Financing Asset Sales and Business Cycles

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Abstract

Using a dynamic model of financing, investment, and macroeconomic risk, we investigate when firms sell assets to fund investments (financing asset sales) across the business cycle. The model reveals that financing asset sales entail a lower wealth transfer from equity to debt than otherwise identical but equity financed investments. Exploring the dynamics of this motive across business cycles helps explain novel stylized facts about asset sales and their business cycle patterns that cannot be rationalized by traditional motives for selling assets.

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1. Introduction

A crucial component of corporate investment decisions relates to the choice of the funding source. In practice, asset sales play an important role for investment financing. For instance in 2011, Thomson Reuter’s announced to raise about USD 1 billion by selling two businesses to fund investments. One year later, Petrobras communicated large asset sales to contribute to the financing needs of nearly USD 15 billion to fund its five-year investment plan. The average proceeds from fixed asset sales correspond to roughly 44% of the average net amount of newly issued equity for U.S. manufacturing firms in Compustat between 1971 and 2010. Similarly, Eisfeldt and Rampini (2006) report that capital reallocation comprises 24% of investment in aggregate. Moreover, Eckbo and Kisser (2015) find that when additionally incorporating liquid assets, the average proceeds from asset sales are approximately the same as the proceeds from the issue of equity plus debt securities, which suggests that asset sales may be higher up in the financing pecking order than previously believed. Yet, asset sales are not a typical financing margin in the academic literature that has documented firm financing variation across business cycles (e.g. Korajczyk and Levy 2003).

This paper studies the decision of firms to sell assets to fund investments (financing asset sales) across business cycles. We show that the cyclicality of a firm’s financing asset sale policy crucially depends on the cyclicality of its growth opportunities, and on the external financing frictions. Investigating the cyclicality of financing asset sales is interesting for several reasons. First, while the cyclicality of external financing sources is intensively studied in the recent literature, the cyclicality of financing asset sales is not discussed (e.g. Covas and Haan 2011). Second, previous work finds that business cyclicality is important to understand financing and investment decisions, as well as to evaluate the cost of debt overhang (e.g., Chen and Manso 2013). Third, changes in the amount or the source of funds that firms raise during an economic downturn affect their capital expenditures and financial positions, which in turn influence the impact and magnitude of a recession.

As a first step of our study, we uncover empirical facts on financing asset sales for a large sample of U.S. manufacturing firms that cannot be explained with traditional motivations for asset sales, such as financial constraints or distress (e.g., Bates 2005, Hovakimian and Titman 2006). Because the motive behind asset sales is unobservable in the data, we focus on the correlation between asset sales and investment as a proxy for the policy of firms regarding their sales of assets to finance investment. The idea behind this approach is that a more frequent use of asset sales to finance investment should lead to a stronger tendency of firms to invest and sell assets contemporaneously. We find that the correlation is (i) more pronounced for firms with higher financial leverage, (ii)
countercyclical, (iii) more countercyclical for firms with less procyclical investment opportunities, and (iv) more countercyclical for firms with lower external financing frictions.

To explain these stylized facts, we consider a dynamic model of financing, investment, and macroeconomic risk to investigate when firms sell assets to fund investments across business cycles. The model environment features business cycle dependence of the equity issuance cost, the asset liquidity, and the growth option. It produces endogenous variation of investment, equity financing, and financing asset sale decisions across business cycles. The analysis starts with a typical firm at time zero that consists of assets in place and a growth option. The firm is optimally financed with equity and risky debt. When the firm exercises the growth option, it is subject to a debt overhang problem in the spirit of Myers (1977). Specifically, the total asset volatility decreases and total earnings increase, which reduces the riskiness of debt. Hence, investment creates a wealth transfer from equityholders to debtholders.

The investment cost of the growth option can be financed by issuing new equity or by selling assets in place. In essence, equityholders select the funding source by assessing an intuitive trade-off. Selling assets when exercising the growth option reduces the substance of the remaining firm assets, which makes debt riskier and hence produces a reverse wealth transfer from debtholders to equityholders that mitigates the wealth transfer due to investment. As a result, equityholders trade off the incremental (or net) friction cost of selling assets relative to the equity issuance cost against the reduction in the wealth transfer problem with asset sales when selecting the optimal funding source.

This trade-off rationalizes the above-mentioned empirical patterns in the data. The wealth transfer problem is larger for more leveraged firms because debt is riskier and, hence, more sensitive to earnings and asset volatility changes. As a consequence, equityholders of more leveraged firms have a stronger incentive to use financing asset sales, which explains stylized fact (i). By exploring the dynamics of the trade-off across the business cycle, the model allows us to examine the endogenous relation between business cycles and financing asset sales. Equityholders delay investment in bad compared to good business cycle states. At the same time, however, the decline in a firm’s asset value results in a higher leverage at investment in bad states. As the wealth transfer problem is more pronounced for a larger leverage at investment, equityholders have a stronger incentive to finance the investment by selling assets in bad compared to good states. This finding rationalizes our empirical regularity (ii). The model also implies that the difference between the leverage at the optimal investment threshold in bad cycles and that in good cycles is more pro-

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1 See, for example, Hackbarth, Miao, and Morellec (2006), Bhamra, Kuehn, and Strebulaev (2010), Chen (2010), and Arnold, Wagner, and Westermann (2013).
nounced for firms with a more procyclical expansion option. That is, the wealth transfer problem at investment is particularly countercyclical for firms with a less procyclical growth option. Thus, the model predicts that firms with a less procyclical growth option should exhibit a more countercyclical tendency to select financing asset sales at investment, which is consistent with finding (iii). Finally, we also analyze the impact of cross sectional differences in financing frictions on the cyclicality of financing asset sales. The trade-off that we investigate between the incremental friction cost of selling assets over the equity issuance cost and the reduction in the wealth transfer only drives equityholders’ financing decision if the equity issuance cost is smaller than the cost of selling assets. Thus, the countercyclicality of financing asset sales is caused by firms with relatively low external financing frictions, which rationalizes result (iv).

In addition, the model sheds light on the quantitative impact of financing asset sales on firm value and corporate policies. Financing asset sales affect the friction cost of investment funding, the wealth transfer problem, and expected future firm substance. Depending on the quantitative importance of these three channels, firm value can increase by more than two percent from the possibility to finance investment with asset sales. For some parameters, however, asset sales reduce ex ante firm value whereas equityholders prefer this financing source ex post due to the wealth transfer problem. In this case, a covenant that prohibits financing asset sales can increase firm value. Exploring the dependence of the value of an asset sale covenant to firms allows us to explain empirical covenant patterns and to derive novel predictions. We also show that financing asset sales accelerate investment, and reduce leverage.

To analyze the dynamic features of the model, we generate simulated panels of model-implied firms that are structurally similar to the Compustat sample. Our simulated panels feature business cycle patterns on investment, equity financing, asset values, coverage ratios, and q values that are similar to those observed in the data. Additionally, the model-implied dynamic patterns of financing asset sales reflect the stylized time series and cross sectional patterns on asset sales and investment that we present in the empirical analysis. The simulations also generate novel testable predictions for asset sales, equity financing, and investment across business cycles.

Our contribution is three-fold. First, our paper provides empirical evidence and theoretical insights that improve our understanding of asset sales as an investment financing margin. In particular, we show that agency conflicts between debt and equity, and their dynamics over the business

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2 We also show that it is important to disentangle the impact of risk aversion and elasticity of intertemporal substitution on the financing asset sale policy. While risk aversion hardly influences the propensity of firms to select financing asset sales, the latter become more important when the elasticity of intertemporal substitution increases.
cycle are important and heretofore neglected determinants of asset sales. Thereby, we complement previous work that associates asset sales with alternative motives. Asquith, Gertner, and Scharfstein (1994), Brown, James, and Mooradian (1994), and Weiss and Wruck (1998) analyze the role of financial distress for asset sales, while Hovakimian and Titman (2006) and Campello, Graham, and Harvey (2010) focus on financial constraints. Warusawitharana (2008) argues that asset reallocations are mainly driven by firm-specific productivity shocks. More recently, Edmans and Mann (2013) revisit the pecking order theory by examining the relative information asymmetry associated with issuing equity and selling assets. Lang, Poulsen, and Stulz (1995), and Bates (2005) focus on the trade-off between investment efficiency and agency costs of managerial discretion associated with selling assets. Morellec (2001) also considers agency conflicts between debt and equity. He highlights that asset liquidity increases the debt capacity only when bond covenants restrict the disposition of assets close to bankruptcy. In contrast, we model asset sales to fund investment and analyze for which firms it is optimal to negotiate debt covenants that admit financing asset sales.

Second, we contribute to the work on business cycles and corporate financial policies. Recently, Chen and Manso (2013) emphasize the cyclical nature of growth opportunities, and the increase of debt overhang in bad states. Begenau and Salomao (2015) explain how large and small firms choose between debt- and equity financing across business cycle. Jermann and Quadrini (2012) investigate how the pecking order between equity and debt is affected by aggregate financial shocks. Neither of these papers considers asset sales. We show that incorporating business cycles is crucial to jointly explain the choice of asset sales as a funding source and firms’ investment decision. While the effect of cyclicality on asset sales through the productivity channel is already explored (e.g. Maksimovic and Phillips 2001, Yang 2008), the impact of cyclicality through the financing channel has so far been neglected. Our findings on the cyclical nature of financing asset sales also complement the literature on the importance of external and internal resources during bad economic states.

Third, this paper relates to a growing field in corporate finance that uses model-simulated data sets to explain stylized facts in real firm data (see e.g. Gomes and Livdan 2004, Hennessy and Whited 2005, Hennessy and Whited 2007, Strebulaev 2007). As endogeneity problems can even be hard to resolve with an appropriate empirical identification strategy, we use model-simulated data to gauge the potential drivers behind the patterns of the relation between financing asset sales and business cycles that we observe in the real data.

3 In this regard, our covenant related results also relate to the empirical literature on the use of asset sale covenants (e.g., Smith and Warner 1979, Bradley and Roberts 2004, Chava, Kumar, and Warga 2010).

4 See, e.g., Choe, Masulis, and Nanda (1993), Duchin, Ozbas, and Sensoy (2010), Lemmon and Roberts (2010), Campello, Graham, and Harvey (2010), and Covas and Haan (2011).
The paper proceeds as follow. In Section 2, we establish empirical facts on the correlation between asset sales and investment. Section 3 introduces the model. Section 4 presents the model solution, and Section 5 derives the predictions generated by the model for a typical firm at initiation. Finally, we simulate model-implied economies of firms to analyze the aggregate dynamics of financing asset sales in Section 6. Section 7 concludes.

2. Stylized facts

In this section, we present empirical patterns of financing asset sales for a sample of 3,022 U.S. manufacturing firms over the 1971–2010 period. The asset sales data in Compustat (item SPPE) does not reveal the motive behind these transactions. Hence, we identify firm characteristics and business cycle related factors that increase the correlation between asset sales and investment. The idea behind this approach is that a more pronounced use of asset sales as an investment funding source should result in a higher correlation between contemporaneous investment and asset sale. Moreover, focusing on this correlation allows us to abstract away from fire sales of financially distressed firms. The reason is that it is unlikely that distressed firms tend to invest heavily in those periods, in which they are forced to sell assets to repay their debt.

Table 1 reports results for OLS panel regressions that explore the correlation of asset sales with investment, leverage, the cyclicality of a firm’s growth opportunities, financial constraints and other controls for various firm characteristics. We include industry fixed effects. The standard errors are autocorrelation robust and clustered at the industry level, and the $R^2$s are adjusted for the number of variables in the regression.

| Column (I) investigates the relation of asset sales and investment controlling for Tobin’s $q$, financial flexibility (cash flow and financial slack), coverage ratio, leverage, and asset volatility. The estimation shows that asset sale and investment exhibit a significantly positive correlation. Cash flow, asset volatility, and $q$ exhibit a negative significant regression coefficient, while financial slack and coverage ratio are not significantly correlated with asset sale. The positive significant association... |

5  All variable definitions, data cleaning filters and summary statistics for the Compustat sample are provided in Appendix A.
6  Our qualitative results are robust to using two-step GMM estimations, a Tobit model to incorporate that most firms do not sell assets frequently, and two-way clustering at the year and the industry level or, alternatively, at the year and the firm level.
tion between asset sale and investment suggests that financing asset sales are a potential source of investment funding. However, we cannot interpret this correlation by itself as an indicator of what may be a potential driver for firms to use financing asset sales.

To explore this question, we first investigate factors known to be related to the wealth transfer problem. For instance, the wealth transfer problem increases with leverage (see e.g. Myers 1977). Hence, in column (II), we analyze the impact of leverage on the relation between asset sale and investment by using an interaction term of investment and leverage. We find that the correlation between asset sale and investment increases with leverage, which suggests that leverage enhances the motive to select asset sales as an investment financing source. Moreover, investment and leverage coefficients become insignificant when we add the interaction term between investment and leverage.

Chen and Manso (2013) show that the wealth transfer problem is more severe in bad states of the business cycle. Hence, we analyze how the correlation between asset sale and investment is related to macroeconomic conditions. In column (III) of Table 1, we additionally incorporate the interaction between investment and a dummy that is equal to one in a bad business cycle state. The positive significant coefficient on this interaction term shows that the correlation between investment and asset sales is higher in downturns, i.e., the financing asset sales policy is countercyclical. This finding emphasizes the importance of recognizing business cycle dynamics when explaining the positive correlation of investment and asset sale.

Next, we link financing asset sales to the cyclicality of growth opportunities. To this end, we add in column (IV) the correlation between a firm’s growth opportunity and the aggregate business cycle state. To construct this correlation measure, we estimate 5-year rolling window correlations between the firm individual $q$ and the aggregate sales growth in our entire sample. A high correlation between a firm’s growth opportunity and the aggregate business cycle state indicates more procyclical expansion opportunities. We additionally incorporate an interaction term that is the product of three variables: investment, a dummy that is equal to one if the sample economy is in a bad state and zero otherwise, and our measure for the cyclicality of the expansion option. We find a negative coefficient for the interaction term between investment, business cycle states, and

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7 In unreported regressions, we replace the dependent variable by net equity issuance. We find that the coefficient estimate of the interaction term of investment and leverage is negative and not significant.

8 For a bad business cycle year, the aggregate sales growth and the average annual equity return across sample firms are both in the bottom 25% of all years. We choose this definition of a downturn because sales growth combined with market based downturn measures are a direct measure of the propagation of positive and negative shocks from the aggregate economy onto the corporate level (see also the downturn definitions in e.g. Opler and Titman 1994, Gibson, John, and Lang 1990).

9 We scale the firm individual $q$ by the SIC3-industry average $q$ to control for industry effects. Using larger windows for the correlation measure within a reasonable range (e.g., seven years) has no qualitative effect on the results.

10 The 25% quantile of the correlation distribution is -0.5, the median is 0.02, and the 75% quantile is 0.56.
the cyclicality of a firm’s growth opportunities. Hence, the correlation between asset sales and investment is more countercyclical for firms with less cyclical expansion options.\footnote{\textsuperscript{11}}

The previous results indicate along several dimensions that the correlation between asset sales and investment increases with firm characteristics that indicate a higher wealth transfer problem. An alternative explanation of our results could arise from the supply side of capital that constitutes a widely discussed determinant of asset sales (e.g. Lang, Poulsen, and Stulz 1995, Hovakimian and Titman 2006, Bates 2005). For instance, high leverage firms may face a larger cost of issuing debt and equity which forces them to sell more assets, particularly during bad business cycles. To test for a financial constraints explanation of our results, we add in column (V) the SA-index as a proxy for the financing constraints of firms.\footnote{\textsuperscript{12}} Higher values of this index indicate lower external financing constraints of a firm. We also incorporate the triple interaction of the SA-index with investment and the business cycle state. Comparing columns (III) and (V) shows that the coefficients on the interaction of leverage with investment and of the business cycle state with investment are robust to controlling for financial constraints. Thus, supply side effects do not rationalize our result that leverage and the business cycle exhibit a significant association with the correlation between asset sales and investment. In addition, the positive coefficient of the triple interaction in column (V) suggests a cross sectional refinement of our result on the cyclicality of financing asset sales. Specifically, the financing asset sales policy is more countercyclical for firms with less external financing constraints.

One concern about our cross sectional prediction on external financing constraints could be that it is driven by asset sale frictions instead of external financing frictions. To mitigate this concern, we scale the firm individual SA-index by the SIC3-industry average of the SA-index. The idea behind this approach is that because firms in the same industry face a similar market for corporate assets, they should be exposed to similar dynamics of asset sale frictions. Our results in column (V) are robust to using the scaled SA-index variable, suggesting that our prediction is generated by cross sectional differences in external financing frictions.

An alternative motive for asset sales besides investment financing needs is financial distress (e.g. Shleifer and Vishny 1992, Weiss and Wruck 1998, Lang, Poulsen, and Stulz 1995). A potential

\footnote{In unreported results, we additionally incorporate the interaction between the bad state dummy and leverage, and the triple interaction between the bad state dummy, leverage, and investment. The coefficient on this triple interaction is positive and significant, indicating that particularly high leverage firms have a more countercyclical financing asset sales policy. This finding provides additional support to the wealth transfer problem as an important driver of the positive relation between asset sales and investments.}

\footnote{According to Hadlock and Pierce (2010), the SA-index is useful to measure financial constraints. Related work supports the view that the ingredients of this index, i.e. size and age, capture the financial constraints of a firm (see e.g. Hennessy and Whited 2007, Fee, Hadlock, and Pierce 2009).}
caveat with our results could be that the relations between leverage as well as the bad state and the financing asset sales policy are, in fact, driven by fire sales of financially distressed firms. To address this concern, we include in column (VI) an interaction term of investment and a dummy that indicates whether the firm individual Altman (1968) Z-score is below a value of three. Values below three imply that a firm is likely to be financially distressed. If financial distress were a driver of the correlation between asset sales and investment, we would expect a positive significant coefficient for the new interaction term. However, column (VI) reveals an insignificant coefficient estimate. Moreover, the interactions between leverage and investment, and between the bad state and investment are robust (compared to column III) to the inclusion of the new interaction term. This finding highlights that fire sales are not the driver behind our main results.

In unreported results we conduct several robustness tests. For instance, our results are not driven by small observations of asset sales or investments. The coefficients and t-statistics hardly change when we drop the smallest 10% or 20% of the absolute values of asset sales and capital expenditures from our sample. Moreover, if we focus on higher property, plant, and equipment values, the coefficients and t-statistics of the explanatory variables become larger.

To summarize, we find that the propensity to select asset sales at investment is (i) stronger for firms with higher financial leverage, (ii) countercyclical, (iii) more countercyclical for firms with less cyclical investment opportunities, and (iv) more countercyclical for firms with lower external financing frictions. These novel stylized facts cannot be explained by traditional motives for asset sales, such as financial constraints or distress.

3. Model

In this section, we study a structural model with time-varying macroeconomic conditions, embedded inside a representative agent consumption-based asset pricing framework. The model allows us to endogenize the effect of cyclicality in a simple and realistic fashion. Moreover, it shows how the values of equity, debt, and growth options that determine firms’ external financing decisions are endogenously affected by time-varying business cycle conditions.

Following Arnold, Wagner, and Westermann (2013), each firm has one growth option that is costly to exercise. The key innovation in our paper is that we allow firms to endogenously select between financing the investment cost with the proceeds from an asset sale or through the issuance

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13 This framework, in the spirit of Bhamra, Kuehn, and Strebulaev (2010) and Chen (2010), determines how aggregate risk and risk prices change with the business cycle. It links the fluctuations in the first and second moments of aggregate growth rates to the values of corporate securities.
of new equity. Moreover, we incorporate business cycle dependent equity issuance cost, asset liquidity, and cyclicality of the growth option.

The structural model approach allows us to analyze equityholders’ endogenous choice between issuing new equity and selling assets to finance the exercise of the growth option in an economy with external financing frictions. In addition, it easily lends itself to analyzing firm behavior in simulated panels to explore the dynamic predictions of the model.

### 3.1. Assumptions

We consider an economy that contains $N$ firms with assets in place and a growth option, a large number of identical infinitely lived households, and a government acting as a tax authority. There are two aggregate states, namely, good ($G$) and bad ($B$) states. Aggregate output, corporate earnings, and external financing frictions depend on the current state. To incorporate time-varying aggregate conditions, we model a time-homogeneous observable Markov chain $I_t \geq 0$ with state space \{G, B\} and generator $Q := [-\lambda_G \lambda_B, \lambda_B - \lambda_B]$, in which $\lambda_i \in (0, 1)$ is the rate of leaving state $i$.

The aggregate output $C_t$ follows a regime-switching geometric Brownian motion

$$\frac{dC_t}{C_t} = \theta_i dt + \sigma_i^C dW_t^C, \quad i = G, B,$$

in which $W_t^C$ is a Brownian motion that does not dependent on the Markov chain. The parameter $\theta_i$ is the regime-dependent growth rate of the aggregate output, and $\sigma_i^C$ the corresponding volatility. In equilibrium, aggregate consumption equals aggregate output. Our representative agent has the continuous-time analog of Epstein-Zin-Weil preferences of stochastic differential utility type (e.g. Duffie and Epstein 1992a, Duffie and Epstein 1992b). The Internet Appendix A.1 derives the dynamics of the stochastic discount factor, the risk-free rates, $r_i$, the market prices of consumption risk, $\eta_i$, and the market prices of jump risk, $\kappa_i$.

The firm earnings process follows

$$\frac{dX_t}{X_t} = \mu_i dt + \sigma_i^{X,C} dW_t^C + \sigma_i^{X,id} dW_t^X, \quad i = G, B,$$

in which $W_t^X$ is a standard Brownian motion describing an idiosyncratic shock that is independent of the aggregate output shock $W_t^C$ and the Markov chain. The parameters $\mu_i$ are the regime-dependent drifts, $\sigma_i^{X,C} > 0$ the firm-specific regime-dependent volatilities associated with the aggregate output process, and $\sigma_i^{X,id} > 0$ the firm-specific volatility of the idiosyncratic Brownian shock.
We denote the risk-neutral measure by $Q$. The expected growth rates, $\tilde{\mu}_i$, of a firm’s earnings under this measure are

$$\tilde{\mu}_i := \mu_i - \sigma^X_C \eta_i,$$

and the risk-neutral transition intensities, $\tilde{\lambda}_i$, are given by

$$\tilde{\lambda}_i = e^{\kappa_i \lambda_i}.$$

A firm is initially financed with equity and infinite maturity debt. Once debt has been issued, the firm pays a continuous coupon $c$. We assume that initial debt carries a covenant that prohibits the issuance of new debt. Such covenants restricting additional debt are ubiquitous in observed debt contracts (e.g.?, Nini, Smith, and Sufi 2009): Corporate taxes are paid at a constant rate $\tau$ and full offsets of losses are allowed. Thus, initial debt allows firms to shield part of their income from taxation. Following e.g. Hackbarth, Miao, and Morellec (2006), the unleveraged after-tax asset value of a firm is

$$V_t = (1 - \tau)X_t y_i, \quad i = G, B,$$

in which $y_i$ is the price-earnings ratio in state $i$ determined by

$$y_i^{-1} = r_i - \tilde{\mu}_i + \frac{(r_i - \tilde{\mu}_j) - (r_i - \tilde{\mu}_i)}{r_j - \tilde{\mu}_j + \tilde{\rho}} \tilde{\rho} \tilde{p} f_j.$$

The parameter $\tilde{\rho} := \tilde{\lambda}_i + \tilde{\lambda}_j$ is the risk-neutral rate of news arrival. $(\tilde{f}_G, \tilde{f}_B) = (\frac{\tilde{\lambda}_B}{\tilde{\rho}}, \frac{\tilde{\lambda}_G}{\tilde{\rho}})$ denotes the long-run risk-neutral distribution. $y^{-1}$ can be interpreted as a discount rate, in which the first two terms are the standard components if the economy could not switch the regime, and the last term reflects the future time spent in regime $j$. As in Bhamra, Kuehn, and Strebulaev (2010), the price-earnings ratio in the main analysis is higher in good states than in bad states i.e. $y_G > y_B$.

We model a firm’s expansion (growth) option as an American call option on its earnings. In particular, a firm (i) can irreversibly exercise this option at any time $\tilde{t}$, (ii) needs to pay the exercise cost $K_{\tilde{i}}$, and (iii) achieves additional future earnings of $s_{\tilde{i}}X_t$ for all $t \geq \tilde{t}$ for some factor $s_{\tilde{i}} > 0$, in which $\tilde{i}$ is the realized state of the economy at the time of exercise. In contrast to Arnold, Wagner, and Westermann (2013), both the exercise cost $K_{\tilde{i}}$ and the factor $s_{\tilde{i}}$ are regime-dependent to model firms with varying degrees of the cyclicality of their growth option. If an expansion option is exer-

\[14\] Covenants restricting stock issuance are rare (. Chava, Kumar, and Warga 2010) We discuss asset sale covenants in Section 5.2.
cised, it is once and for all converted into assets in place, so the firm consists of only invested assets.

As initial debt is covenant protected, firms can finance the exercise cost $K_i$ by either issuing new equity or by selling assets in place. Both sources of financing impose frictions on the firm. First, we explicitly consider external financing frictions i.e. that new equity financing is costly, as suggested by the literature (e.g. Campello and Hackbarth 2012). In particular, each equity-financed $1 leads to a regime-dependent issue cost of $\Upsilon_i$. The regime dependency of $\Upsilon_i$ allows us to capture the notion that external equity financing is more restricted during bad states (e.g. Erel, Julio, Kim, and Weisbach 2011). The cost $\Upsilon_i$ can be interpreted as the linear component of the equity issuance cost. Hence, a firm with access to equity financing in a given regime can finance the exercise cost $K_i$ by issuing new equity of $K_i(1 + \Upsilon_i)$.

Second, Pulvino (1998) and Jovanovic and Rousseau (2002) argue that selling assets is costly. The cost occurs because assets are partially firm-specific and the firm-specific component is irreversibly lost in asset transfers, or because existing assets are not made-to-order and, therefore, may require additional disassembling costs to tailor the assets to the buyer’s specific needs. We incorporate this friction by stating that the proceeds from selling assets on the market correspond to $0 \leq \Lambda_i \leq 1$ times the value of the assets to the firm. Consistent with Shleifer and Vishny (1992), the parameter $\Lambda_i$ can be interpreted as the regime-dependent liquidity of the firm’s assets in place, and is calibrated such that $\Lambda_G > \Lambda_B$. After exercising the expansion option, the firm obtains current earnings of $(s_i + 1)X_t$ i.e. $s_iX_t$ from the expansion option, and $X_t$ from existing assets in place. The value of the existing assets in place at option exercise corresponds to $(1 - \tau)X_t\Upsilon_i$. The value of the assets required to be sold to finance the exercise cost of the expansion option is given by $K_i/\Lambda_i$ or by $\frac{K_i/\Lambda_i}{(1-\tau)X_t\Upsilon_i}$ as a fraction of current earnings. As a result, total earnings of a firm at any point in time after financing the exercise cost by selling assets correspond to

$$\left(s_i + 1 - \frac{K_i/\Lambda_i}{(1 - \tau)X_t\Upsilon_i}\right)X_t.$$  

(7)

Shareholders have the option to default on their debt obligations. Specifically, default is triggered when they are no longer willing to inject additional equity capital to meet net debt service requirements (e.g. Leland 1998). Upon default, a firm is immediately liquidated. Debtholders receive the liquidation value of the total unleveraged asset value i.e. of the unleveraged assets in place plus the unleveraged growth option, less bankruptcy costs. The liquidation proceeds correspond to $\Lambda_i$ times the total unleveraged asset value. Bankruptcy costs include, for example, lawyers’ and accountants’ fees, or the value of the managerial time spent in administering the bankruptcy. They
correspond to a fraction $1 - \alpha_i$ of the proceeds from liquidation, with $\alpha_i \in (0, 1]$. Hence, the recovery rates to debtholders correspond to $\Lambda_i \alpha_i$ times the unleveraged asset value upon default. The assumption that debtholders also recover a fraction of the unleveraged expansion option implies that the option is transferrable. At default, however, the growth option is far out-of-the-money for most parameter specifications and has, consequently, only limited value. Hence, assumptions regarding its transferability or recovery rate have a negligible impact on our results.

Finally, we assume proportional costs of issuing initial equity $\chi_i$, and initial debt $\nu_i$. Equityholders face the following decisions. First, once debt has been issued, they select the default, expansion, and investment-financing policies that maximize the ex post value of equity. Second, they determine the initially optimal capital structure by choosing a coupon that maximizes firm value.

4. Model solution

Firms can finance investments by selling assets or by issuing equity in each regime, which leaves us with four different funding strategies: financing by issuing equity in good states and selling assets in bad states, financing by issuing equity in both good states and bad states, financing by selling assets in good states and issuing equity in bad states, and financing by selling assets in both good and bad times. In what follows, we derive the solution for a firm that applies the first funding strategy i.e. financing by issuing equity in good states and selling assets in bad states. The solutions for the second to fourth funding strategies can be derived similarly.

4.1. Value of corporate securities after investment

After exercising its expansion option, a firm consists of only invested assets. Let $\hat{d}_i(X)$ denote the value of corporate debt, $\hat{t}_i(X)$ the value of the tax shield, and $\hat{b}_i(X)$ the value of bankruptcy costs of a firm with only invested assets. We show the standard solutions for the values of these securities in the Internet Appendix A.2. The firm value after investment, $\hat{v}_i(X)$, can be expressed as the value of assets in place plus the tax shield minus bankruptcy costs:

$$\hat{v}_i(X) = (1 - \tau)y_iX + \hat{t}_i(X) - \hat{b}_i(X).$$  

As total firm value equals debt plus equity values, the equity value after investment, $\hat{e}_i(X)$, is

$$\hat{e}_i(X) = \hat{v}_i(X) - \hat{d}_i(X).$$
Equityholders chose the default policy to maximize the ex post value of their claim. The equity value at default corresponds to zero. Hence, the default policy can be derived by equating the first derivative of the equity value to zero at the default boundary in each regime:

\[
\begin{align*}
\hat{e}_G'(D^*_G) &= 0 \\
\hat{e}_B'(D^*_B) &= 0
\end{align*}
\] (10)

We solve this system numerically. The value of corporate securities is solved similarly for a firm with a scaled level of earnings after investment. The default policy is then expressed in terms of this scaled earnings level.

4.2. The value of the growth option

To study cyclicality of expansion options, we extend the model of Arnold, Wagner, and Westermann (2013) by allowing regime-dependency of the additional earnings factor \( s_i \), and the exercise cost \( K_i \) of the option. In each regime \( i \), a firm exercises a growth option immediately whenever \( X \geq X_i \) (option exercise region); otherwise, it optimally waits (option continuation region). This structure implies a system of ordinary differential equations (ODEs) with associated boundary conditions given in the Internet Appendix A.3. The following proposition presents the value of the growth option, \( G_i(X) \), in a leveraged firm (leveraged growth option) that finances the exercise cost by issuing equity in good states, and by selling assets in bad states for \( X_G \leq X_B \).

Proposition 1. The value of a leveraged growth option in state \( i \) is

\[
G_i(X) = \begin{cases} 
\hat{A}_i X^{\gamma_3} + \hat{A}_i X^{\gamma_4} & 0 \leq X < X_G, \quad i = G, B \\
\bar{C}_1 X^\beta_{1i} + \bar{C}_2 X^\beta_{2i} + \bar{C}_3 X + \bar{C}_4 & X_G \leq X < X_B, \quad i = B \\
(1 - \tau) s_B X y_B - K_B / \Lambda_B & X \geq X_B \quad i = B \\
(1 - \tau) s_G X y_G - K_G (1 + \Upsilon_G) & X \geq X_G \quad i = G 
\end{cases}
\] (11)
in which $[X_G, X_B]$ are the exercise boundaries in the good and bad states, respectively, and

$$
\beta_{1,2}^B = \frac{1}{2} \mu_B - \frac{\hat{\mu}_B}{\sigma_B} \pm \sqrt{\left(\frac{1}{2} - \frac{\hat{\mu}_B}{\sigma_B}\right)^2 + \frac{2(r_B + \hat{\lambda}_B)}{\sigma_B^2}},
$$

$$
\bar{C}_3 = \frac{\hat{\lambda}_B (1 - \tau) s_{G Y G}}{r_B - \hat{\mu}_B + \hat{\lambda}_B},
$$

$$
\bar{C}_4 = -\frac{\hat{\lambda}_B K_B}{r_B + \lambda_B}.
$$

(12)

The parameters $\gamma_3$ and $\gamma_4$ reflect the positive roots of the quadratic equation

$$
(\hat{\mu}_B \gamma + \frac{1}{2} \sigma_B^2 \gamma (\gamma - 1) - \hat{\lambda}_B - r_B)(\hat{\mu}_G \gamma + \frac{1}{2} \sigma_G^2 \gamma (\gamma - 1) - \hat{\lambda}_G - r_G) = \hat{\lambda}_B \hat{\lambda}_G.
$$

(13)

$A_G$ is a multiple of $A_B$, $k = 3, 4$, i.e. $A_B = \bar{l}_k A_G$ with $\bar{l}_k := \frac{1}{\Lambda_G} (r_G + \hat{\lambda}_G - \hat{\mu}_G \gamma_k - \frac{1}{2} \sigma_G^2 \gamma_k (\gamma_k - 1))$, and $r_i^p$ is the perpetual risk-free rate given by

$$
r_i^p = r_i + \frac{r_j - r_i}{\bar{p} + r_j} \bar{p} \hat{f}_j,
$$

(14)

in which $\bar{p} = \hat{\lambda}_1 + \hat{\lambda}_2$ is the risk-neutral rate of news arrival and $(\hat{f}_G, \hat{f}_B) = \left(\frac{\hat{\lambda}_G}{\bar{p}}, \frac{\hat{\lambda}_B}{\bar{p}}\right)$ the long-run risk-neutral distribution. $[\bar{A}_G, \bar{A}_4, \bar{C}_1, \bar{C}_2]$ solve the linear system in the Internet Appendix A.3.

Proposition 1 presents the value function of the leveraged growth option for any given pair of exercise boundaries $X_G \leq X_B$. The optimal exercise boundaries of this option are determined in the next section because they depend on the capital structure of the firm with the expansion opportunity. Additionally, note that the growth option value also depends on the asset liquidity and the equity issuance cost.

To derive the values of corporate securities before investment, we additionally use the value of an unleveraged option $G_i^{unlev}$ that corresponds to the value of an option in an all equity financed firm. The optimal exercise boundaries of this option simply maximize the value of the option. As these boundaries do not depend on the capital structure of a firm, they can be derived by additionally imposing smooth-pasting conditions at the corresponding option exercise boundaries (see the Internet Appendix A.3).

As we consider a regime-dependent additional earnings factor $s_i$ and exercise cost $K_i$ of the option, we also encounter the case in which the exercise boundary in good states, $X_G$, is larger than the exercise boundary in bad states, $X_B$. It occurs when $s_B$ is considerably larger than $s_G$,
4.3. Value of corporate securities before investment

Once the values of corporate securities after investment and of the growth option are determined, we can derive the values of corporate securities before investment of a firm that finances the exercise cost by issuing equity in good times, and by selling assets in bad times. Let \( d_i(X) \) denote the debt value of a firm with invested assets and an expansion option in regime \( i = G, B \). Proposition 2 presents the value of debt before investment.

**Proposition 2.** The value of infinite maturity debt in state \( i \) is

\[
d_i(X) = \begin{cases} 
\alpha_i \Lambda_i \left( (1 - \tau) X y_i + G_{i}^{\text{unlev}}(X) \right) & X \leq D_i, \quad i = G, B, \\
C_1 X^{\beta_G^i} + C_2 X^{\beta_G^i} + C_5 X^{\gamma_3} + C_6 X^{\gamma_4} + \lambda_G \frac{\alpha_B \Lambda_B \left( 1 - \tau \right) X}{r_G - \mu_G + \lambda_G} + \frac{c}{r_G + \lambda_G} & D_G < X \leq D_B, \quad i = G \\
A_i X^{\gamma_3} + A_i X^{\gamma_2} + A_i X^{\gamma_3} + A_i X^{\gamma_4} + \frac{c}{r_G} & D_B < X \leq X_G, \quad i = G, B \\
B_i X^{\beta_B^i} + B_2 X^{\beta_B^i} + Z(X) + \frac{\lambda_B}{c_i} \left( \frac{r_B + \lambda_B}{r_B + \lambda_B} \right) + \frac{c}{r_B + \lambda_B} & X_G < X \leq X_B, \quad i = B \\
\hat{d}_G \left( (s_G + 1)X \right) & X > X_G, \quad i = G \\
\hat{d}_B \left( (s_B + 1 - \frac{K_B}{\Lambda_B} \right) X \right) & X > X_B, \quad i = B 
\end{cases}
\]

in which \([D_G, D_B]\) are the default and \([X_G, X_B]\) the exercise boundaries, and

\[
\beta_{i,2} = \frac{1}{2} - \frac{\hat{\mu}_i}{\sigma_i^2} \pm \sqrt{\left( \frac{1}{2} - \frac{\hat{\mu}_i}{\sigma_i^2} \right)^2 + \frac{2(\hat{\mu}_i + \lambda_i)}{\sigma_i^2}} \quad (16)
\]

\[
C_5 = \alpha_B \Lambda_B \frac{\bar{l}_3}{l_3} A_{G3}^{\text{unlev}}, \quad (17)
\]

\[
C_6 = \alpha_B \Lambda_B \frac{\bar{l}_4}{l_4} A_{G4}^{\text{unlev}}, \quad (18)
\]

with

\[
Z(X) = \lambda_B B_5 X^{\gamma_1} + \lambda_B B_6 X^{\gamma_2}. \quad (19)
\]
The parameters $B_5$ and $B_6$ are determined by

$$B_5 = \frac{(s_B + 1)^2 \hat{A}_{G1}}{r_B - \hat{\mu}_B \gamma_1 - \frac{1}{2} \hat{\sigma}^2_B \gamma_1 (\gamma_1 - 1) + \hat{\lambda}_B},$$

and

$$B_6 = \frac{(s_B + 1)^2 \hat{A}_{G2}}{r_B - \hat{\mu}_B \gamma_2 - \frac{1}{2} \hat{\sigma}^2_B \gamma_2 (\gamma_2 - 1) + \hat{\lambda}_B},$$

and $\gamma_k, k = 1, 2, 3, 4$ are the roots of the quadratic equation

$$(\hat{\mu}_B \gamma + \frac{1}{2} \hat{\sigma}^2_B \gamma (\gamma - 1) - \hat{\lambda}_B - r_B)(\hat{\mu}_G \gamma + \frac{1}{2} \hat{\sigma}^2_G \gamma (\gamma - 1) - \hat{\lambda}_G - r_G) = \hat{\lambda}_B \hat{\lambda}_G.$$  

$A_{Bk}, k = 1, 2, 3, 4,$ is a multiple of $A_{Gk}$ with the multiple factor

$$l_k := \frac{1}{\hat{\lambda}_G} (r_G + \hat{\lambda}_G - \hat{\mu}_G \gamma_k - \frac{1}{2} \hat{\sigma}^2_G \gamma_k (\gamma_k - 1)),$$

and $r^p_i$ reflects the perpetual risk-free rate given by

$$r^p_i = r_i + \frac{r_j - r_i}{\bar{p}} \tilde{p} f_j,$$

in which $\bar{p} = \hat{\lambda}_1 + \hat{\lambda}_2$ is the risk-neutral rate of news arrival and $\left(\hat{f}_G, \hat{f}_B\right) = \left(\frac{\hat{\lambda}_B}{\bar{p}}, \frac{\hat{\lambda}_G}{\bar{p}}\right)$ the long-run risk-neutral distribution. $\hat{d}_i (\cdot)$ is the debt value of a firm with only invested assets. $[A_{G1}, A_{G2}, A_{G3}, A_{G4}, C_1, C_2, B_1, B_2]$ solve a linear system given in the Internet Appendix A.4.

Proof. See the Internet Appendix A.4.

According to Proposition 2, a firm’s debt value function is defined along three different regions depending on the value of $X$. Below the default threshold i.e. $X \leq D_i$, the firm is in the default region in which it defaults immediately. The firm stands in the continuation region if $X$ is between the default threshold and the exercise boundary of the corresponding state i.e. if $D_i < X \leq X_i$.

Finally, the debt value function in the exercise region, reached when $X > X_i$, directly visualizes the financing source for the option exercise cost. In the good states, the option exercise cost $K_G$ is financed by issuing new equity of $K_G(1 + \Upsilon_G)$. Hence, the earnings of the firm are scaled by $s_G + 1$.

In the bad states, the exercise cost $K_B$ is financed by selling $\frac{K_B / A_B}{(1-\tau)X_{19B}}$ of the assets in place, such
that the earnings of the firm are scaled by \((s_B + 1 - \frac{K_B}{\Lambda_B(1-\tau)X_{t_B}})\).

The value of the tax shield before investment is calculated by using the solution (15) in Proposition 2, in which we replace \(c\) and \(\alpha\) by \(c\tau\) and zero, respectively, and \(\hat{d}_i\) in the last line line of (15) by \(\hat{t}_i\). The value of bankruptcy costs before investment is derived by using the same steps as for the debt value with two simple modifications. First, \(c\) and \(\alpha\) need to be replaced by zero and \((1 - \alpha)\), respectively. Second, while the going concern value of the expansion option is given by its leveraged value, the value of the option at default corresponds to its unleveraged value. Therefore, the expansion option’s value switches from \(G_i(X)\) to \(\alpha_i\Lambda_iG_i^{unlev}(X)\) upon default. As a consequence, the functional form of the solution (15) in the default region \(X \leq D_i\) needs to be adapted to \((1 - \alpha_i\Lambda_i)y_iX(1 - \tau) - \alpha_i\Lambda_iG_i^{unlev}(X) + G_i(X)\). The Internet Appendix A.5 shows the resulting solution for the value of bankruptcy costs \(b_i(X)\).

Next, firm value before investment, \(f_i\), in regime \(i = G, B\) is given by the value of assets in place \((1 - \tau)y_iX\), plus the growth option value \(G_i(X)\) and the value of tax benefits from debt \(t_i(X)\), minus the value of default costs \(b_i(X)\) i.e.

\[
f_i(X) = (1 - \tau)y_iX + G_i(X) + t_i(X) - b_i(X). \tag{25}
\]

As firm value equals the sum of debt and equity values, the equity value before investment of a firm that finances investment by issuing equity in good states and selling assets in bad states, \(e_i^{ES}(X, c)\), \(i = G, B\), is

\[
e_i(X, c) = f_i(X) - d_i(X) = (1 - \tau)y_iX + G_i(X) + t_i(X) - b_i(X) - d_i(X). \tag{26}
\]

Equityholders select the default and investment policies that maximize the ex post value of their claim. We denote these policies by \(D_i^*\) and \(X_i^*\), respectively. The default policy that maximizes the equity value is determined by setting the first derivative of the equity values to zero at the default boundary in each state. Simultaneously, we obtain the optimal exercise thresholds by equating the first derivative of the equity values at the exercise thresholds to the first derivative of the equity values of a firm with only invested assets after expansion, evaluated at the corresponding earning levels in both states. These four optimality conditions represent smooth-pasting conditions for equity of a firm that finances the option exercise cost by issuing equity in good states and selling.
assets in bad states at the respective boundaries:

\[
\begin{align*}
  e'_G(D^*_G, c) &= 0 \\
  e'_B(D^*_B, c) &= 0 \\
  e'_G(X^*_G, c) &= e'_G((s_G + 1)X^*_G, c) \\
  e'_B(X^*_B, c) &= e'_B\left(\left((s_B + 1 - \frac{K_B/\Lambda_B}{1-\tau})X^*_B\right), c\right).
\end{align*}
\]  

(27)

The System \[27\] is solved numerically. As these equations are evaluated simultaneously, the four conditions are interdependent. Similar systems can be derived for a firm that finances the option exercise cost by issuing equity in both good states and bad states, by selling assets in good states and issuing equity in bad states, or by selling assets in both states.

Denote by \( e^{m,n*}(X, c) \) the equity value given optimal ex post default and expansion thresholds. The exponents \( m \in \{E, S\} \) and \( n \in \{E, S\} \) indicate the funding sources in good states and bad states, respectively. \( E \) denotes equity financing and \( S \) selling assets. For each coupon level \( c \), equityholders select the ex post optimal funding source \( \Omega^*_i \) that maximizes the value of equity, i.e.,

\[
\Omega^*_i := \arg\max_{m,n} \left(e^{m,n*}(X,c)\right). 
\]  

(28)

Debtholders anticipate the ex post default, expansion, and funding source policies chosen by shareholders. Equityholders incorporate the values of equity and initial debt in their capital structure decision because they obtain debt-issue proceeds. Thus, the optimal capital structure is determined ex ante by the coupon level \( c^* \) that maximizes the value of equity and debt, i.e., firm value. Denote by \( f^*_i(X) \) the firm value given optimal default boundaries, expansion thresholds, and the optimal funding source. The ex ante optimal coupon of the firm is given by

\[
e^*_i := \arg\max_{c} \left(f^*_i(X,c) - \chi_i e^*_i(X,c) - \nu_i d^*_i(X,c)\right). 
\]  

(29)

5. Results

In this section, we study the implications of the model for a typical model firm. We first describe the parameter choice for our baseline calibration before we derive the hypothesis in Section 5.2.
5.1. Parameter choice

We summarize our parameter choices in Table 2. Panel A shows the firm characteristics. The initial value of the idiosyncratic earnings $X$ is set to ten. While the starting value for earnings is arbitrary, our results do not depend on this choice. We set the tax advantage of debt to $\tau = 0.15$ as suggested in the literature (e.g., Hackbarth, Miao, and Morellec 2006). Bhamra, Kuehn, and Strebulaev (2010) estimate growth rates and systematic volatilities of earnings in a two-regime model. Their estimates are similar to those obtained by other authors who jointly estimate consumption and dividends with a state-dependent drift and volatility (e.g., Bonomo and Garcia 1996). Hence, we set earnings growth rates ($\mu_i$) and volatilities ($\sigma_{i}^{X,C}$) to their empirical counterparts reported in Bhamra, Kuehn, and Strebulaev (2010). The idiosyncratic volatility is set to $0.168$. Arnold, Wagner, and Westermann (2013) show that using this volatility calibration, a simulated sample of firms with growth options has an average asset volatility of approximately 25%, which corresponds to the average asset volatility of firms with rated debt outstanding (see Schaefer and Strebulaev 2008).

The main costs of external equity discussed by Fazzari, Hubbard, Petersen, Blinder, and Poterba (1988) are tax costs, adverse selection premia, and flotation costs. Hansen (2001) and Corwin (2003) estimate equity issuance costs around 7% for IPOs and SEOs, respectively. Altinkilic and Hansen (2000) argue that equity costs derive mainly from the variable component. The linear variable component estimated in Hennessy and Whited (2007) is 9.1%. Concerning cyclicalities, Bayless and Caplinsky (1996) find that a typical hot market issuer would forego up to 2.33% in additional equity value if he would issue in a cold market instead. To reflect these empirical quantities, we choose as a benchmark case $\Upsilon_G = 0.08$ and $\Upsilon_B = 0.1$. This setting gives us a cyclicality for the equity issuance cost of a two percentage points difference between good and bad states, and an average total equity issuance cost of 8.71%. We assume that $\Upsilon_i = \chi_i = \nu_i$ in the baseline firm.

There are only a few empirical studies that estimate the cost of selling assets. Pulvino (1998) finds costs of selling commercial aircrafts between zero and 14%. Strebulaev (2007) assumes that the cost of selling assets lies between 0.05 to 0.25%. Acharya, Bharath, and Srinivasan (2007) show that creditors of defaulted firms recover 10 to 15 percentage points less in a distressed state of the industry than in a healthy state of the industry, i.e., that asset liquidity is cyclical. Overall, we only

15 The weights for this average correspond to the long-run, risk-neutral distribution of the Markov chain. One could also simulate a large sample of firms and determine the weights according to the occurrence of equity issues in the two states.
have vague empirical evidence on the appropriate choice of the parameters for the cost of selling assets. Hence, to avoid that our results are driven by this choice when analyzing firms’ endogenous financing decisions, we set \( \Lambda_i \) such that \( K_i/\Lambda_i = K_i(1 + \Upsilon_i) \), i.e., the friction adjusted cost of exercising the expansion option by selling assets corresponds to that of exercising the expansion option by issuing new equity. This calibration yields \( \Lambda_G = 0.9259 \) and \( \Lambda_B = 0.9091 \).

One caveat is that equity issuance cost and asset liquidity are hard to estimate. We address this issue in two different ways. First, we base our parameter choice on empirical results of previous works. Second, we perform numerous robustness checks with alternative equity issuance cost and asset liquidity parameters. We find that our qualitative predictions are not affected by varying these parameters within plausible ranges.

Bankruptcy costs are assumed to be 30% of the unleveraged assets’ liquidation proceeds. Hence, the recovery rates correspond to \( \Lambda_i(1 - 0.3) \), i.e., to 0.63 in good states and 0.57 in bad states. These values are in accordance with the unconditional standard of 0.6 used in the literature (e.g. Chen 2010), and with the notion in e.g. Acharya, Bharath, and Srinivasan (2007) that recovery rates fall during bad states.

Panel B of Table 2 shows the parameters we use to capture growth options. We select exercise prices of \( K_G = 183.13 \) and \( K_B = 160 \), respectively. The decline from \( K_G \) to \( K_B \) corresponds to the relative decline in the value of invested assets following a shift from good to bad states of 12.61%, which is similar to that assumed in e.g. Hackbahrth, Miao, and Morellec (2006). We validate the robustness of our predictions by presenting results for alternative choices of the absolute level of \( K_i \).

The scale parameter \( s_i \) depends on the cyclicality of the firm’s option. We use baseline scale parameters of \( s_G = 1.0925 \) and \( s_B = 1.03 \). These parameters imply that, given optimal financing at initiation, the average \( q \) is 1.3. The \( q \) of a model firm is obtained by dividing firm value by the value of its invested assets. To calculate the average \( q \), the initial \( q \) in good and bad states is weighted by the long-run distribution of the Markov chain. To generate typical firms with different degrees of the cyclicality of the expansion option, we alter \( s_G \) and \( s_B \) while keeping the size of the average \( q \) at initiation fixed at its empirical counterpart.

Finally, Panel C, lists the variables describing the underlying economy. The rates of leaving state \( i (\lambda_i) \), the consumption growth rates (\( \theta_i \)), and the consumption growth volatilities \( \sigma^C_i \) are estimated in Bhamra, Kuehn, and Streubulaev (2010). In the model economy, the expected duration of regime \( B \) (\( R \)) is 3.68 (2.03) years, and the average fraction of time spent in regime \( B \) (\( R \)) is 64% (36%). The annualized rate of time preference, \( \rho \), is 0.015, the relative risk aversion, \( \gamma \), equal
to ten, and the elasticity of intertemporal substitution, $\Psi$, set to 1.5. This parameter choice is commonly used in the literature (e.g., Bansal and Yaron 2004, Chen 2010). It implies that the nominal interest rates are $r_G = 0.0736$ and $r_B = 0.0546$.

5.2. Derivation of model predictions

Exercising an expansion option has two implications for equityholders. First, it increases total earnings. Second, the total asset volatility decreases because the expansion option is riskier than the assets in place (see e.g. Arnold, Wagner, and Westermann 2013). Both effects induce a wealth transfer from equityholders to debtholders as debt becomes less risky. The friction cost of selling assets to finance the investment can be larger than that of issuing new equity, i.e., $K_i/\Lambda_i$ may be higher than $K_i(1 + \Upsilon_i)$. At the same time, however, selling assets upon investment reduces the substance of the remaining firm assets, which renders debt more risky. The corresponding wealth transfer from debtholders to equityholders ameliorates the initial wealth transfer problem from the exercise of the expansion option. Hence, equityholders trade off the incremental friction cost of selling assets over the equity issuance cost against the reduction in the wealth transfer when deciding whether to sell assets or to issue equity to finance the exercise of the expansion option.

As debt becomes riskier and, consequently, more sensitive to earnings and asset volatility changes with larger leverage, the wealth transfer problem is more severe for highly leveraged firms. Hence, equityholders of such firms tend to finance the expansion option by selling assets. This insight leads to our first model prediction.

**Prediction 1.** *Firms with a larger leverage have a stronger tendency to finance the exercise cost of the expansion option by selling assets.*

Prediction 1 explains why we find that, empirically, the correlation between asset sales and investment is higher for firms with larger leverage.

Next, we investigate how the wealth transfer problem in the baseline firm depends on different states of the business cycle. During bad times, leverage increases because the assets of a firm lose more value relative to the decrease in value of the outstanding debt. At the same time, equityholders optimally invest at a higher level of earnings in the bad state. A higher investment threshold induces a larger asset value upon investment and hence lower leverage. To see which effect dominates, Fig. 1 plots the leverage upon investment for a baseline firm with an initially optimal capital structure and endogenous choice of the funding source. The equity issuance cost parameter in good states, $\Upsilon_G$, is plotted on the x-axis. The corresponding equity issuance cost parameter in bad states is
determined by adding 0.02. In this way, we maintain the same difference between the equity issuance costs in good states and bad states as in the baseline parameter specification. The dashed line depicts the leverage at investment during bad states, the solid line that during good states. The bumps around $\gamma_G = 0.075$ occur due to the switch in the firm’s optimal financing strategy. Fig. 1 shows that leverage at investment is larger during bad states than during good states. As the wealth transfer problem is more severe for higher leverage, and because asset sales ameliorate this problem, equityholders’ trade-off between the cost of financial frictions and the wealth transfer leads to the second model prediction.

**Prediction 2.** *Firms are more likely to fund investments by selling assets during bad business cycle states.*

Prediction 2 provides an explanation for why the correlation between asset sales and investment is significantly higher during bad business cycle states in our Compustat sample.

The procyclical nature of aggregate investment (see e.g. Barro 1990) suggests that growth options are more valuable during good times than during bad times. We argue that the degree of this cyclicity of the growth option is different across firms. To model a firm with a relatively higher value of the expansion option in the good states, i.e., with a higher cyclicity of the expansion option, relative to the baseline firm, we increase the scale parameter in good times, $s_G$, from 1.0925 to 1.099, and decrease the scale parameter in bad states, $s_B$, from 1.03 to 1.005, leaving the average $q$ at initiation unchanged at 1.3. A higher scale parameter in good times, and a lower scale parameter in bad times make it relatively more (less) attractive to exercise the option in the good (bad) state compared to the baseline firm. The optimal investment threshold in the good state decreases from 20.18 to 19.67, and that in the bad state increases from 20.48 to 22.23. Hence, firms with a stronger cyclicity of the expansion option have a lower tendency to invest during bad times. Additionally, Fig. 2 compares leverage levels upon investment of the baseline firm to those of the firm with a more cyclical growth option. The dotted and dashed-dotted lines depict leverage ratios upon investment in good and bad times of the firm with a more cyclical growth option. The expansion option of the baseline firm has a relatively higher value during bad times than that of the firm with a more cyclical growth option. Hence, equityholders in the baseline firm optimally invest at a

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16 The cyclicity of the expansion option can also be altered by changing the investment cost $K_i$. The qualitative predictions from the model also hold in this case.
lower earnings threshold in bad times, which induces that the asset value is lower and the leverage at investment is higher. Similarly, they invest at a higher earnings threshold in good times than in the firm with a more cyclical growth option such that the leverage at investment is lower. Hence, the difference between leverage at investment in bad and good cycles decreases with the cyclicality of the expansion option. Therefore, the wealth transfer problem at investment is particularly countercyclical for firms with a less cyclical growth option. Because equityholders trade off the financing cost differential between equity issuance and asset sales against the reduction in the wealth transfer problem when selecting the funding source, we can phrase our third model prediction.

**Prediction 3.** *Firms with a less cyclical expansion option have a more countercyclical propensity to financing investments by selling assets.*

This prediction explains our empirical finding that the correlation between asset sales and investment is more countercyclical for firms with less cyclical growth opportunities.

Finally, the trade-off between the incremental friction cost of selling assets over the equity issuance cost and the reduction in the wealth transfer problem only drives the cyclical patterns of financing asset sales if a model firm’s equity issuance cost is lower than the cost of selling assets. Otherwise, equityholders do not trade off the friction cost against the wealth transfer problem and simply select asset sales as the investment funding source. Thus, the countercyclical dynamics of the wealth transfer problem is more relevant for the investment financing decision of a firm with low financing frictions. This model insight generates the cross-sectional prediction that the correlation between asset sales and investment is more countercyclical for firms with lower external financing frictions, which rationalizes our empirical finding (iv).

**Prediction 4.** *Firms with lower external financing frictions have a more countercyclical propensity to financing investments by selling assets.*

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Of course, external financing frictions also influence the initial capital structure.
regimes. On the right hand side of the dashed line, they prefer financing asset sales in both regimes. Between the two lines equityholders’ optimal financing strategy implies the issuance of equity in good times, and selling assets in bad times. Recall that in case of the baseline firm with an equity issuance cost of 0.08 in good states and 0.1 in bad states, the costs of selling assets, $\Lambda$, are calibrated such that the friction cost of issuing equity corresponds to the friction cost of selling assets. In an unleveraged firm as shown on the x-axis, equityholders simply select the funding source based on this financing friction cost: If the equity issuance cost in good states is smaller than 0.08, they finance the exercise cost of the option by issuing equity; otherwise, they finance this cost by selling assets. The figure shows that for larger initial coupons, the range of equity issuance costs for which equityholders prefer equity financing in both regimes declines, and the range for which they prefer selling assets increases. The reason is that asset sales reduce the wealth transfer problem in particular for high leverage firms, and equityholders trade off this reduction against the incremental friction cost of selling assets over issuing equity when selecting the funding source.

The figure also shows the higher propensity for financing assets sales in bad business cycle states. The region in which equityholders select financing asset sales in both regimes (on the right side of the dashed line) is smaller than the region in which they optimally sell assets during bad states (on the right side of the solid line).

The model enables us to investigate the impact of agents’ preferences on corporate policy decisions. To investigate how the financing asset sale policy is affected, we increase both $\gamma$ and $\Psi$ by 25%. A higher risk aversion $\gamma$ increases the investment thresholds, mainly because the risk-neutral earnings growth rates decreases, and the value of risky claims declines relative to the investment cost. A greater $\gamma$, however, also raises the leverage for a given level of earnings and coupon, as it particularly reduces the value of claims that pay more in good states than in bad states such as equity. The second effect dominates such that the leverage at investment increases with risk aversion. A higher leverage at investment implies a stronger wealth transfer problem that enhances equityholders’ tendency to select financing asset sales. At the same time, firms also reduce the optimal initial leverage when risk aversion is larger, which dampens this increase in the relevance of financing asset sales. For example, in the optimally financed baseline firm with $\gamma = 10$ equityholders switch to a strategy, in which they use equity financing in bad states, at an equity issuance cost of $\Upsilon_G = 7.65\%$ and to a strategy with equity financing in both states at $\Upsilon_G = 7.45\%$. In
the optimally financed firm with $\gamma = 12.5$ they switch to these strategies at $\Upsilon_G = 7.64\%$ and $\Upsilon_G = 7.42\%$, respectively. Hence, the asset sale policy is fairly robust to the assumed risk aversion.

Increasing the elasticity of intertemporal substitution $\Psi$ to 1.875 renders the representative agent more tolerant towards a consumption profile that is low today, but high tomorrow, which lowers the risk-free interest rate. So, the growth option value rises, and equityholders invest earlier. Earlier investment entails a larger leverage at investment, which induces more financing asset sales. A lower risk-free rate also increases the value of equity by more than the value of debt. Hence, the leverage for a given initial coupon declines. Due to the increase in the optimal initial coupon with $\Psi$, however, the initial leverage is hardly affected compared to the baseline firm. As the initial leverage choice does not counterbalance the increase in the importance of financing asset sales with $\Psi$ caused by the investment timing, the financing asset sale policy is more sensitive to the elasticity of intertemporal substitution than to risk aversion. In particular, in the optimally financed firm with $\Psi = 1.875$ equityholders already switch to the strategy, in which they use equity financing in bad states, at $\Upsilon_G = 7.56\%$ and to the strategy with equity financing in both states at $\Upsilon_G = 7.35\%$.

After analyzing the ex post incentives of equityholders to select asset sales at investment, we now investigate the quantitative importance of financing asset sales for firm value, corporate leverage, and covenant value. Financing asset sales affect firms through three channels, namely funding frictions, investment timing, and future asset substance. First, they entail a different friction cost than issuing equity. Second, the wealth transfer problem affects equityholders’ investment timing. The (ex post) equity value maximizing earnings thresholds for the option exercise of a firm that finances the investment cost by issuing equity are plotted in Fig. 4. The lower solid line depicts the optimal investment threshold for various levels of leverage in the good state. The higher solid line is the corresponding threshold in the bad state. As expected, equityholders invest earlier in the good state. We refer to the investment thresholds without debt (at zero leverage) as the option value-maximizing threshold. The larger the leverage, the later the equityholders invest compared to the option value-maximizing threshold due to the wealth transfer problem (underinvestment). The dashed lines in Fig. 4 depict the optimal investment thresholds of a firm that sells assets to finance the investment cost. The lower dashed line is the threshold in the good state, the higher dashed line that in bad times. Third, financing asset sales reduce the substance of firm assets after investment, which induces a smaller initial coupon and tax shield.

The option exercise thresholds for financing asset sales in Fig. 4 are closer to the option value-maximizing threshold than those for equity financing, particularly for large leverage firms in which
the wealth transfer problem is more pronounced\textsuperscript{18} Hence, financing asset sales mitigate the underinvestment problem compared to equity financed investment, thereby accelerating investment.

Because we shut down the first channel in our base setting (by choosing the friction cost of selling assets to be equal to the equity issuance cost) and the second offsets the third channel, the impact of financing asset sales on our baseline firm value is relatively small. In particular, the ability to sell assets to finance investment reduces firm value by 0.05%. Depending on parameters, however, the value to firms of the ability to sell assets to finance investment can be important quantitatively. For example, the baseline firm value with a large equity issuance cost ($\Upsilon_G = 0.16$, $\Upsilon_B = 0.18$) decreases by 1.27%, and that with a very large equity issuance friction ($\Upsilon_G = 0.24$, $\Upsilon_B = 0.26$) by 2.42% without financing asset sales. This pattern becomes even stronger for firms with a higher value of the growth option.

A firm’s ability to sell assets to finance investment also affects corporate leverage. The optimal initial leverage of the baseline firm is 47.91%. Without financing asset sales, this leverage increases to 48.30%. The reason is that the third channel dominates the second channel. Specifically, the possibility of financing asset sales reduces the expected asset substance after investment, which decreases the optimal initial leverage compared to a firm that can only use equity to finance the investment. This effect is stronger than the increase in the optimal initial leverage due to the mitigation of the underinvestment problem.

Finally, we quantify the value of a covenant that prohibits financing asset sales on firms in Fig. 5. The solid line plots the %-impact of this covenant on the baseline firm value against the equity issuance cost $\Upsilon_B$. The covenant only adds value if equity financing at investment increases ex ante firm value (the impact of the third channel dominates that from the first and second channels) but, at the same time, the ex post incentives of equityholders are such that they select asset sales due to the wealth transfer problem. In this case, the covenant serves equityholders to ex ante commit to equity financing at investment. For low levels of $\Upsilon_B$, the covenant does not add value because even without the covenant equityholders select equity financing ex post that also maximizes ex ante

\textsuperscript{18} For certain parameter combinations with a high scale parameter $s_i$, and a low exercise cost $K_i$, financing asset sales can also induce overinvestment such that the dashed thresholds in Fig. 4 decrease with leverage. The reason is that the expansion option is almost immediately exercised for these parameter combinations. As a consequence, the investment cost constitutes a much larger fraction of the asset value upon exercise than for parameter combinations for which the option is exercised at a larger level of $X$. Hence, the impact on leverage from financing asset sales is also larger, and the corresponding higher wealth transfer can induce equityholders to exercise the option at an earnings level below the option value-maximizing threshold.
firm value. For high levels of $\Upsilon_B$, a covenant reduces firm value as equityholders must finance the investment cost by issuing expensive equity. The solid line in Fig. 5 implies that the covenant is of limited value to the baseline firm. Restricting financing asset sales only enhances firm value in an intermediate range of $\Upsilon_B$, in which the ex post financing strategy of equityholders deviates from the firm value maximizing policy.

The dashed line plots the value of the covenant for a high leverage firm. As shown in Fig. 3, the ex post incentives of equityholders to select asset sales due to the wealth transfer increase with leverage. Therefore, restricting equityholders with a covenant becomes more important. The dashed-dotted line shows the case of a firm with both high leverage and a large option value. A more valuable expansion option is exercised earlier, which entails a higher leverage at investment. As the wealth transfer problem increases with leverage at investment, equityholders’ incentive to select asset sales ex post even though equity financing would maximize ex ante firm value rises. Hence, a covenant is particularly valuable for high leveraged firms with a large expansion option as long as the equity issuance cost is relatively low. For a high equity issuance cost, however, restricting financing asset sales with a covenant reduces firm value with a valuable expansion option even more than that of the baseline firm. The reason is that if the option is exercised earlier, the need to issue expensive equity at investment due to the covenant has a higher impact on the initial firm value. Finally, we consider a firm with high leverage and a large, more cyclical expansion option (see the dotted line). The impact of a covenant on firm value is slightly smaller than in the case with a less cyclical growth option because equityholders have a lower propensity to exercise the option during bad states, in which the wealth transfer problem is particularly severe.

Our results speak to the covenant literature. Figure 5 implies that the value to firms from a restricting asset sale covenant is limited, i.e., below one percent for reasonable parameter values. The loss from such a covenant, however, can be large if the equity issuance cost is high. This insight provides an intuition for why the literature reports that observed asset sale covenants provide substantial flexibility to finance expansion investments with asset sales (see e.g. Smith and Warner 19).

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$^{19}$ The high leverage is generated by increasing $\chi_B$ to 0.18, and decreasing $\nu_B$ to zero.

$^{20}$ We set $\chi_B$ to 0.18, $\nu_B$ to zero, and increase the scale parameter by 0.5 compared to the baseline firm.

$^{21}$ We set $\chi_B$ to 0.18, $\nu_B$ to zero, and increase the scale parameters by 0.507 in the good and by 0.482 in the bad states compared to the baseline firm.
In addition, we explain the observation in Bradley and Roberts (2004) that firms with larger leverage have a higher probability of including an asset sale covenant.

There is mixed empirical evidence regarding the impact of growth opportunities on the likelihood of asset sale covenants. Bradley and Roberts (2004) report that firms with a higher market-to-book ratio have a larger probability of including asset sale covenants. Similar studies, however, find that high growth firms are typically less likely to include restrictive asset sale covenants (e.g. Kahan and Yermack 1998, Nash, Netter, and Poulsen 2003, Chava, Kumar, and Warga 2010, Reisel 2014). A novel prediction from our analysis is that these conflicting results may be explained by external financing frictions. As we show in Figure 5, the probability of firms implementing restrictive asset sale covenants should increase with growth opportunities only when financing frictions are low. For large financing frictions, the propensity for such covenants should decline with growth opportunities.

6. Aggregate dynamics of simulated samples

The analysis of a typical firm at initiation in Section 5.2 contributes to our understanding of the optimal selection between asset sales and equity issuance as sources of investment financing. In this section, we follow Strebulaev (2007) and study the aggregate dynamics of simulated model-implied economies by investigating the cross sectional properties of corporate policies in a way that makes our results comparable to empirical evidence. The simulation approach is important for two reasons. First, the analysis of a typical firm at initiation in Section 5.2 does not allow us to analyze the dynamic features predicted by the model. We need to simulate the model to generate time series of investment, financing, and default observations across business cycles. Comparing the resulting simulated data patterns to those observed in our Compustat sample enables us to validate the model. We can also measure how the propensity of model firms to use financing asset sales relates to firm and business cycle characteristics. This analysis helps us to confirm our explanations for the empirical regression results on the relation between investments and financing asset sales, and to derive new empirically testable predictions about the impact of time-varying business cycle conditions on the dynamic time serial patterns of financing asset sales.

Second, the analysis of a typical (average) firm does not consider the time evolution of the cross sectional distribution of real firm characteristics. As investment, financing, and default rates are nonlinear in firm characteristics, however, it is crucial to measure these rates for simulated samples

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22 For example, asset sale covenants often allow firms explicitly to sell assets in the ordinary course of business, or as long as the proceeds from the asset sale are used to purchase new fixed assets Smith and Warner (1979).
of firms that match the empirical cross sectional distribution of real firm characteristics. Only the
dynamic features of the average rates in these simulated matched samples should then be compared
to the empirical average behavior of real firms, and be used to derive new predictions.

6.1. Details on the Simulation

For each simulation we generate an economy of model firms. We set up a grid of different firms,
each featuring a unique combination of coupon, scale parameter, and equity issuance cost. Coupons
range from two to 20. These optimal initial coupons are generated by varying \( \chi_i \) and \( \nu_i \) between
zero and 0.31 with a step size of two. Scale parameters for firms with a less cyclical growth opportu-
nity range from 0.79 in the good state and 0.73 in the bad state, and for firms with a more cyclical
growth opportunity from 0.80 in the good state and 0.71 in the bad state to the largest possible
value such that the option is not exercised immediately. The step size is 0.3. Equity issuance costs
at investment range from 0.04 to 0.09 in the good state, with a step size of 0.005. The equity
issuance cost parameter in the bad state is obtained by adding 0.02 to the corresponding value
in the good state. The remaining parameters are equal to those of the baseline firm. The grid
contains 849 different firm types. The earnings path of each firm type is then simulated forward 25
times over 10 years. The initial state of the simulated economy is selected according to the long-run
historical distribution of the states. Firms are exposed to the same macroeconomic shocks, but
experience different idiosyncratic shocks, resulting in a model-implied economy populated by more
than 20,000 different firms. This model-implied economy has a broad range of leverage ratios,
growth opportunities, and equity issuance costs at the last simulated date.

Next, we calculate average leverage, Tobin’s \( q \), and equity issuance cost for each firm in our
Compustat sample to match the model-implied economy to the cross sectional distribution of real
firms (see Appendix A for details). We consider a total of 1352 Compustat firms for which we obtain
all three measures. Firms with a \( q \) value below 1.15, and above 2.15 are winsorized because model-
implied economies hardly contain firms with extremely low or high values of the growth option.

To match the model-implied economy with their empirical counterpart we select for each ob-
servation in the Compustat sample the firm at the last date of the simulated economy that has
the minimal Euclidean distance with respect to leverage, \( q \), and the equity issuance cost. The

\footnote{We verify in simulations with various alternative grids and lower variations of \( \chi_i \) and \( \nu_i \) that our results are
qualitatively robust. In addition, we rerun our baseline simulation with firms that implement an asset sale
covenant at initiation if it is optimal to do so. Our qualitative results are robust to this setting even if the cost of
implementing this covenant is relatively small.}

\footnote{Firms with a growth option that accounts for less than 13% of firm value almost never exercise their option, and
firms with a growth option that accounts for more than 54% of firm value almost immediately exercise their option.}
matching is accurate, with an average Euclidean distance of 0.0226. The procedure allows us to construct a cross sectional distribution of model-implied matched firms that closely reflects its empirical counterpart. These matched firms are quarterly simulated forward over 60 years under the historical probability measure. The equityholders of each firm behave optimally conditional on current earnings and on the current business cycle: If current earnings are below the corresponding regime-dependent default boundary, they default immediately; if current earnings are above the corresponding regime-depending option exercise threshold, they exercise the expansion option and select the optimal funding source for the option exercise cost; otherwise, equityholders take no action. To maintain a balanced sample of firms when we simulate the matched firms over time, we exogenously introduce new firms. In particular, we replace each defaulted or exercised firm by a new firm whose growth option is still intact. Replaced firms have the same initial parameter values as the corresponding defaulted or exercised firm at initiation. To ensure robustness of our results, the entire simulation is repeated 100 times. We then analyze the simulated matched samples.

6.2. Results for the Simulated Matched Samples

In this section, we first illustrate that a typical simulated matched sample exhibits realistic properties to validate the model approach. We then show that the model explains the empirical patterns that we observe in the Compustat data. The model also generates novel predictions for financing asset sales, and for the impact of this financing source on equity issuance and investment.

Table 3 reports averages over all simulations of the mean values, as well as the standard deviations of these means, for important variables of the simulated matched samples. We also provide statistics that condition on the bad and good states, respectively.

The results in Table 3 show that, while firms in a simulated sample are only initially matched statically to the average leverage, Tobin’s $q$, and equity issuance cost of Compustat firms, the model generates many key dynamic properties that we observe in our empirical sample (see Appendix A, Table 5). That is, firms in the simulated samples exhibit, on average, procyclical asset values, $q$ values, coverage ratios, and equity values. The average corporate leverage is countercyclical. The simulated samples also resemble several other dynamic features of the Compustat data. For instance, high $q$ firms have on average a lower leverage and invest more than low $q$ firms.

Next, we investigate in more detail the dynamics of equity financing and investments predicted
by a typical simulation of a matched sample. Fig. 6 shows the time series of the relative amount of firms that issue equity in the typical sample. The shaded areas are bad states. The model firms exhibit procyclical aggregate equity issuance patterns that correspond to well established findings in the empirical literature (e.g., Choe, Masulis, and Nanda 1993, Bayless and Caplinsky 1996).

INSERT FIGURE 6 NEAR HERE

Fig. 7 depicts the time series of the investment rate, which is the fraction of firms that exercise their expansion option. The aggregate investment pattern is procyclical, as typically reported in the empirical literature (see e.g. Barro 1990, Cooper, Haltiwanger, and Power 1999).

INSERT FIGURE 7 NEAR HERE

Fig. 8 shows the time series of the aggregate default rate of the typical simulated sample. Aggregate defaults are countercyclical, and often spike in the beginning of a bad state. This pattern is consistent with empirical observations (see e.g. Duffie, Saita, and Wang 2007, Das, Duffie, Kapadia, and Saita 2007).

INSERT FIGURE 8 NEAR HERE

After verifying that the model features realistic sample properties, we now analyze the model’s predictions with regard to the cyclical nature of financing asset sales. Fig. 9 depicts the time series of the relative number of firms that sell assets to finance the exercise cost of the option in the typical simulated sample. Financing asset sales are generally procyclical, mainly because there is more financing demand from investments during good states. Yang (2008) shows that the procyclicality of asset sales can be due to higher efficiency gains or lower financing costs during good states. Maksimovic and Phillips (2001) argue that more assets are sold in good business cycles due to firms’ refocusing in boom. Our results, though, suggest that financing needs also contribute to the procyclical nature of asset sales.

Fig. 9 also implies that a pronounced financing asset sales activity can occur in the very beginning of a bad state. This pattern is mainly driven by firms with a less cyclical growth option that have a relatively low investment threshold during bad states. As earnings still tend to be high in the very beginning of a bad state when the economy just left a good state, such firms may benefit from the reduction in the investment cost. These investments lead to clustered financing needs
that are partially covered by financing asset sales. The clustering levels off when earnings start to decline with the duration of a bad state.\footnote{Decreasing the proportion of firms with a less cyclical growth option reduces the clustering, and, hence, the investment rate during bad states. It does, however, not affect the dynamics of the propensity of firms to use financing asset sales.}

\begin{center}
\textbf{INSERT FIGURE 9 NEAR HERE}
\end{center}

Fig. 10 compares the time series of investment (solid line) to that of financing asset sales (dashed line). The difference between the dashed and solid lines decreases during bad states, which indicates that asset sales are a relatively more important funding source for firms’ investment activities during bad states. Hence, Fig. 10 illustrates that the aggregate dynamics of asset sales and investment across states of the model are consistent with our finding in the data that the correlation between asset sales and investment is significantly higher during bad business cycle states.

\begin{center}
\textbf{INSERT FIGURE 10 NEAR HERE}
\end{center}

In Table 4 we summarize additional features of the aggregate simulated model dynamics of financing asset sales that corroborate our predictions from a typical firm at initiation. The conditional asset sale ratio is the percentage of firms in the simulated matched samples that, upon investment, finance the exercise cost of the option by selling assets. As the sources of uncertainty are well defined in the model, we do not run regressions on the simulated samples.\footnote{There are no control variables required for financing asset sales in our simulated samples. From an econometric point of view, it is even problematic to apply regression techniques on simulated samples because most model-firm variables are highly collinear.} Instead, we directly use this conditional ratio in the simulated samples to show that the wealth transfer motive of the model generates financing asset sales patterns that are consistent with the stylized facts in the Compustat sample of Table 1.

Overall, 42\% of the investments in the simulated samples are financed with asset sales. If we only consider firms that are in the highest leverage tercile, this ratio increases to 64\%. For firms in the lowest leverage tercile, the ratio decreases to 35\%. The result that highly leveraged firms in the simulated matched samples have a stronger tendency to use financing asset sales upon investment provides support to Prediction 1 and to the stylized empirical fact that the correlation between asset sales and investment increases in leverage.

\begin{center}
\textbf{INSERT TABLE 4 NEAR HERE}
\end{center}
In bad states, the conditional asset sale ratio increases to 54%, and amounts to 38% in good states. This finding confirms Prediction 2 that firms have a higher propensity to sell assets upon investment during bad states, which is also corroborated by the increased correlation between asset sales and investment during bad business cycle states in the real data. Lines six to nine in Table 4 report the asset sale ratios for firms in the simulated samples with a relatively low (LC) and high (HC) cyclicality of the expansion option during good and bad states, respectively. Consistent with Prediction 3 and the empirical pattern (iii), the ratio is more countercyclical for firms with a less cyclical growth option. Finally, the last four lines show that the countercyclicality of the tendency to use financing asset sales at investment in the simulated samples is more pronounced for firms with low external financing frictions (LF) compared to firms with high external financing friction (HF). In particular, the asset sale ratio increases by 22.33 percentage points for LF firms from good to bad states, but only by 6.8 percentage points for HF firms. Hence, our simulations also confirm the cross sectional Prediction 4 and the empirical pattern (iv).

Our results also generate novel testable predictions on the impact of asset sales on equity financing and investment across business cycles. First, Covas and Haan (2011) argue that there are cross sectional differences with respect to the cyclicality of equity financing. Our theory explains to what extent financing asset sales contribute to these differences. Specifically, asset sales enhance the procyclicality of equity financing because they substitute more strongly for the issuance of equity in bad than in good states. The degree of the cyclicality of this substitution is more pronounced for firms with higher leverage, a lower cyclicality of its investment opportunities, and smaller external financing frictions (see Table 4). Therefore, the model predicts that financing asset sales should amplify the pro cyclic equity issuance pattern, particular for firms with higher leverage, a lower cyclicality of its investment opportunities, and smaller external financing frictions.

Second, as shown by Hovakimian and Titman (2006), financing assets sales influence corporate investment, especially for firms that are more financially constraint. In the model, funds from voluntary divestitures indeed accelerate investment, and more so for those firms with larger equity issuance costs. We also speak to the impact of financing asset sales on the cyclicality of investment. While the availability of funds from voluntary asset sales enhances firm investment in both states, the importance of this financing margin particularly increases in bad states compared to good states. According to Table 4, the countercyclicality of the relevance of financing asset sales for investment should be specifically pronounced for firms with higher leverage, a lower cyclicality of their investment opportunities, and smaller external financing frictions. These results help
understanding the cross sectional differences in the procyclicality of corporate investments.

7. Conclusion

In this paper, we analyze the decision of firms to sell assets to fund investments (financing asset sales) across business cycles. We begin by presenting novel patterns of financing asset sales for a sample of U.S. Compustat firms. We find that the correlation between asset sales and investment is significantly higher (i) for firms with larger leverage, and (ii) in bad business cycle states. Additionally, we show that the countercyclicality of the tendency to use financing asset sales depends on the cyclicality of firms’ investment opportunities and external financing frictions in the cross section. These stylized facts cannot be explained by traditional motives for asset sales, such as financial distress.

Against the backdrop of the stylized facts, we study a dynamic model that endogenizes the choice between asset sales and equity issuance to fund capital expenditures. Notably, asset liquidity, growth option, and equity issue cost are subject to cyclicality. Recognizing the impact of cyclicality on financing and investment decisions improves our understanding financing asset sales.

In the model, investment creates a standard wealth transfer from equityholders to debtholders (Myers 1977). However, selling assets upon investment reduces the substance of a firm’s assets, which makes debt riskier. The corresponding wealth transfer from debtholders to equityholders ameliorates the standard wealth transfer problem. We show that the dynamics of the trade-off between the cost of selling assets, the cost of issuing equity, and the magnitude of the wealth transfer problem across business cycles both in a typical and a cross section of simulated model firms explain financing asset sales patterns in the Compustat sample. They also imply novel testable predictions.

Our empirical and theoretical observation that the dynamics of the wealth transfer problem across business cycles drive financing asset sales improves the understanding of firms’ financial and investment decisions across business cycles. For tractability, we abstract away from certain real firm dimensions in the model. Similar to selling assets, for instance, using internal liquidity to finance investment also reduces a firm’s asset substance and, hence, transfers wealth from debt to equity. Thus, whereas our basic mechanism still applies to a broader definition of asset sales that incorporates liquid assets, future work could explore specific aspects of the choice between using internal liquidity and selling assets to fund investments.
Appendix A. Data and variables

Our sample includes all U.S. manufacturing firms (SIC codes between 2000 and 3999) from the Compustat annual research file from 1971 to 2010. All variables are deflated to 1982 dollars using the CPI. Only firms with at least 24 consecutive months of data remain in the sample. Furthermore, we winsorize the sample with regard to the book-to-market ratio, market equity, age, investment, asset sale, and stock returns at the 99% and 1% level. We exclude firms with a $q$ below zero or above ten to address issues of investment opportunity measurement in the data. We also eliminate very small firms with less than five million dollars in fixed assets. The final sample entails 3,022 firms.

We consider the following firm individual variables: $F_t$ are the net fixed assets (PPENT) at the beginning of the period $t$, and Total Assets are the book values of the assets (AT). Asset Sale is equal to the cash proceeds received from the sale of fixed assets (SPPE), and Investment is obtained from the Compustat item capital expenditures (CAPX). Both variables are scaled by $F_t$. We compute the firm individual sales growth as first difference of the Compustat item SALE. We standardize the firm individual sales growth by subtracting the mean and scaling it with its standard deviation. To compute the sample aggregate sales growth we compute then for each year the value-weighted mean sales growth across all sample firms. Age is the number of years a firm has been listed at the NYSE/AMEX/NASDAQ, i.e., the current year minus the first year of a firm’s stock price entry in the merged CRSP/Compustat file. Using Total Assets and Age, we construct the SA-index as measure of financial constraints following Hadlock and Pierce (2010) as:

$$-0.737 \times \text{Total Assets} + 0.043 \times (\text{Total Assets})^2 - 0.04 \times \text{Age}. \quad (A.1)$$

$q$ is a proxy for growth opportunities and calculated as the sum of total debt and market equity divided by the book value of total assets (cf., Hovakimian and Titman 2006). Financial Slack corresponds to the sum of cash and short-term investments (CHE) scaled by $F_t$. We define Total Debt as the sum of total liabilities (LT) and total preferred stock (PSTK) excluding deferred taxes (TXDB) and convertible debt (DCVT) scaled by Total Assets. As a proxy for Cash Flow we use the sum of income before extraordinary items, depreciation and amortization (IB + DP) scaled by $F_t$. Cov. Ratio is EBITDA divided by interest expenses (XINT). We adopt an iterative procedure to calculate Asset Volatility, following the steps in Vassalou and Xing (2004). In particular, we estimate the volatility of equity with daily equity values over the past 12 month for each firm-year observation. This volatility serves as a starting guess for the estimation of the asset volatility.
Applying the Black-Scholes formula, we then compute daily asset values over the past 12 month using the daily equity values, total liabilities, the starting guess for the asset volatility, and the risk-free interest rate from CRSP. Next, we calculate the standard deviation of these asset values, and use it as the volatility of assets for the next iteration. We repeat this procedure until the asset volatilities from two consecutive iterations converge to a tolerance level of $10E^{-4}$. The Altman (1968) Z-score is a widely used measure of financial distress. It is computed for each firm as:

$$Z = 1.2 \cdot \frac{ACT - LCT}{AT} + 1.4 \cdot \frac{RE}{AT} + 3.3 \cdot \frac{NI + XINT + TXT}{AT} + 0.6 \cdot \frac{ME}{LT} + 0.999 \cdot \frac{SALE}{AT}. \quad (A.2)$$

A value above 2.99 indicates that the firm is not financially distressed. We compute the equity issuance costs for our sample firms according to the cost function in Hennessy and Whited (2007). They provide estimates for the equity issuance cost function for small, large, and all firms. At the end of each year, we sort firms according to their size ($ME$) into tercile portfolios. (Using the SA-index instead of size as sorting variable does not change the quality of our results.) We then compute the equity issuance cost for the firms in each portfolio for the subsequent year according to the amount of equity that a firm issues in the corresponding year ($SSTK$). For the firms in the lowest size portfolio, we use the estimation results of Hennessy and Whited (2007) for small firms, for the highest size tercile the estimations for large firms, and for the medium size tercile the estimation results that Hennessy and Whited (2007) obtain for the full sample. We winsorize the estimated equity issuance costs at the 90% level to control for outliers.

In Table 5, we report basic variable characteristics for the full sample (Panel A), for bad states (Panel B), and for good states (Panel C). The table shows the mean, the standard deviation (Std), the median, the 25 percent (Q25) and the 75 percent quantiles (Q75). We define an aggregate downturn of our firm economy as years in which the sample aggregate sales growth and the annual return across sample firms are in the bottom 25% across all years. We choose this definition of a business cycle downturn mainly because sales growth combined with market based downturn measures are a direct measure of the propagation of positive and negative shocks from the aggregate economy onto the corporate level (see also the downturn definitions in e.g. Opler and Titman 1994, Gilson, John, and Lang 1990). All other years are identified as good state.
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Tables

Table 1
Compustat sample asset sale determinants

The table reports regression coefficients for linear regressions with industry fixed effects and industry clustered autocorrelation robust $t$-statistics (in parentheses) with Asset Sale as dependent variable. Asset Sale are the cash proceeds from the sale of fixed capital. Investment is equal to capital expenditures. Cashflow is the first lag of the sum of income before extraordinary items and depreciation and amortization. $q$ is the first lag of the sum of the book value of total debt and the market value of equity divided by the book value of total assets. Financial Slack are the cash proceeds from the sale of fixed capital. Investment, Cash Flow, Asset Sale, and Financial Slack are scaled by the book value of the beginning-of-period net fixed assets. The variable Cov. Ratio is the first lag of the ratio of EBITDA divided by the interest expenses. Asset Volatility is the estimated volatility of a firm’s assets. Leverage is the first lag of (LT+PSTK-TXDB-DCTVT) scaled by Total Assets. Bad State is a dummy that is one if the aggregate sales growth and the average annual equity return across all firms in the sample are, simultaneously, in the bottom 25% of all years. Corr(q, Salesgr.) is the firm individual 5-year rolling correlation of the firm’s $q$ with the aggregate annual sales growth across all firms. SA-Index is the financial constraints measure of Hadlock and Pierce (2010). I_{Low Z} is a dummy that is one if a firm has a Z-Score (see Equation (A.2)) value below 3. The sample period is 1971 to 2010. N is the number of observations in the corresponding regression. The full sample consists of an unbalanced sample of 3,022 U.S. manufacturing firms.

<table>
<thead>
<tr>
<th>Dependent variable: Asset sale</th>
<th>(I)</th>
<th>(II)</th>
<th>(III)</th>
<th>(IV)</th>
<th>(V)</th>
<th>(VI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Investment</td>
<td>0.024</td>
<td>0.005</td>
<td>0.004</td>
<td>0.003</td>
<td>0.005</td>
<td>0.0071</td>
</tr>
<tr>
<td></td>
<td>(5.20)</td>
<td>(0.57)</td>
<td>(0.44)</td>
<td>(0.34)</td>
<td>(0.66)</td>
<td>(0.83)</td>
</tr>
<tr>
<td>Cash Flow</td>
<td>-0.002</td>
<td>-0.002</td>
<td>-0.002</td>
<td>-0.004</td>
<td>-0.002</td>
<td>-0.002</td>
</tr>
<tr>
<td></td>
<td>(-7.16)</td>
<td>(-7.48)</td>
<td>(-7.45)</td>
<td>(-7.01)</td>
<td>(-7.41)</td>
<td>(-9.69)</td>
</tr>
<tr>
<td>$q$</td>
<td>-0.003</td>
<td>-0.003</td>
<td>-0.003</td>
<td>-0.003</td>
<td>-0.003</td>
<td>-0.003</td>
</tr>
<tr>
<td></td>
<td>(-14.59)</td>
<td>(-13.26)</td>
<td>(-13.46)</td>
<td>(-11.87)</td>
<td>(-13.53)</td>
<td>(-13.46)</td>
</tr>
<tr>
<td>Financial Slack</td>
<td>-0.000</td>
<td>-0.000</td>
<td>-0.000</td>
<td>0.000</td>
<td>-0.000</td>
<td>-0.000</td>
</tr>
<tr>
<td></td>
<td>(-2.71)</td>
<td>(-1.12)</td>
<td>(-1.10)</td>
<td>(0.98)</td>
<td>(-1.25)</td>
<td>(-1.80)</td>
</tr>
<tr>
<td>Cov. Ratio</td>
<td>-0.000</td>
<td>-0.000</td>
<td>-0.000</td>
<td>-0.000</td>
<td>-0.000</td>
<td>-0.000</td>
</tr>
<tr>
<td></td>
<td>(-1.40)</td>
<td>(-1.29)</td>
<td>(-1.28)</td>
<td>(-0.51)</td>
<td>(-1.29)</td>
<td>(-4.76)</td>
</tr>
<tr>
<td>Assetvolatility</td>
<td>-0.001</td>
<td>-0.001</td>
<td>-0.001</td>
<td>-0.004</td>
<td>-0.001</td>
<td>-0.001</td>
</tr>
<tr>
<td></td>
<td>(-3.02)</td>
<td>(-3.07)</td>
<td>(-2.82)</td>
<td>(-2.86)</td>
<td>(-2.79)</td>
<td>(-2.82)</td>
</tr>
<tr>
<td>Leverage</td>
<td>0.012</td>
<td>0.004</td>
<td>0.004</td>
<td>0.002</td>
<td>0.004</td>
<td>0.006</td>
</tr>
<tr>
<td></td>
<td>(2.89)</td>
<td>(0.73)</td>
<td>(0.77)</td>
<td>(0.39)</td>
<td>(0.88)</td>
<td>(1.08)</td>
</tr>
<tr>
<td>Lever. x Invest.</td>
<td>0.044</td>
<td>0.044</td>
<td>0.052</td>
<td>0.041</td>
<td>0.053</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(2.42)</td>
<td>(2.58)</td>
<td>(2.43)</td>
<td>(2.21)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bad State x Invest.</td>
<td>0.019</td>
<td>0.016</td>
<td>0.015</td>
<td>0.021</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(3.23)</td>
<td>(1.93)</td>
<td>(2.28)</td>
<td>(3.40)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bad State</td>
<td>-0.006</td>
<td>-0.005</td>
<td>-0.002</td>
<td>-0.006</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(-5.15)</td>
<td>(-5.50)</td>
<td>(-2.53)</td>
<td>(-5.22)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Corr(q, Salesgr.)</td>
<td>0.001</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td></td>
<td>(1.43)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Invest. x Corr(q, Salesgr.)</td>
<td>0.000</td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td></td>
<td>(0.01)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Invest. x SA-Index</td>
<td>0.007</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.32)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bad State x SA-Index</td>
<td>-0.000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(-2.40)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Invest. x Bad State x SA-Index</td>
<td>2.667</td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td></td>
<td>(2.66)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I_{Low Z}</td>
<td>0.000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(2.35)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Invest. x I_{Low Z}</td>
<td>0.000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(1.06)</td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

Industry-Fixed Effects | Yes | Yes | Yes | Yes | Yes | Yes |
Adj. $R^2$               | 0.033 | 0.034 | 0.035 | 0.034 | 0.036 | 0.033 |
No. of Obs.              | 17468 | 17468 | 14514 | 17468 | 17468 | 17257 |
Table 2
Baseline parameter choice

This table summarizes our baseline parameter choice. Panel A lists the annualized parameters of a typical Compustat firm. Panels B and C report our parameter choice for the expansion option and the macroeconomy, respectively.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Parameter value</th>
<th>Panel A: Firm Characteristics</th>
<th>Good State (G)</th>
<th>Bad State (B)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initial earnings level ($X$)</td>
<td>10</td>
<td>10</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tax advantage of debt ($\tau$)</td>
<td>0.15</td>
<td>0.15</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Earnings growth rate ($\mu_i$)</td>
<td>0.0782</td>
<td>-0.0401</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Systematic earnings volatility ($\sigma_{X,C}^i$)</td>
<td>0.0834</td>
<td>0.1334</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Idiosyncratic earnings volatility ($\sigma_{X,id}^i$)</td>
<td>0.168</td>
<td>0.168</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Equity issuance cost ($\Upsilon_i$)</td>
<td>0.08</td>
<td>0.1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Asset Liquidity ($\lambda_i$)</td>
<td>0.9259</td>
<td>0.9091</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Recovery rate ($\alpha_i$)</td>
<td>0.63</td>
<td>0.57</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Parameter value</th>
<th>Panel B: Expansion Option Parameters of a Typical Firm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exercise price ($K_i$)</td>
<td>183.13</td>
<td>160</td>
</tr>
<tr>
<td>Scale parameter ($s_i$)</td>
<td>1.0925</td>
<td>1.03</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Parameter value</th>
<th>Panel C: Economy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rate of leaving regime $i$ ($\lambda_i$)</td>
<td>0.2718</td>
<td>0.4928</td>
</tr>
<tr>
<td>Consumption growth rate ($\theta_i$)</td>
<td>0.0420</td>
<td>0.0141</td>
</tr>
<tr>
<td>Consumption growth volatility ($\sigma_{C}^i$)</td>
<td>0.0094</td>
<td>0.0114</td>
</tr>
<tr>
<td>Rate of time preference ($\rho$)</td>
<td>0.015</td>
<td>0.015</td>
</tr>
<tr>
<td>Relative risk aversion ($\gamma$)</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Elasticity of intertemporal substitution ($\Psi$)</td>
<td>1.5</td>
<td>1.5</td>
</tr>
</tbody>
</table>
Table 3
Simulated sample results

The table provides summary statistics for the simulated matched samples over the full sample period, bad states, and good states. The sample period is 50 years with simulated quarterly observations. Each simulated sample consists of 1352 firms that are matched to our Compustat sample. Firms are replaced in case of investment or default. We report the mean of the mean values of 100 simulated samples, and the standard deviation (Std) of the mean across simulations. Total Assets ($TA$) is the total value of firm assets. Investment, Asset Sale, and Equity Finance are the annualized percentage number of firms that invest, sell assets, or issue equity, respectively. The $q$ of model firms is obtained by dividing the value of the firm by the value of its invested assets. The variable Cov. Ratio corresponds to firm earnings divided by coupon payments. Leverage is the market value of debt divided by the market value of the firm. Equity Value/TA is the market value of equity scaled by total the total firm value.

<table>
<thead>
<tr>
<th>Variable</th>
<th>All States Mean</th>
<th>All States Std</th>
<th>Bad State Mean</th>
<th>Bad State Std</th>
<th>Good State Mean</th>
<th>Good State Std</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Assets ($TA$)</td>
<td>194.52</td>
<td>12.98</td>
<td>161.37</td>
<td>9.37</td>
<td>215.33</td>
<td>9.46</td>
</tr>
<tr>
<td>Investment</td>
<td>0.081</td>
<td>0.009</td>
<td>0.059</td>
<td>0.007</td>
<td>0.095</td>
<td>0.01</td>
</tr>
<tr>
<td>Asset Sales</td>
<td>0.034</td>
<td>0.012</td>
<td>0.031</td>
<td>0.01</td>
<td>0.036</td>
<td>0.014</td>
</tr>
<tr>
<td>Equity Finance</td>
<td>0.047</td>
<td>0.013</td>
<td>0.028</td>
<td>0.01</td>
<td>0.059</td>
<td>0.015</td>
</tr>
<tr>
<td>$q$</td>
<td>1.45</td>
<td>0.024</td>
<td>1.38</td>
<td>0.018</td>
<td>1.50</td>
<td>0.018</td>
</tr>
<tr>
<td>Cov. Ratio</td>
<td>1.83</td>
<td>0.164</td>
<td>1.75</td>
<td>0.146</td>
<td>1.88</td>
<td>0.171</td>
</tr>
<tr>
<td>Leverage</td>
<td>0.43</td>
<td>0.027</td>
<td>0.48</td>
<td>0.025</td>
<td>0.39</td>
<td>0.022</td>
</tr>
<tr>
<td>Equity Value/TA</td>
<td>0.576</td>
<td>0.027</td>
<td>0.518</td>
<td>0.025</td>
<td>0.612</td>
<td>0.023</td>
</tr>
</tbody>
</table>

Table 4
Conditional asset sale ratios

The table provides summary statistics for conditional asset sale ratios from the simulated samples. Asset sale and investment are both dummy variables that are equal to one in case of an asset sale or an investment, respectively. To calculate conditional asset sale ratios, we aggregate over all simulations the asset sale and investment observations for the sample that we consider, and divide the sum of asset sale observations by the sum of investment observations. We compute this ratio for all firms, for firms in the highest and the lowest leverage terciles with resorting in every period, during bad and good states, and for firms with a more (H) or less (L) cyclical growth option. For details on the simulation see Section 6. $LC_{bad}$ and $LC_{good}$ are asset sale ratios of firms with a low cyclicality of the expansion option during bad and good states, respectively. $HC_{bad}$ and $HC_{good}$ indicate the ratios for firms with a high cyclicality in the two states. $LF_{bad}$ and $LF_{good}$ are asset sale ratios of firms with low external financing frictions during bad and good states, respectively. $HF_{bad}$ and $HF_{good}$ indicate the ratios for firms with high external financing frictions in the two states.

<table>
<thead>
<tr>
<th>Asset Sale Conditional on Investment</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Asset Sales</td>
<td>42.13%</td>
</tr>
<tr>
<td>High Leverage Firms</td>
<td>64.31%</td>
</tr>
<tr>
<td>Low Leverage Firms</td>
<td>34.69%</td>
</tr>
<tr>
<td>Bad States</td>
<td>53.72%</td>
</tr>
<tr>
<td>Good States</td>
<td>38.25%</td>
</tr>
<tr>
<td>$LC_{bad}$</td>
<td>48.75%</td>
</tr>
<tr>
<td>$LC_{good}$</td>
<td>41.22%</td>
</tr>
<tr>
<td>$HC_{bad}$</td>
<td>46.12%</td>
</tr>
<tr>
<td>$HC_{good}$</td>
<td>41.79%</td>
</tr>
<tr>
<td>$LF_{bad}$</td>
<td>22.67%</td>
</tr>
<tr>
<td>$LF_{good}$</td>
<td>0.34%</td>
</tr>
<tr>
<td>$HF_{bad}$</td>
<td>89.40%</td>
</tr>
<tr>
<td>$HF_{good}$</td>
<td>82.60%</td>
</tr>
</tbody>
</table>
Table 5
Compustat sample summary statistics

The table provides summary statistics for different sample variables in Panel A. In Panel B and Panel C, the table reports summary statistics for bad (Panel B) and good (Panel C) states. We define an aggregate downturn of our firm economy as years in which the sample aggregate sales growth and the average annual equity return across sample firms are, simultaneously, in the bottom 25% of all years. All other years are considered as a good state. The table reports the mean, the standard deviation (Std), the median, the 25 percent (Q25), and the 75 percent quantile (Q75). Total Assets (AT) and Fixed Assets (F) are in million dollars, measured at the beginning of each year. q is the sum of the book value of total debt and the market value of equity divided by the book value of total assets. Investment is equal to capital expenditures. Asset Sale are the cash proceeds from sale of fixed capital. Cash Flow is the sum of income before extraordinary items and depreciation and amortization. Fin. Slack is the sum of cash and short-term investments. Investment, Asset Sale, Cash Flow, and Fin. Slack are scaled by the book value of the beginning-of-period net fixed assets. Asset Volatility is the estimated volatility of a firms’ assets. Total debt is (LT+PSTK-TXDB-DCVT). Market Equity is computed as the CRSP monthly share price (PRC) multiplied with the number of outstanding shares (SHROUT). The variable Cov. Ratio is computed by dividing EBITDA with the interest expenses. The sample period is 1971 to 2010. The sample consists of 3,022 U.S. manufacturing firms.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>Std</td>
<td>Mean</td>
<td>Std</td>
</tr>
<tr>
<td>Total Assets (TA)</td>
<td>1140.98</td>
<td>3857.31</td>
<td>968.21</td>
</tr>
<tr>
<td>Fixed Assets (F)</td>
<td>347.59</td>
<td>1135.23</td>
<td>310.37</td>
</tr>
<tr>
<td>q</td>
<td>1.3397</td>
<td>1.4996</td>
<td>0.881</td>
</tr>
<tr>
<td>Investment/F</td>
<td>0.2104</td>
<td>0.1145</td>
<td>0.2226</td>
</tr>
<tr>
<td>Asset Sales/F</td>
<td>0.0169</td>
<td>0.0347</td>
<td>0.0171</td>
</tr>
<tr>
<td>Cash Flow/F</td>
<td>0.3413</td>
<td>0.7816</td>
<td>0.366</td>
</tr>
<tr>
<td>Fin. Slack/F</td>
<td>0.7583</td>
<td>1.6365</td>
<td>0.4752</td>
</tr>
<tr>
<td>Asset Volatility</td>
<td>0.3951</td>
<td>0.5696</td>
<td>0.5313</td>
</tr>
<tr>
<td>Total Debt/TA</td>
<td>0.4384</td>
<td>0.1798</td>
<td>0.4654</td>
</tr>
<tr>
<td>Market Equity</td>
<td>1162.14</td>
<td>3292.83</td>
<td>602.09</td>
</tr>
<tr>
<td>Cov. Ratio</td>
<td>54.62</td>
<td>735.27</td>
<td>27.90</td>
</tr>
<tr>
<td>Total Assets (TA)</td>
<td>1156.14</td>
<td>3954.12</td>
<td>1194.69</td>
</tr>
<tr>
<td>Fixed Assets (F)</td>
<td>350.85</td>
<td>1163.99</td>
<td>602.09</td>
</tr>
<tr>
<td>q</td>
<td>1.38</td>
<td>1.4974</td>
<td>0.436</td>
</tr>
<tr>
<td>Investment/F</td>
<td>0.2194</td>
<td>0.1142</td>
<td>0.0168</td>
</tr>
<tr>
<td>Asset Sales/F</td>
<td>0.0168</td>
<td>0.0392</td>
<td>0.3391</td>
</tr>
<tr>
<td>Cash Flow/F</td>
<td>0.3391</td>
<td>0.7909</td>
<td>0.7832</td>
</tr>
<tr>
<td>Fin. Slack/F</td>
<td>0.7832</td>
<td>1.6652</td>
<td>0.3831</td>
</tr>
<tr>
<td>Asset Volatility</td>
<td>0.3831</td>
<td>0.5120</td>
<td>0.436</td>
</tr>
<tr>
<td>Total Debt/TA</td>
<td>0.436</td>
<td>0.1807</td>
<td>1194.69</td>
</tr>
<tr>
<td>Market Equity</td>
<td>57.00</td>
<td>765.49</td>
<td>57.00</td>
</tr>
<tr>
<td>Cov. Ratio</td>
<td>57.00</td>
<td>765.49</td>
<td>57.00</td>
</tr>
</tbody>
</table>
Figures

**Figure 1. Leverage at investment.** This figure shows the leverage ratios upon investment of a firm that chooses initially an optimal leverage ratio as a function of the equity issuance cost. Equityholders optimally finance the exercise cost of the option in good states (solid line) and bad states (dashed line).

**Figure 2. Leverage at investment and cyclicity of the Growth Option.** This figure shows the leverage ratios upon investment of a firm that chooses initially an optimal leverage ratio as a function of the equity issuance cost. Equityholders optimally finance the exercise cost of the option in good states (solid line) and bad states (dashed line). The dashed-dotted and the dotted lines are the corresponding leverage ratios upon investment of a firm with a more cyclical growth option than the baseline firm.
Figure 3. Optimal financing choice. This figure depicts equityholders’ optimal financing choice. In the region to the right of the dashed line, they select asset sales in good states and bad states to finance the exercise cost of the option. In the region to the left of the solid line, they issue equity in good states and bad states. Between the dashed and the solid lines, equityholders issue equity in good states, and sell assets in bad states to finance the exercise cost.

Figure 4. Optimal investment thresholds. This figure shows the earnings levels at which equityholders optimally exercise the growth option for a range of initial leverage ratios. The lower and upper solid lines are the investment thresholds in good and bad states, respectively, for a firm that finances the option’s exercise cost by issuing equity. The lower and upper dashed lines are the investment thresholds in good and bad states for a firm that finances the exercise cost by selling assets.
Figure 5. Asset sale covenant and firm value. This figure illustrates the quantitative impact of a covenant that restricts financing asset sales on the percentage value of firms. The solid line shows the covenant value for the baseline firm. The dashed line plots the covenant value for a firm with a high leverage, and the dashed-dotted line for a firm with both a large value of the expansion option and a high leverage. The dotted line is a firm with a large value of the expansion option, a high leverage, but a more cyclical option.

![Covenant Value Chart]

Figure 6. Aggregate equity financing. This figure plots the aggregate quarterly ratio of firms in a typical simulated economy that issue equity over time. The shaded regions are bad states, and the white regions are good states.

![Equity Financing Chart]
**Figure 7. Aggregate investment.** This figure plots the aggregate quarterly ratio of firms in a typical simulated economy that invest over time. The shaded regions are bad states, and the white regions are good states.

**Figure 8. Aggregate default.** This figure plots the aggregate quarterly ratio of firms in a typical simulated economy that default over time. The shaded regions are bad states, and the white regions are good states.
Figure 9. Aggregate financing asset sales. This figure plots the aggregate quarterly ratio of firms in a typical simulated economy that sell assets over time. The shaded regions are bad states, and the white regions are good states.

Figure 10. Aggregate investment and financing asset sales. This figure plots the aggregate quarterly ratio of firms in a typical simulated economy that invest (solid line), and the aggregate ratio of firms that sell assets (dashed line) over time. The shaded regions are bad states, and the white regions are good states.