among the regressors. It declines from 0.58 to 0.07, a value statistically indistinguishable from zero. Momentum loads positively on debt and equity issuance, consistent with the prediction that winners rely less on external financing compared to losers. The fifth specification adds the value factor. Because of the negative correlation between value and momentum, including value among the regressors results in a larger momentum alpha. The alpha remains statistically insignificant. The final specification considers only the Fama and French three factors and the external financing factors. The alpha is still low and statistically insignificant. This evidence shows that momentum winners and losers differ in terms of their use of external financing as predicted by the model.

B. Momentum and market timing

The underlying driver of the investment and financing patterns of momentum firms in the model is the market timing motive, which is stronger for firms that face greater uncertainty regarding equity issuance costs. To test this prediction, I look at how the profitability of momentum relates to equity issuance cost dispersion. I obtain equity issuance fee data from the Thomson One SDC database, where fees are expressed as a percentage of the total amount issued. The period covers January 1970 to April 2018. It is important to note that these fee measures represent only the observable component of the total cost of issuance. Hennessy & Whited (2007) show that the unobservable component can be substiantial, but provide these estimates only at an aggregate level. Given the lack of granular estimates of the total costs and to the extent that the observed fees would correlate with the unobservable component, I only rely on observed fees to obtain some suggestive evidence.

Table IV shows the performance of momentum strategies constructed along different equity issuance fee dispersion terciles. Consistent with the model intuition, momentum strategy average returns and alphas increase monotonically with fee dispersion and are significant only among the high fee tercile. The momentum strategy in the high fee tercile delivers a significant average return of 62 basis points per month, close to the unconditional return of the strategy.

The next key prediction of the model is that winners are more financially constrained than losers, but only during times of eased financing conditions. Taking this prediction to the data, I refer to both firm-level empirical measures of financial constraints, as well as market-wide proxies that aim to capture the overall state of the financing markets in the U.S.. The firm-level measures are from Hoberg & Maksimovic (2015), constructed based on textual analysis of the Management Discussion and Analysis (MD&A) section in 10-Ks, that distinguish between debt and equity constraints[11]. I refer to two market-wide proxies for financing conditions: the St. Louis Fed Financial Stress Index (STLFSI) and Moody's Seasoned Baa Corporate Bond Yield Relative to Yield on 10-Year Treasury (BAA10Y). Positive value of the STLFSI indicate financing conditions are tighter than average, while negative values indicate eased conditions. In a similar spirit, I consider times when the BAA10Y is above-average as tight conditions, and eased otherwise.

Figure 4 shows average winner and loser portfolio financial constraints around formation, separately for times of favourable financing conditions and times of tight financing conditions. Winners are generally more constrained than losers during periods when the STFLSI and the BAA spread indicate eased financing markets. The reverse is true during tight financing markets, whereby losers are significantly more constrained than winners. These results support the prediction of the importance of financing constraints in driving the momentum premium.

A direct implication of the relative degree of financial constraints of winners and losers conditional on the state of the financing markets is the conditional profitability of the strategy. I first examine the performance of momentum strategies conditional on the state of the financing markets. Cooper et al. (2004) show that momentum strategies deliver significant returns only following up markets, supporting the overreaction theories of Daniel et al. (1998) and Hong & Stein (1999), although also consistent with the model of Sagi & Seasholes (2007). Despite the inherent overlap, here I focus specificaly on the state of the financing markets. Table III shows the performance of momentum strategies conditional on

[11] Alternative accounting-based measures such as the Kaplan & Zingales (1997) index or the Whited & Wu (2006) index suffer from several drawbacks. Hadlock & Pierce (2010) argue that these indexes rely on endogenous financial choices such as leverage and cash holdings, limiting their reliability as financial constraints measures. FML (2016) stress that these indexes may not necessarily identify constrainted firms but largely indicate high growth firms that rely on equity financing. The Hadlock & Pierce (2010) index relies on size and age, firm-level features that are rather persistent and would not capture the rapid changes in the degree of financial constraints firms face during tight financing markets. Buehlmaier & Whited (2018) also construct a constraints measure that relies on textual analysis. I use the Hoberg & Maksimovic (2015) measure because of data availability.

several proxies for overall financial conditions. In addition to the STLFSI and BBA spread indicators, the table also considers the Chicago Fed National Financial Conditions Index (NFCI) and a market state indicator based on Cooper et al. (2004), that equals one when the cumulative return on the CRSP value-weighted index over the previous 36 months is negative and zero otherwise. The table reports positive and signficant momentum returns during times of eased financing conditions, and insignificant returns when financing conditions are tight. The opposite is true for the value premium. The differences in performance between easy and tight financing states are more significant when considering the average strategy return over a one year holding period.

C. Momentum and investment

I next explore the implications of market timing and financial constraints on the investment choices of momentum firms. The model predicts that, because of more valuable market timing options for both winners and losers compared to the cross-section, both legs of the momentum strategy should be high investment firms. Figure 5 shows that this is indeed the case. Winners and losers have the highest investment levels compared to firms in the intermediate past performance portfolios. This implies that the investment factor, CMA, is short both winners and losers, which explains why CMA does not play a role in pricing momentum in the results shown in Table II. The loading on CMA is positive, indicating a lower level of investment for winners compared to losers. Figure 5 confirms the average investment of the winner portfolio is lower around formation, in line with model predictions.

Table V presents the results of conditional double sorts on investment and momentum. Firms are first sorted in three portfolios based on their investment levels (investment is measured as the year-on-year change in total assets, lagged using the Fama & French (1992) methodology). Within each of the three portfolios, firms are sorted into quintiles based on past performance. The returns to the three momentum portfolios along the investment terciles increase monotonically with investment. A momentum strategy is profitable only among high investment firms, earning 65 basis points per month, with a test statistic of 3.68, a result that is close to the returns of unconditional momentum strategies. This shows that unconditional momentum strategies concentrate on high investment firms. Relative to the Fama & French (2015) five factors, momentum earns a significant alpha only along the high investment tercile.

D. Value and external financing

Panel B in Table II shows that the value factor loads heavily on the investment factor, CMA, with the alpha of value strategies becoming insignificant. The positive loading on investment indicates high book-to-market firms invest less relative to low book-to-market firms. The lower investment can be driven by asymmetric capital adjustment costs, as in Zhang (2005). Figure 6 supports a role for financial constraints. The Hoberg & Maksimovic (2015) financial constraints measure shows that high book-to-market firms are at greater risk of delaying investments because of liquidity issues than low book-to-market firms. The difference in average portfolio constraints are generally larger during tight financing markets, consistent with the model predictions. Table III further shows that value strategies deliver higher returns during tight financing markets.

E. Value and momentum combination

The third panel in Table II provides spanning tests on the equal-weighted combination of value and momentum. Asness et al. (2013) argue that the high Sharpe ratio of the combination represents an even greater challenge for rational explanations. The value-momentum combination earns an unconditional premium of 43 basis points with a test statistic of 4.31.

It has a positive and significant alpha relative to both the Fama and French two and four factors (regressors do not include value). The final specification includes the Fama and French four factors as well as the debt and equity issuance factors. The alpha becomes statistically insignificant, with the external financing factors pricing the momentum exposure and the investment factor pricing the value exposure.

V. Discussion

The theoretical set up in this paper considers a partial equilibrium model where the stochastic discount factor is specified exogenously. The exogenous specification cannot distinguish between the effects of rational pricing, learning or sentiment. The empirical evidence presented here suggests managers respond to the time-variation in equity financing costs as predicted by the model and that financing frictions are important for the two premia. The key market frinction in the model can be driven by information asymmetries, supporting a rational explanation, but it can also be driven by sentiment, supporting a behavioral explanation. A general equilibrium set up that also models consumer preferences would be able to answer the question of whether value and momentum do indeed reflect rational pricing. Because the model would not collapse to the conditional CAPM given two sources of aggregate risk, such a set up would be promising.

While the current model framework is necessarily rich, with this being primarily a quantitative exercise, a specification of the cash-flow process that incorporates greater persistence would be more realistic. The key intuitions of the model would not change, but it could speak more to the persistence of the profitabilities of the two strategies.

The decline of the profitability of the value strategy since the Great Recession represents another important point of discussion. This may seem in line with the argument in

Schwert (2002) that market anomalies typically disappear after their discovery. While some attenuation can of course come with increased investor attention and greater efficiency, it is important to note that financing conditions have been easy during the last decade (confirmed by the STLFSI and CNFCI indexes) , with central banks keeping interest rates at record low levels and engaging in unprecedented quantitative easing. Starting from the last quarter of 2020 the return to value strategies has in fact rebounded, earning on average 36 basis points per month over the period September 2020 to June 2021.

VI. Conclusion

This paper shows that value and momentum premia emerge naturally within a framework that considers firm investment and financing decisions in the presence of uncertain financing costs. Momentum effects arise from differences in financing costs during good times that make winners riskier than losers, despite, and especially because of, higher expected growth. The value premium in the model captures the risk-premium between high and low capitalized firms, which is amplified during tight financing conditions. Time-variation in financing costs drive the two premia and their negative correlation.

The empirical evidence on the predicted dynamics is largely supportive. Equity market timing motives, as captured by the dispersion of equity issuance fees, are stronger for momentum firms. Consistent with the model predictions, there is a tight connection between the performance of value and momentum strategies and the overall state of the financing markets, with the difference in performance being more pronounced compared to conditioning on overall stock market returns. When momentum strategies are profitable, the Hoberg & Maksimovic (2015) measures indicate winners are more constrained than losers. The reverse is true during tight financing conditions. These measures indicate that value firms are more financially constrained than growth firms, even more so during tight financing markets.

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VII. Tables

Table I. Conditional double-sorts. This table shows the performance of momentum portfolios constructed using dependent double sorts on equity issuance and debt. Equity issuance refers to the cash proceeds from issuing equity obtained from the cash-flow statement (Compustat variable SSTK). Debt is the sum of long-term debt and debt in current liabilities (Compustat variables DLT and DLC). Equity issuance and debt are scaled by lagged total assets. The table reports the average return of the high-minus-low past performance portfolio, $\overline{r}^{MOM}$, within each tercile, the Fama and French five factor alpha, α^{FF5}, and the betas with respect to the Fama and French (2015) five factors: the market, β_{mkt}, size, β_{smb}, value, β_{hml}, profitability, β_{rmw}, and investment, β_{cma}. The sample period covers January 1975 to December 2018.

	$\overline{r}^{MOM}$	α^{FF5}	β_{mkt}	β_{smb}	β_{hml}	β_{rmw}	β_{cma}
A. SSTK							
High	0.34	0.53	-0.17	-0.17	-0.04	0.04	-0.07
	[2.08]	[2.89]	[-3.14]	[-2.51]	[-0.52]	[0.24]	[-0.68]
(2)	0.23	0.18	-0.07	-0.04	-0.18	0.395	0.22
	[1.61]	[1.16]	[-1.83]	[-0.71]	[-2.81]	[3.08]	[2.56]
Low	0.16	0.10	-0.04	0.021	-0.12	0.19	0.24
	[0.85]	[0.46]	[-0.73]	[0.299]	[-1.26]	[1.05]	[2.50]
B. Debt							
High	0.41	0.84	-0.39	-0.38	-0.13	0.24	-0.25
	[1.81]	[3.57]	[-5.78]	[-3.69]	[-1.10]	[1.09]	[-1.90]
(2)	0.07	0.04	-0.03	-0.01	-0.08	0.212	0.08
	[0.48]	[0.25]	[-0.55]	[-0.22]	[-0.90]	[1.16]	[0.60]
Low	0.52	0.39	0.10	0.23	-0.14	-0.22	0.32
	[2.63]	[2.11]	[1.97]	[3.00]	[-1.38]	[-1.42]	[3.02]

Table II. Spanning tests. This table shows the results of regressions of the monthly returns of the Fama and French value, momentum factors and an equally-weighted combination of the two on different explanatory variables. These include the Fama and French five factors: the market factor (MKT), the size factor (SMB), the investment factor (CMA) and the profitability factor (RMW). The additional factors include a factor constructed sorting on the debt to assets ratio (Debt), cash proceeds from equity issuance scaled by assets (SSTK) and a proxy for the relative distance from target cash (DTC). The sample period covers May 1973 to December 2018. Newey and West test statistics are presented in paretheses.

	A. Momentum						B. Value			C. 50/50 Combination			
	(1)	(2)	(3)	(4)	(5)	(6)	(1)	(2)	(3)	(1)	(2)	(3)	(4)
α	0.60	0.81	0.58	0.07	0.14	0.18	0.26	0.38	0.00	0.43	0.52	0.28	0.11
	[3.26]	[4.71]	[2.70]	[0.26]	[0.55]	[0.79]	[2.11]	[2.60]	[0.05]	[4.31]	[5.26]	[2.55]	[0.83]
β_{MKT}		-0.18	-0.11	-0.01	-0.01	-0.02		-0.16	0.01		-0.14	-0.05	-0.01
		[-2.45]	[-1.46]	[-0.11]	[-0.17]	[-0.36]		[-3.62]	[0.21]		[-3.69]	[-1.33]	[-0.23]
β_{SMB}		0.09	0.16	0.26	0.26	0.20		-0.03	-0.06		0.03	0.08	0.13
		[0.81]	[1.49]	[2.56]	[2.71]	[2.05]		[-0.41]	[-0.83]		[0.73]	[1.50]	[2.77]
β_{HML}		-0.37	-0.60		-0.49								
		[-2.67]	[-3.89]		[-3.74]								
β_{CMA}			0.46	0.02	0.33				1.03			0.43	0.33
			[1.72]	[0.09]	[1.39]				[14.39]			[3.98]	[2.78]
β_{RMW}			0.32	0.33	0.26							0.19	0.10
			[1.58]	[1.79]	[1.54]							[1.90]	[1.27]
β_{Debt}				0.98	0.87	0.99							0.38
				[4.04]	[3.54]	[4.15]							[3.11]
β_{SSTK}				0.40	0.62	0.54							0.42
				[1.95]	[2.87]	[2.43]							[4.22]
R^2 (%)		7.27	11.06	18.57	22.51	16.78		6.83	48.64		6.91	21.15	30.42

Table III. Value and momentum performance conditional on financial conditions. This table reports the average returns to value and momentum strategies conditional on proxies for overall financing conditions. BAA10Y is Moody's Seasoned Baa Corporate Bond Yield Relative to Yield on 10-Year Treasury Constant Maturity. *Low* periods denote months where the BAA10Y spread is below its historical average; *High* periods refer to months where the spread is above average. BAA10Y is available for the period January 1986 to December 2019. NFCI is the Chicago Fed's National Financial Conditions Index. Positive values of the NFCI indicate financial conditions that are tighter than average, while negative values indicate financial conditions that are looser than average. NFCI is available from January 1971 to December 2019. STLFI is the St. Louis Fed Financial Stress Index. Negative values suggest below-average financial market stress, indicating easy financing conditions; positive value suggest above-average financial market stress, indicating tight financing conditions. STLFI is available from December 1993 to December 2019. The market state indicator is based on Cooper et al. (2004) indicator, equal to one when the cumulative return on the CRSP value-weighted index over the previous 36 months is negative and zero otherwise. Perfomance is shown for two hodling periods (H): one month (H = 1), and twelve months (H = 12). Test statistics presented in parentheses.

Holding period (H)	$H = 1$		$H = 12$	
	Momentum	Value	Momentum	Value
Panel A. Moody's BAA spread				
Easy	1.64	-0.27	0.63	-0.21
	[3.53]	[-1.02]	[5.03]	[-2.20]
Tight	0.06	0.48	-0.38	0.46
	[0.06]	[1.15]	[-1.51]	[3.92]
Test for equality (Easy - Tight) = 0	[1.55]	[-1.59]	[3.89]	[-4.45]
B. CNFCI Index				
Easy	1.37	0.28	0.53	0.31
	[3.15]	[1.16]	[4.41]	[3.86]
Tight	1.13	0.64	0.23	0.62
	[1.39]	[1.48]	[1.29]	[5.44]
Test for equality (Easy - Tight) = 0	[0.29]	[-0.77]	[1.37]	[-2.14]
C. STLFSI Index				
Easy	1.40	-0.70	0.70	-0.44
	[3.01]	[-2.65]	[5.63]	[-4.76]
Tight	-0.11	0.98	-1.03	0.68
	[-0.07]	[1.88]	[-2.71]	[4.82]
Test for equality (Easy - Tight) = 0	[1.15]	[-3.20]	[5.22]	[-6.89]
D. Market state indicator				
UP Market	1.73	0.06	0.61	0.29
	[3.40]	[0.21]	[4.75]	[3.12]
DOWN Market	0.81	0.79	0.25	0.53
	[1.36]	[2.51]	[1.63]	[5.69]
Test for equality (Easy - Tight) = 0	[1.17]	[-1.71]	[1.82]	[-1.84]

Table IV. Conditional double-sorts on momentum and equity issuance fee dispersion. This table shows the performance of momentum portfolios constructed using dependent double sorts on equity issuance fee dispersion. Issuance fees, expressed as a percentage of amount issued, are obtained from the Thomson One SDC database. Fee dispersion is measured as the standard deviation of the fees paid by each firm in the intersection between CRSP and SDC. The table reports the average return of the high-minus-low past performance portfolio, $\overline{r}^{MOM}$, within each fee dispersion tercile, the Fama and French five factor alpha, α^{FF5}, and the betas with respect to the Fama and French (2015) five factors: the market, β_{mkt}, size, β_{smb}, value, β_{hml}, profitability, β_{rmw}, and investment, β_{cma}. The sample period covers January 1975 to December 2018.

	$\overline{r}^{MOM}$	α^{FF5}	β_{mkt}	β_{smb}	β_{hml}	β_{rmw}	β_{cma}
High	0.59	0.69	0.06	-0.11	0.07	-0.06	-0.36
	[2.64]	[2.97]	[0.84]	[-1.07]	[0.48]	[-0.30]	[-2.44]
(2)	0.07	-0.12	0.13	0.16	-0.00	0.256	-0.04
	[0.43]	[-0.73]	[3.44]	[2.40]	[-0.01]	[2.142]	[-0.56]
Low	-0.11	-0.34	0.24	0.45	0.32	-0.04	-0.38
	[-0.44]	[-1.56]	[2.95]	[3.18]	[1.98]	[-0.23]	[-2.70]

Table V. Conditional double-sorts on momentum and investment. This table shows the performance of momentum portfolios constructed using dependent double sorts on investment. Investment is the year-on-year change in total assets. The table reports the average return of the high-minus-low past performance portfolio, $\overline{r}^{MOM}$, within each investment tercile, the Fama and French five factor alpha, α^{FF5}, and the betas with respect to the Fama and French (2015) five factors: the market, β_{mkt}, size, β_{smb}, value, β_{hml}, profitability, β_{rmw}, and investment, β_{cma}. The sample period covers January 1975 to December 2018.

	$\overline{r}^{MOM}$	α^{FF5}	β_{mkt}	β_{smb}	β_{hml}	β_{rmw}	β_{cma}
High	0.65	0.89	-0.13	-0.09	-0.24	-0.11	-0.07
	[3.68]	[4.61]	[-2.73]	[-1.13]	[-2.44]	[-0.74]	[-0.79]
(2)	0.00	0.04	-0.11	-0.06	-0.03	0.256	0.04
	[0.03]	[0.26]	[-3.47]	[-1.18]	[-0.55]	[2.120]	[0.42]
Low	0.06	-0.02	-0.09	0.03	-0.09	0.487	0.134
	[0.32]	[-0.09]	[-1.56]	[0.25]	[-0.72]	[2.370]	[0.96]

VIII. Figures

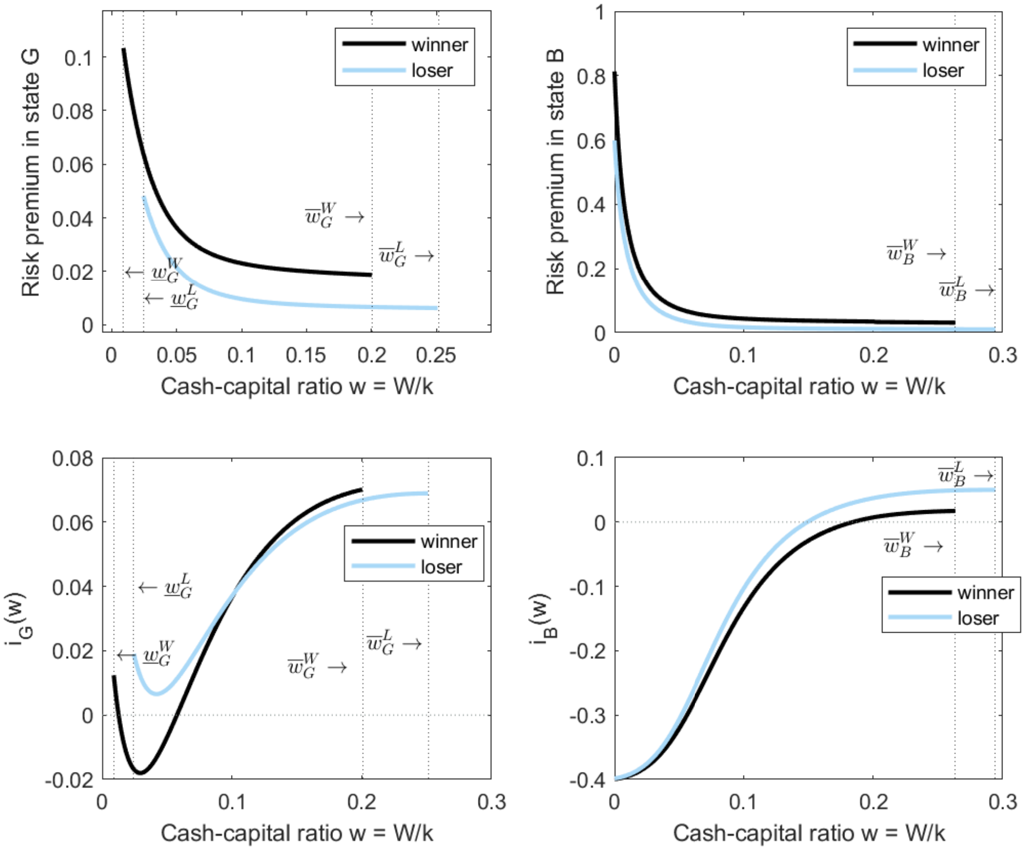

Figure 1. **Momentum effects.** This figure plots the risk premia and investment conditional on the market state for firms that differ in terms of expected cash-flow growth and equity issuance costs. Winner firms have expected cash-flow growth rates: $\alpha_G^W = 24\%$ and $\alpha_B^W = 18\%$ and a fixed cost of issuing equity of $\phi_G^W = 0.5\%$, where G denotes the good state and B the bad state. Loser firms have expected cash-flow growth rates: $\alpha_G^L = 22\%$ and $\alpha_B^L = 20\%$ and a fixed cost of issuing equity of $\phi_G^W = 0.1\%$. All other parameters remain at the same level as those calibrated for the average firm. Panels C and D show the respective investment levels, $i_s(w)$, given the firm cash balance and given the market states$s$.

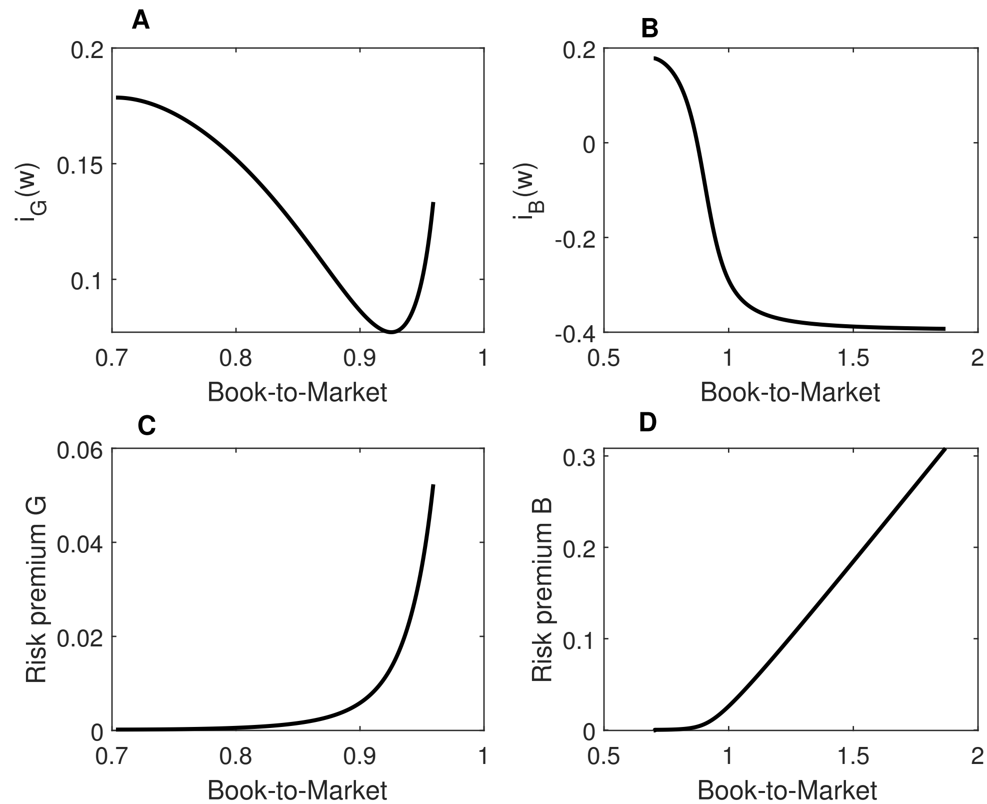

Figure 2. **Value effects.** The plots show how investment and the risk premium in the model change with the book to market ratio. Panels A and B show the relationship between investment and book-to-market during favourable market conditions and unfavourable market conditions, respectively. Panels C and D show the relationship between the total risk premium and book to market during favourable market conditions and unfavourable market conditions, respectively. Results are based on the numerical solution for the average firm.

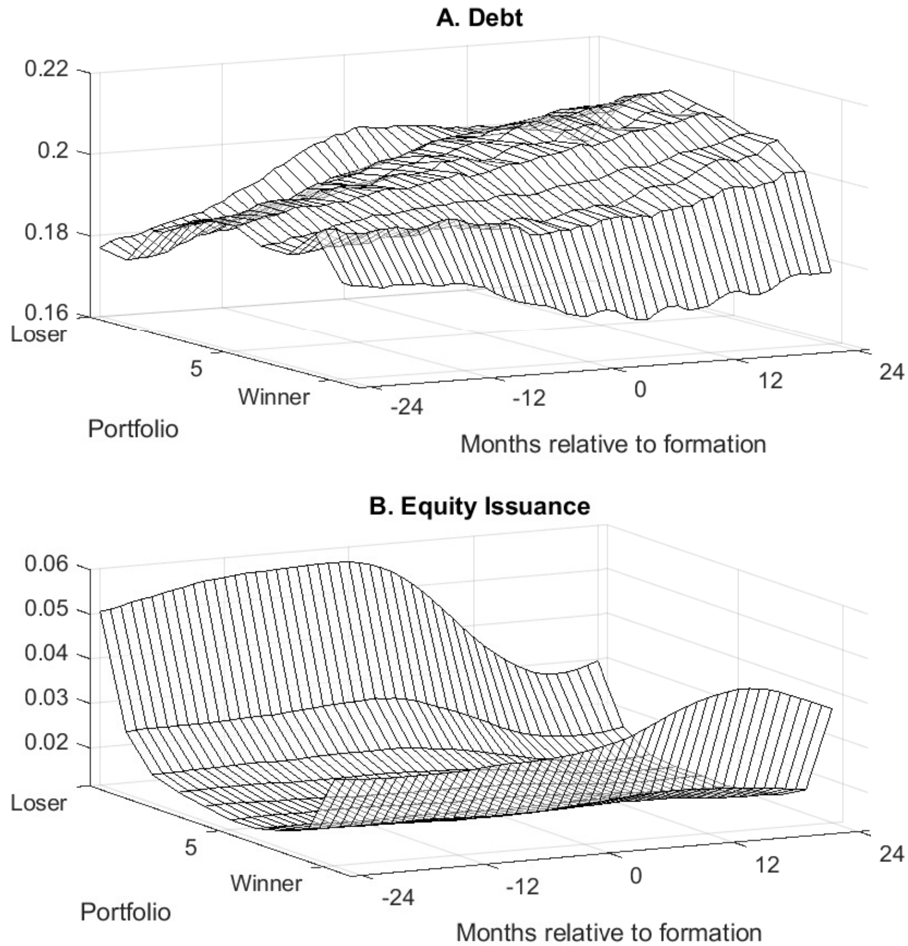

Figure 3. **Evolution of fundamentals for past performance portfolios.** The plots show how average portfolio debt, equity issuance and investment change around momentum portfolio formation. Average debt is the value-weighted average of the debt-to-assets ratio for each of the ten past performance portfolios. The statistics are computed starting from two years before formation, up to two years after.

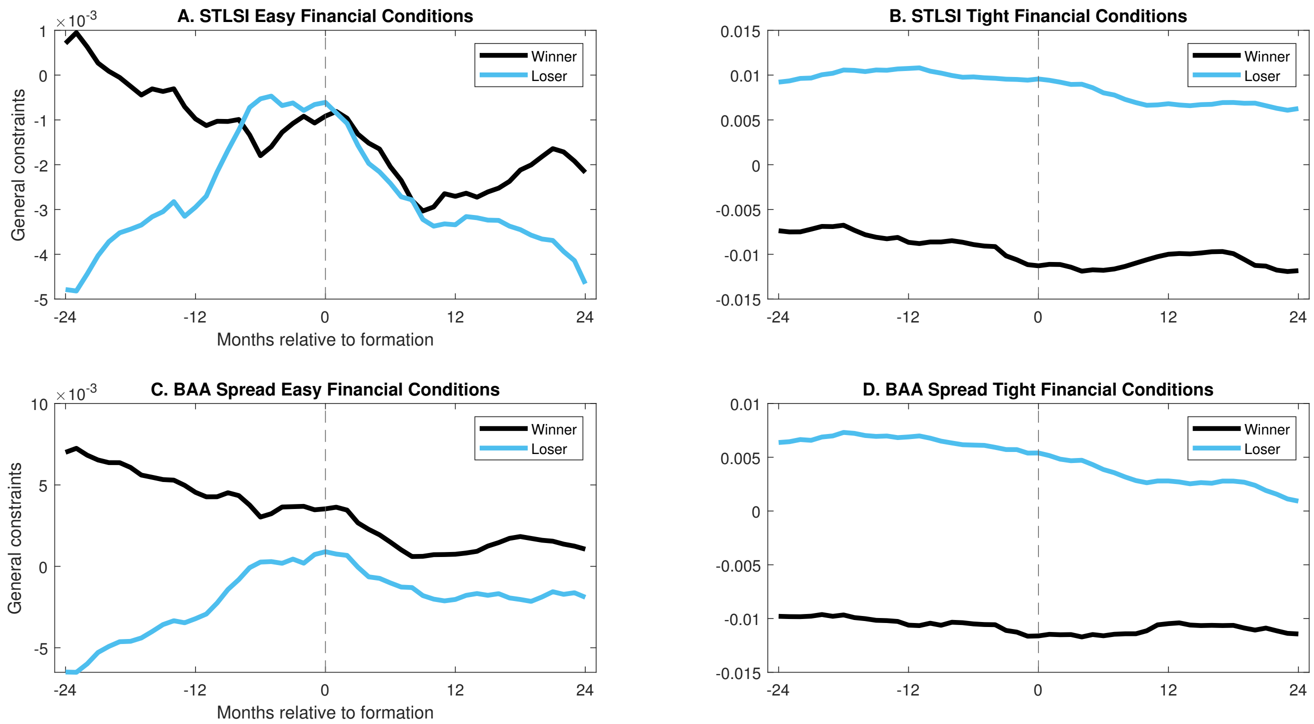

Figure 4. **Momentum General Constraints.** The plots show how average portfolio financing constraints change around momentum portfolio formation conditional on the state of the market. The constraints measure is the Hoberg & Maksimovic (2015) general financial constraint estimate based on textual analysis of the Management Discussion and Analysis (MD&A) section in 10-Ks. The statistics pertain to value-weighted averages, computed starting from two years before formation to two years after. Plots A and B show the evolution of portfolio equity constraint statistics conditional on overall financial conditions being easy or tight as identified by the St. Louis Fed Financial Stress Index (STLFSI). Plots C and D show portfolio statistics when the market financing state is determined based on Moody's BAA Spread. Financing conditions are classified as tight when the spread is above average, and easy otherwise. The period covers January 1997 to December 2015.

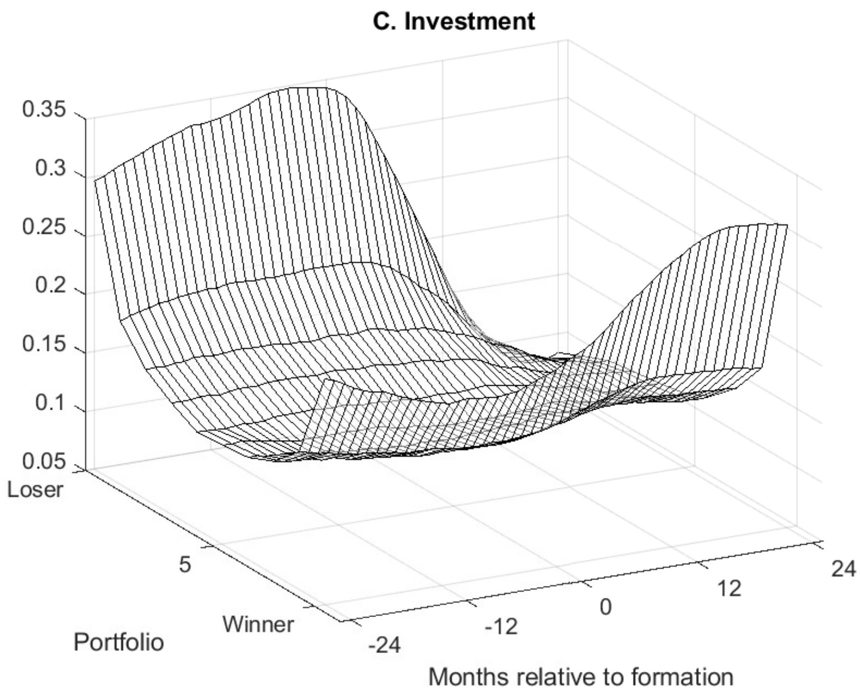

Figure 5. **Evolution of investment for past performance portfolios.** The plots show how average portfolio debt, equity issuance and investment change around momentum portfolio formation. Average debt is the value-weighted average of the debt-to-assets ratio for each of the ten past performance portfolios. The statistics are computed starting from two years before formation, up to two years after.

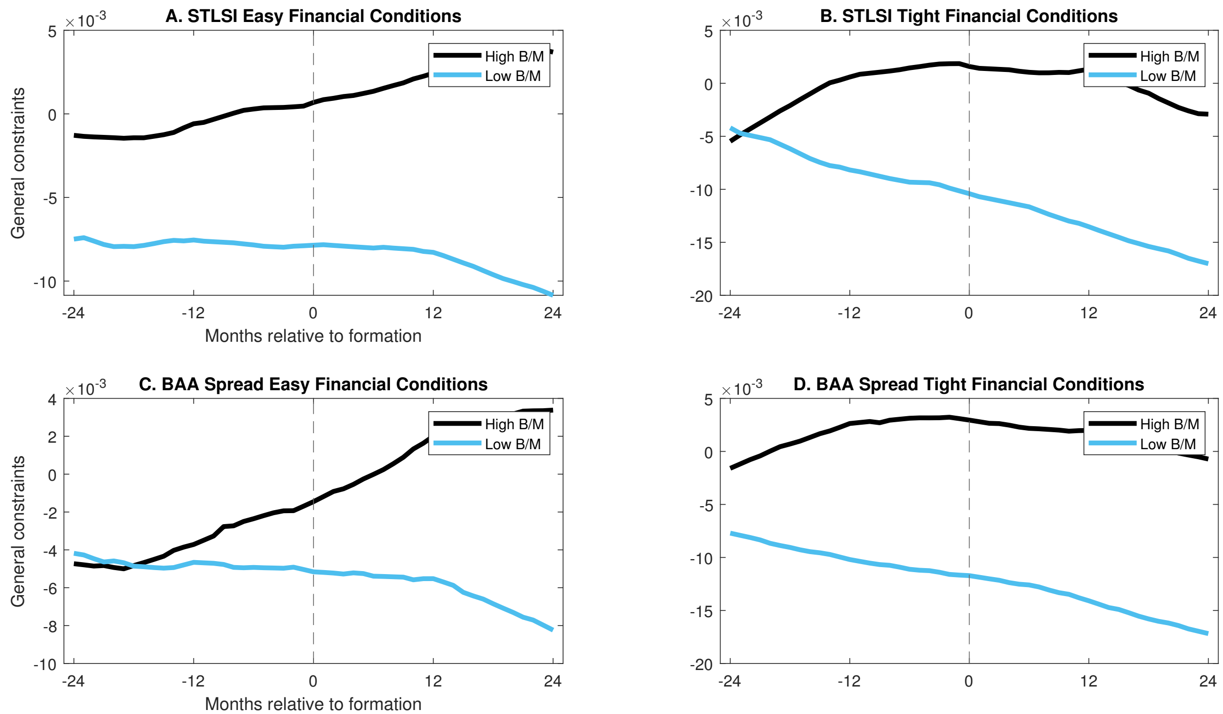

Figure 6. **Value general constraints.** The plots show how average portfolio financial constraints change around value portfolio formation conditional on the state of the market. The constraints measure is the Hoberg & Maksimovic (2015) general financial constraint estimate based on textual analysis of the Management Discussion and Analysis (MD&A) section in 10-Ks. The statistics pertain to value-weighted averages, computed starting from two years before formation to two years after. Plots A and B show the evolution of portfolio equity constraint statistics conditional on overall financial conditions being easy or tight as identified by the St. Louis Fed Financial Stress Index (STLFSI). Plots C and D show portfolio statistics when the market financing state is determined based on Moody's BAA Spread. Financing conditions are classified as tight when the spread is above average, and easy otherwise. The period covers January 1997 to December 2015.

Appendix A. The model

The basic model setup is similar to Bolton et al. (2011),DeMarzo, M. Fishman & Wang (2012) and Bolton et al. (2013). The model considers a financially constrained firm that faces stochastic investment and financing opportunities. The firm can be in one of two possible states of the world, denoted by $s_t = G, B$. State G represents the good state of the world and state B represents the bad state of the world. Investment and external financing opportunities are better in the good state G and worse in the bad state B. States differ in terms of the growth rates in expected cash flows (investment opportunities) and the costs of external financing (financing opportunities). There is a constant probability, ζ_s, that the economy switches from the current state s to state s^-, where s^- denotes a state that is different form s. External financing opportunities involve new equity and credit lines.

Production requires two inputs, cash and capital. The firm buys and sells capital at a price of one. The following accounting identity applies to the firm's capital stock:

$$dK_t = (I_t - \delta K_t)\, dt, \quad t \geq 0, \tag{A1}$$

where K denotes the capital stock, I denotes investment and $\delta \geq 0$ the rate of capital depreciation.

Firm cash flows are subject to shocks, dA_t, that follow an arithmetic Brownian motion:

$$dA_t = \mu(s_t)dt + \sigma(s_t)dZ_t^A, \tag{A2}$$

where Z_t^A is a standard Brownian motion, and $\mu(s_t)$ and $\sigma(s_t)$ represent the drift and volatility in state s.

Operating revenues are proportional to capital and given by $K_t\, dA_t$ (AK production technology). The operating profit of the firm is also proportional to capital and given by:

$$dY_t = K_t dA_t - I_t dt - \Gamma(I_t, K_t, s_t)dt, \quad t \geq 0, \tag{A3}$$

where I_t is investment over the time increment dt, $\Gamma(I_t, K_t, s_t)$ is the investment adjustment cost. The cost of adjusting investment can change depending on the state of the world. It is assumed to be homogeneous of degree one in I and K. Denoting the firm's investment to capital ratio as i ($i = I/K$), the investment adjustment cost can be expressed as:

$$\Gamma(I_t, K_t, s_t) = g_s(i)\, K,$$

where $g_s(i)$ is increasing and convex. $g_s(i)$ is given by:

$$g_s(i) = \frac{\theta_s (i - \nu_s)^2}{2}, \tag{A4}$$

where θ_s is the investment adjustment cost parameter in state s and ν_s a constant.

At any time τ_0, shareholders can liquidate firm assets. A constant fraction $l > 0$ of the firm's capital stock determines the realized value upon liquidation L_t, given by:

$$L_t = l\, K_t.$$

The firm can use cash holdings to cover potential losses and finance investment. Let W_t denote the firm's cash holdings at time $t > 0$. Cash within the firm earns a lower rate of return compared to the risk-free rate, $r(s_t)$, making it costly. Let $\lambda > 0$ denote the carry cost of cash. The firm's optimal cash policy involves weighting the marginal cost of carrying cash against the marginal benefit of holding cash. When cash holdings exceed a certain level, the marginal value of cash outside the firm exceeds the marginal value of cash inside the firm. Distributing cash to shareholders at this point becomes optimal. Distributions can take the form of either dividends or share repurchases.

The firm can also use external financing to cover potential losses and finance investment. External financing involves credit lines and new equity issues. Only a fixed portion of the firm's capital, $c > 0$, is posted as collateral for the credit line. This limits the credit line draw down to an amount of cK. Credit line access involves a cost in the form of a spread of α_s over the risk-free rate on the amount borrowed.

External equity financing is also costly. As in Bolton et al. (2013), the costs of equity issuance involve a fixed component, $\phi_s K$, where ϕ_s is the fixed cost parameter in state s, and a proportional component, $\gamma_s > 0$, where γ_s is the marginal cost parameter in state s. The fixed cost of equity issuance scales with size to ensure that the firm does not grow out of this cost. This assumption also preserves the model's homogeneity in the capital stock K. Let dX_t denote the cost of issuing a net amount of equity of dH_t. The total cost of issuing new equity is given by $dX_t = \phi_{s_t} K_t 1_{dH_t > 0} + \gamma_{s_t} dH_t$.

The relative costs of holding cash, drawing down the credit line and issuing new equity determine the pecking order between internal funds, external borrowing and external equity financing. In the baseline calibration, the firm first exhausts its cash holdings, then accesses a credit line. When the optimal maximum credit line draw down is reached, the firm issues equity. With stochastic equity financing opportunities, the firm optimally chooses to tap the equity market sooner than it would if financing opportunities did not change. The optimal maximum credit line draw down in this set up is, as a result, smaller in good times.

Having specified production technology and financing, the dynamics of the firm's cash holdings can be expressed by:

$$dW_t = (r(s_t) - \lambda)W_t dt + dY_t + dF_t - dD_t \tag{A5}$$

where dD_t is the dividend paid over the time increment dt and $dF_t = dH_t + cdK_t$ is the net external financing for the same time increment, including both equity and credit lines. Equation (5) is an accounting identity where distributions to shareholders and external financing are endogenously determined. Cash reserves increase with the interest earned on the existing cash balance (the first term), the firm's operating profit (the second term) as well as any external financing obtained over the period (the third term). Cash reserves decrease with any distributions to shareholders (the last term).

Appendix I. Systematic risk and the pricing of risk

This model incorporates two sources of systematic risk: (1) a small diffusion shock to cash flows and (2) a large shock when the economy switches from one state to another. With risk-averse investors, the physical and risk-neutral probability measures are distinct. The diffusion shocks to productivity correlate with the aggregate market with a correlation coefficient of ρ_s. Each state of the economy assumes a constant market price of risk, denoted as η_s. Under the risk-neutral measure $\mathbb{Q}$, the firm's cash flow shocks are given by:

$$dA_t = \hat{\mu}_s + \sigma_s d\hat{Z}_t^A, \tag{A6}$$

where $\hat{Z}_t^A$ is a standard Brownian motion under the risk-neutral measure $\mathbb{Q}$ and $\hat{\mu}_s$ is the risk-adjusted drift of the cash flow process in state s. This can be written as:

$$\hat{\mu}_s = \mu_s - \rho_s \eta_s \sigma_s. \tag{A7}$$

Similar to Bolton, Chen and Wang (2013), the wedge between the transition intensity under the physical probability measure and the transition intensity under the risk-neutral measure represents the risk premium associated with the risk of the economy switching states. Let $\hat{\zeta}_G$ denote the transition intensity from the good state G to the bad state B and $\hat{\zeta}_B$ denote the transition intensity from the bad state G to the good state B, both under the risk-neutral measure. The risk-adjustments related to state switching are then given by:

$$\hat{\zeta}_G = e^{\kappa_G} \zeta_G \quad and \quad \hat{\zeta}_B = e^{\kappa_B}, \tag{A8}$$

where κ_G and κ_G represent the risk adjustments associated with the change of state. The transition intensity out of state G (B) is higher (lower) under the risk-neutral measure compared to the physical measure. This implies $\kappa_G = -\kappa_B > 0$.

Appendix II. Firm optimality

Management chooses investment, external financing, cash savings and payout policies and liquidation time to maximize shareholder value. In each state of the economy s, there are two state variables in the firm's optimization problem: firm size K_t and the cash balance W_t.

$$P(K, W, s) = \max_{L,I} \mathbb{E}_0^{\mathbb{Q}} \left[\int_0^{\tau_o} e^{-\int_0^t r_u du} dU_t + e^{-\int_0^{\tau_0} r_u du} (L_\tau + W_\tau) \right] \tag{A9}$$

where $dU_t = dD_t - dF_t$ represents the net payouts to shareholders and r_u is the interest rate at time u. The first term in equation (B9) is the present discounted value of net payouts to incumbent shareholders until the liquidation time τ_0. The second term represents the present discounted value of the firm in the event of liquidation.

Appendix III. Model solution

The solution to problem (B9) requires specification of the firm's optimal financing, payout and liquidation policies. Consider first financing and liquidation. The firm chooses to exhaust its cash holdings before accessing external markets. Cheaper internal funds make this an optimal decision. Only when the cash balance reaches zero does the firm consider external financing. At this point, the firm either obtains external funds or liquidates. If the cost of external financing is not too high, the firm starts to draw down a credit line. The firm draws down the credit line up to a limit $\underline{W}_s < 0$ that represents the lower boundary for the firm's cash to capital ratio. The lower boundary equals the credit line limit $-c_s$ in each state of the economy. Different investment and financing opportunities in each state determine different lower boundaries/credit line limits.

Consider next payout policy. The benefit of cash holdings is highest at low levels because of the need to delay costly external financing or avoid inefficient liquidation. This implies that at high levels of cash holdings their benefit is low and might become lower than the carry costs. Because shareholders can invest this cash at the risk-free rate, which is higher than the rate cash earns inside the firm, the marginal benefit of cash outside the firm becomes higher than the marginal benefit of cash inside the firm. At this point it becomes optimal to distribute excess cash to shareholders. Optimality then suggests that there is a target cash level $\overline{W}_s$ for each state s, where the marginal benefit of cash is equal to its marginal cost, with any excess cash over this level being distributed to shareholders.

To solve for firm value, consider first the interior region $(0, \overline{W}_s)$ for $s = G, B$. In this region, the firm does not distribute cash to shareholders nor obtain external financing. Firm value in this region satisfies the following ODE:

$$\begin{aligned} r_s P(K,W,s) = \max_I \; & [(r_s-\lambda)W + \hat{\mu}_s K - I - \Gamma(I,K,s)]P_W(K,W,s) \\ & + \frac{\sigma_s^2 K^2}{2} P_{WW}(K,W,s) + (I-\delta K)P_K(K,W,s) \\ & + \hat{\zeta}_s(P(K,W,s^-) - P(K,W,s)) \end{aligned} \tag{A10}$$

where P_W denotes the first order derivative of the firm value function with respect to the cash balance W, P_K denotes the first order derivative of the firm value function with respect to capital K and P_{WW} denotes the second order partial derivative with respect to the cash balance. The left-hand side of (B10) represents the required rate of return for investing in the firm. Under the risk-neutral measure, $\mathbb{Q}$, this is the risk-free rate. The first and the second term on the right-hand side of equation (B10) represent the effects of changes in cash holdings and their volatility on firm value. The third term captures the marginal effects of investment. The last term represents the expected change in firm value when the state changes from s to s^-.

Firm value is homogeneous of degree one in capital K and cash W in each state. This allows to define the problem as a function of only one state variable based on the ratio of cash-to-capital $w = W/K$. Firm value can, therefore, be written as:

$$P(K,W,s) = p_s(w)K,$$

where $p_s(w)$ represents the scaled value function in state s. This makes it possible to rewrite the shareholders' optimization problem in $(0, \overline{w})$ as:

$$r_s p_s(w) = \max_{i_s} \left[(r_s - \lambda)w + \hat{\mu}_s - i_s - g_s(i_s)\right] p_s'(w) + \frac{\sigma_s^2}{2} p_s''(w) + (i_s - \delta)(p_s(w) - w p_s'(w)) + \hat{\zeta}_s (p_{s^-}(w) - p_s(w)) \tag{A11}$$

The first-order condition for the investment-to-capital ratio $i_s(w)$ is:

$$i_s(w) = \frac{1}{\theta}\left(\frac{p_s(w)}{p_s'(w)} - w - 1\right) + v_s, \tag{A12}$$

where $p_s'(w) = P_W(K, W, s)$ is the marginal value of cash in state s.

When the marginal source of financing is the credit line, that is the region $(\underline{W}_s, 0)$, firm value solves the following ODE:

$$r_s P(K, W, s) = \max_{I} \left[(r_s + \alpha)W + \hat{\mu}_s K - I - \Gamma(I, K, s)\right] P_W(K, W, s) + \frac{\sigma_s^2 K^2}{2} P_{WW}(K, W, s) + (I - \delta K) P_K(K, W, s) + \hat{\zeta}_s (P(K, W, s^-) - P(K, W, s)), \tag{A13}$$

where α is the spread over the risk-free rate that the firm pays when the credit line is used. Similarly to the first region, the cash-to-capital ratio can be used as the one state variable in the optimisation problem. Equation (B13) can then be re-written as:

$$r_s p_s(w) = \left[(r_s + \alpha)w + \hat{\mu}_s - i_s - g_s(i_s)\right] p_s'(w) + \frac{\sigma_s^2}{2} p_s''(w) + (i_s - \delta)(p_s(w) - w p_s'(w)) + \hat{\zeta}_s (p_{s^-}(w) - p_s(w)) \tag{A14}$$

When cash holdings exceed the upper payout boundary $(W \geq \overline{W}_s)$, the firm starts to distribute cash to shareholders. For each state s, the payout boundary $\overline{w}_s = \overline{W}_s/K$ satisfies the following value matching condition:

$$p_s'(\overline{w}) = 1. \tag{A15}$$

Optimality also requires the the super contact condition (Dumas, 1991):

$$p_s^{''}(\overline{w}) = 0. \tag{A16}$$

When cash holdings exceed the target, in each state s, the firm pays the excess over the target to current shareholders. This means that firm value above the payout boundary ($w > \overline{w}_s$) is given by:

$$p_s(w) = p_s(\overline{w}_s) + w - \overline{w}_s. \tag{A17}$$

Cash distributions to shareholders occur following increases of the cash-to-capital ratio due to cash-flow shocks or when the state switches from s to s^- and the current cash balance is above $\overline{w}_{s^-}$.

The firm will issue equity only after it reaches its optimal maximum credit line draw down. This means that $-c$ equals the lower boundary for equity issuance, $\underline{w}_s$. This boundary can be crossed either due to declines in the cash-to-capital ratio related to diffusion shocks or when the economy switches from state s to state s^- and the current cash-to-capital ratio is below the new credit line limit ($w < -c_{s-}$). In each state s, when the cash balance is below $-c_s$, firm value satisfies:

$$p_s(w) = p_s(m_s) - \phi_s - (1 + \gamma_s)(m_s - w). \tag{A18}$$

At the external equity financing boundary $-c_s$, the following value matching and smooth pasting conditions apply:

$$p_s(-c_s) = p_s(m_s) - \phi_s - (1 + \gamma_s)(m_s + c), \tag{A19}$$

$$p_s^{'}(-c_s) = 1 + \gamma_s. \tag{A20}$$

The firm value function is continuous and smooth everywhere, and therefore two additional boundary conditions are needed when the cash balance reaches zero. At each point, the firm compares continuation value to liquidation value. If the liquidation value is higher, shareholders choose to liquidate. Because the firm's capital is always productive, the firm never voluntarily liquidates before it runs out of cash. In the case of liquidation, firm value is given by:

$$p_s(0) = l_s. \tag{A21}$$

Enterprise value represents firm value net of the value of short-term illiquid assets. In the model, it is then defined as $P(K, W, s) - W$. Average q is defined as the ratio between enterprise value and the capital stock,

$$q_s(w) = \frac{P(K, W, s) - W}{K} = p_s(w) - w. \tag{A22}$$

The sensitivity of average q relative to changes in the cash-to-capital ratio measures how much enterprise value changes with an extra dollar of cash inside the firm. It is given by:

$$q_s^{'}(w) = p'_s(w) - 1. \tag{A23}$$

Appendix B. Calibration

Table VI. Benchmark parameter values. This table lists the benchmark parameter values used to solve and simulate the model with market timing of equity as well as the one where credit lines are allowed. All parameters are presented in annualized form.

Parameter	Value state G	Value state B	Description
r	5%	5%	Risk-free rate
δ	15%	15%	Rate of capital depreciation
μ	22.7%	22.7%	Expected productivity shock
σ	12%	12%	Volatility of productivity shock
θ	1.8	1.8	Investment adjustment cost parameter
ν	15%	15%	Center of adjustment cost parameter
λ	1.5%	1.5%	Carry cost of cash
γ	10%	10%	Marginal cost of equity issuance
ρ	0.4	0.4	Correlation between Z_t^A and Z_t^M
η	0.4	0.4	Price of risk for technology shocks
ζ_s	0.1	0.5	State transition intensity
l_s	1	0.4	Liquidation value of capital
ϕ_s	0.1%	30%	Fixed cost of equity issuance
κ_s	ln(3)	-ln(3)	Price of risk for financing shocks
α_s	1.5%	1.5%	Cost of credit line, spread over risk-free rate