Review of Finance, 2018, 243–277
doi: 10.1093/rof/rfx040
Advance Access Publication Date: 22 August 2017

Financing Asset Sales and Business Cycles*

Marc Arnold[1], Dirk Hackbarth[2], and Tatjana Xenia Puhan[3]

[1]University of St. Gallen, [2]Boston University, and [3]University of Mannheim

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. Equity financed investment transfers wealth from equity to debt because asset volatility declines and earnings increase when firms invest. Financing asset sales reduce asset collateral and, hence, transfer wealth back from debt to equity. Exploring the dynamics of the heretofore overlooked "asset sale versus external equity" financing margin 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.

JEL classification: D92, E32, E44, G12, G32, G33

Keywords: Asset sales, Business cycle, Financial policy, Real options

Received January 27, 2017; accepted June 27, 2017 by Editor Alex Edmans.

* We are grateful to Alex Edmans (the editor), Rui Albuquerque, Heitor Almeida, Snehal Banerjee, Gadi Barlevy, Andrea Buffa, Wouter Den Haan, Giovanni Favara, Arvind Krishnamurthy, Robert Korajczyk, Andrey Malenko, Antonio Mello, Mitchell Petersen, Dimitris Papanikolaou, Costis Skiadas, Ilya Strebulaev (the referee), Günter Strobl, Gustavo Suarez, Sheridan Titman, Ramona Westermann, and to seminar participants at Boston University, Brandeis University, Copenhagen Business School, Frankfurt School of Finance, Hong Kong University of Science and Technology, NBER Summer Institute Capital Markets and the Economy in Cambridge, Northeastern University, Northwestern University, University of Hong Kong, University of Illinois, University of St. Gallen, University of West Virginia, University of Wisconsin, the 2014 EFA Meetings, the 2016 NBER Summer Institute on Capital Markets and the Economy, and the 9th Annual Corporate Finance Conference for comments and suggestions. Part of this research was conducted while Puhan visited Kellogg School of Management at Northwestern University and was PhD student of the Swiss Finance Institute and the University of Zurich. T.X.P. gratefully acknowledges financial support of the Swiss National Foundation and the Zell Center for Risk Research.

1. Introduction

A crucial component of corporate investment decisions relates to funding source. In practice, asset sales play an important role in investment financing. For instance, Thomson Reuters announced the sale of two business units for USD 1 billion to fund investments in 2011. One year later, Petrobras initiated large asset sales to contribute to financing needs of nearly USD 15 billion to fund its 5-year investment plan. The average proceeds from fixed asset sales correspond to roughly 44% of the average net amount of newly issued equity for US manufacturing firms in COMPUSTAT between 1971 and 2010. Similarly, Eisfeldt and Rampini (2006) report that capital reallocation comprises 24% of investment.

Moreover, Eckbo and Kisser (2015) find when also including liquid assets, the average proceeds from asset sales are about the same as the proceeds from the issue of equity plus debt securities, which suggests that asset sales are more significant than previously believed. Yet, the academic literature on variation in firm financing across business cycles (e.g., Korajczyk and Levy, 2003) is largely silent on the "asset sale versus external equity" financing margin.

This paper studies the heretofore overlooked funding source, namely the decision to sell assets to fund investments (financing asset sales) across business cycles. The cyclicality of a firm's financing asset sale policy crucially depends on the cyclicality of its growth opportunities, and on external financing frictions. Investigating the cyclicality of financing asset sales is important for several reasons. First, whereas the cyclicality of external financing sources has been studied extensively in the recent literature (e.g., Covas and Den Haan 2011), the cyclicality of financing asset sales has not been discussed. Second, previous work finds that business cycles are important for understanding financing and investment decisions as well as for evaluating the cost of debt overhang (e.g., Chen and Manso, 2016). Third, changes in the amount or 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.

We consider a dynamic model of financing, investment, and macroeconomic risk to investigate when, across business cycles, firms sell assets to fund investments.[1] Equity issuance cost, asset liquidity, and growth option depend on the business cycle, which produces endogenous variation in 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 selects an optimal capital structure by trading off tax shields against bankruptcy costs, and it acts in the best interest of equityholders. As investment reduces the riskiness of debt, exercising the growth option transfers wealth from equity to debt.

For funding investment, we abstract from new debt financing to examine a novel financing margin, that is, issuing equity or selling assets, which generates an intuitive trade-off. On the one hand, selling assets reduces asset collateral, which makes debt riskier and hence produces a reverse wealth transfer from debtholders to equityholders that mitigates the

1 See, for example, Hackbarth, Miao, and Morellec (2006); Bhamra, Kuehn, and Strebulaev (2010b); Chen (2010); and Arnold, Wagner, and Westermann (2013). Our paper innovates by incorporating the endogenous choice between financing investments by asset sales or equity issuances. Moreover, we incorporate business-cycle-dependent equity issuance cost, asset liquidity, and cyclicality of the growth option.

wealth transfer due to investment. On the other hand, firms face frictions, such as costs of external equity due to asymmetric information, underwriting fees, and liquidation costs for selling assets (e.g., Pulvino, 1998; Hennessy and Whited, 2007). Firms trade off the mitigation of the wealth transfer problem with asset sales against the incremental (or net) frictions of selling assets relative to issuing equity when selecting the optimal funding source.

Exploring this trade-off across the business cycle, we find four main results. First, financing asset sales are more pronounced for firms with higher financial leverage, because the wealth transfer benefit of asset sales is stronger if debt is riskier. Second, financing asset sales are countercyclical. Firms optimally invest at a higher leverage in bad compared with good states. As the wealth transfer problem is more pronounced when leverage is high, firms have a stronger incentive to finance investment by selling assets in bad states. Third, financing asset sales are more countercyclical for firms with a less procyclical investment option, because such firms invest earlier in bad states and later in good states compared with a baseline firm. As earlier investment entails higher leverage at investment, the difference between leverage at investment in bad and good states is more pronounced for firms with a less procyclical expansion option. Hence, the wealth transfer problem at investment is particularly countercyclical for firms with a less procyclical growth option. Fourth, financing asset sales are more countercyclical for firms with lower equity financing frictions because the trade-off causing countercyclicality drives financing decisions only if the financing friction cost of issuing new equity is lower than that of selling assets. Appendix B provides empirical support for the model's four predictions on asset sales in a large COMPUSTAT sample of US manufacturing firms.

In addition, the model sheds light on the quantitative impact of financing asset sales on firm value. Asset sales affect the net friction cost of financing investment, reduce expected future asset collateral, and influence investment timing. Depending on these three channels, firm value can increase by more than 2% from the ability to sell assets. For some parameter values, asset sales reduce firm value, but equityholders still select this financing source *ex post* due to the wealth transfer problem. In this case, a covenant that prohibits financing asset sales increases firm value. These firm value implications explain the empirical pattern that highly levered firms are more likely to include asset sale covenants (e.g., Bradley and Roberts, 2015). We also show that financing asset sales increase credit spreads.

Finally, we analyze the dynamic features of the model in simulated samples, which are structurally similar to the COMPUSTAT sample, and confirm the model's four predictions. In addition, these samples feature business cycle patterns on investment, equity financing, asset values, coverage ratios, and Tobin's q reflected in the COMPUSTAT data. The simulations also provide novel predictions. For example, asset sales amplify the procyclicality of equity financing because they particularly substitute equity issues in bad states. This tendency should be more pronounced for firms with higher leverage, less cyclical growth opportunities, and smaller external financing frictions that use more financing asset sales. For such firms, asset liquidity should also accelerate investment particularly in bad states.

Our contribution is two-fold. First, we show that agency conflicts between debt and equity, and their dynamics over the business cycle are important and heretofore neglected determinants of asset sales. We thereby complement previous work that associates asset sales with alternative motives such as financial distress, financial constraints, productivity shocks, and information asymmetry.[2] Edmans and Mann (2016) examine the relative

2 See, for example, Asquith, Gertner, and Scharfstein (1994); Brown, James, and Mooradian (1994); Hovakimian and Titman (2006); Campello, Graham, and Harvey (2010); and Warusawitharana (2008).

information asymmetry associated with issuing equity and selling assets as a driving motive behind a firm's financing choice. They show that this motive can lead to procyclical asset sales. Our focus on the agency motive complements Lang, Poulsen, and Stulz (1995) and Bates (2005), who investigate the trade-off between investment efficiency and agency costs of managerial discretion associated with selling assets, and Morellec (2001) who analyzes equityholders' incentive to liquidate assets to meet coupon payments. None of these studies considers the agency conflict associated with the financing of investment. Modeling this conflict also allows us to rationalize the use of asset sale covenants described in the empirical literature.[3]

Second, we contribute to work focusing on the impact of business cycles on corporate financial policies, which does not consider asset sales (Jermann and Quadrini, 2012; Begenau and Salomao, 2016; Chen and Manso, 2016; Westermann, 2017). We show that incorporating business cycles is crucial for jointly explaining the choice of asset sales as a funding source and investment decisions. Whereas the effect of cyclicality on asset sales through the productivity channel has already been explored (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.[4]

The paper proceeds as follows. Section 2 introduces and Section 3 solves the model. Section 4 derives four predictions generated by the model for a typical firm at initiation. We simulate model-implied economies of firms to analyze the aggregate dynamics of financing asset sales in Section 5. Section 6 discusses model limitations and Section 7 concludes.

2. Model Setup

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 denoted by good (G) and bad (B). Aggregate output, corporate earnings, and financing frictions depend on the 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

$$Q := \begin{bmatrix} -\lambda_G & \lambda_G \\ \lambda_B & -\lambda_B \end{bmatrix},$$

in which $\lambda_i \in (0, 1)$ is the rate of leaving state i. The representative agent has the continuous-time analog of Epstein–Zin–Weil preferences of stochastic differential utility type (Duffie and Epstein, 1992). The utility index U_t over a consumption process C_s solves

$$U_t = \mathbb{E}^{\mathbb{P}}\left[\int_t^{\infty} \frac{\rho}{1-\delta} \frac{C_s^{1-\delta} - ((1-\omega)U_s)^{\frac{1-\delta}{1-\omega}}}{((1-\omega)U_s)^{\frac{1-\delta}{1-\omega}} - 1} \mathrm{d}s | \mathcal{F}_t\right], \tag{1}$$

3 See, for example, Smith and Warner (1979); Chava, Kumar, and Warga (2010); and Bradley and Roberts (2015).

4 See, for example, Choe, Masulis, and Nanda (1993); Duchin, Ozbas, and Sensoy (2010); Lemmon and Roberts (2010); Campello, Graham, and Harvey (2010); and Covas and Den Haan (2011).

in which ρ is the rate of time preference, ω is the coefficient of relative risk aversion for a timeless gamble, and $\Psi := \frac{1}{\delta}$ is the elasticity of intertemporal substitution for deterministic consumption paths. Incorporating the separability of time and state preferences and assuming that $\Psi > 1$, that is, that the representative agent has a preference for early resolution of uncertainty and require expected returns that increase with uncertainty about future consumption, are necessary to capture the impact of aggregate risk on corporate security values. Online Appendix A.1 derives the dynamics of the stochastic discount factor.[5]

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

$$\mathrm{d}C_t = \theta_i C_t \mathrm{d}t + \sigma_i^C C_t \mathrm{d}W_t^C, \; i = G, B, \tag{2}$$

where W_t^C is a Wiener process that does not depend on the Markov chain, θ_i is a regime-dependent growth rate of the aggregate output, and σ_i^C is the corresponding volatility. In equilibrium, aggregate consumption equals aggregate output. The earnings process follows:

$$\mathrm{d}X_t = \mu_i X_t \mathrm{d}t + \sigma_i^{X,C} X_t \mathrm{d}W_t^C + \sigma^{X,id} X_t \mathrm{d}W_t^X, \quad i = G, B, \tag{3}$$

where W_t^X is a Wiener process and $\sigma^{X,id}$ is an idiosyncratic volatility that is independent of the aggregate output shock W_t^C and the Markov chain. The parameters μ_i are the regime-dependent drifts and $\sigma_i^{X,C}$ are firm-specific regime-dependent volatilities associated with the aggregate output process.

We denote the risk-neutral measure by $\mathbb{Q}$ and the market price of consumption risk by $\eta_i = \omega\sigma_i^C$. The expected growth rates, $\tilde{\mu}_i$, of a firm's earnings under the $\mathbb{Q}$ measure are

$$\tilde{\mu}_i := \mu_i - \sigma_i^{X,C}\eta_i. \tag{4}$$

Moreover, the Markov chain's transition intensities under the $\mathbb{Q}$ measure are

$$\tilde{\lambda}_i = e^{\kappa_i}\lambda_i, \tag{5}$$

where $\kappa_i = (\delta - \omega) \log\left(\frac{b_j}{b_i}\right)$ are the market prices of jump risk (see Online Appendix A.1).

A firm is initially financed with equity and infinite maturity debt. The proportional cost of issuing initial equity is φ_i and that of initial debt is Υ_i. Ritter and Welch (2002) provide an overview of the various sources of IPO costs.

Once debt has been issued, the firm pays a coupon c. We assume that initial debt carries a covenant that prohibits issuance of new debt. Covenants restricting new debt are ubiquitous in observed debt contracts (e.g., Chava and Roberts, 2008; Nini, Smith, and Sufi, 2009).[6] Corporate taxes are paid at a constant rate τ and full offsets of losses are allowed. Thus, debt allows firms to shield part of their income from taxation. Following, for example, Hackbarth, Miao, and Morellec (2006), the unlevered after-tax asset value of a firm is

$$V_t = (1 - \tau) X_t y_i, \quad i = G, B, \tag{6}$$

5 This framework, in the spirit of Bhamra, Kuehn, and Strebulaev (2010b); Chen (2010); and Arnold, Wagner, and Westermann (2013), allows aggregate risk and risk prices to change with the business cycle. It links the fluctuations in the first two moments of aggregate growth rates to corporate security values. Online appendices are available at http://ssrn.com/abstract=3003964 or by request from the authors.

6 We discuss in Section 6 what would change without it. Covenants restricting stock issuance are rare (e.g., Chava, Kumar, and Warga 2010). We discuss asset sale covenants in Section 4.2.

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

$$y_i^{-1} = r_i - \tilde{\mu}_i + \frac{(r_i - \tilde{\mu}_j) - (r_i - \tilde{\mu}_i)}{r_j - \tilde{\mu}_j + \tilde{p}} \tilde{p} \tilde{f}_j. \tag{7}$$

r_i are the risk-free rates defined in Online Appendix A.1. $\tilde{p} := \tilde{\lambda}_i + \tilde{\lambda}_j$ is the risk-neutral rate of news arrival. $(\tilde{f}_G, \tilde{f}_B) = (\frac{\tilde{\lambda}_B}{\tilde{p}}, \frac{\tilde{\lambda}_G}{\tilde{p}})$ are the long-run risk-neutral distributions. y_i^{-1} are the discount rates, in which the first two terms are the standard components if the economy could not switch regimes and the last term reflects the future time spent in regime j.

We model a firm's expansion (growth) option as an American call option on its earnings. A firm can irreversibly exercise this option at any time $\bar{t}$. By paying the exercise cost $k_{\bar{i}}$, it scales future earnings to $s_{\bar{i}} X_t$ for all $t \geq \bar{t}$ for some factor $s_{\bar{i}} > 0$, in which $\bar{i}$ is the realized state of the economy at exercise. Thus, we extend the framework of Arnold, Wagner, and Westermann (2013) by considering regime dependency of both $k_{\bar{i}}$ and $s_{\bar{i}}$ to incorporate varying degrees of a growth option's cyclicality. If an expansion option is exercised, 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 $k_{\bar{i}}$ by either issuing new equity or selling assets in place. Our model incorporates that issuing new equity entails direct exogenous friction costs φ_i such as underwriting fees or search frictions (e.g., Hennessy and Whited, 2007; Hugonnier, Malamoud, and Morellec, 2015). All costs a firm faces after initiation are labeled with small letters. Due to the new equity friction cost, each new equity-financed \$1 leads to a regime-dependent issue cost of $\varphi_{\bar{i}}$. The regime dependency of φ_i allows us to capture the notion that external equity financing is more restricted during bad states (e.g., Erel *et al.*, 2011). A firm with access to equity financing in a given regime can finance the exercise cost $k_{\bar{i}}$ by issuing new equity of $k_{\bar{i}}(1 + \varphi_{\bar{i}})$.

Our model assumes that selling assets is costly. In practice, such a 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 a buyer's specific needs (Pulvino, 1998; Jovanovic and Rousseau, 2002). We incorporate this exogenous friction by stating that the proceeds from selling assets on the market correspond to $0 \leq \Xi_i \leq 1$ times the value of the assets to the firm. Consistent with Shleifer and Vishny (1992), the parameter Ξ_i can be interpreted as the regime-dependent liquidity of the firm's assets. We assume $\Xi_G > \Xi_B$. After exercising the expansion option, the firm obtains current earnings of $(s_{\bar{i}} + 1)X_t$, that is, $s_{\bar{i}} X_t$ from the expansion option, and X_t from existing assets in place. The value of assets in place at option exercise corresponds to $(1 - \tau)X_{\bar{t}} y_{\bar{i}}$. The value of assets sold to finance the exercise cost of the expansion option is $k_{\bar{i}}/\Xi_{\bar{i}}$ or $\frac{k_{\bar{i}}/\Xi_{\bar{i}}}{(1-\tau)X_{\bar{t}} y_{\bar{i}}}$, expressed as a fraction of current earnings. Thus, after financing the exercise cost by selling assets, firm earnings are

$$\left(s_{\bar{i}} + 1 - \frac{k_{\bar{i}}/\Xi_{\bar{i}}}{(1 - \tau)X_{\bar{t}} y_{\bar{i}}} \right) X_t. \tag{8}$$

Shareholders have the option of defaulting on their debt obligations. Specifically, default is triggered when shareholders are no longer willing to inject additional equity capital to meet net debt service requirements. Upon default, a firm is immediately liquidated. Debtholders receive the liquidation value of the total unlevered asset value, that is, of the unlevered assets in place plus the unlevered growth option, less bankruptcy costs. The liquidation proceeds correspond to Ξ_i times the total unlevered 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 $\Xi_i \alpha_i$ times the unlevered asset value upon default. The assumption that debtholders also recover a fraction of the unlevered expansion option implies that the option is transferrable. At default, however, this option has only limited value and, hence, assumptions regarding its transferability or recovery have a negligible impact on our results.

Equityholders face the following decisions. First, they select the default, expansion, and investment-financing policies that maximize the *ex post* equity value. Second, they determine the initial capital structure that maximizes *ex ante* equity, that is, firm value.

3. Model Solution

Firms finance investments by selling assets or by issuing equity in each regime, which leaves us with four alternative funding strategies: financing by (a) issuing equity in good states and selling assets in bad states, (b) issuing equity in both good states and bad states, (c) selling assets in good states and issuing equity in bad states, or (d) selling assets in both good and bad times. We derive the solutions for the first funding strategy.[7]

3.1 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, $\hat{t}_i(X)$ denote the value of the tax shield, and $\hat{b}_i(X)$ denote the value of bankruptcy costs of a firm with only invested assets at (scaled) earnings X. The standard solutions for the values of these securities are presented in Online Appendix A.2. Firm value after investment is the value of assets in place plus tax shield minus bankruptcy costs, that is, $\hat{v}_i(X) = (1 - \tau) y_i X + \hat{t}_i(X) - \hat{b}_i(X)$. The equity value after investment is $\hat{e}_i(X) = \hat{v}_i(X) - \hat{d}_i(X)$.

Equityholders choose 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. That is, we numerically solve the system of equations $\hat{e}'_G(D^*_G) = 0$ and $\hat{e}'_B(D^*_B) = 0$.

3.2 The Value of the Growth Option

To study the 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 $X \geq X_i$ (the option exercise region); otherwise, it optimally waits (the option continuation region). This structure implies a system of ordinary differential equations (ODEs) with associated boundary conditions given in Online Appendix A.3. Proposition 1 presents the value of the growth option, $G_i(X)$, of a levered firm that issues equity in good states and sells assets in bad states for $X_G \leq X_B$. We label the option of a levered firm the "levered growth option."

7 The solutions for the second–fourth strategies can be derived analogously (see Online Appendix).

Proposition 1. *The value of a levered growth option in state i is*

$$G_i(X) = \left\{ \begin{array}{lll} \bar{A}_{i3}X^{\gamma_3} + \bar{A}_{i4}X^{\gamma_4} & 0 \leq X < X_G, & i = G, B \\ \bar{C}_1 X^{\beta_1^B} + \bar{C}_2 X^{\beta_2^B} + \bar{C}_3 X + \bar{C}_4 & X_G \leq X < X_B, & i = B \\ (1-\tau)s_B X y_B - k_B/\Xi_B & X \geq X_B & i = B \\ (1-\tau)s_G X y_G - k_G(1+\varphi_G) & X \geq X_G & i = G \end{array} \right\}, \tag{9}$$

in which $[X_G, X_B]$ *are the exercise boundaries in good and bad states, respectively. We define* γ_3, γ_4, $\bar{A}_{i3}$, $\bar{A}_{i4}$, $\beta_{1,2}^B$, $\bar{C}_1$, $\bar{C}_2$, $\bar{C}_3$, *and* $\bar{C}_4$ *in* Online Appendix *A.3.*

Proof: See Online Appendix A.3. □

If X is below the higher exercise boundary X_B in the first two lines of Equation (9) in Proposition 9, the option is in the continuation region. At or above X_B in the third line, the option is exercised and financed by selling assets. In the fourth line, the option is exercised and financed by issuing new equity.

We also encounter the case in which the exercise boundary in good states, X_G, is higher than that in bad states, X_B, if s_B is considerably larger than s_G or k_B is much smaller than k_G. The solution to this case is obtained by interchanging the regime names in the derivation of the presented solution with $X_G \leq X_B$.

3.3 Value of Corporate Securities before Investment

We now derive the values of corporate securities before investment of a firm that issues equity in good times and sells 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*

$$d_i(X) = \begin{cases} \alpha_i \Xi_i \left((1-\tau) X y_i + G_i^{unlev}(X) \right) & X \leq D_i, \quad i = G, B, \\ C_1 X^{\beta_1^G} + C_2 X^{\beta_2^G} + C_5 X^{\gamma_3} + C_6 X^{\gamma_4} + \tilde{\lambda}_G \dfrac{\alpha_B \Xi_B y_B (1-\tau)}{r_G - \tilde{\mu}_G + \tilde{\lambda}_G} X + \dfrac{c}{r_G + \tilde{\lambda}_G} & D_G < X \leq D_B, \quad i = G \\ A_{i1} X^{\gamma_1} + A_{i2} X^{\gamma_2} + A_{i3} X^{\gamma_3} + A_{i4} X^{\gamma_4} + \dfrac{c}{r_i^p} & D_B < X \leq X_G, \quad i = G, B \\ B_1 X^{\beta_1^B} + B_2 X^{\beta_2^B} + Z(X) + \tilde{\lambda}_B \dfrac{c}{r_i^p \left(r_B + \tilde{\lambda}_B \right)} + \dfrac{c}{r_B + \tilde{\lambda}_B} & X_G < X \leq X_B, \quad i = B \\ \hat{d}_G((s_G + 1)X) & X > X_G, \quad i = G \\ \hat{d}_B \left(\left(s_B + 1 - \dfrac{k_B/\Xi_B}{(1-\tau) X_{\bar{t}} y_B} \right) X \right) & X > X_B, \quad i = B, \end{cases} \tag{10}$$

in which $[D_G, D_B]$ *are the default boundaries and* $[X_G, X_B]$ *are the exercise boundaries. We define* A_{i1}, A_{i2}, A_{i3}, A_{i4}, C_1, C_2, C_5, C_6, B_1, B_2, $\beta_{1,2}^i$, $Z(X)$, γ_1, γ_2, γ_3, *and* γ_4 *in* Online Appendix *A.4.* G_i^{unlev} *is the value of an unlevered option in* Online Appendix *A.3,* r_i^p *is the* *perpetual risk-free rate in Online Appendix A.1, and* $\hat{d}_i(\cdot)$ *is the debt value of a firm with only invested assets.*

Proof: See Online Appendix A.4. □

According to Proposition 2, a firm's debt value function is defined across three regions, depending on the value of X. Below the default threshold, that is, $X \leq D_i$, the firm is in the default region in which it defaults immediately. The firm is in the continuation region if X is between the default and exercise thresholds of the corresponding state, that is, if $D_i < X \leq X_i$. Finally, the debt value function in the exercise region for $X > X_i$ visualizes the financing source for the investment cost. In good states, the option exercise cost k_G is financed by issuing new equity of $k_G(1+\varphi_G)$. Hence, a firm's earnings are scaled by $s_G + 1$. In bad states, the exercise cost k_B is financed by selling $\frac{k_B/\Xi_B}{(1-\tau)X_i y_B}$ of assets in place, such that earnings are scaled by $s_B + 1 - \frac{k_B/\Xi_B}{(1-\tau)X_i y_B}$.

The value of the tax shield before investment is calculated by using solution (10) in Proposition 2, in which we replace c and α by $c\tau$ and zero, respectively, and $\hat{d}_i$ in the last line line of Equation (10) 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 α need to be replaced by 0 and $(1-\alpha)$, respectively. Second, while the going concern value of the expansion option is given by its levered value, the value of the option at default corresponds to its unlevered value. Therefore, the expansion option's value switches from $G_i(X)$ to $\alpha_i \Xi_i G_i^{unlev}(X)$ upon default. As a consequence, the functional form of solution (10) in the default region $X \leq D_i$ needs to be adapted to $(1-\alpha_i\Xi_i)y_i X(1-\tau) - \alpha_i \Xi_i G_i^{unlev}(X) + G_i(X)$. Online Appendix A.5 shows the solution for the value of bankruptcy costs $b_i(X)$.

Next, firm value before investment, f_i, is given by assets in place $(1-\tau)y_i X$, plus the growth option $G_i(X)$ and the tax benefit of debt $t_i(X)$, minus default costs $b_i(X)$, that is,

$$f_i(X) = (1-\tau)y_i X + G_i(X) + t_i(X) - b_i(X). \tag{11}$$

The equity value before investment of a firm issuing equity in good states and selling assets in bad states, $e_i^{ES}(X, c)$, $i = G, B$, is

$$e_i(X, c) = f_i(X) - d_i(X) = (1-\tau)y_i X + G_i(X) + t_i(X) - b_i(X) - d_i(X). \tag{12}$$

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. 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 at the respective boundaries for equity of a firm with the investment financing strategy of issuing equity in good states and selling assets in bad states:

$$\begin{cases} e'_G(D_G^*, c) &= 0 \\ e'_B(D_B^*, c) &= 0 \\ e'_G(X_G^*, c) &= \hat{e}_G{}'((s_G+1)X_G^*, c) \\ e'_B(X_B^*, c) &= \hat{e}_B{}'\left(\left(\left(s_B + 1 - \frac{k_B/\Xi_B}{(1-\tau)X_{\bar{i}} y_B}\right)X_B^*\right), c\right). \end{cases} \tag{13}$$

System (13) is solved numerically. Analogous systems can be derived for each of the alternative investment financing strategies.

Denote by $e_i^*(X,c)$ the equity value given that equityholders choose the *ex post* default, expansion, and investment financing policies that maximize the value of equity for each coupon level c. Debtholders anticipate the 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 values of initial equity and debt, that is, firm value. Denote by $f_i^*(X)$ the firm value given equityholders' default boundaries, expansion thresholds, and funding source. The firm's *ex ante* optimal coupon is then determined by

$$c_i^* := \arg\max_c \left(f_i^*(X,c) - \Phi_i\, e_i^*(X,c) - \Upsilon_i\, d_i^*(X,c)\right). \tag{14}$$

4. Model Results

In this section, we first describe the parameter choice. We then derive model predictions with a typical firm and investigate quantitative implications.

4.1 Parameter Choice

We display our parameter choices for firm, option, and economy characteristics in Table I. Panel A shows firm characteristics. The initial value of the idiosyncratic earnings X is set to 10. We use a tax advantage of debt of $\tau = 0.15$ as suggested in the literature (e.g., Hackbarth, Miao, and Morellec, 2006). We choose earnings growth rates (μ_i) and volatilities ($\sigma_i^{X,C}$) equal to the empirical counterparts estimated by Bhamra, Kuehn, and Strebulaev (2010b) in a two-regime model. 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%.

The main costs of external equity discussed by Fazzari *et al.* (1988) are tax costs, adverse selection premia, and flotation costs. Hansen (2001) and Corwin (2003) estimate equity issuance costs of 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 cyclicality, 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 estimates, we choose as a benchmark case $\varphi_G = 0.08$ and $\varphi_B = 0.1$. This choice gives us two-percentage-point of cyclicality and an average equity issuance cost of 8.71%.[8] We assume that $\varphi_i = \Phi_i = \Upsilon_i$ in the baseline firm.

Only a few empirical studies have ventured vague empirical estimates of the cost of selling assets. Pulvino (1998) finds that the cost of selling commercial aircraft falls between 0 and 14%. Strebulaev (2007) assumes that the cost of selling assets falls between 0.05% and 0.25%. Acharya, Bharath, and Srinivasan (2007) show that creditors of defaulted firms

8 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.

Table I. Baseline parameter choice

This table summarizes our baseline parameter choices. 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.

Parameter	Parameter value	
Panel A: Firm characteristics	Good state (G)	Bad state (B)
Initial earnings (X)	10	10
Recovery rate (α_i)	0.63	0.57
Tax advantage of debt (τ)	0.15	0.15
Earnings growth rate (μ_i)	0.0782	−0.0401
Systematic earnings volatility ($\sigma_i^{X,C}$)	0.0834	0.1334
Idiosyncratic earnings volatility ($\sigma^{X,id}$)	0.168	0.168
Additional equity issuance cost (φ_i)	0.08	0.1
Initial equity issuance cost (Φ_i)	0.08	0.1
Initial debt issuance cost (Υ_i)	0.08	0.1
Asset Liquidity (Ξ_i)	0.9259	0.9091
Panel B: Expansion option parameters of a typical firm		
Exercise price (k_i)	183.13	160
Scale parameter (s_i)	1.0925	1.03
Panel C: Economy		
Rate of leaving regime i (λ_i)	0.2718	0.4928
Consumption growth rate (θ_i)	0.0420	0.0141
Consumption growth volatility (σ_i^C)	0.0094	0.0114
Rate of time preference (ρ)	0.015	0.015
Relative risk aversion (ω)	10	10
Elasticity of intertemporal substitution (Ψ)	1.5	1.5

recover 10–15 percentage points less of their nominal in a distressed state of the industry than in a healthy state of the industry, that is, that asset liquidity is cyclical. To illustrate the basic investment financing trade-off, we set $\Xi_{\bar{i}}$ such that $k_{\bar{i}}/\Xi_{\bar{i}} = k_{\bar{i}}(1+\varphi_{\bar{i}})$, that is, the friction costs of exercising the expansion option by selling assets correspond to those of exercising the expansion option by issuing new equity. This calibration yields $\Xi_G = 0.9259$ and $\Xi_B = 0.9091$. We perform numerous robustness checks with alternative equity issuance costs and asset liquidity parameters.

Bankruptcy costs are assumed to be 30% of the unlevered assets' liquidation proceeds. Hence, the recovery rates correspond to $\Xi_i(1-0.3)$, that is, 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, for example, Acharya, Bharath, and Srinivasan (2007) that recovery rates fall during bad states.

Panel B of Table I 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 reflects the relative decline of 12.61% in the value of invested assets following a shift from good to bad states chosen in Hackbarth, Miao, and Morellec (2006). We validate the robustness of our predictions by presenting results for alternative choices of k_i.

The scale parameter s_i depends on the cyclicality of a firm's option. We use baseline scale parameters of $s_G = 1.0925$ and $s_B = 1.03$. These parameters imply that, given optimal

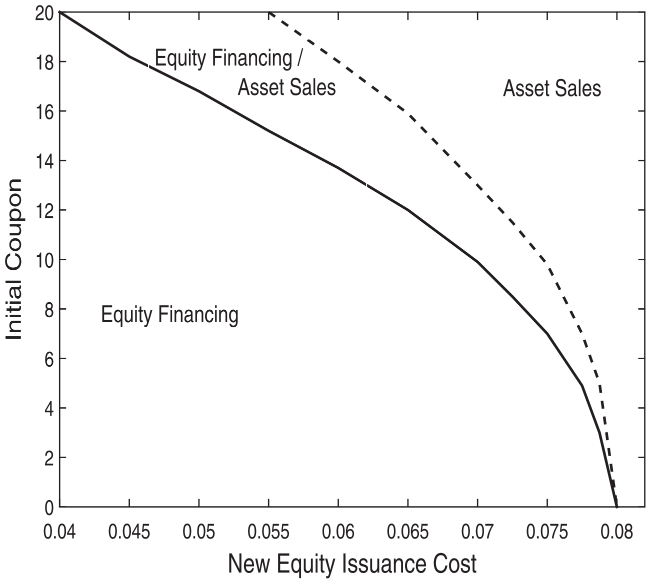

Figure 1. Financing choice. This figure depicts equityholders' financing choices in firms with initially optimal capital structures. In the region to the right of the dashed line, equityholders select asset sales in good states and bad states to finance the exercise cost of an option. In the region to 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.

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 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.

Finally, Panel C lists the variables describing the underlying economy. The rates of leaving state i (λ_i), the consumption growth rates (θ_i), and the consumption growth volatilities σ_i^C are estimated in Bhamra, Kuehn, and Strebulaev (2010b). 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, ρ, is 0.015, the relative risk aversion, ω, is equal to 10, and the elasticity of intertemporal substitution, Ψ, is set to 1.5. This parameter choice is commonly used in the literature (e.g., Bansal and Yaron, 2004; Chen, 2010) and it implies that the nominal interest rates are $r_G = 0.0736$ and $r_B = 0.0546$.

4.2 Derivation of Model Predictions

Figure 1 illustrates how firms select between financing the investment cost of the expansion option with new equity or asset sales. The x-axis plots the equity issuance cost in good states while that in bad states is determined by adding 0.02 to maintain a constant difference. The y-axis shows the optimal initial coupon that determines a firm's leverage ratio. We generate multiple leverages by varying the initial debt issuance cost Υ_i. In the region to the left of the solid line, equityholders issue new equity in both regimes. To the right of the dashed line, they prefer financing the investment cost by selling assets in both regimes. Between the two lines, equityholders issue new equity in good times and sell assets in bad times.

To develop the intuition behind the financing choice, we first consider a benchmark firm without debt. This all-equity firm shows the investment financing policy that is not distorted by the presence of debt. The all-equity firm value corresponds to the value of assets in place $(1-\tau)y_iX_i$ plus the value of the unlevered growth option G_i^{unlev}. Figure 1 depicts the all-equity firm's investment financing choice at the bottom of the figure (initial coupon equal to zero). The firm simply selects the funding source based on the financing friction cost. As the friction costs of selling assets, Ξ_i, are calibrated to correspond to an equity issuance cost of $\varphi_G = 0.08$, the all-equity firm issues equity if $\varphi_G < 0.08$ and sells assets otherwise.

We now investigate levered firms. Exercising the expansion option has two implications that are relevant for equityholders of levered firms. First, it increases total earnings. Second, total asset volatility declines because the expansion option is riskier than assets in place (see e.g., Arnold, Wagner, and Westermann, 2013). Both effects induce a transfer of wealth from equityholders to debtholders as debt becomes less risky. To mitigate this wealth transfer, firms can sell assets to finance the investment cost, which depletes the collateral of remaining firm assets. As lower collateral renders debt riskier, financing asset sales transfer wealth back from debtholders to equityholders, which reduces the initial wealth transfer problem. Hence, levered firms acting in the best interests of equityholders trade off the incremental friction cost of selling assets over the equity issuance cost against the reduction in the wealth transfer.

For more highly levered firms, debt is riskier and, thus, more sensitive to earnings and asset volatility changes. Hence, the wealth transfer motive for selling assets is stronger, which increases firms' tendency to sell assets. In Figure 1, the range of equity issuance costs for which firms select equity financing in both regimes declines and the range for which they sell assets increases with leverage. Leverage leads to substantial deviation from the investment financing policy of an all-equity firm. For instance, increasing leverage from 0.5 to 0.7 (corresponding to initial coupons of 8.2 and 13, respectively) reduces the threshold at which firms select equity financing from 7.3% to 6.2%. This insight leads to our first model prediction.

Prediction 1. *Firms with high leverage tend to finance investment by selling assets.*

Next, we investigate how the wealth transfer motive depends on business cycle states. During bad times, leverage increases because equity loses more value than debt. On the other hand, equityholders optimally invest at a larger earnings threshold, producing higher asset value upon investment and hence lower leverage. To see which effect dominates, Figure 2 plots leverage upon investment of a baseline firm in good states (solid line) and bad states (dashed line). The new equity issuance cost parameter in good states, φ_G, is plotted along the x-axis. Leverage at investment is higher during bad states than good states.[9] As the wealth transfer problem is more severe for higher leverage and because asset sales ameliorate this problem, equityholders' trade-off leads to our second model prediction.

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

Figure 1 also shows this higher propensity for financing assets sales in bad states. The region for financing asset sales in both regimes (on the right side of the dashed line) is smaller

9 The bumps around $\varphi_G = 0.075$ occur due to the switch in the firm's optimal financing strategy.

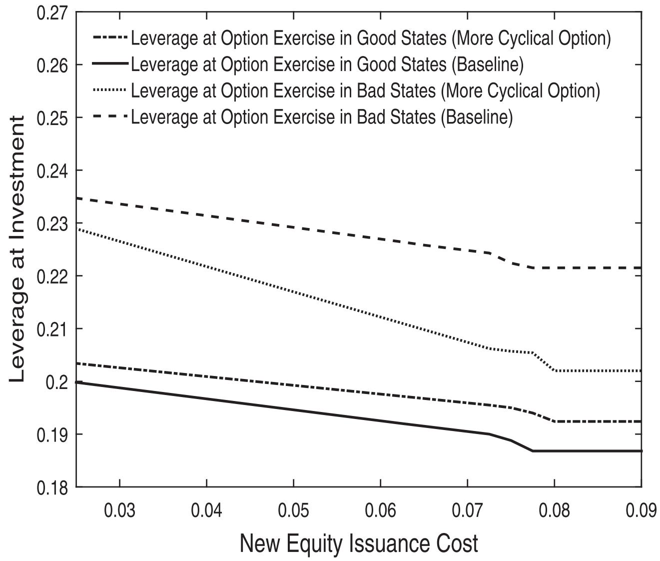

Figure 2. Leverage at investment and the cyclicality of the growth option. This figure shows leverage ratios upon investment of a firm with an initially optimal capital structure as a function of the equity issuance cost. Equityholders optimally finance the exercise cost of an option in good states (solid 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.

than that in which equityholders sell assets during bad states (on the right side of the solid line).

We now investigate the impact of the cyclicality of the growth option on investment financing. To model a firm with stronger procyclicality for the expansion option than the baseline firm, we increase the scale parameter in good times, s_G, from 1.0925 to 1.099, and decrease that in bad states, s_B, from 1.03 to 1.005, leaving the average q at initiation unchanged at 1.3.[10] This higher cyclicality makes it relatively more (less) attractive to exercise the option in the good (bad) state compared with the baseline firm. The optimal investment threshold in good states declines from 20.18 to 19.67, and that in bad states increases from 20.48 to 22.23. Thus, firms with a more procyclical expansion option invest less during bad times. In addition, Figure 2 compares leverage levels at investment of the baseline firm with those of the firm with a more procyclical growth option. The dotted and dashed-dotted lines depict leverages of the latter firm upon investment in good and bad times. 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 lower earnings threshold in bad times. Therefore, the asset value is lower and the leverage at investment is higher. In contrast, they invest at a higher

10 The cyclicality of the expansion option can also be altered by changing the investment cost k_i. The qualitative predictions of the model also hold in this case.

earnings threshold in good times than in the firm with a more cyclical growth option such that the leverage at investment is lower. Thus, the difference between leverages at investment in bad and good times declines with the cyclicality of the expansion option, which reduces the countercyclicality of the wealth transfer problem. Equityholders' trade-off then leads to our third model prediction.

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

Finally, the trade-off drives the cyclical pattern of financing asset sales only if a firm's equity issuance cost is lower than the friction cost of selling assets. Otherwise, equityholders always choose asset sales. Thus, the countercyclical dynamics of the wealth transfer problem are more relevant for the investment financing decision of a firm with low new equity financing frictions. Hence, the correlation between asset sales and investment is more countercyclical for firms with lower external financing frictions.

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

We also investigate how agents' preferences affect financing asset sales. To this end, we increase both ω and Ψ by 25%. A higher risk aversion ω raises investment thresholds, mainly because the risk-neutral earnings growth rates decrease and the value of risky claims declines relative to the investment cost. A greater ω, however, also raises 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 leverage at investment increases with risk aversion. Higher leverage at investment implies a more severe wealth transfer problem that strengthens equityholders' tendency to select financing asset sales. At the same time, firms also reduce initial leverage for higher risk aversion, which dampens this increase in the relevance of financing asset sales. For example, in the optimally financed baseline firm with $\omega = 10$, equityholders switch to a strategy in which they use equity financing in bad states at an equity issuance cost of $\varphi_G = 7.65\%$, and to a strategy with equity financing in both states at $\varphi_G = 7.45\%$. The optimally financed firm with $\omega = 12.5$ switches to these strategies at $\varphi_G = 7.64\%$ and $\varphi_G = 7.42\%$, respectively. Hence, the financing asset sale policy is fairly robust to risk aversion.

Increasing the elasticity of intertemporal substitution Ψ to 1.875 makes the representative agent more tolerant toward 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 higher 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, leverage for a given initial coupon declines. Insofar as the firm selects a higher coupon for a higher Ψ, however, initial leverage is hardly affected. That is, leverage does not offset the increased importance of financing asset sales due to the effect of a higher Ψ on investment timing. Thus, the financing asset sale policy is more sensitive to the elasticity of intertemporal substitution (Ψ) than to risk aversion (ω). In particular, in the optimally financed firm with $\Psi = 1.875$ already switches to the strategy with equity financing in bad states at $\varphi_G = 7.56\%$, and to the strategy with equity financing in both states at $\varphi_G = 7.35\%$.

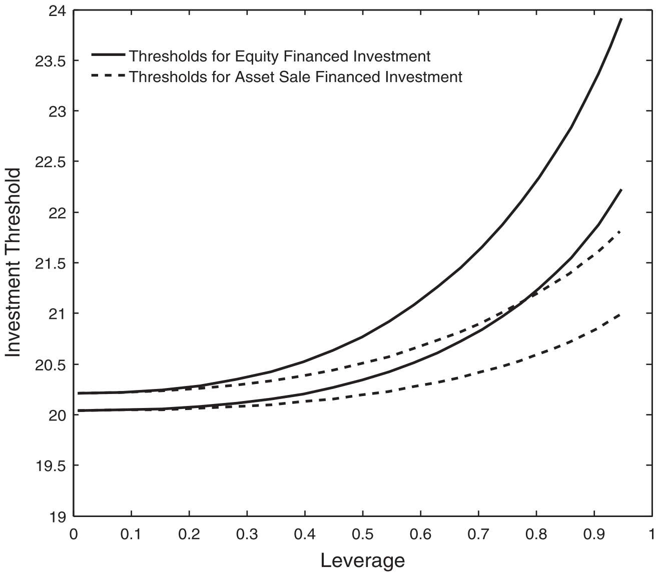

Figure 3. Optimal investment thresholds. This figure shows the earnings levels at which equityholders optimally exercise the growth option for a range of initial leverage ratios. The lower and upper solid lines are the investment thresholds in good and bad states, respectively, for a firm issuing equity. The lower and upper dashed lines are the investment thresholds in good and bad states for a firm selling assets.

4.3 Quantitative Analysis

We now investigate the quantitative impact of financing asset sales. Asset sales affect firm value through three channels: funding frictions, expected collateral, and investment timing. We briefly discuss each channel. First, financing asset sales increase firm value if the friction cost of selling assets is lower than that of issuing equity. Second, financing asset sales reduce, in expectation, firms' asset collateral. Thus, optimal initial leverage is smaller than when issuing new equity, which reduces the tax shield and firm value.

Third, and most importantly, the wealth transfer problem affects equityholders' investment timing. Figure 3 plots investment thresholds against leverage. The thresholds of the all-equity firm correspond to those at zero leverage. The higher line is the threshold in bad states and the lower the threshold in good states. As expected, equityholders invest earlier in good states. The figure shows that leverage induces equityholders to delay investment. Specifically, the equity-value-maximizing thresholds of a firm issuing equity in both states (solid lines) increase with leverage. Thus, levered firms acting in the best interest of equityholders underinvest compared with the all-equity firm due mainly to the wealth transfer problem. The dashed lines in Figure 3 depict investment thresholds of a levered firm that sells assets in both states. While this firm also underinvests, the distortion is less severe than in case of equity financing because selling assets mitigates the wealth transfer problem. Hence, the dashed thresholds in Figure 3 are closer to the all-equity thresholds than to those for equity-financed investment, particularly for highly levered firms in which the wealth transfer problem is more severe. Quantitatively, increasing leverage from 0.5 to 0.7 raises

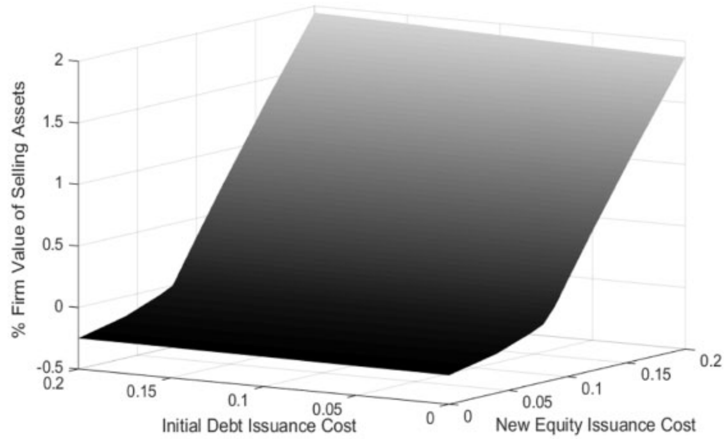

Figure 4. Firm value of selling assets. This figure shows the percentage value to firms of selling assets to finance the investment cost.

the distance to investment in good states by 9.3% $\left(\frac{21.7-20.7}{10.7}\right)$ with equity financed investment, but only by 3.8% $\left(\frac{20.8-20.4}{10.4}\right)$ with financing asset sales. Thus, asset sales mitigate the underinvestment problem compared with equity financing, thereby accelerating investment and increasing firm value.

Figure 4 summarizes the value to firms of selling assets for various issuance costs. The x-axis depicts initial debt issuance costs (Υ_i) and the y-axis new equity issuance costs (φ_G). The z-axis plots the percentage value difference between a firm that sells assets and one that issues new equity. For firms with high new equity issuance frictions, selling assets increases firm value by up to 2% due mainly to the first channel. For firms with new equity issuance friction equal to that of selling assets ($\varphi_G = 0.08$), the third channel induces a slightly negative value from asset sales. A higher initial debt issuance cost increases the value of selling assets because such firms implement small initial leverage so that the future collateral reduction from selling assets is less important. Finally, for firms with low new equity issuance frictions the value of selecting financing asset sales is negative due to the higher friction cost of selling assets.

We now investigate the quantitative impact of the agency cost of debt from the investment financing distortion. This cost arises if financing an investment with new equity maximizes *ex ante* firm value but equityholders select financing asset sales *ex post* due to the wealth transfer problem. In this case, firms should commit *ex ante* to equity-financed investment by implementing a covenant that prohibits asset sales. The (positive) value to firms of such a covenant quantifies the agency cost of the financing policy distortion. The solid line of Figure 5 plots the percentage impact of this covenant on firm value against the equity issuance cost φ_B. For low φ_B, the covenant does not add value because equity financing increases both *ex ante* firm value and *ex post* equity value compared with asset sales. Hence, equityholders select the-firm-value-maximizing policy even without the covenant. For high φ_B, a covenant reduces firm value as equityholders must issue expensive new equity. The solid line in Figure 5 implies that the covenant is of limited value to the baseline

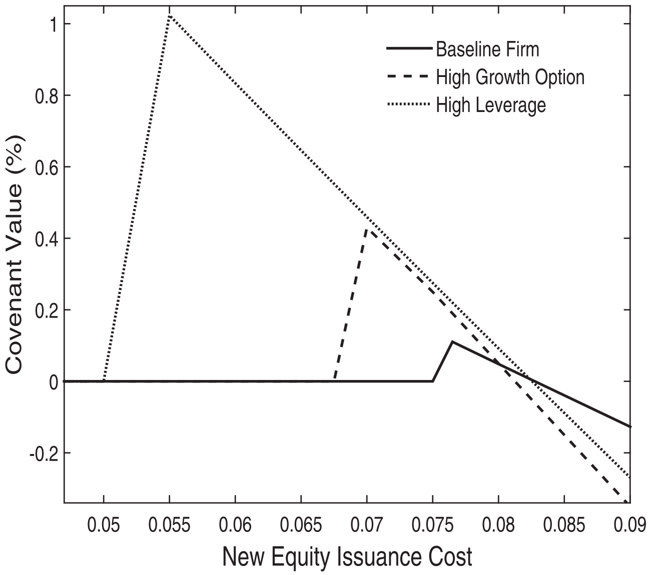

Figure 5. Asset sale covenants and firm value. This figure illustrates the impact of a covenant that restricts financing asset sales on the percentage value of firms. The solid line shows the covenant value for the baseline firm. The dashed line plots covenant values for a high-growth firm. We create this firm by increasing the scale parameter by 0.5 in both states compared with the baseline firm. The dotted line is a firm with both an expansion option of higher value and higher leverage. We create this firm by setting φ_G to 0.18, Υ_G to zero, and increasing the scale parameter by 0.5 in both states compared with the baseline firm.

firm. Preventing asset sales only enhances firm value in an intermediate range of φ_B, in which equityholders' *ex post* investment financing strategy deviates from the firm-value-maximizing policy.

The dashed line plots the value of the covenant for a firm with a larger growth option than the baseline firm such that average q is 1.6.[11] A larger option is exercised earlier, which entails higher leverage at investment. Thus, equityholders' distorting selection of asset sales is more severe and a covenant is more valuable than in the baseline case. The dotted line represents a firm in which we also increase leverage to 0.71.[12] It shows that restricting equityholders with a covenant is particularly important for highly levered firms because leverage augments the wealth transfer distortion. The agency cost of up to 1% from the financing distortion that a covenant prevents is comparable in magnitude to that of shareholder–debtholder agency costs in Parrino and Weisbach (1999) and Hackbarth and Mauer (2012). For a large new equity issuance cost, however, preventing financing asset sales with a covenant reduces a high-growth firm's value even more than that of a baseline firm. The reason is that if the growth option is exercised earlier, the need to issue expensive equity at investment due to the covenant has a stronger impact on initial firm value.

11 To create this firm, we increase the scale parameter by 0.5 in both states.

12 To create this firm, we set φ_G to 0.18, Υ_G to 0, and increase the scale parameter by 0.5 in both states compared with the baseline firm.

Our results contribute to the covenant literature. Figure 5 implies that the value to firms of an asset sale covenant is limited, that is, below 1% for reasonable parameter values. The value of the loss from such a covenant, however, can be large if the equity issuance cost is high. This insight provides an intuition suggesting 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, 1979; Bradley and Roberts, 2015).[13] In addition, we explain the observation in Bradley and Roberts (2015) that firms with higher leverage incur a greater probability of including asset sale covenants.

There is mixed empirical evidence regarding the impact of growth opportunities on the likelihood of asset sale covenants. Bradley and Roberts (2015) report that firms with higher market-to-book ratios are more likely to include asset sale covenants. Similar studies find, however, that high-growth firms are typically less likely to include restrictive asset sale covenants (Kahan and Yermack, 1998; Nash, Netter, and Poulsen, 2003; Chava, Kumar, and Warga, 2010; Reisel, 2014). A novel prediction of our analysis is that these conflicting results may be explained by external financing frictions. As we show in Figure 5, the probability that firms implement 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.

Finally, we also investigate the impact of financing asset sales on credit spreads. When we fix leverage at the optimal level of the firm with asset sales, the covenant reduces credit spreads by two basis points (bps) in the base firm, by 7 bps in the high-leverage firm, and by 16 bps in the firm with both high leverage and a large expansion option. This result complements Morellec (2001) who shows that the motive to sell assets to meet coupon payments or allocate assets to better uses affects credit spreads. We find that the motive to sell assets to finance investment also influences these spreads.

5. Aggregate Dynamics of Simulated Samples

Section 4.2 analyzes the choice between asset sales and equity issuance of a typical firm. 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 brings the model's predictions to life. To this end, we simulate cross-sectional distributions of model-implied firm samples that are matched to a COMPUSTAT sample of 3,022 US manufacturing firms over the 1971–2010 period.[14] Details on the simulation are presented in Appendix A. The simulation approach is important for two reasons. First, the analysis of a typical firm at initiation in Section 4.2 does not allow us to analyze the dynamic features predicted by the model. Specifically, we need to simulate the model to generate investment, financing, and default observation time series across business cycles that are comparable to real-world data to validate the model approach. We can also measure in the simulations how the propensity of model firms to use financing asset sales relates to firm and business cycle characteristics. In addition, the analysis helps us to derive new

13 For example, asset sale covenants often allow firms 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 (see e.g., Smith and Warner, 1979).

14 All variable definitions, data-cleaning filters, and summary statistics for the COMPUSTAT sample are provided in Appendix B.

Table II. Simulated sample results

This 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 1,352 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 a 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 a firm. Equity Value/TA is the market value of equity scaled by total firm value.

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

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 of firms that match the empirical cross-sectional distribution of real firm characteristics. Only the dynamic features of these simulated matched samples should then be compared with the empirical average behavior of real firms.

Table II 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.

Table II shows that, whereas model firms are statically matched only to leverage, Tobin's q, and equity issuance cost of COMPUSTAT firms, simulated model firm samples reflect the key empirical dynamic properties shown in Table IV. That is, firms in simulated samples exhibit, on average, procyclical asset values, q values, coverage ratios, and equity values. The average corporate leverage is countercyclical. Moreover, model firms exhibit procyclical aggregate equity issuance and investment consistent with the corresponding patterns in the empirical literature (e.g., Barro, 1990; Choe, Masulis, and Nanda, 1993; Bayless and Caplinsky, 1996). The simulated samples also resemble several other dynamic features of the COMPUSTAT data (not tabulated). For instance, high-q firms have on average a lower leverage and invest more than low-q firms. In addition, aggregate default rates are countercyclical, as reported in Das *et al.* (2007).

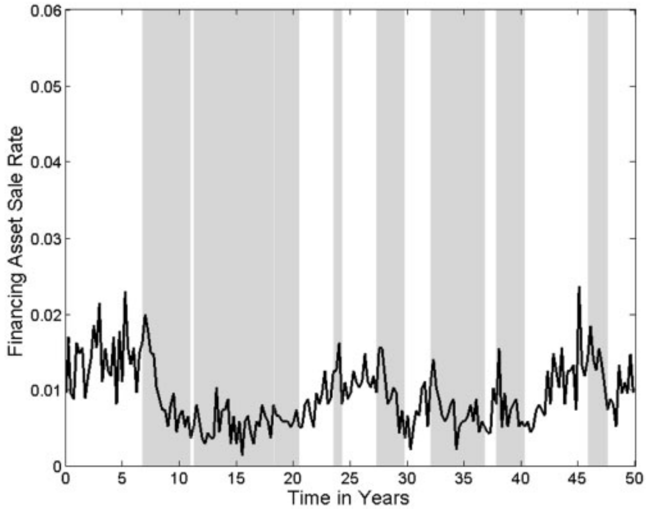

Figure 6. Aggregate financing asset sales. This figure plots the aggregate quarterly ratio of firms in a typical simulated economy that sell assets over time. The shaded regions are bad states, and the white regions are good states.

We now analyze the model's predictions with regard to the cyclical nature of financing asset sales. Figure 6 depicts the time series of the relative number of firms that sell assets in a typical simulated sample. The shaded areas are bad states. Financing asset sales are 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.

Figure 6 also implies that pronounced financing asset sales activity can occur in the very beginning of a bad state. This pattern is driven mainly 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.[15]

Figure 7 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, Figure 7 illustrates that the aggregate dynamics of asset sales and investment across states of the model are consistent with

15 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.

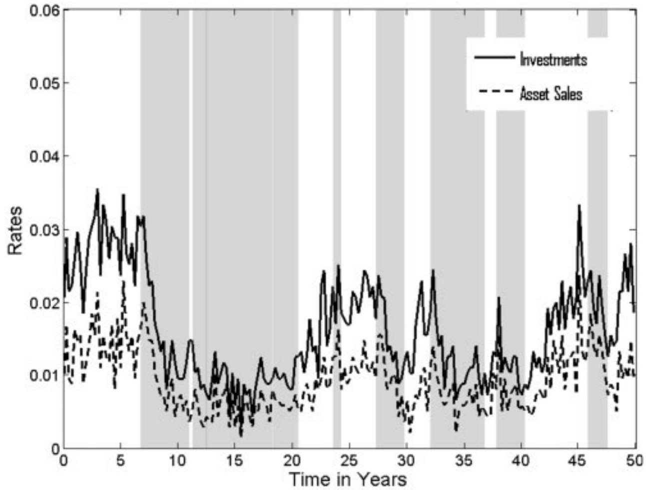

Figure 7. Aggregate investment and financing asset sales. This figure plots the aggregate quarterly ratio of firms in a typical simulated economy that invest (solid line), and the aggregate ratio of firms that sell assets (dashed line) over time. The shaded regions are bad states, and the white regions are good states.

Prediction 2 that the correlation between asset sales and investment is significantly stronger during bad states.

In Table III we summarize additional features of the aggregate simulated model dynamics of financing asset sales that corroborate our predictions for a typical firm. The conditional asset sale ratio is the percentage of firms in the simulated matched samples that sell assets. We use this ratio to investigate financing asset sale patterns in simulated samples.[16]

Overall, 42% of investments in the simulated samples are financed with asset sales. This ratio increases to 64% for firms in the highest leverage tercile and declines to 35% for firms in the lowest tercile, which supports Prediction 1. In bad states, the conditional asset sale ratio increases to 54% and amounts to 38% in good states, which is consistent with Prediction 2. Lines 6–9 in Table III report the ratios for firms in the simulated samples with relatively low (LC) and high (HC) cyclicality of the expansion option during good and bad states, respectively. Consistent with Prediction 3, 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 in the simulated samples is more pronounced for firms with low external financing friction (LF) compared with firms with high external financing friction (HF). Specifically, 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

16 We do not need to run regressions in simulated samples as the sources of uncertainty are well defined in the model. It is even problematic to apply regression techniques on simulated samples because most model-firm variables are highly collinear.

Table III. Conditional asset sale ratios

This 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 re-sorting 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 5. LC_{bad} and LC_{good} are asset sale ratios of firms with low cyclicality of the expansion option during bad and good states, respectively. HC_{bad} and HC_{good} indicate the ratios for firms with high cyclicality in the two states. LF_{bad} and LF_{good} are asset sale ratios of firms with small external financing frictions during bad and good states, respectively. HF_{bad} and HF_{good} indicate the ratios for firms with large external financing frictions in the two states.

Asset sale conditional on investment	(%)
Total asset sales	42.13
High leverage firms	64.31
Low leverage firms	34.69
Bad states	53.72
Good states	38.25
LC_{bad}	48.75
LC_{good}	41.22
HC_{bad}	46.12
HC_{good}	41.79
LF_{bad}	22.67
LF_{good}	0.34
HF_{bad}	89.40
HF_{good}	82.60

Prediction 4. We validate all four predictions in our empirical COMPUSTAT sample in Appendix B.

Our results also generate novel testable predictions regarding the impact of asset sales on equity financing and investment across business cycles. First, Covas and Den Haan (2011) find cross-sectional differences regarding the cyclicality of equity financing. Our theory explains the extent to which financing asset sales contribute to these differences. Specifically, asset sales enhance the procyclicality of equity financing because they substitute more strongly for equity issues in bad states than in good states. The degree of the cyclicality of this substitution is more pronounced for firms with higher leverage, less cyclical investment opportunities, and smaller external financing frictions (see Table III). Thus, the model predicts that financing asset sales should amplify the procyclical equity issuance pattern particularly for such firms.

Second, as shown by Hovakimian and Titman (2006), financing assets sales influence corporate investment, especially for financially constrained firms. In our model, funds from voluntary divestitures indeed accelerate investment, all the more so for firms with larger equity issuance costs. We also address the impact of financing asset sales on the cyclicality of investment. Whereas the availability of funds from asset sales enhances investment in both states, the importance of this financing margin increases particularly in bad states compared with good states. According to Table III, the countercyclicality of the relevance of financing asset sales for investment should be pronounced for firms with higher leverage, less cyclical investment opportunities, and smaller external financing frictions. These results help to illuminate the cross-sectional differences in the procyclicality of corporate investments.

6. Discussion of Model Limitations

A caveat that applies to our approach is that we abstract from new debt financing. Bhamra, Kuehn, and Strebulaev (2010a) investigate dynamic debt restructuring in the macroeconomic framework that we consider. They show that, whereas optimal leverage is procyclical at refinancing points, it is countercyclical in aggregate dynamics because the countercyclical leverage effect at work in our model, namely that market values of equity drop more than those of debt in bad states, dominates the impact of firms' procyclical debt choice. Hence, the countercyclical dynamics of the wealth transfer problem that drive our main results should be present in case of dynamic debt restructuring when investment is financed by issuing equity or selling assets. In addition, these authors find that unconstrained firms exhibit less-procyclical debt issuance behavior. Hence, a dynamic debt framework could even strengthen Prediction 4 because an unconstrained firm should then have a more countercyclical wealth transfer problem. New debt, however, could also be used to finance investment. New debt makes initial debt riskier, which constitutes, besides asset sales, an alternative channel to reduce the wealth transfer problem associated with investment (e.g., Hackbarth and Mauer 2012). In this case, our results should be more relevant to firms with limited access to new debt, firms with high frictions to renegotiate existing debt, or financially constrained, smaller firms.

Another caveat is that the wedge between the friction costs of asset sales and new equity issuance could generate our results if it was cyclical. Appendix B addresses this possibility in two ways. First, following Shleifer and Vishny (1992), asset liquidity should be industry specific because it is due to the ability of firms in the same industry to buy assets. Even after controlling for industry-fixed effects, however, we find that financing asset sales are more countercyclical for firms with higher leverage. Second, we calculate a relative external financing constraint measure for each firm that is scaled by the corresponding industry average. The financing asset sales policy is more countercyclical for firms with smaller relative external financing frictions. This result supports Prediction 4. If the wedge were to drive our results, the countercyclicality should be determined by firms in the same industry with higher external financing frictions.

7. Conclusion

This paper analyzes firms' decisions to sell assets to fund investments (financing asset sales) across business cycles. We begin by studying a dynamic model that endogenizes the choice between asset sales and equity issuance to fund capital expenditures. Notably, asset liquidity, the growth option, and equity issue costs are cyclical. Recognizing the impact of business cycles on financing and investment helps us better understand financing asset sales.

In the dynamic model, investment creates a standard wealth transfer from equityholders to debtholders (Myers, 1977). However, selling assets upon investment reduces firms' asset collateral, which makes debt outstanding riskier. The corresponding reverse wealth transfer from debtholders to equityholders mitigates the standard wealth transfer problem. We show how the dynamics of the trade-off between the cost of selling assets, the cost of issuing equity, and the wealth transfer problem across business cycles drive asset sales as an investment financing source. We derive a number of novel predictions and verify them in the data.

The dynamics of the wealth transfer problem across business cycles have broader implications. For example, we abstract from internal liquidity to fund investment. Reducing liquidity also decreases a firm's collateral and hence transfers wealth from debt to equity. Whereas our model's mechanism applies to heterogeneous assets too, future research could explore implications of this heterogeneity on financing–investment interactions across business cycles.

Supplementary Material

Supplementary material is available in the Online Appendix.

Appendix A: 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 2 to 20. These optimal initial coupons are generated by varying Φ_i and Υ_i between 0 and 0.31 with a step size of 2. Scale parameters for firms with a less cyclical growth opportunity 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.[17] 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 the 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 B for details on the COMPUSTAT sample). We consider a total of 1,352 COMPUSTAT firms for which we obtain all three measures. Firms with a q-value below 1.15 or above 2.15 are winsorized because model-implied economies hardly include firms with extremely low or high values of the growth option.[18]

17 We verify in simulations with various alternative grids and lower variations of Φ_i and Υ_i that our results are robust.

18 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.

To match the model-implied economies with their empirical counterparts we select for each observation 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 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 on a quarterly basis 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 the robustness of our results, the entire simulation is repeated 100 times. We then analyze the simulated matched samples.

Appendix B: Empirical Validation

In this section, we examine the model's novel predictions in a large real-firms sample using our COMPUSTAT firms of Section 5.

B.1 Empirical Approach

The asset sales data in COMPUSTAT (item SPPE) do not reveal the motive behind these transactions. Hence, we identify firm characteristics and factors related to the business cycle 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 stronger correlation between contemporaneous investment and asset sale. Moreover, focusing on this correlation allows us to abstract away from fire sales of financially distressed firms because it is unlikely that distressed firms would invest heavily in those periods, in which they are forced to sell assets to repay their debts. Using OLS regressions, we investigate firm and business cycle determinants that drive this correlation.

B.2 Data

Our sample includes all US 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% levels. We exclude firms with a q below 0 or above 10 to address issues of investment opportunity measurement in the data. We also eliminate very small firms with less than 5 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 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 a firm's 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 then calculate 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, that is, 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 a measure of financial constraints, following Hadlock and Pierce (2010) as:

$$-0.737 * \text{Total Assets} + 0.043 * (\text{Total Assets})^2 - 0.04 * \text{Age}. \tag{B.1}$$

q is a proxy for growth opportunities and is 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 outlined in Vassalou and Xing (2004). In particular, we estimate the volatility of equity with daily equity values over the past 12 months for each firm-year observation. This volatility serves as a starting guess for the estimation of asset volatility. Applying the Black–Scholes formula, we then compute daily asset values over the past 12 months using the daily equity values, total liabilities, the starting guess for 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 below $10E-4$. The Altman (1968) Z-score is a widely used measure of financial distress. It is computed for each firm as:

$$Z = 1.2 * \frac{\text{ACT} - \text{LCT}}{\text{AT}} + 1.4 * \frac{\text{RE}}{\text{AT}} + 3.3 * \frac{\text{NI} + \text{XINT} + \text{TXT}}{\text{AT}} + 0.6 * \frac{\text{ME}}{\text{LT}} + 0.999 * \frac{\text{SALE}}{\text{AT}}. \tag{B.2}$$

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 the 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 portfolio by size, we use the estimation results of Hennessy and Whited (2007) for small firms, for the highest tercile by size the estimations for large firms, and for the tercile of medium-sized firms 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.

B.3 Results

In Table IV, 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% (Q25), and the 75% quantiles (Q75). We define an aggregate downturn of our firm economy as years in which the sample aggregates 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., Gilson, John, and Lang, 1990; Opler and Titman, 1994). All other years are identified as being in the good state.

Table V reports the results of OLS panel regressions that explore the correlations 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^2s are adjusted for the number of variables in the regression.[19]

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. It shows that asset sale and investment exhibit a significantly positive correlation. Cash flow, asset volatility, and q exhibit a negative and significant regression coefficient, while financial slack and coverage ratio are not significantly correlated with asset sale.

In column (II), we analyze the impact of leverage on the relationship between asset sale and investment by using an interaction term for investment and leverage. The correlation between asset sale and investment increases with leverage, which suggests that leverage enhances financing asset sales. This result supports Prediction 1. Investment and leverage coefficients are insignificant when we add the interaction term between investment and leverage.[20]

To shed light on Prediction 2, we analyze how the correlation between asset sale and investment is related to macroeconomic conditions. In column (III) of Table V, we incorporate the interaction between investment and a dummy that is equal to one in a bad business cycle state.[21] The positive and significant coefficient on this interaction term shows that the

19 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 industry levels or, alternatively, at the year and firm levels.

20 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.

21 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., Gilson, John, and Lang, 1990; Opler and Titman, 1994).

Table IV. COMPUSTAT sample summary statistics

This table provides summary statistics for 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 aggregates 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 to be in a good state. The table reports the mean, the standard deviation (Std), the median, the 25% (Q25), and the 75% quantile (Q75). Total Assets (AT) and Fixed Assets (F) are in millions of 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 represents 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 firm's assets. Total debt is (LT + PSTK-TXDB-DCVT). Market Equity is computed as the CRSP monthly share price (PRC) multiplied by the number of outstanding shares (SHROUT). The variable Cov. Ratio is computed by dividing EBITDA with interest expenses. The sample period is 1971–2010. The sample consists of 3,022 US manufacturing firms.

Variable	Mean	Std
Panel A: Summary statistics—full sample period		
Total Assets (TA)	1140.98	3857.31
Fixed Assets (F)	347.59	1135.23
q	1.3397	1.4996
Investment/F	0.2104	0.1145
Asset Sales/F	0.0169	0.0347
Cash Flow/F	0.3413	0.7816
Fin. Slack/F	0.7583	1.6365
Asset Volatility	0.3951	0.5606
Total Debt/TA	0.4384	0.1798
Market Equity	1162.14	3292.83
Cov. Ratio	54.62	735.27
Panel B: Summary statistics—bad business cycle states		
Total Assets (TA)	968.21	2496.12
Fixed Assets (F)	310.37	730.69
q	0.881	1.4479
Investment/F	0.2226	0.1175
Asset Sales/F	0.0171	0.04
Cash Flow/F	0.366	0.6669
Fin. Slack/F	0.4752	1.2302
Asset Volatility	0.5313	0.8914
Total Debt/TA	0.4654	0.1669
Market Equity	602.09	2514.02
Cov. Ratio	27.90	172.81

(continued)

Table IV. Continued

Variable	Mean	Std
Panel C: Summary statistics—good business cycle states		
Total Assets (TA)	1156.14	3954.12
Fixed Assets (F)	350.85	1163.99
q	1.38	1.4974
Investment/F	0.2194	0.1142
Asset Sales/F	0.0168	0.0392
Cash Flow/F	0.3391	0.7909
Fin. Slack/F	0.7832	1.6652
Asset Volatility	0.3831	0.5120
Total Debt/TA	0.436	0.1807
Market Equity	1194.69	3325.69
Cov. Ratio	57.00	765.49

correlation between investment and asset sales is higher in downturns, that is, the financing asset sales policy is countercyclical. This finding supports Prediction 2 and emphasizes the importance of recognizing business cycle dynamics when explaining the positive correlation between investment and asset sale.

Next, we link financing asset sales to Prediction 3, that is, 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 firm-level individual q and the aggregate sales growth in our entire sample.[22] A strong correlation between a firm's growth opportunity and the aggregate business cycle state indicates more procyclical expansion opportunities.[23] 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 states, and the cyclicality of a firm's growth opportunities. Thus, the correlation between asset sales and investment is more countercyclical for firms with less cyclical expansion options, which supports model Prediction 3.[24]

Furthermore, it is well known that the supply side of capital can create asset sale incentives (e.g., Lang, Poulsen, and Stulz, 1995; Bates, 2005; Hovakimian and Titman, 2006).

22 We scale the firm individual q by the SIC3-industry average q to control for industry effects. Using larger windows within a reasonable range (e.g., 7 years) has no qualitative effect on the results.

23 The 25% quantile of the correlation distribution is -0.5, the median is 0.02, and the 75% quantile is 0.56.

24 In unreported results, we also 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 adopt more countercyclical financing asset sales policies. This finding provides additional support for the view that the wealth transfer problem is an important driver of the positive relationship between asset sales and investments.

Table V. COMPUSTAT sample asset sale determinants

This 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 represents the cash proceeds from the sale of fixed capital. Investment is equal to capital expenditures. Cash flow 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 is the first lag of the sum of cash and short-term investments. 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-DCVT) 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). $I_{\text{Low}\,Z}$ is a dummy that is 1 if a firm has a Z-Score (see Equation (B.2)) value below 3. The sample period is 1971–2010. N is the number of observations in the corresponding regression. The full sample consists of an unbalanced sample of 3,022 US manufacturing firms.

Dependent variable: asset sale	(I)	(II)	(III)	(IV)	(V)	(VI)
Investment	0.024	0.005	0.004	0.003	0.005	0.0071
	(5.20)	(0.57)	(0.44)	(0.34)	(0.60)	(0.83)
Cash Flow	−0.002	−0.002	−0.002	−0.004	−0.002	−0.002
	(−7.16)	(−7.48)	(−7.45)	(−7.01)	(−7.41)	(−9.69)
q	−0.003	−0.003	−0.003	−0.003	−0.003	−0.003
	(−14.59)	(−13.26)	(−13.46)	(−11.87)	(−13.53)	(−13.46)
Financial Slack	−0.000	−0.000	−0.000	0.000	−0.000	−0.000
	(−2.71)	(−1.12)	(−1.10)	(0.98)	(−1.25)	(−1.80)
Cov. Ratio	−0.000	−0.000	−0.000	−0.000	−0.000	−0.000
	(−1.40)	(−1.29)	(−1.28)	(−0.51)	(−1.29)	(−4.76)
Asset Volatility	−0.001	−0.001	−0.001	−0.004	−0.001	−0.001
	(−3.02)	(−3.07)	(−2.82)	(−3.86)	(−2.79)	(−2.82)
Leverage	0.012	0.004	0.004	0.002	0.004	0.006
	(2.89)	(0.73)	(0.77)	(0.39)	(0.88)	(1.08)
Lever.×Invest.		0.044	0.044	0.052	0.041	0.053
		(2.42)	(2.38)	(2.58)	(2.43)	(2.21)
Bad State×Invest.			0.019	0.016	0.015	0.021
			(3.23)	(1.93)	(2.28)	(3.40)
Bad State			−0.006	−0.005	−0.002	−0.006
			(−5.15)	(−3.56)	(−2.53)	(−5.22)
Corr(q, Salesgr.)				0.001		
				(1.43)		
Invest.×Corr(q, Salesgr.)				−0.001		
				(−0.26)		
Bad State×Corr(q, Salesgr.)				0.005		
				(2.25)		
Invest.×Bad State×Corr(q, Salesgr.)				−0.024		
				(−2.34)		

(continued)

Table V. Continued

Dependent variable: asset sale	(I)	(II)	(III)	(IV)	(V)	(VI)
SA-Index					0.000	
					(0.84)	
Invest.×SA-Index					0.007	
					(0.32)	
Bad State×SA-Index					−0.000	
					(−2.40)	
Invest.×Bad State×SA-Index					2.667	
					(2.66)	
$I_{\mathrm{Low}\,Z}$						0.000
						(2.45)
Invest.×$I_{\mathrm{Low}\,Z}$						0.006
						(1.06)
Industry-fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Adj. R^2	0.033	0.034	0.035	0.034	0.036	0.033
Number of observation	17,468	17,468	14,514	17,468	17,468	17,257

We add in column (V) the SA-index as a proxy for the financing constraints firms face.[25] Higher values of this index indicate lower external financing constraints. We also incorporate the triple interaction of the SA-index with investment and the business cycle state. Comparing Columns (III) and (V) show 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 that the financing asset sales policy is more countercyclical for firms with less external financing constraints, which supports Prediction 4 of our model. This result is robust to scaling the firm individual SA-index by the SIC3-industry average of the SA-index.

A common motive for asset sales is financial distress (e.g., Shleifer and Vishny, 1992). A potential caveat with our results could be that the relationships between leverage as well as the bad state and the financing asset sales policy are, in fact, driven by fire sales conducted by 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 3. Values below 3 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 and 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 with column III) to the inclusion of the new interaction term. This finding highlights that fire sales are not the driver behind our main results.

25 According to Hadlock and Pierce (2010), the SA-index is useful for measuring financial constraints. Related work supports the view that the ingredients of this index, that is, size and age, capture the financial constraints of a firm (see e.g., Hennessy and Whited, 2007).

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 bottom 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, a basic empirical validation is consistent with our four model predictions. These empirical findings cannot be explained by traditional motives for asset sales, such as financial distress or external financing constraints.

References

Acharya, V., Bharath, S. T., and Srinivasan, A. (2007): Does industry-wide distress affect defaulted firms? Evidence from creditor recoveries, *Journal of Financial Economics* **85**, 787–821.

Altinkilic, O. and Hansen, R. S. (2000): Are there economies of scale in underwriting fees? Evidence of rising external financing costs, *Review of Financial Studies* **13**, 131–218.

Altman, E. I. (1968): Financial ratios, discriminant analysis and the prediction of corporate bankruptcy, *Journal of Finance* **23**, 589–609.

Arnold, M., Wagner, A., and Westermann, R. (2013): Growth options, macroeconomic conditions and the cross-section of credit risk, *Journal of Financial Economics* **107**, 350–385.

Asquith, P., Gertner, R., and Scharfstein, D. (1994): Anatomy of financial distress: an examination of junk bond issuers, *Quarterly Journal of Economics* **109**, 625–658.

Bansal, R. and Yaron, A. (2004): Risks for the long run: a potential resolution of asset pricing puzzles, *Journal of Finance* **59**, 1481–1507.

Barro, R. J. (1990): The stock market and investment, *Review of Financial Studies* **3**, 115–131.

Bates, T. W. (2005): Asset sales, investment opportunities and the use of proceeds, *Journal of Finance* **60**, 105–135.

Bayless, M. and Caplinsky, S. (1996): Is there a window of opportunity for seasoned equity issuance?, *Journal of Finance* **51**, 253–278.

Begenau, J. and Salomao, J. (2016): Firm financing over the business cycle. Working Paper Harvard Business School.

Bhamra, H. S., Kuehn, L.-A., and Strebulaev, I. A. (2010a): The aggregate dynamics of capital structure and macroeconomic risk, *Review of Financial Studies* **23**, 4187–4241.

Bhamra, H. S., Kuehn, L.-A., and Strebulaev, I. A. (2010b): The levered equity risk premium and credit spreads: a unified framework, *Review of Financial Studies* **23**, 645–703.

Bradley, M. and Roberts, M. R. (2015): The structure and pricing of corporate debt covenants, *Quarterly Journal of Finance* **5**, 1550001.

Brown, D., James, C., and Mooradian, R. (1994): Asset sales by financially distressed firms, *Journal of Corporate Finance* **1**, 233–257.

Campello, M., Graham, J. A., and Harvey, C. R. (2010): The real effects of financial constraints: evidence from a financial crisis, *Journal of Financial Economics* **97**, 470–487.

Chava, S., Kumar, P., and Warga, A. (2010): Managerial agency and bond covenants, *Review of Financial Studies* **23**, 1120–1148.

Chava, S. and Roberts, M. R. (2008): How does financing impact investment? The role of debt covenant violations, *Journal of Finance* **63**, 2085–2121.

Chen, H. (2010): Macroeconomic conditions and the puzzles of credit spreads and capital structure, *Journal of Finance* **65**, 2171–2212.

Chen, H. and Manso, G. (2016): Macroeconomic risk and debt overhang, *Review of Corporate Finance Studies* **6**, 1–38.

Choe, H., Masulis, R. W., and Nanda, V. (1993): Common stock offerings across the business cycle, *Journal of Empirical Finance* **1**, 3–31.

Corwin, S. A. (2003): The determinants of underpricing for seasoned equity offers, *The Journal of Finance* **58**, 2249–2279.

Covas, F. and Den Haan, W. J. (2011): The cyclical behavior of debt and equity finance, *American Economic Review* **101**, 877–899.

Das, S. R., Duffie, D., Kapadia, N., and Saita, L. (2007): Common failings: how corporate defaults are correlated, *Journal of Finance* **62**, 93–117.

Duchin, R., Ozbas, O., and Sensoy, B. A. (2010): Costly external finance, corporate investment, and the subprime mortgage credit crises, *Journal of Financial Economics* **97**, 418–435.

Duffie, D. and Epstein, L. G. (1992): Stochastic differential utility, *Econometrica* **60**, 353–394.

Eckbo, E. and Kisser, M. (2015): Does tradeoff theory explain high-frequency debt issuers? Working Paper Tuck School of Business.

Edmans, A. and Mann, W. (2016): Financing through asset sales. Mimeo.

Eisfeldt, A. L. and Rampini, A. A. (2006): Capital reallocation and liquidity, *Journal of Monetary Economics* **53**, 369–399.

Erel, I., Julio, B., Kim, W., and Weisbach, M. S. (2011): Macroeconomic conditions and capital raising. NBER working paper No. 16941.

Fazzari, S. M., Hubbard, G. R., Petersen, B. C., Blinder, A. S., and Poterba, J. M. (1988): Financing constraints and corporate investment, *Brookings Papers on Economic Activity* **1988**, 141–206.

Gilson, S. C., John, K., and Lang, L. H. P. (1990): Troubled debt restructurings: an empirical study of private reorganization of firms in default, *Journal of Financial Economics* **27**, 315–353.

Hackbarth, D. and Mauer, D. C. (2012): Optimal priority structure, capital structure, and investment, *Review of Financial Studies* **25**, 747–796.

Hackbarth, D., Miao, J., and Morellec, E. (2006): Capital structure, credit risk, and macroeconomic conditions, *Journal of Financial Economics* **82**, 519–550.

Hadlock, C. J. and Pierce, J. R. (2010): New evidence on measuring financial constraints: moving beyond the KZ index, *Review of Financial Studies* **23**, 1909–1940.

Hansen, R. S. (2001): Do investment banks compete in IPOs? The advent of the 7% plus contract, *Journal of Financial Economics* **59**, 313–346.

Hennessy, C. A., and Whited, T. (2007): How costly is external financing? Evidence from a structural estimation, *Journal of Finance* **62**, 1705–1745.

Hovakimian, G. and Titman, S. (2006): Corporate investment with financial constraints: sensitivity of investment to funds from voluntary asset sales, *Journal of Money, Credit and Banking* **38**, 357–374.

Hugonnier, J., Malamoud, S., and Morellec, E. (2015): Capital supply uncertainty, cash holdings, and investment, *Review of Financial Studies* **28**, 391–445.

Jermann, U. and Quadrini, V. (2012): Macroeconomic effects of financial shocks, *American Economic Review* **102**, 238–271.

Jovanovic, B. and Rousseau, P. (2002): The Q-theory of mergers, *American Economic Review* **92**, 198–204.

Kahan, M. and Yermack, D. (1998): Investment opportunities and the design of debt securities, *The Journal of Law, Economics, and Organization* **14**, 136–151.

Korajczyk, R. A. and Levy, A. (2003): Capital structure choice: macroeconomic conditions and financial constraints, *Journal of Financial Economics* **68**, 75–109.

Lang, L., Poulsen, A., and Stulz, R. (1995): Asset sales, firm performance, and the agency costs of managerial discretion, *Journal of Financial Economics* **37**, 3–37.

Lemmon, M. and Roberts, M. R. (2010): The response of corporate financing and investment to changes in the supply of credit, *Journal of Financial and Quantitative Analysis* **45**, 555–587.

Maksimovic, V. and Phillips, G. (2001): The market for corporate assets: who engages in mergers and assets sales and are there efficiency gains?, *Journal of Finance* **56**, 2019–2065.

Morellec, E. (2001): Asset liquidity, capital structure, and secured debt, *Journal of Financial Economics* **61**, 173–206.

Myers, S. C. (1977): Determinants of corporate borrowing, *Journal of Financial Economics* **5**, 147–175.

Nash, R., Netter, J., and Poulsen, A. (2003): Determinants of contractual relations between shareholders and bondholders: investment opportunities and restrictive covenants, *Journal of Corporate Finance* **9**, 201–232.

Nini, G., Smith, D., and Sufi, A. (2009): Creditor control rights and firm investment policy, *Journal of Financial Economics* **92**, 400–420.

Opler, T. C. and Titman, S. (1994): Financial distress and corporate performance, *Journal of Finance* **49**, 1015–1040.

Parrino, R. and Weisbach, M. S. (1999): Measuring investment distortions arising from stockholder–bondholder conflicts, *Journal of Financial Economics* **53**, 3–42.

Pulvino, T. C. (1998): Do asset fire-sales exist? An empirical investigation of commercial aircraft transactions, *Journal of Finance* **53**, 939–978.

Reisel, N. (2014): On the value of restrictive covenants: empirical investigation of public bond issues, *Journal of Corporate Finance* **27**, 251–268.

Ritter, J. R. and Welch, I. (2002): A review of IPO activity, pricing, and allocations, *Journal of Finance* **57**, 1795–1828.

Shleifer, A. and Vishny, R. W. (1992): Liquidation values and debt capacity: a market equilibrium approach, *Journal of Finance* **47**, 1343–1266.

Smith, C. W. and Warner, J. B. (1979): On financial contracting: an analysis of bond covenants. *Journal of Financial Economics* **7**, 117–161.

Strebulaev, I. A. (2007): Do tests of capital structure theory mean what they say?, *Journal of Finance* **62**, 1747–1787.

Vassalou, M. and Xing, Y. (2004): Default risk in equity returns, *Journal of Finance* **59**, 831–868.

Warusawitharana, M. (2008): Corporate asset purchases and sales: theory and evidence, *Journal of Financial Economics* **87**, 471–497.

Westermann, R. (2017): Measuring agency costs over the business cycle. Mimeo.

Yang, L. (2008): The real determinants of asset sales, *Journal of Finance* **63**, 2231–2262.