The Dynamics of Corporate Debt Structure *

Michael Halling† Jin Yu‡ Josef Zechner§

ABSTRACT

This paper shows that the average U.S. listed firm increases leverage and implements a more diversified debt structure during recessions by increasing the share of private debt. In the cross-section, borrowing strategies diverge: approximately 40% of firms decrease leverage and increase debt concentration by reducing the proportion of public debt, while the remaining 60% increase leverage and decrease debt concentration by augmenting public debt with private debt. Characteristics of these two samples of firms differ sharply. A model of corporate investment and financing choices, where private debt is more expensive but offers flexibility to restructure, can rationalize these dynamics.

JEL Classifications: G01, G32.

Keywords: corporate debt structure dynamics, debt concentration, business cycle variation, cluster analysis.

*Acknowledgments: We are grateful to David Dennis (discussant), Murray Frank (discussant), Kai Li (discussant), Phong Ngo, Takeshi Yamada, and seminar and conference participants at the Australian National University, Tepper School of Business, NFA (2020), AFA (2021) and CICF(2021). We particularly thank Hendro Sugandi for excellent research assistance. All errors are our responsibility.

†University of Luxembourg, 6, rue Richard Coudenhove-Kalergi, L-1359 Luxembourg. Email: michael.halling@uni.lu

‡Department of Banking and Finance, Monash University, 900 Dandenong Road, Caulfield East, VIC 3145, Australia. Email: jin.yu@monash.edu

§Vienna University of Economics and Business (CEPR and ECGI), Welthandelsplatz 1, 1020 Vienna, Austria. Email: josef.zechner@wu.ac.at

1 Introduction

Corporate debt comes in different incarnations. Importantly, it comes in the form of private debt, which includes term loans and drawn credit lines, and market debt, such as senior and subordinated bonds or notes and commercial paper. While there is an extensive theoretical and empirical literature studying firms' overall leverage, much less is known about how firms choose their debt structures, i.e. which types of debt firms raise and how they decide on their relative mix. Even less is known about how corporate debt structures evolve over time. Which debt funding sources become more and which become less important during recessions? In particular, do firms typically rely more or less on public or on private debt? Do firms diversify more or less across sources of debt during recessions, i.e. is debt concentration pro- or counter-cyclical? And how do the dynamics of debt concentration differ in the cross-section of firms?

To address these questions, we first report some stylized facts that relate to the above questions. We then derive a theoretical model of firms' investment and debt structure choices, in particular their choices between private and market debt, that can capture the observed stylized facts. In this model, private debt is more expensive than market debt in normal times, due to costs of intermediation, but offers the flexibility to restructure the claim in a bad state. We show that the resulting dynamics of overall leverage, debt concentration and the private debt to total assets ratio are inherently linked: firms that increase their leverage during recessions do so by increasing their private debt to total assets ratio, thereby decreasing their debt concentration. On the contrary, firms that decrease leverage during recessions do so by reducing their public debt to assets ratio, and this coincides with an increase in their debt concentration, since it makes them rely more exclusively on private debt.

To test these predictions empirically, we merge data from Compustat and Capital IQ, using balance sheet data on seven different debt sources: term loans, drawn credit lines, senior bonds and notes, subordinated bonds and notes, commercial paper, capital leases, and other debt. The final sample spans the time period 2001 to 2020 and covers three recessions (the one in 2001, the GFC and the early period of the Covid-19 recession).

The main empirical results are obtained from a multivariate regression setting in which we control for a broad set of firm characteristics and in which we comprehensively capture business cycle dynamics through the effects of (i) time-varying firm characteristics, (ii) time-varying regression coefficients, and (iii) the business cycle itself, through a recession dummy. The coefficients on this recession dummy reflect the unconditional effect of the business cycle.

For the full sample, these results show that private debt target (i.e., model-implied) ratios increase significantly during recessions, whereas target market debt ratios actually decrease. Target debt concentration decreases significantly, as well. This is consistent with the average firm pursuing a strategy to increase leverage during recessions by mostly relying on private debt, which leads to a more balanced use of debt types, given its stronger reliance on market debt during expansions. In contrast, firms which decrease leverage during recessions move towards more concentrated debt structures by a disproportionately large reduction of their market debt ratios.

In the cross-section, we find that firms that increase their leverage and decrease their debt concentration are more profitable, larger, have credit ratings, pay dividends and have lower cash holdings. These results fit well with the intuition of the theoretical model that suggests that "strong" firms, which are characterized by low credit risk, feature pro-cyclical debt concentration dynamics. By contrast, firms with opposite characteristics increase debt concentration in recessions and reduce their leverage.

To shed more light on firms' dynamic capital structure choices, we also analyze transitions between debt structure clusters and how these transitions are affected by the business cycle. This allows us to analyze firms' joint decisions regarding multiple sources of debt and to discretize the outcome space. The cluster analysis identifies 7 common debt structures which we pool into three main clusters: (i) public debt only (SBN), (ii) private debt only (TLDC) and (iii) a combination of market and private debt (MIX). The largest cluster is TLDC, with almost 45% of all firms, followed by SBN, with approximately 32%, and MIX with approximately 23%. Firms that fall in one of the first two clusters raise more than 90% of their total debt via the respective debt source and, as a consequence, they exhibit very concentrated debt structures.

The transition matrix indicates that firms in the private debt cluster (TLDC) pre-recession tend to stay in this cluster with 91% probability. By contrast, firms in the public debt cluster (SBN) remain in that cluster substantially less frequently, with a probability of 77%, and, thus, have a 23% probability of switching out of this cluster during a recession. For these switching firms, the highest transition probability is to the MIX cluster (15.0%). Firms that are in the pre-recession MIX cluster have an even lower probability of staying in this cluster. For the switching MIX firms, the largest transition probability is to the private debt cluster (14.4%).

We also estimate multinomial logit regressions, which predict transitions for firms conditional on their lagged cluster assignments. In these regressions, we control for a recession dummy, as well as for a set of traditional firm characteristics. We find that recessions significantly increase the probability of firms switching from public debt (SBN cluster) to either the MIX or the private debt cluster (TLDC cluster). While the transition probability increases during recessions by 54% in the first case, it increases by even 80% in the latter case.

Consistent with the theoretical framework, we finally document that large firms with tangible assets, cash holdings and current ratings tend to continue to rely almost exclusively on public debt during recessions and thus exhibit significantly smaller probabilities of transitioning. We further corroborate these findings by comparing the average changes in firm characteristics that firms experience when entering into a recession across firms with different debt structure dynamics. Most importantly, we observe that the negative market-to-book shock suffered by firms in cluster SBN that remain in that cluster during recessions amounts to only -15%, compared to shocks of approximately -24% (-35%) experienced by firms transitioning from the SBN cluster to the MIX (TLDC) cluster in recessions.

While our main sample has the advantage of providing granular data on various debt sources in firms' balance sheets, it has the disadvantage of covering a relatively short time period. Given the focus of our study on business-cycle dynamics, we thus validate the results from the main sample by analyzing an alternative data set that extends the time-series back to 1980. To construct this data set, we use information on bond issuance from Mergent FSID to calculate the market debt ratio at the firm level. We then define the difference between total leverage and the market debt proxy as the measure of private debt to total assets. While these data are noisier and less granular than the Capital-IQ data, they establish the robustness of our main empirical results, as they also hold when we calculate market debt from issuance data in this longer time-series.

Our analysis of debt structure dynamics takes a demand-side corporate finance perspective: since the business cycle affects firms' payoff distributions, the costs and benefits of private versus public debt change over the business cycle as well, and this affects firms' demand for different forms of debt. In addition, supply dynamics may also affect the costs and benefits of private versus public debt. For example, central banks or governments may introduce policies when their economies enter a recession, such as providing government loan guarantees to banks, or quantitative easing measures, such as those introduced in the wake of the Global Financial Crisis. Thus, while we find empirical evidence in support of the main predictions from a demand-driven debt structure tradeoff, the empirical findings may also be influenced by supply effects. It is not straightforward, however, to conjecture a purely supply-side channel that could produce the cross-sectional patterns in debt structure dynamics that we document in the data and that accord well with the predictions from our demand-oriented framework. Also, the aforementioned policy interventions in the supply of private and market debt have been implemented during the recent recessions, while we document the robustness of our main results also using data that include recessions in the 80ties and 90ties. A detailed analysis of the interactions between demand- and supply-effects on debt-structure dynamics would clearly be interesting, but is beyond the scope of this paper.

Related Literature. Our paper is related to several strands of literature. First, there are a number of theoretical papers that analyze why firms may wish to use several forms of debt simultaneously. Most of them focus on the effects of a multi-tiered debt structure on equityholders' and debtholders' future actions. For example, Bergloef and von Thadden (1994), Bolton and Scharfstein (1996), and Hackbarth et al. (2007) derive multi-tiered debt as a solution to the Hart and Moore (1994) problem of strategic default by firm owners. Zhong (2021) extends this literature by allowing a dynamic evolution of creditor dispersion. Rajan (1992) and Park (2000) show that a multi-tiered debt structure affects debtholders' future liquidation and rent-extraction strategies, respectively. Heinkel and Zechner (1990), Hackbarth and Mauer (2011) and Donaldson et al. (2019) find that multi-tiered liability structures can be optimal to balance equityholders' subsequent over- and underinvestment incentives.[1]

These papers do not focus on the dynamics of the relative use of public and different types of private debt over the business cycle, as we do. Our theoretical framework is most closely related to Crouzet (2017) who derives a dynamic model in which firms can issue both public bonds and private debt. Public debt allows firms to move to a bigger scale, and this improves their liquidation values in financial distress, thereby making private debt cheaper. This complementarity between private debt and public debt makes it optimal for some firms to use a multi-tiered debt structure. Crouzet (2017) focuses on supply effects of the business cycle, since he allows private debt to become more expensive in recessions. As a consequence, more firms switch to pure bond debt, private debt becomes less prevalent and debt concentration increases during recessions. In contrast, our model focuses on corporate demand for private and public debt that varies with the business cycle. In particular, as credit risk increases for many firms in recessions, demand for renegotiable private debt increases relative to public debt. This tends to make debt concentration counter-cyclical since some firms that were largely bond financed during expansions, add more private debt to their debt

[1] There is also a large theoretical literature on the benefits and costs of alternative sources of corporate debt, explaining why different firms may have preferences for different types of debt. Many of these theories are related to renegotiation in financial distress. I.e. public debt, such as corporate bonds, is considered to be difficult to renegotiate, due to coordination problems. Other lenders, in particular banks, can renegotiate their claims with firms in financial distress more easily. See, for example, Chemmanur and Fulghieri (1994), Bolton and Freixas (2000), Morellec et al. (2015). Roberts and Sufi (2009) provide empirical support for the importance of debt renegotiability of loans, as 94% of loans with maturity longer than three years are renegotiated in their sample. Diamond (1991) focuses on the monitoring ability of bank debt, which allows younger firms to build reputation, whereas more mature firms switch to public debt. Faulkender and Petersen (2006) argue that bank debt might be more costly than public debt due to a tax disadvantage coming from the organizational form. However, these papers do not analyze why firms wish to simultaneously utilize multiple sources of debt.

structure in recessions. Our model also generates cross-sectional heterogeneity of business cycle effects on firms' leverage and debt dispersion, similar to what is observed in the data.

Second, our paper contributes to an emerging empirical literature on corporate debt structure that has established several key facts. First, Barclay and Smith (1995), Johnson (1997) and, more recently, Rauh and Sufi (2010) all find that firms tend to diversify across more than one source of debt. Second, empirical studies show that debt structure is linked to firm characteristics.[2] For example, Rauh and Sufi (2010) document that firms with lower credit quality have a more multi-tiered debt structure. In a pioneering study, Colla et al. (2013) analyze a broad sample of firms. They find that debt concentration varies widely across firms and that firms with few debt types are more opaque, have high bankruptcy costs and may lack access to some debt markets. In contrast to Rauh and Sufi (2010), they find that credit quality and debt concentration are inversely related (i.e., firms with lower credit quality tend to have more concentrated debt structures), albeit that relation is not monotone across credit quality buckets. None of these papers focuses on the dynamics of debt structure over the business cycle and their cross-sectional differences, as we do.[3]

Finally, our paper is related to work on the interaction between the macro economy, with a particular focus on crisis periods, and the relative roles of private versus public debt in corporate capital structures. While several papers document the resilience of bond markets during crises and the pro-cyclicality of bank debt (see, for example, Ivashina and Scharfstein (2010), Becker and Ivashina (2014), De Fiore and Uhlig (2015), Halling et al. (2020) and Becker and Benmelech (2021)), others emphasize the importance of funding via bank debt during recessions or crises (see, for example, Acharya and Steffen (2020), Li et al. (2020), Greenwald et al. (2021) and Acharya et al. (2021)). The latter papers stress that firms obtain large amounts of liquidity from drawn credit lines during crises such as the onset of COVID-19.

We extend this literature in several ways. First, we focus on time-series variations in debt structure triggered by a sample of expansions and recessions, whereas the papers cited above focus on specific crises, such as COVID-19 or the GFC, or on specific monetary policy shocks. Second, compared to some of the above studies, we use a broader definition of bank debt, including both term loans and drawn credit lines. Third, we focus on changes in the relative importance of private versus public debt on firms' balance sheets and do not only consider the mix of newly issued debt, as some of the papers referenced above do. Finally, some of the

[2] John et al. (2021) study debt concentration in an international setup and document the importance of country-level characteristics, such as creditor protection laws, on firms' debt structure choices.

[3] There exists a small theoretical literature that analyzes business cycle effects on total leverage without distinguishing between different sources of debt. Important contributions to this literature are Hackbarth et al. (2006) and Bhamra et al. (2010).

existing papers use aggregate data, such as flow of funds data, which also include non-listed firms, or rely on subsamples of listed firms that satisfy specific criteria, such as participation in the syndicated loan market.[4] We instead concentrate on publicly listed U.S. firms and explore potential cross-sectional variations in debt structure dynamics among them.

Compared to the above literature, we document several novel results. First, we show that the average publicly listed firm's funding structure shifts towards more extensive use of private debt during recessions, both for the sample from 2001 to 2020 and for the extended sample going back to the 1980s. Second, we document that both term loans and drawn credit lines contribute to these dynamics. Third, we find that the average firm's market debt to assets target ratio drops significantly during recessions. Fourth, our analysis implies that debt structure dynamics must always be interpreted in light of pronounced cross-sectional heterogeneity: Smaller, less profitable firms decrease debt levels in recessions and concentrate more on a single debt source, namely private debt. Larger, more profitable firms increase debt levels. We show both theoretically and empirically, that the most profitable among those, rely on bond funding even in recessions, consistent with the literature emphasizing the resilience of bond funding.

Finally, both our theoretical and our empirical results accord well with the finding in Crouzet (2021), that firms which rely more on private debt also cut back investment more in response to a contractionary monetary policy shock. Whereas in Crouzet (2021) this is explained by counter-cyclical costs of financial intermediation, a similar prediction arises endogenously in our model for recessions, via the relation between the profitability of firms' investment projects and the business cycle. In our setting, the least profitable firms are the ones which simultaneously rely on private debt and cut back investment during recessions, even when the cost of financial intermediation remains constant. Thus, in our analysis debt structure dynamics are driven solely by demand effects which jointly reflect the increasing benefits of private debt and the diminished profitability of corporate investment projects in recessions.

The rest of the paper is organized as follows. Section 2 presents stylized facts that motivate our empirical analysis and the model of optimal debt structure choice in Section 3. Section 4 describes the data as well as the empirical strategy used to test the model predictions. In Section 5, we analyze the business cycle dynamics of individual debt types and of debt concentration. We also document that our findings are robust to using an alternative data set that extends the time-series of debt structure data back to 1980. Finally, we use cluster analysis in Section 6 to study debt structure transitions over the business cycle.

[4]See Graham et al. (2015) for a related discussion of issues and challenges in reconciling aggregate and firm-level results as well as potential sample selection effects related to corporate leverage decisions.

Section 7 concludes.

2 Stylized Facts

We start our investigation by presenting some key stylized facts about the joint dynamics of leverage, the relative use of private versus market debt over the business cycle as well as the corresponding dynamics of debt concentration measures. Table 1 summarizes these results. Panel A shows that, during the sample period, the average U.S. publicly listed firm (the sample will be described in detail in Section 4.2) has 28% book (*bl*) and 20% market leverage (*ml*) during expansionary observations and that book leverage as well as market leverage increase during recessions, by 2.4% and 3.6% relative to total assets, respectively. Thus, both market leverage and book leverage show counter-cyclical dynamics, consistent with the findings reported in Halling et al. (2016). There is, however, large cross-sectional variation, as slightly more than 40% of sample firms exhibit pro-cyclical leverage dynamics, i.e. decreasing leverage in recessions.

To see how these leverage characteristics are related to the mix of private versus market debt, we start by comparing the ratios of private debt, defined as term loans and drawn credit lines, and market debt, defined as senior and subordinated bonds or notes and commercial paper, over total assets, in Panel A of Table 1. On average, firms have a market debt to asset ratio of around 14.1% and a private debt to asset ratio of 13.4%. Thus, over the entire sample period, the importance of bank-based debt and the one of market-based debt funding are very similar.

However, the dynamics of the share of private debt and the one of market debt over the business cycle seem to differ quite substantially, as seen from Panels A and B of Figure 1. While the average private debt to total assets ratio increases during recessions for the full sample (All Firms), this is not the case for market debt ratios. Referring to Panel A of Table 1, the ratio of private debt to total assets increases in recessions for the average firm, from 13.1% during expansions to 14.6% during recessions, which corresponds to a relative increase of approximately 11.5%. In contrast, the ratio of market debt to total assets decreases from 14.3% during expansions to 13.6% in recessions, a relative decrease of over 5%.

The dynamics of market and private debt calculated from the entire sample of firms mask interesting cross-sectional variations. This is because the choices of corporate debt funding sources seem to be related to leverage dynamics. When sorting the sample into firms with counter-cyclical and pro-cyclical *leverage* ratios, respectively, we find that the private debt to asset ratios mirror overall leverage dynamics closely: firms that increase total leverage during recessions (i.e. counter-cyclical leverage dynamics) rely heavily on private debt, as the private debt to asset ratio increases by 4.5 percentage points (see Table 1, Panel B) representing a more than 36% increase relative to the private debt to asset ratio during expansions. In contrast, for firms with pro-cyclical *leverage* dynamics, the private debt to asset ratio drops during recessions, but only by around 3 percentage points, which represents a relative drop of less than 22% (see Table 1, Panel C).

We also find that the dynamics of private debt are driven by both sources of private debt, term loans as well as drawn credit. In the case of drawn credit, these findings fit nicely to the recent literature on firms' funding decisions during Covid-19 (e.g., Acharya et al. (2021), or Li et al. (2020)). Our evidence, however, that firms with counter-cyclical leverage dynamics also extensively use term loans during recessions adds a novel and nuanced aspect to the debate of the importance of private debt during crises.[5]

Panel B in Figure 1 shows that, when sorting firms according to their overall leverage dynamics, the market debt to total asset ratio of firms with counter-cyclical leverage increases only by around 2 percentage points during recessions. This represents an approximately 15% increase relative to the average market debt to asset ratio in expansions and, thus, a significantly smaller change than the one found for private debt. In contrast, the market debt to total asset ratio drops by almost 5 percentage points during recessions for firms with pro-cyclical leverage dynamics. This represents a relative drop in the market debt to asset ratio during expansions of over 33% and is thus much larger than the one found for private debt.

To summarize, private debt and market debt seem to play different roles when firms manage their leverage over the business cycle. While private debt seems to be the preferred choice for firms increasing their leverage during recessions, market debt seems to be the preferred debt source to reduce for firms lowering their leverage during recessions.

Next, we report the patterns for debt concentration, measured by the Herfindahl-Hirschman Index, with market debt and private debt as the two debt components (*HHI*, the construction is explained in Section 4.2). Table 1 shows that the average firm exhibits a concentration measure of 73.3% in its debt structure during expansions and that this measure drops to 72.3% during recessions. Firms that increase their leverage, however, diversify their debt structure much more during recessions, leading to a statistically significant drop of -4.4 percentage points in the debt concentration measure. The opposite is true for firms that lower their leverage during recessions. They tend to rely more on a single debt type during recessions, leading to an increase in debt concentration of 4.2 percentage points. We observe very

[5] As discussed in the introduction, some of the existing papers use aggregate data covering both non-listed and listed firms and/or focus on specific crisis periods. We instead concentrate on publicly listed U.S. firms and include recessions with and without financial/banking crises.

similar patterns when measuring debt concentration by the fraction of firms that borrow more than 90% of their leverage from a single debt source.

In the following section, we introduce a theoretical framework that can reconcile these stylized facts in a simple setting in which firms trade off the costs and benefits of private and market debt.

3 A Model of Optimal Debt Structure Choice

This section develops a model of debt structure choice, in which public and private debt have different benefits and costs. We show that this implies that some firms prefer to fund their investments solely by public debt, others prefer to use exclusively private debt and still other firms choose a mix of the two. Specifically, private debt is provided to the firm by single or few lenders, such as banks, and can be renegotiated if the firm's investment is not profitable. The disadvantage of private debt comes in the form of costs of financial intermediation. In contrast, public debt does not involve such costs, but the dispersed bondholders cannot coordinate, so they do not engage in debt forgiveness.[6]

We consider a discrete-time economy with firms entering each period with assets in place A_0. If successful, the firm's productivity is H and thus its end-of-period cash flow is A_0H, which occurs with probability 0.5. If it fails, the firm's productivity becomes $Z_f \in \{M, L\}$, where $H > M > L > 0$, and its cash flow is A_0Z_f. Particularly, $Z_f = M$ if the economy is in an expansion state and $Z_f = L$ if the economy is in a recession.[7] To allow for heterogeneity across firms, L and M are firm specific, but we suppress firm subscripts for simplicity.

Assets in place are funded before the firm type and the state of the macro economy are observed, so that debt financing is assumed to be senior and limited to a face value equal to the lowest possible payoff in the failure state, i.e., $F_0 = A_0L_{\min}$. I.e., senior debtholders are secured by assets that they can seize in bankruptcy, without incurring costs. This makes debt riskless. For simplicity and because some firms might not have access to public bond

[6]The empirical predictions derived from this model do not depend on this specific tradeoff, however, as we show in the Internet Appendix. There we develop a model with qualitatively identical empirical predictions, in which private debt provides better incentives for lenders to monitor the firm, thereby reducing investment distortions. In the Internet Appendix, we also extend our model to allow fixed issuance costs of public debt and derive qualitatively similar empirical predictions.

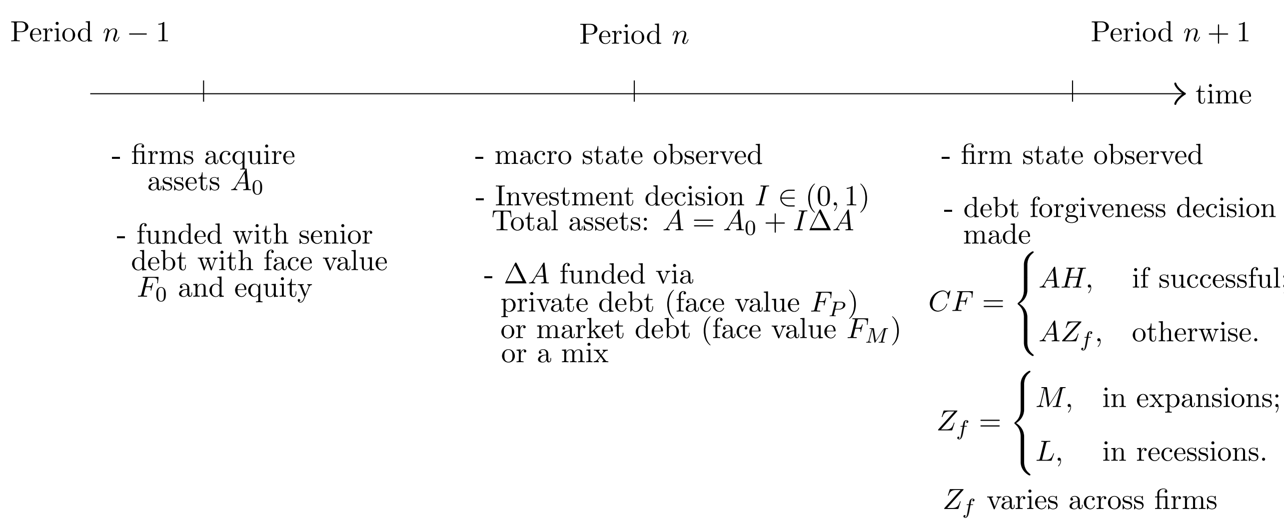
[7]Kiyotaki and Moore (1997) show that temporary technological shocks can lead to persistent fluctuations in output. In particular, these shocks lead to amplified drops in the value of collateral assets, in accordance with our model assumption that lenders face more downside risk in recessions. There is also evidence that negative shocks to household balance sheets during the Great Recession resulted in a severe decline in consumer demand by households, thus contributing to firms' downside risk (see Mian et al. (2013) and Giroud and Mueller (2017)). Moreover, existing theory papers on the business cycle dynamics of capital structure calibrate their models to U.S. data and show that recessions decrease output by either lowering the level or the growth rate of firm cash flows (see, e.g., Hackbarth et al. (2006) and Bhamra et al. (2010).

markets, we assume that it is obtained by borrowing from a bank. The remaining funding must be provided by the owners' equity. In the Internet Appendix we also provide the analysis for the case in which the initial debt financing is done via market debt and show that even stronger empirical predictions can be derived in this case.

Once the firm type and the macro state are revealed, each firm is endowed with a growth opportunity (a 'project'), which involves an investment decision $I \in \{0, 1\}$. If $I = 1$, the firm expands its assets by ΔA at a cost of ΔA since we normalize the price of physical assets to one. Denote by $A \equiv A_0 + \Delta A$ the total assets after the investment. The incremental cash flow of this project is thus ΔAH if the firm succeeds and ΔAZ_f if it fails.

The firm can fund its project with either market debt (face value F_M) or private debt (face value F_P) or a mix of both. Without loss of generality, we assume that all debt is pure discount. Both firm owners and market debt holders (i.e., bondholders) are risk neutral and their discount rate is normalized to zero. Private debt (e.g. bank debt) incurs a cost of financial intermediation and is therefore priced at a discount rate $\rho > 0$. All financial securities are single-period claims and assets (both A and ΔA) have a zero scrap value at the end of each period. If final cash flows are below the total face value of debt, lenders decide on whether to engage in debt forgiveness or not.

In summary, there are three dates in each period and the sequence of events of a particular Period n is given as follows:



The firm's balance sheet upon investment before subtracting any costs of bankruptcy can be summarized as follows:

	Success	Failure ($Z_f = M$ or L)
Total assets	$(A_0 + \Delta A)H$	$(A_0 + \Delta A)Z_f$
Secured debt	$F_0 = A_0 L_{\min}$	$F_0 = A_0 L_{\min}$
Other debt & equity claims	$(A_0 + \Delta A)H - F_0$	$(A_0 + \Delta A)Z_f - F_0$

For notational convenience we define the total cash flow available for distributions (to other claim holders) in the failure state by

$$\Delta CF(Z_f) = (A_0 + \Delta A)Z_f - F_0.$$

It is straightforward to show that there exist two critical profitability levels in the failure state: Z_M, and Z_I, where $Z_M < Z_I$, such that firms can fund the investment project with riskless debt if $Z_f \geq Z_M$, and that the investment project will not be realized at all if $Z_f < Z_I$. The exact derivation of these two critical profitability levels is provided in Appendix B.

We refer to firms with $Z_f \geq Z_M$ as "strong", to the ones with $Z_I \leq Z_f < Z_M$ as "average" and to the ones with $Z_f < Z_I$ as "weak". Then it follows that strong firms use riskless public debt to fund the intermediate investment. Average firms must resort to risky debt to finance the investment. To avoid costly bankruptcy, a private lender will provide debt relief as long as it is incentive compatible for her to do so whereas bondholders cannot coordinate and therefore do not engage in debt forgiveness. We assume that all cash flows are lost in this case due to costs of bankruptcy. Therefore, as shown in the Appendix, average firms optimally use a mix of public and private debt as long as the costs of financial intermediation reflected in private debt are sufficiently low. The amount of private debt is always minimized, just to ensure enough debt forgiveness in order to avoid costly bankruptcy. Finally, weak firms do not invest, since the project has a negative NPV to those firms for all possible debt structures. These results are summarized in the following Proposition:

Proposition 1 *Strong firms fund the intermediate investment by issuing only public debt. Average firms fund the intermediate investment by issuing a mix of private and public debt. Weak firms do not invest and do therefore not require any additional debt.*

Proof. See Appendix B. ■

3.1 Debt Structure and the Business Cycle

In this subsection we use the results of Proposition 1 to derive predictions for the dynamics of corporate debt structures over the business cycle. Before we do that, we summarize the model parameter assumptions underlying these predictions.

Assumption 1 *There exist some firms for which $Z_f < Z_M$.*

Assumption 2 *The cost of intermediation, ρ, satisfies* $\rho < \frac{0.5\Delta CF(L)}{\Delta A - \Delta CF(L)} \ \ \forall L.$

Assumption 3 $M_{\min} > Z_I > L_{\min}$.

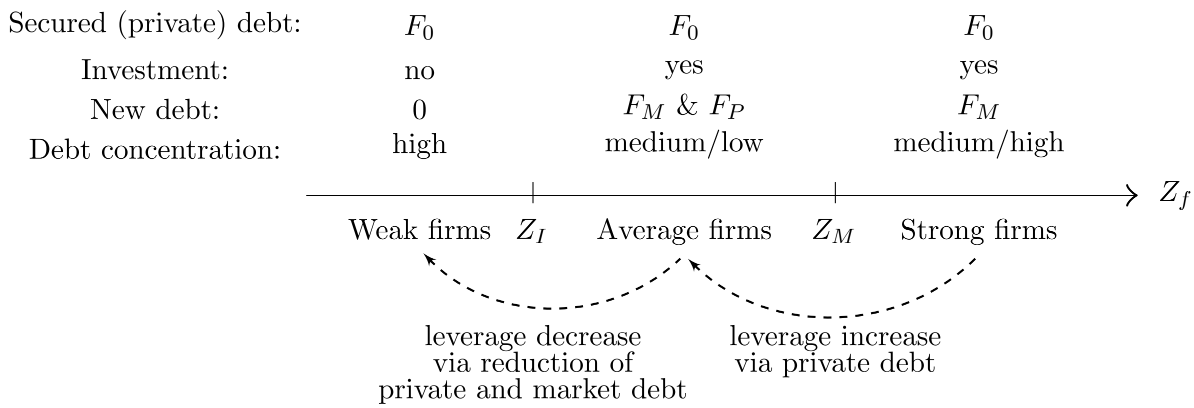
Assumption 1 rules out the uninteresting case in which all firms can fund their investment by issuing riskless public debt. In other words, even in an expansion state, there are at least some firms that find it optimal to invest but cannot fully fund the investment with riskless market debt.

Assumption 2 is required to obtain Proposition 1 and ensures that risky market debt does not dominate private debt. Specifically, assumption 2 implies that, even in a recession state, the gain from avoiding bankruptcy associated with the appropriate amount of private debt outweighs the additional cost of intermediation, implicit in the private debt's higher discount rate ρ.[8] The inequality follows since the expected costs of bankruptcy in the absence of restructuring is 0.5 $\Delta CF(L)$. To make restructuring in the failure state happen, requires $F_M \leq \Delta CF(L)$ which in turn requires the firm to raise capital via private debt funding of at least $\Delta A - \Delta CF(L)$. This is associated with a cost of intermediation of $\rho(\Delta A - \Delta CF(L))$.

Finally, Assumption 3 rules out uninteresting cases where the cross-section of firms' debt structure choices do not differ over the business cycle. The second inequality ensures that in a recession, there are at least some firms which do not find it optimal to invest. The first inequality, i.e. $M_{\min} > Z_I$, is only made for ease of exposition and is without loss of generality. It says that weak firms do not exist in expansions. Without this assumption, i.e. if $M_{\min} < Z_I$, weak firms would also exist in expansions, but this would not alter our empirical predictions, since such firms would become even weaker in recessions. Thus, they would have no demand for debt regardless of the macroeconomic state.

We now turn to predictions for debt structure dynamics and the business cycle that follow from the model. Proposition 1 implies that corporate debt structure and investment policies depend crucially on the cash flow generated by the project in the bad state, $\Delta CF(Z_f)$, which monotonically increases with profitability Z_f. In the following figure, we therefore place firms on the Z_f-axis where firms exhibit decreasing Z_f when moving from right to left, and provide their optimal debt structures. Since $L < M$, recessions shift the distribution of firms to the left along the Z_f-axis.

[8]Note that during expansions for those firms with $\Delta CF(M) < \Delta A$, $\rho < \dfrac{\Delta CF(L)}{2(\Delta A - \Delta CF(L))} < \dfrac{\Delta CF(M)}{2(\Delta A - \Delta CF(M))}$ because $L < M$.



In expansions, strong firms ($M \geq Z_M$) are able to issue riskless market debt and save the cost of financial intermediation. If these firms remain strong in recessions, i.e. $L \geq Z_M$, nothing changes, although market leverage dynamics will be mechanically counter-cyclical due to the denominator effect. That is, the market value of total assets, $(A_0 + \Delta A)\frac{1}{2}(H + Z_f)$, is pro-cyclical, leading to an increase in market leverage in recessions.

However, a subset of these firms will be sufficiently negatively affected by the recession, so that for them $L < Z_M$. These firms find it optimal to resort to a mix of market and private debt which optimally trades off bankruptcy costs against the cost of financial intermediation. As a consequence, the structure of debt issuance shifts towards a mix of market and private debt when the economy moves from an expansion to a recession. In other words, during recessions these firms, on average, increase the amount of assets financed by private debt. At the same time, both the book and the market leverage of the average strong firm increases when entering recessions. First, as recessions increase credit risk for at least some of these firms, they must issue debt with a higher face value, thereby increasing book leverage. Second, there is the previously discussed denominator effect.[9] This leads to the following empirical prediction:

Prediction 1 *For firms that are strong in expansions ($M \geq Z_M$), both total leverage dynamics and private debt to total assets ratios are counter-cyclical, on average.*

The debt concentration dynamics of strong firms depend on the type and the level of initial debt, F_0, which has so far been assumed to be private. Below, we identify conditions, under which the model generates unambiguous business cycle predictions for debt concentration dynamics even for these firms.

Prediction 2 *Suppose one of the following conditions is satisfied:*

- *initial debt's face value, F_0, is sufficiently small; or*

[9]In some, but plausibly rare cases, strong firms during expansions may be hit so severely by recessions that they become weak firms. For them, the private debt to total assets ratio also increases during recessions because such firms do not acquire any market-debt-funded assets during recessions. Their overall leverage decreases in comparison to expansions, since they do not acquire any debt funded assets in recessions.

- *initial debt (face value = F_0) is market debt.*

Then for firms that are strong in expansions ($M \geq Z_M$), debt concentration decreases during recessions, on average.

The intuition is simple. As long as F_0 is sufficiently small (the first condition), market debt becomes the dominating source of funding for strong firms. In recessions, some of them become average firms and substitute private debt for public debt, compared to expansions, thereby moving to a more diversified debt structure. Next, if the second condition holds, the business cycle pattern of debt concentration is even more straightforward: in expansions strong firms raise only market debt, and since the initial debt is now also public debt, they exhibit perfectly concentrated debt structures. In recessions, some of these firms diversify their debt structure since they issue both market and private debt to fund the investment, implying that the average debt structure becomes more diversified. The Internet Appendix shows in detail how the two above conditions imply Prediction 2.

Finally, we consider those firms that do not find it profitable to finance the project in a recession since they become weak firms. Such firms either already have a very low cash flow in the failure state even in an expansion (that is, their M is sufficiently close to Z_I), or they are very sensitive to macroeconomic shocks (that is, their L is substantially lower than M) or both. Note that, in addition to the decrease in their investment project's profitability, they are also confronted with an increase in the cost of financial intermediation when considering funding the project, since $\rho(\Delta A - \Delta CF(L)) > \rho(\Delta A - \Delta CF(M))$. Thus, such firms forgo the investment project and have no incentive to raise debt since their cash flow satisfies $L < Z_I$. On average, these firms' debt concentration therefore increases. Also, their book leverage ratio decreases during recessions and decreases more than their market leverage ratio, which is also affected by the denominator effect.[10]

Prediction 3 *For firms that are average during expansions and become weak in recessions ($Z_I > L$), book leverage dynamics are pro-cyclical and debt concentration dynamics are counter-cyclical, on average. Moreover, if at least one of the conditions in Prediction 2 holds, then these firms also exhibit pro-cyclical private debt to total assets ratios, on average.*

For the latter part of Prediction 3, note that for these firms the private debt to total assets ratio is F_0/A_0 during recessions and $(F_0 + F_P)/(A_0 + \Delta A)$ during expansions and thus, the ratio is pro-cyclical as long as $F_0/A_0 < F_P/\Delta A$, which holds under the first condition. Next, if initial debt financing takes a form of market debt (the second condition), our model predicts even stronger pro-cyclical dynamics of the private debt to total assets ratio since the ratio is strictly positive during expansions and zero during recessions.

The above predictions together imply:

[10]There is one more, rather uninteresting, case, namely firms that are weak even in expansions. Their book leverage and private debt to total assets ratio do not vary over the business cycle.

Prediction 4 *Recessions make corporate debt structures diverge: firms with high profitability such that for them $M \geq Z_M$, on average increase their leverage and diversify more across debt sources in recessions whereas firms with sufficiently low profitability such that for them $L < Z_I$ decrease their leverage on average and implement concentrated debt structures.*

The overall effect of recessions on firms' leverage and debt structures depends on the distribution of firm profitability in the economy and on the economic impact of recessions. If most firms are sufficiently profitable and/or the adverse effect of recessions on their cash flows is sufficiently small, so that they largely use market debt in expansions and that they still invest even during recessions, then recessions lead to leverage increases and to decreases in debt concentration for the average firm. On the contrary, if the initial profitability for most firms is sufficiently low and/or the adverse impact of recessions is sufficiently severe, then most firms cut back their investments during recessions compared to expansions, and this leads to decreasing book leverage and increasing debt concentration.

4 Empirical Strategy

This section presents the empirical framework for the tests of the theoretical predictions derived in Section 3. We first discuss the empirical methodology to capture business cycle dynamics and to proxy for optimal target levels of debt concentration as well as the usage of individual debt types. Second, we provide a comprehensive and detailed data description.

4.1 Empirical Models of Debt Concentration and Debt Types

Our empirical strategy builds on the existing empirical capital structure literature (see, for example, Hovakimian et al. (2001), Korajczyk and Levy (2003), Hovakimian et al. (2004), Leary and Roberts (2005), and Halling et al. (2016)) and is based on panel regressions with firm fixed effects. To account for costly capital structure adjustments which imply that firms are usually not at their target unless one observes a lumpy adjustment, the estimation is based on a sample of refinancing firm quarters/years, where we observe substantial capital structure adjustments, using a 5% cutoff (more on this in Section 4.2 where we describe data and sample). We apply this cutoff both when we analyze firms' debt concentration as well as their reliance on individual debt sources. Thus, throughout the paper we interpret the output of the empirical models as proxying for optimal debt concentration and optimal choices of different debt sources. Specifically, we estimate the following panel models with firm fixed effects:

$$\mathbf{Y}_{i,t+1} = \beta_0 + \beta_0^{rec}\mathbf{1}_{t+1}^{rec} + \sum_s \mathbf{X}_{i,t}\mathbf{1}_{t+1}^{s}\beta^s + f_i, \quad s \in S \equiv \{rec, exp\} \tag{1}$$

where $\mathbf{Y}$ is debt concentration or a debt type (scaled by total assets). The recession dummy ($\mathbf{1}^{rec}$) captures the unconditional effect of the business cycle. We also interact each firm characteristic with a recession and an expansion dummy to explicitly model variation in the coefficients across the business cycle. $\mathbf{X}$ is the vector of firm characteristics (see Section 4.2 for a motivation of the choice and details on their construction), that is,

$$\mathbf{X} = [size, mtb, \ profit, tang, capx, divpayer, cash, rated] .$$

Following Halling et al. (2016), we measure the dynamics of debt concentration and of the reliance on different debt types over the business cycle as follows. Let $\mathbf{TY}(\mathbf{X}, \mathbf{1}^{rec}, \mathbf{1}^{exp})$ be the fitted dependent variable estimated from equation (1). Consider now an individual firm with time-varying firm characteristics $\mathbf{X}^{exp}$ and $\mathbf{X}^{rec}$ during expansions and recessions, respectively. After purging time-invariant firm fixed effects, this firm's debt structure across different macroeconomic states is given by

$$\mathbf{TY}^{exp} = \mathbf{TY}(\mathbf{X}^{exp}, \mathbf{1}^{exp} = 1, \mathbf{1}^{rec} = 0) = \beta_0 + \mathbf{X}^{exp}\beta^{exp}; \tag{2}$$

and

$$\mathbf{TY}^{rec} = \mathbf{TY}(\mathbf{X}^{rec}, \mathbf{1}^{exp} = 0, \mathbf{1}^{rec} = 1) = \beta_0 + \beta_0^{rec} + \mathbf{X}^{rec}\beta^{rec}. \tag{3}$$

Taking the difference between the two allows us to assess the cyclicality of the analyzed dependent variable for a given firm. In detail, taking the difference yields the following expression:

$$\Delta\mathbf{TY} = \mathbf{TY}^{rec} - \mathbf{TY}^{exp} = \beta_0^{rec} + (\mathbf{X}^{rec}\beta^{rec} - \mathbf{X}^{exp}\beta^{exp}) . \tag{4}$$

Importantly, the functional form of this firm-level measure allows us to model the effects of (i) time-varying firm characteristics, (ii) time-varying coefficients, and (iii) the business cycle itself, through the recession dummy, on the cyclicality of the dependent variable for the average firm. The combined effects of (i) and (ii) are captured by $(\mathbf{X}^{rec}\beta^{rec} - \mathbf{X}^{exp}\beta^{exp})$. Thus, this definition of cyclicality goes beyond what is captured by effect (iii), i.e. beyond analyzing the sign of β_0^{rec}.

4.2 Data and Sample Description

The sample is based on quarterly data from Compustat and Capital IQ from 2001[11] through 2020. We start with all firm-quarters in Compustat. Following the literature (e.g., Colla et al. (2013) and Halling et al. (2016)), we remove financial and utility firms. Applying the following filters, we drop firm-quarters with: (1) missing or zero value of total assets; (2) missing or zero value of total

[11] The coverage of debt type data by Capital IQ is not comprehensive until 2002 (see footnote 4, Colla et al. (2013)). However, for our type of study the time-series dimension, in particular observations during recessions, are crucial and, thus, we decided to also include 2001 in the analysis. We apply several data cleaning steps, as discussed in this section, to ensure the quality of the final data set.

debt (short-term debt plus long-term debt); and (3) book (market) leverage greater than one or less than zero. We also remove very small firms that have an average book value of total assets less than 5 million U.S. dollars.[12]

Firm variables include the natural logarithm of net sales (*sales*), market-to-book ratio (*mtb*), operating income before depreciation to total assets ratio (*profit*), net property, plant, and equipment to total assets ratio (*tang*), capital expenditures to total assets ratio (*capx*), cash to total assets ratio (*cash*), and a dividend payer dummy (*divpayer*).[13] We winsorize the continuous firm characteristics at the 1st and 99th levels except market to book which is winsorized at the 95th level. We extract S&P long term issuer credit rating for U.S. firms from Compustat (Rauh and Sufi (2010)). We also create a rating dummy (*rated*) which equals one if a firm is rated (in any month of a quarter); and zero otherwise.

As in Colla et al. (2013), we use Capital IQ debt variables to identify seven distinctively different debt types: term loans (*tl*), drawn credit lines (*dc*), senior bonds and notes (*sbn*), subordinated bonds and notes (*sub*), commercial paper (*cp*), capital leases (*cl*), and other debt (*others*).[14] We ignore capital leases in the empirical analysis because of an accounting standard change in February 2016 whose implications jeopardize our objective to analyze the dynamics of debt concentration and individual debt types in a consistent manner *across time*.[15]

Next, we merge the filtered Compustat firm-quarters with those from Capital IQ. Capital IQ provides detailed information on debt types, which also allows us to compute total debt (sum of six mutually exclusive debt types). We further remove firm-quarters when the absolute difference between total debt from the two data sources exceeds 10% of total debt. Finally, we aggregate term loans and drawn credit lines to define bank or private debt and aggregate senior bonds and notes, subordinated bonds and notes, and commercial paper to define market debt. The main focus of the paper will be on these two debt types.

Using the two aggregated debt types, we construct two alternative debt specialization measures. First, we define a normalized Herfindahl-Hirschman Index (HHI) of debt type usage:

$$\frac{\sum_{n=1}^{2}\left(\frac{\text{debt source}_n}{\text{total debt}}\right)^2 - \frac{1}{2}}{1-\frac{1}{2}}. \tag{5}$$

Second, we calculate an exclusive debt usage dummy, *Excl90*, which equals one if a firm has more

[12] Constant 2002Q4 dollars are used to adjust total assets (and sales) when necessary.

[13] The selection of firm-level variables largely follows Frank and Goyal (2009).

[14] Other debt in Capital IQ refers to unclassified debt types. There is evidence that some firms in pre-2010 years labeled certain types of debt (*sbn* being the most prominent example) as other debt in their 10Qs and then recognize the actual debt type in their 10Ks of the same year. We therefore remove firm-quarters with other debt exceeding 3% of total debt.

[15] Colla et al. (2013) show that the mean and median capital leases-to-total debt ratios are, respectively, 5% and 0% and, thus, play a rather limited role in firms' debt structures. We note that the results are not driven by this decision. In an earlier version of the paper our sample ended in 2017 and in that version we included capital leases in our analyses. We obtained qualitatively and quantitatively similar results.

than 90% of its total debt in one debt type; and zero otherwise.

As mentioned in Section 4.1, the existing empirical capital structure literature suggests that firms tend to make substantial and infrequent leverage adjustments.[16] We define a firm-quarter as experiencing a substantial leverage increase if the change in its total debt less net equity issuance (that is, equity issuance less equity repurchase) to its lagged total assets ratio is greater than 5%. Similarly, a firm-quarter experiences a substantial leverage decrease if the ratio is less than -5%. A refinancing dummy is turned on in a firm-quarter if it either increases or decreases its leverage (see, for example, Leary and Roberts (2005)). We then apply the same methodology to different types of debt and define debt-type-specific refinancing events. The final refinancing sample that we use in our empirical analysis, labeled ref_all, includes all firm-quarter observations where total leverage or any individual debt type experiences a substantial change.

These refinancing events represent situations in which firms, most likely, make active choices to change and adjust their leverage, debt concentration or exposure to individual debt sources and, accordingly, move those variables to optimal levels in the process.[17] Thus, focusing on those observations allows us to interpret the resulting multivariate models as describing firms' target level policies. For robustness we also replicate our main empirical results for the full sample of observations, i.e. including also periods without significant leverage or debt structure adjustments.

Capital IQ data are predominantly annual (i.e., many quarterly observations are missing) during earlier years of the sample period while later on quarterly data are available much more consistently. This, however, means that at the quarterly frequency later business cycles would dominate earlier ones in terms of numbers of observations. To counteract this imbalance we convert the quarterly data to annual data. We hereby define annual data not in terms of calendar years but relative to the event of business cycle recessions. For example, the four consecutive quarters before the peak of the business cycle in the 4th quarter of 2007 (the start of the recession), from the 4th quarter in 2006 to the 3rd quarter in 2007, are collapsed into one annual observation. To aggregate four consecutive quarters into one annual observation, we select the quarterly observation that either has best data quality or that corresponds to the fiscal year end.[18]

To define recessions, we use the National Bureau of Economic Research (NBER) U.S. business cycle expansions and contractions. Given the time-series dimension of the Capital IQ data, we cover

[16]The dynamic tradeoff theory (see, for example, Fischer et al. (1989)) offers a rationale for such patterns of capital structure adjustments.

[17]Korteweg et al. (2020) analyze this accounting-based approach to identify significant leverage adjustments using hand-collected data from corporate filings. They report that around 10% of leverage adjustments might be due to "passive" events; i.e., events that are not driven by corporate actions. Such "passive" leverage adjustments could, for example, be driven by investor actions (e.g., option exercise).

[18]Specifically, we assume that the quarter with the smallest value of "other debt" in Capital IQ has best data quality. As discussed in a previous footnote, we observed that "other debt" in the Capital IQ data frequently captures unclassified debt types that eventually get reallocated to one of the other debt types. Thus, we assume that observations with low values of other debt represent observations in which all debt is appropriately classified as one of the explicit debt types. In most cases, the two criteria agree and select the same observation, as the fiscal-year end quarter usually is the observation with best data quality according to our definition.

the recession in 2001 and the subsequent post-recession period (i.e., burst of the tech-bubble), the full business-cycle associated with the Global Financial Crisis in 2007, and the pre-recession as well as the 2020-recession triggered by Covid-19. For most empirical analyses, we construct an event window that includes four annual periods before and after recessions.[19]

Before moving to the detailed empirical analysis, Panel A of Table 2 summarizes our base-case sample of US public firms. There are 24,808 annual expansionary and 5,738 annual recessionary observations. That is, slightly more than 18% of observations are in economic downturns. Firm characteristics vary substantially over the business cycle. We document pro-cyclical dynamics of size (size), profitability (profit), market-to-book ratio (mtb), the fraction of dividend payers (divpayer), and the fraction of firms with ratings (rated). These patterns provide intuitive evidence that firms experience negative shocks during recessions. Hence, firms become less profitable, their market values deteriorate relative to book values, and they reduce dividend payments during recessions.

5 Debt Structure Dynamics

Motivated by the predictions from the theoretical model, we first investigate the dynamics of corporate debt structures by analyzing in detail how firms adjust their use of market and private debt over the business cycle. Next, we evaluate whether firms diversify more or less across multiple debt sources during recessions. In both analyses, we also analyze how debt structure dynamics are related to the dynamics of leverage over the business cycle. Finally, we complement the main analyses with results from an extended data set that goes back to the 1980s.

5.1 Cyclicality of Individual Debt Types

The model predicts that firms which increase total leverage in recessions exhibit substantially different dynamics of their use of private versus market debt and of their debt concentration than firms decreasing total leverage in recessions. In our empirical strategy, we therefore frequently split the sample into firms with pro-cyclical and those with counter-cyclical total leverage dynamics. According to Table 1, the differences in average leverage variables and debt structure characteristics across these two samples are economically very small and statistically insignificant in most cases (for example, the average market leverage ratio is 20.5% (20.9%) in the case of firms with counter-cyclical (pro-cyclical) leverage dynamics). In contrast, firms in these two samples exhibit very distinct characteristics, as shown in Table 2. Those with counter-cyclical leverage dynamics tend to be significantly larger, more profitable, pay dividends more frequently and are rated more frequently

[19] In robustness tests we use shorter event windows. Further more, we present results that use a differently constructed sample that has much less granular information on debt types (only market versus private debt) but that extends back to the beginning of the 80ties in Section 5.3. Thus, in this case, we cover four business cycles completely (i.e., the recessions in 1981, 1990, 2000 and 2007). In addition we cover the post-recession period of the recession in 1980, as well as the pre-recession period of the recession in 2020.

than firms with pro-cyclical dynamics. They also have lower market-to-book ratios and lower cash holdings. Overall, firms with pro-cyclical dynamics seem to be financially more constrained and may be interpreted to represent "weak"firms with respect to their cash-flow expectations compared to firms that are able to lever up during recessions.

As discussed in Section 2, the debt structure dynamics are sharply different for these two subsamples of firms, which accords well with model predictions. Firms increasing their leverage during recessions tend to use predominantly private debt and substantially less frequently market debt. Firms decreasing their leverage during recessions, in contrast, follow the opposite pattern. Their preferred choice seems to be to reduce market debt and to a substantially smaller extent private debt. This drop in private debt is driven by a reduction in term loans, as changes in drawn credit appear fairly small across the business cycle (see Table 1).

We now turn to a multivariate analysis of firms' debt structure decisions over the business cycle, controlling for changing firm characteristics (see Section 4.1 for a detailed description). The multivariate framework is designed to allow for an unconditional effect of the business cycle through a recession dummy and for variation in coefficient estimates across the business cycle through interaction terms. As a consequence, the fitted values of the debt structure reflect both the unconditional effect of the recession, the effect of different coefficient estimates and, of course, the effect of the realized dynamics of the explanatory variables over the business cycle.

Main regressions are based on a 4-year event window around recessions and are estimated from the refinancing sample, that is, firm-year observations that reflect substantial leverage as well as individual debt type changes capturing the idea that firms make active choices in those periods. For each debt type, we also estimate the models separately for the sub-samples of firms with counter-cyclical and pro-cyclical leverage dynamics. As robustness tests, we report results based on the full sample of firm-year observations and results that use a shorter event time window around recessions of one year. Detailed results of these robustness tests are reported in the Internet Appendix.

Table 3 summarizes the results. To simplify the reading of the table, we do not report individual coefficient estimates, with the exception of the one for the REC dummy that captures the unconditional effect of the business cycle on debt type dynamics.[20] The coefficients of the REC dummy are mostly significant and consistent with the patterns discussed previously. In the case of market debt, the full sample estimate is negative but small and statistically insignificant. Patterns, however, become more pronounced when analyzing the sub-samples. While firms that increase leverage during recessions only raise a moderate amount of additional market debt (the coefficient estimate indicates an increase of market debt by 2.5 percentage points during recessions), firms that reduce their leverage during recessions cut back on their market debt substantially. In the latter case, market debt drops by 4 percentage points during recessions. All these changes are economically large, as they are measured relative to total assets.

In the case of private debt normalized by total assets, we observe a relatively small but statis-

[20] The Internet Appendix contains a table with all coefficient estimates for the interested reader's reference.

tically significant increase of 1.8 percentage points in recessions for all firms. This effect, however, hides a lot of the cross-sectional variation among firms. Once we separate firms by their leverage dynamics, we find that firms that increase their leverage during recessions rely on private debt extensively increasing it by 9.2 percentage points while those firms decreasing their leverage during recessions decrease private debt by 8.5 percentage points.

Table 3 also shows the dynamics of model-implied debt ratios over the business cycle, which we refer to as *target* debt ratios. As discussed above, these estimates of debt ratios not only reflect the unconditional effect of a recession, but also the variation in regression coefficients and in firm characteristics across the business-cycle. Controlling for these other sources of variation in the empirical model sharpens the models' main results. For all firms and the sample of refinancing observations, we find that target market debt ratios relative to total assets drop by slightly less than 1 percentage point during recessions (this corresponds to a drop by more than 5% when compared to the average market debt during expansions), while target private debt ratios increase by 1.5 percentage points (corresponding to an increase of almost 10%).

While these full sample results are already sizable, effects become much larger once we condition on leverage dynamics. Firms with pro-cyclical leverage dynamics tend to predominantly reduce market debt, reducing it by almost 6 percentage points or almost 36% relative to average levels during expansions. In contrast, firms with counter-cyclical leverage dynamics seem to rely less on market debt, as in this case the market debt ratio increases only by 2.8 percentage points or slightly less than 19%.

The picture is reversed for private debt. In this case, firms with counter-cyclical leverage dynamics rely on private debt to a large extent, increasing it by almost 6 percentage points or an impressive 36%. On the other side, firms decreasing their leverage during recessions also decrease private debt but to a lesser extent, as the reduction is only 4.2 percentage points or 27%, on average.[21]

All of the above results are basically unchanged, and in some cases become even more pronounced, if we move from the sample of refinancing observations to the full sample or if we shorten the event window from four annual observations to one annual observation pre- and post-recession. Overall, the above results show that a large fraction of firms, in particular those with pro-cyclical leverage dynamics, reduce their dependence on market debt during recessions. Similarly, we find that private lending plays an important role during recessions by allowing some firms to increase their leverage.

[21] These results are consistent with the predictions of the theoretical model with respect to the dynamics of private debt to total assets. Regarding the dynamics of market debt to total assets, the model implies pro-cyclical dynamics for those firms that increase their leverage during recessions, which appears to be at odds with the empirical results. However, firms with pro-cyclical leverage dynamics would also reduce their exposure to market debt in the model, which is consistent with the empirical evidence.

5.2 Cyclicality of Debt Specialization

Next we analyze how the concentration of firms' debt structures varies with the business cycle. Preliminary analyses presented in Section 2 suggest that debt concentration, either measured by the Herfindahl-Hirschman Index or the fraction of firms that obtain at least 90% of their leverage from one debt type, tends to be moderately pro-cyclical when pooling all firms together (see Table 1). The stylized facts also show that firms with counter-cyclical leverage feature significantly pro-cyclical debt concentration whereas the opposite is true for firms with pro-cyclical leverage. Overall, debt concentration mirrors leverage dynamics, which is a pattern that endogenously arises within the model.

We now evaluate the validity of these patterns in a comprehensive, multivariate framework that controls for firm characteristics. Table 4 summarizes the results. We first focus on the unconditional effect of recessions captured by the coefficient of the REC dummy in the model and on the dynamics of model-implied debt concentration levels.

For our main sample with refinancing observations, the point estimate of the recession dummy is negative and sizable in economic terms, indicating an unconditional reduction in debt concentration of almost 4% during recessions. The estimate, however, is not significant at conventional levels with a p-value of 13%. Splitting the sample according to leverage dynamics, we find more pronounced and statistically significant effects for firms with counter-cyclical leverage dynamics. They decrease their debt concentration by almost 11 percentage points during recessions. Firms with pro-cyclical leverage dynamics, in contrast, show a tendency to increase debt concentration during recessions by almost 5 percentage points, albeit not statistically significant.

To measure the combined effect of (i) the recession, (ii) the variation in coefficients estimates across the business cycle, and (iii) the variation in firm characteristics over the business cycle, we use the multivariate models to calculate estimates of target debt concentration (i.e., the fitted values of the regressions) for each firm during expansions as well as during recessions. Table 4 reports the corresponding values and shows that target debt specialization drops by statistically significant 1.3 percentage points for the full sample of firms. Again, the effects are very different and economically more pronounced in the sub-samples: firms with counter-cyclical (pro-cyclical) leverage dynamics decrease (increase) target debt concentration by 5.1 (3.8) percentage points during recessions, on average. All these effects are statistically significant.

We perform extensive additional empirical analyses to assess the robustness of these patterns. The Internet Appendix contains detailed tables with the results for the full sample of firm-year observations (instead of using the refinancing sample) and a shorter event window (instead of using an event window of four annual periods prior and post recessions). Dynamics of target debt concentration are consistent across all these specifications.

5.3 Extending the sample: Going back to the 80s

One limitation of our main Compustat-Capital IQ sample is the relatively short time-series dimension that only covers three recessions. To assess the robustness of our results, this section presents findings based on data that go back to 1980, which doubles the number of business cycles in the sample by adding the recessions in 1980, 1981/82 and 1990/91 to the sample. This dataset is constructed from the Mergent FSID database that provides detailed information on new bond issues by non-financial, non-utility, publicly listed firms. We merge this information with quarterly firm characteristics using Compustat including information on total leverage as well as the same set of firm characteristics that were included in the analysis so far.

To obtain debt-structure information for this longer sample, we construct each firm's fraction of market debt in a given quarter, using data on each firm's past bond issues. Essentially, we accumulate the face values of all bond issues of a given firm and subtract all amortizations. The difference between total leverage from Compustat and our proxy for market-based debt derived from the Mergent data is then labeled as being bank-based debt.[22] It is important to point out that, although we use the same terminology as in the main analysis, the debt definitions used in this section differ somewhat from the ones used before. The main difference between the market debt variable constructed from Mergent and the one derived from Capital IQ is that the Mergent database mostly excludes privately placed bonds. We verified this by checking several individual firms and tracking their issuance activity in recent years manually. Thus, we explicitly excluded the few privately placed bonds included in the Mergent sample and, thus, our measure has to be interpreted as being a measure of publicly issued bonds. In contrast, Capital IQ adds publicly issued as well as privately placed senior bonds and notes into the corresponding data item. Similarly, the bank-based debt variable considered in this analysis is a residual value, as explained above, and, thus, might also capture sources of debt that are not related to term loans or drawn credit (e.g., commercial paper or privately placed bonds).

The accuracy of the above procedure crucially depends on the coverage of bond issuances in the Mergent database. In a different paper on primary bond markets, Halling et al. (2020), we performed extensive tests comparing the coverage of Mergent with the coverage of SDC, an alternative provider of bond issuance data, and found that, at least in the most recent 20 years both databases cover a similar, but not perfectly matching, number of issuance events. Thus, while coverage is certainly not complete, and in particular not during earlier years of our sample, it appears adequate for the purpose of our exercise.

To obtain the correct stock of bond-based funding, we need to observe all relevant issuance activities historically (i.e., all outstanding bonds at a given point in time). As a consequence, we need to define a "burn-in" period to accumulate issuance information for a given firm as a proxy for

[22] We also followed a similar procedure for syndicated loans using Dealscan data. In this case, however, the data coverage in the cross-section as well as the level of granularity of the available data — especially, in terms of adjustments to outstanding loan amounts over time — was not sufficient to construct a stock of syndicated loans.

the total amount of bond debt outstanding. We end up using issuance information starting in the early 70s such that our subsequent analysis can start in 1980 to maximize the number of recessions covered. Given that average corporate bond maturities are well below 10 years, we consider this procedure as rather conservative.

A potential source of noise could be that bonds may not always be outstanding until maturity. While Mergent, in principle, provides very detailed information on potential changes to the amount outstanding of a given bond, the quality of these data, in particular in the time-series dimension, is likely to be imperfect. To minimize the impact of such potential inaccuracies on our measures of interest, we apply filters (in addition to those that we also apply in case of the main sample). For example, we drop observations for which market-based debt exceeds total leverage as reported in Compustat.

Panels A and B of Figure 2 show the dynamics of private and market debt over the business cycle. Consistent with our main results, we observe pronounced counter-cyclical dynamics for private debt that are driven by firms with overall counter-cyclical leverage dynamics. In the case of market debt, we find an overall decreasing pattern in event-time. In the case of firms with counter-cyclical leverage dynamics, however, market debt also increases during recessions but to a much smaller extent than private debt. In the case of firms that reduce leverage during recessions, market debt shows a pronounced decrease during recessions, dropping from slightly below 13% to slightly above 9% of total assets.

Next, we use these measures of private and market debt as dependent variables in the multivariate empirical framework introduced before. Panel A of Table 5 summarizes the corresponding results. The unconditional effects (i.e., the coefficients of the *rec* dummy) are qualitatively the same as those derived before — a positive (negative) coefficient is found for private (market) debt but these coefficient estimates are not statistically significant. Considering the two sub-samples of firms, we find pronounced and significant differences for private debt but much smaller and statistically insignificant effects for market debt.

The table also shows how model-implied target levels vary over the business cycle. We find that both market debt as well as private debt increase during recessions by around 1 percentage point for the "all firms"sample. This is different from our earlier finding based on the Capital IQ data in which we documented a decrease of target market debt during recessions of 80 bps (see Table 3). Both of these effects, however, are small in economic terms and the difference observed across samples could be due to measurement error in the long time-series market debt variable. Remarkably, however, once we condition on leverage dynamics, the business-cycle dynamics of model-implied private debt and market debt become qualitatively and, to a large extent, also quantitatively very similar.

The same also holds for debt concentration, as is shown in Panel B of Table 5. In the case of the extended sample, we find that target debt concentration drops during recessions for the average firm by 2.4 percentage points. This effect is driven by firms that tend to increase their leverage during recessions, as their model-implied debt concentration drops by 6 percentage points. In contrast, firms with pro-cyclical leverage dynamics move towards more concentrated debt structures during recessions increasing their debt concentration by almost 3 percentage points.

To conclude, the results reported in this section are consistent with our earlier empirical findings and with the predictions of the theoretical model. This indicates that our empirical results regarding debt structure dynamics are not only a result of the specific recessions covered in the main sample period.

6 Debt Structure Transitions: A Cluster Analysis

This section corroborates the findings on debt dynamics by analyzing transitions between debt structure clusters and how they are affected by the business cycle. The key advantage of cluster analysis is that it analyzes multiple variables (i.e., different sources of debt in our context) jointly and that it discretizes the outcome space into a limited number of commonly-chosen debt structures. This allows us to shed light on how these debt structure choices vary with the macro economy.

6.1 Empirical Methodology

More specifically, cluster analysis relies on the minimization of the variance within clusters (in terms of the Euclidean distance of a firm-year or firm-quarter observation from the center of its own cluster) and the maximization of the variance between clusters (in terms of the Euclidean distance of a firm-year or firm-quarter observation from the center of other clusters).[23] It is based on the five primary debt sources (sbn, tl, dc, sub, and cp) as well as $others$, all scaled by total debt.

The cluster analysis yields the following seven clusters: firms that use (i) only senior bonds and notes (SBN), (ii) only term loans (TL), (iii) only drawn credit (DC), (iv) a combination of term loans and drawn credit (TL+DC), (v) a combination of senior bonds and term loans (SBN+TL), (vi) a combination of senior bonds and drawn credit (SBN+DC), and finally (vii) a residual group of firms with debt structures that use almost all individual debt types (SUB+3). In order to make the cluster analysis comparable to our earlier empirical analysis and to link it to the theoretical framework, we further aggregate these seven clusters into the following three: (a) firms with a concentrated debt structure using only senior bonds and notes (SBN), (b) firms with a concentrated debt structure using only private debt (TLDC), and (c) firms using a diversified debt structure (MIX).[24]

Table 6 provides summary statistics for the three clusters. The most popular debt structure is found in about 45% of all observations and relies predominantly on private debt (TLDC), either

[23]We use the STATA command *cluster kmeans* to run the cluster analysis. We estimate up to 15 clusters and identify seven clusters as the "optimal" number of clusters using the Calinski-Harabasz index as a stopping rule.

[24]To be precise, cluster TLDC combines firms in clusters TL, DC and TL+DC. Cluster MIX combines firms in clusters SBN+TL, SBN+DC and SUB+3.

term loans or drawn credit. On average, 96% of total debt of firms in this cluster comes from private debt sources and their average debt concentration is 88%. Firms in the TLDC-cluster tend to be small, have low profitability, a small fraction of tangible assets, and are neither likely to pay dividends nor to be rated. Almost 33% of firm year observations fall within the cluster of firms that use predominantly senior bonds and notes (SBN). By construction, their debt concentration is high with 86%. These firms look very different from those relying mostly on private debt. They are larger, have high market to book ratios, pay dividends frequently and are rated often. Finally, the MIX cluster is the least popular cluster with 23% of the firm year observations being assigned to that cluster. An average HHI of 26% shows the diversified nature of the debt structures in that cluster. In terms of firm characteristics, firms in this cluster seem to be somewhat in the middle between firms in concentrated clusters with the exception that these firms are substantially more profitable and more levered, on average.

6.2 Cluster Transitions over the Business Cycle

To shed more light on how individual firms move between debt clusters over the business cycle, we next calculate a transition matrix which contains the probabilities with which firms in a particular cluster before the onset of a recession[25] switch to another cluster during a recession. Panel A of Table 7 shows the resulting matrix. As one would expect, most firms remain within their pre-recession cluster but firms in the TLDC cluster show an especially high probability, namely 91%, of continuing with this debt structure during the recession. In contrast, only 77% (72%) of firms in cluster SBN (MIX) keep their debt structure in the recession.

Remarkably, the next most popular transition when entering a recession is that firms in cluster SBN switch to cluster MIX, which occurs with 15.0% probability, followed by firms in cluster MIX during the pre-recession period transitioning to cluster TLDC during recessions (14.4%). While in the first case debt concentration decreases during recessions, it increases in the latter case. When viewed through the lens of the model, these transitions match several empirical predictions of the model. Firms switching from cluster SBN to cluster MIX are consistent with Prediction 1, as some "strong"firms that were able to fund themselves almost exclusively via market debt in the pre-recession period add private debt during recessions, since their cash-flow prospects are negatively affected by the recession. By doing so, they exhibit pro-cyclical debt concentration dynamics (see Prediction 2). Similarly, firms that use a mix of private and market debt during expansions (i.e., "average"firms in cluster MIX) tend to move towards more concentrated debt structures (i.e., cluster TLDC) during recessions (see Prediction 3).

While these simple transition results are in line with the predictions from the theoretical model, two important questions remain to be addressed. First, it is not clear whether the transition prob-

[25]To determine a firm's debt cluster, e.g., SBN, in the pre-recession period, we use the *time-series mode* of its cluster assignments during pre-recession years to ensure that we assign the most frequent cluster to the firm. However, this does not necessarily mean that the firm is in this cluster during all pre-recession years.

abilities just discussed are different from average transition probabilities during normal times. Second, transition probabilities may, at least partly, be driven by changes in firm characteristics, rather than the business cycle variation. To address these questions, we complement the analysis with results from multinomial logit regressions which predict individual transition events. Multinomial logit models represent generalizations of traditional logit models in which the dependent variable can take on more than two possible outcomes. We distinguish three models in Panel B of Table 7. In Model (1), for example, we condition on all firms that are in cluster SBN in the previous period. The dependent variable can then take on three values: $DV = 0$ indicates that a given firm remains in cluster SBN (i.e., the base group), $DV = 1$ indicates that the firm switches to cluster MIX, and $DV = 2$ indicates that the firm switches to cluster TLDC. Independent variables are (i) a recession dummy, and (ii) the same set of firm characteristics as used before. Model (2) follows the same structure but analyzes firms that belong to the MIX cluster when entering a new period, while Model (3) focuses on firms that enter a period belonging to the TLDC cluster. The main motivation for this empirical setup is to condition on a firm's cluster before the analyzed period to ensure that we compare apples to apples when studying drivers of transitions.

Panel B of Table 7 shows the corresponding results. Focusing on Model (1), we find positive and highly significant coefficients on the REC dummy for both transitions, from cluster SBN to MIX and from cluster SBN to TLDC, indicating that these transitions become significantly more frequent during recessions, as our model would predict. In relative terms, the transition from cluster SBN to MIX (SBN to TLDC) becomes almost 54% (80%) more likely during a recession than during normal times. When considering individual firm characteristics, a consistent picture emerges: large firms with tangible assets, cash holdings and current ratings tend to remain in the SBN cluster and show significantly smaller probabilities of transitioning. These firms could be described as being most resilient to financial crises.

Inspecting the results for the other models in Panel B reveals that the only other significant coefficient of the REC dummy is for the transition from the MIX to the TLDC cluster, which we already discussed in some detail above. This result is consistent with the model predictions for "average"firms that rely on diversified debt structures during normal times but concentrate on private debt once they are hit by a business cycle shock. Coefficient estimates of firm characteristics suggest that the stronger of those "average"firms — being larger, having more tangible assets, more cash and featuring credit ratings — exhibit lower probabilities of switching to the TLDC cluster, again consistent with the model.

In all other regression specifications, the coefficients of the REC dummy are insignificant as are most coefficients on individual firm characteristics. This lack of empirical evidence is not too surprising, as these transitions happen much less frequently (see Panel A of Table 7) and are not easily reconciled with our economic framework.

The next step of the analysis is to provide the characteristics of the firms that choose a specific transition when moving into a recession. Note that Panel B of Table 7 provides evidence on the impact of firm characteristics on transitions independent from the business cycle. Adding interaction terms between the REC dummy and firm characteristics could tackle this issue but is econometrically challenging given the multinomial logit setup. Thus, Panel C of Table 7 follows a simpler empirical strategy and reports percentage changes in firm characteristics for groups of firms performing specific transitions.

For brevity, we focus again on the characteristics of firms transitioning from (i) cluster SBN to MIX, (ii) from cluster SBN to TLDC, and (iii) from cluster MIX to TLDC when entering a recession, since these transitions conform most closely to the model predictions and have also received most empirical support in earlier analyses. We hereby compare the average change in characteristics for transitioning firms to the ones of firms in the same pre-recession cluster that are not switching. Significance levels are related to those differences.

For the three transitions of interest we find a coherent picture that is consistent with the model predictions. Firms performing one of those transitions suffer from significantly more negative MTB and cash shocks entering into recessions. For example, while the negative MTB shock of firms in cluster SBN that remain in that cluster during recessions amounts to -15%, it is equal to approximately -24% (-35%) for firms transitioning from the SBN cluster to the MIX (TLDC) cluster in recessions. Thus, as predicted by the model, those firms that are more negatively affected by the business cycle shock, as captured by the drop in market valuations relative to book values, end up diversifying their debt structure, which is concentrated in market debt during expansions, by adding private debt during recessions.

Finally, Panel D of Table 7 investigates in more detail how firms actually implement debt structure transitions and what the consequences are for total leverage. Specifically, we define variables that capture the frequency of firms increasing total leverage or an individual debt type where we count as debt increases situations in which a given firm raises a debt type by more than 5% of lagged total debt. Remarkably, more than 78% of the firms that transition from cluster SBN pre-recession to cluster MIX in the recession increase their leverage in the process. This is a significantly larger fraction than the one we observe for firms that remain in cluster SBN over the business cycle (only 40% of those firms increase total debt). This result is consistent with the theoretical model that predicts that these firms simultaneously change their debt structure and increase leverage to fund investments. In absolute terms, these firms increase their book leverage by almost 6 percentage points relative to total assets, which is an economically large effect, especially during recessions. These results also dovetail nicely with the earlier results on the dynamics of private debt and its interaction with leverage cyclicality.

It is also interesting to observe that among the firms that transition from cluster SBN to MIX, almost 60% use Drawn Credit to do so. This confirms recent findings which indicate that credit lines provide important sources of liquidity and short-term funding during crises (see, for example, Li et al. (2020), Greenwald et al. (2021) and Acharya et al. (2021)). Interestingly, however, 36% of the firms transitioning from SBN to MIX significantly increase their term loans during recessions.

Thus, drawn credit lines are not the exclusive path towards a diversified debt structure that firms pursue when entering a recession. We observe similar patterns for firms transitioning from cluster SBN to TLDC and from cluster MIX to TLDC. In those latter cases, the fraction of firms relying on term loans during the transition even exceeds those relying on Drawn Credit. This indicates that "strong"and "average"firms that rely either exclusively or, at least to some extent, on market debt during expansions also have access to private debt via term loans during recessions.

7 Conclusion

This paper documents that U.S. public firms increase their target ratios of private debt to total assets during recessions, but that the opposite is the case for public debt. These dynamics imply that debt concentration moves pro-cyclically for the average firm, i.e. it spreads its borrowing more evenly across private and public debt in recession periods. However, there is substantial cross-sectional variation, implying that firms' debt funding strategies diverge sharply during recessions. Approximately 40% of firms concentrate their borrowing more in private debt and decrease leverage, while the remaining 60% increase their leverage and diversify by augmenting their public debt with private debt. The latter firms tend to be larger, more profitable, pay dividends, and to have a rating, fewer growth options and lower cash levels. The former firms have exactly the opposite characteristics, consistent with the view that it may become very unattractive or expensive for them to access public debt markets in recessions. The predictions from our model of firms' investment and financing choices, where private debt is more expensive but offers flexibility to restructure, accord well with these findings.

We provide further evidence on the sources of the debt concentration and debt structure dynamics by performing a cluster analysis. Firms in the private debt cluster almost never switch out of this cluster when entering a recession. By contrast, firms in the public debt cluster exhibit a substantially higher probability of switching to another debt cluster, either MIX (i.e., a combination of public and private debt) or private debt only, in a recession. Multinomial logit models shed light on the underlying firm characteristics and, consistent with the model predictions, reveal that "strong" firms that are resilient to business cycle shocks tend to remain in the public debt cluster and exhibit significantly smaller transition probabilities.

In summary, the analysis of the dynamics of corporate debt composition appears to be a fruitful avenue to enhance our understanding of corporate capital structure decisions. Our paper represents a first step, but several extensions appear possible. For example, while we have focused on the various sources of private versus public corporate debt, there are other dimensions of debt structure, such as convertibility, seniority, or maturity. Also, there are other potential tradeoffs that may determine debt structure choices, such as the commitment to make future payments to debtholders, possibly generating additional testable predictions for the behavior of corporate debt structures. Finally, it would be interesting to compare debt structure dynamics in countries with different institutional environments. International evidence would also increase the number of recessions in the analysis and could be exploited to study the importance of supply-side effects.

Appendix A

Our main data sources are Compustat, Capital IQ and the National Bureau of Economic Research's (NBER) business cycle dates. This appendix presents definitions of the variables used in the empirical analysis (see Table A1).

Table A1 Variable Definitions

Variables (Acronyms)	Definition
Firm characteristics	
Total Assets (*at*)	The book value of total assets
Sales (*size*)	The natural logarithm of net sales (in 2002 USD)
Market to book ratio (*mtb*)	The market value of total assets to the book value of total assets ratio
Profitability (*profit*)	The operating income before depreciation to total assets (book value) ratio
Tangibility (*tang*)	The net PPE to total assets (book value) ratio
Capital expenditures (*capx*)	The capital expenditures to total assets (book value) ratio
Cash (*cash*)	The cash and short-term investments to total assets (book value) ratio
Dividend payer (*divpayer*)	A dummy variable equals one if payout is greater than zero; and zero otherwise
Rated (*rated*)	A dummy variable equals one if a firm is rated (in any month of a quarter); and zero otherwise
Debt structure variables	
Term loans (*tl*)	Term loans
Drawn credit line (*dc*)	Drawn credit line
Senior bonds and notes (*sbn*)	Senior bonds and notes
Subordinated bonds and notes (*sub*)	Subordinated bonds and notes
Commercial paper (*cp*)	Commercial paper
Other debt and total trust-preferred stock (*others*)	Other debt and total trust-preferred stock
Private debt (*pd*)	Sum of term loans and drawn credit line
Market debt (*md*)	Sum of senior and subordinated bonds and notes and commercial paper
Debt concentration (HHI)	A normalized Herfindahl-Hirschman Index of debt concentration (Colla, Ippolito, and Li, 2013)
Excl90 ($Exl90$)	A dummy variable equals one if a firm obtains at least 90% of its debt from one debt type; and zero otherwise
Debt variables	
Total debt (*ttd*)	Short term debt plus long term debt
Book leverage (*bl*)	The total debt to total assets (book value ratio
Market leverage (*ml*)	The total debt to total assets (market value) ratio
Business cycle dummies	
Recession (*rec*)	A recession dummy defined based on NBER business cycle dates
Expansion (*exp*)	A dummy variable equals one less rec

Appendix B

This appendix solves for the equityholders' optimal debt-structure choice. To facilitate this, we first derive two critical profitability cutoffs, Z_M and Z_I. The former denotes the critical profitability level such that a firm with $Z_f \geq Z_M$ can fund the intermediate investment by issuing riskless debt, whereas Z_I is defined such that firms with $Z_f < Z_I$ do not find it optimal to invest. Thus, Z_M is defined by the condition that, upon investment, the available cash flow after repaying senior debt claims in the bad state just covers the cost of the investment, ΔA:

$$\Delta CF(Z_M) \equiv (A_0 + \Delta A)Z_M - F_0 = \Delta A, \tag{6}$$

where $F_0 = A_0\ L_{\min}$. Solving yields

$$Z_M = \frac{F_0 + \Delta A}{A_0 + \Delta A} \tag{7}$$

To derive the second critical profitability level, Z_I, we conjecture that firms issue the maximum amount of riskless public debt and fund the rest of the investment cost with private debt. We will then show below that this conjecture actually holds in equilibrium. Note that the maximum amount of riskless public debt that can be issued is

$$(A_0 + \Delta A)Z_I - F_0.$$

Hence, the remaining amount of the intermediate investment, i.e.

$$\Delta A - [(A_0 + \Delta A)Z_I - F_0]$$

is conjectured to be funded by private debt, which must earn an expected rate of return of ρ. Also note that the investment generates expected incremental cash flows equal to

$$\Delta A \frac{H + Z_I}{2}.$$

Hence, the project's NPV for equityholders is

$$NPV = \Delta A \frac{H + Z_I}{2} - [(A_0 + \Delta A)Z_I - F_0] - (1 + \rho)[\Delta A - [(A_0 + \Delta A)Z_I - F_0]]. \tag{8}$$

Solving for Z_I by setting the NPV to zero yields

$$Z_I = \frac{(2 - H)\Delta A + 2\rho(\Delta A + F_0)}{\Delta A + 2\rho(\Delta A + A_0)}. \tag{9}$$

Having defined these two critical profitability levels, we can now turn to firms' debt structure choices.

Strong Firms: $Z_f \geq Z_M$

We first consider firms, for which $Z_f \geq Z_M$. In this case the firm can fully fund its project with risk-free debt without incurring any bankruptcy costs. Equityholders' optimal debt structure problem is

$$\max_{F_P, F_M} E = V_0(Z_f) + \frac{\Delta A}{2}(H + Z_f) - F_P - F_M \tag{10}$$

subject to

$$D_M = F_M,$$
$$D_P = \frac{1}{1+\rho} F_P,$$
$$D_P + D_M = \Delta A$$

where D_M and D_P denote the values of market and private debt, respectively, and $V_0(Z_f)$ is the equity value without the investment:

$$V_0(Z_f) = A_0 \frac{H + Z_f}{2} - F_0.$$

Put together, the above three constraints imply that

$$F_M + \frac{1}{1+\rho} F_P = \Delta A.$$

Solving for F_M and taking its partial derivative w.r.t. F_P yields

$$\frac{\partial F_M}{\partial F_P} = -\frac{1}{1+\rho} < 0.$$

As a result, the partial derivative of equity value w.r.t. F_P is

$$\frac{\partial E}{\partial F_P} = -\frac{\partial F_M}{\partial F_P} - 1 = \frac{-\rho}{1+\rho} < 0.$$

Intuitively, private debt incurs a financial intermediation cost, captured by private lenders' higher discount rate $\rho > 0$. Thus, it is optimal for the firm to issue only market debt, that is, $F_P = 0$ and $F_M = \Delta A$.

Under the optimal debt structure, the equity value attains the first-best outcome:

$$E = V_0(Z_f) + NPV^*(Z_f). \tag{11}$$

where $NPV^*(Z_f)$ denotes the investment project's NPV in the absence of any frictions, i.e. when debtholders do not charge any costs of financial intermediation and the firm does not incur any bankruptcy costs.

Average Firms: $Z_I \leq Z_f < Z_M$

Firms for which $Z_I \leq Z_f < Z_M$ find it optimal to invest, but cannot fully fund the project with risk-free debt. We first derive the value of equity for the case in which the firm funds its project with market debt only and subsequently the case where it uses a mix of market and private debt. We will also show that issuing only private debt is a dominated strategy.

All Market Debt Financing

Without private debt, default occurs when the project fails and cash flows to investors are zero due to bankruptcy costs. The firm's balance sheet and payoffs to equity holders and new market debt holders are given by

	Success state	Failure ($Z_f = M$ or L)
Total assets	$(A_0 + \Delta A)H$	$(A_0 + \Delta A)Z_f$
Secured (private) debt	F_0	F_0
New market debt	F_M	0
Equity	$(A_0 + \Delta A)H - F_0 - F_M$	0

The firm's capital structure problem is

$$\max_{F_M} E = \frac{1}{2}((A_0 + \Delta A)H - F_0 - F_M) \tag{12}$$

subject to

$$D_P = \frac{1}{2}F_M = \Delta A.$$

The equity value becomes

$$\begin{aligned} E &= \frac{1}{2}((A_0 + \Delta A)H - F_0 - 2\Delta A) \\ &= \frac{1}{2}A_0(H + Z_f) - F_0 + \Delta A\left(\frac{1}{2}(H + Z_f) - 1\right) - \frac{1}{2}\left((A_0 + \Delta A)Z_f - F_0\right) \\ &= V_0(Z_f) + NPV^*(Z_f) - \frac{1}{2}\Delta CF(Z_f). \end{aligned} \tag{13}$$

In short, using only market debt financing, the equity value is equal to its first-best value (see equation (11)) less the expected bankruptcy costs $\frac{1}{2}\Delta CF(Z_f)$.

Mix of Market and Private Debt

A mix of market and private debt can only be optimal, if this leads to restructuring in the failure state. Otherwise all market debt would dominate. The firm's balance sheet and payoffs to equity holders and new private and market debt holders are given by

	Success state	Failure ($Z_f = M$ or L)
Total assets	$(A_0 + \Delta A)H$	$(A_0 + \Delta A)Z_f$
Secured private debt	F_0	F_0
New market debt	F_M	F_M
New private debt	F_P	$(A_0 + \Delta A)Z_f - F_0 - F_M$
Equity	$(A_0 + \Delta A)H - F_0 - F_P - F_M$	0

Equityholders' optimal debt structure problem is

$$\max_{F_P, F_M} E = \frac{1}{2}((A_0 + \Delta A)H - F_0 - F_P - F_M) \tag{14}$$

subject to

$$\begin{aligned}
&D_M = F_M, \\
&D_P = \frac{1}{2(1+\rho)}(F_P + \Delta CF(Z_f) - F_M), \\
&D_P + D_B = \Delta A, \\
&\Delta CF(Z_f) - F_M \geq 0
\end{aligned}$$

where the final inequality is an incentive compatibility constraint ensuring that the private lender is weakly better off with debt relief.

Substituting for D_P and D_M from the equations above this yields

$$\Delta A = F_M + \frac{(F_P + \Delta CF(Z_f) - F_M)}{2(1+\rho)}. \tag{15}$$

Solving for F_M gives

$$F_M = \frac{\Delta A - \frac{1}{2(1+\rho)}(F_P + \Delta CF(Z_f))}{1 - \frac{1}{2(1+\rho)}}. \tag{16}$$

The partial derivative of F_M w.r.t. F_P is given by

$$\frac{\partial F_M}{\partial F_P} = \frac{-1}{1+2\rho} < 0. \tag{17}$$

Thus, private and market debt are substitutes for financing investment. However, due to (i) the cost of financial intermediation and (ii) private lenders' loss from providing debt relief, a one-unit decrease in F_M must be compensated by a $(1+2\rho)$-units increase in F_P.
As the value of equity is

$$E = \frac{1}{2}(A_0 + \Delta A)H - F_0 - F_P - F_M), \tag{18}$$

the partial derivative of equity value w.r.t. private debt is given by

$$\frac{\partial E}{\partial F_P} = -\frac{1}{2}\left(1 + \frac{\partial F_M}{\partial F_P}\right) = \frac{-\rho}{1+2\rho} < 0. \tag{19}$$

Thus, it is always optimal to issue as little private debt as possible, given the conjecture of sufficient debt relief in the bad state by the private lenders such that the new market debt can be fully repaid.[26] However, for debt forgiveness to happen, the incentive compatibility constraint must hold. Substituting for F_M in the constraint yields

$$\Delta CF(Z_f) - \frac{\Delta A - \frac{1}{2(1+\rho)}(F_P + \Delta CF(Z_f))}{1 - \frac{1}{2(1+\rho)}} \geq 0$$

or

$$F_P \geq 2(1+\rho)(\Delta A - \Delta CF(Z_f)). \tag{20}$$

Since equity value decreases in F_P, the above condition holds as an equality at the optimum. The optimal face values are

$$F_P = 2(1+\rho)(\Delta A - \Delta CF(Z_f)), \quad F_M = \Delta CF(Z_f). \tag{21}$$

With the optimal face values, the equity value is

$$\begin{aligned}
E &= \frac{1}{2}\left((A_0 + A)H - F_0 - \underbrace{\Delta CF(Z_f)}_{=F_M} - \underbrace{2(1+\rho)\left(\Delta A - \Delta CF(Z_f)\right)}_{F_P}\right) \\
&= \frac{1}{2}A_0(H + Z_f) - F_0 + \Delta A\left(\frac{1}{2}(H + Z_f) - 1\right) - \rho\left(\Delta A - \Delta CF(Z_f)\right) \\
&= V_0(Z_f) + NPV(Z_f) \\
&= V_0(Z_f) + NPV^*(Z_f) - \rho\left(\Delta A - \Delta CF(Z_f)\right).
\end{aligned} \tag{22}$$

That is, the equity value is equal to its first best value less the financial intermediation cost of private debt $\rho\left(\Delta A - \Delta CF(Z_f)\right)$. It is easy to show that for sufficiently low costs of financial intermediation such that $\rho < \frac{\Delta CF(L)}{2(\Delta A - \Delta CF(L))}$ $\forall L$, equity value under pure market debt as given by equation (13) is always less than the resulting equity value under a mix of market and private debt, as given by equation (22). For the remainder of this analysis we assume that this condition holds.

Weak Firms: $Z_f < Z_I$

Recall that Z_I is the critical profitability level that makes the project's NPV just equal to zero. Since $NPV(Z_f)$ in equation (22) is continuous and monotonically increasing in Z_f, it follows that firms with $Z_f < Z_I$ do not find it optimal to invest whereas those with $Z_f \geq Z_I$ do. Thus, weak firms do not invest and do not issue private or public debt.

This completes our proof of Proposition 1.

[26] Note that $\lim_{\rho \to 0} \frac{\partial E}{\partial F_P} = 0$. That is, as the cost of financial intermediation becomes zero, the firm is indifferent between private debt and market debt, given that restructuring takes place.

References

Acharya, V. V., Engle, R., Steffen, S., 2021. Why did bank stocks crash during covid-19?, working paper.

Acharya, V. V., Steffen, S., 2020. The Risk of Being a Fallen Angel and the Corporate Dash for Cash in the Midst of COVID. The Review of Corporate Finance Studies 9, 430–471.

Barclay, M. J., Smith, Clifford W., J., 1995. The maturity structure of corporate debt. The Journal of Finance 50, 609–631.

Becker, B., Benmelech, E., 2021. The resilience of the u.s. corporate bond market during financial crises, working paper.

Becker, B., Ivashina, V., 2014. Cyclicality of credit supply: Firm level evidence. Journal of Monetary Economics 62, 76 – 93.

Bergloef, E., von Thadden, E.-L., 1994. Short-term versus long-term interests: Capital structure with multiple investors. The Quarterly Journal of Economics 109, 1055–1084.

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

Bolton, P., Freixas, X., 2000. Equity, bonds, and bank debt: Capital structure and financial market equilibrium under asymmetric information. Journal of Political Economy 108, 324–351.

Bolton, P., Scharfstein, D. S., 1996. Optimal debt structure and the number of creditors. Journal of Political Economy 104, 1–25.

Chemmanur, T., Fulghieri, P., 1994. Reputation, renegotiation, and the choice between bank loans and publicly traded debt. The Review of Financial Studies 7, 475–506.

Colla, P., Ippolito, F., Li, K., 2013. Debt specialization. Journal of Finance 68, 2117–2141.

Crouzet, N., 2017. Aggregate Implications of Corporate Debt Choices. The Review of Economic Studies 85, 1635–1682.

Crouzet, N., 2021. Credit Disintermediation and Monetary Policy. IMF Economic Review 69, 23–89.

De Fiore, F., Uhlig, H., 2015. Corporate debt structure and the financial crisis. Journal of Money, Credit and Banking 47, 1571–1598.

Diamond, D. W., 1991. Monitoring and reputation: The choice between bank loans and directly placed debt. Journal of Political Economy 99, 689–721.

Donaldson, J. R., Gromb, D., Piacentino, G., 2019. Conflicting priorities: A theory of covenants and collateral, working Paper.

Faulkender, M., Petersen, M. A., 2006. Does the source of capital affect capital structure? Review of Financial Studies 19, 45–79.

Fischer, E. O., Heinkel, R., Zechner, J., 1989. Dynamic capital structure choice: Theory and tests. The Journal of Finance 44, 19–40.

Frank, M. Z., Goyal, V. K., 2009. Capital structure decisions: Which factors are reliably important? Financial Management 38, 1–37.

Giroud, X., Mueller, H. M., 2017. Firm Leverage, Consumer Demand, and Employment Losses During the Great Recession. The Quarterly Journal of Economics 132, 271–316.

Graham, J. R., Leary, M. T., Roberts, M. R., 2015. A century of capital structure: The leveraging of corporate america. Journal of Financial Economics 118, 658–683.

Greenwald, D. L., Krainer, J., Paul, P., 2021. The credit line channel, working paper.

Hackbarth, D., Hennessy, C. A., Leland, H. E., 2007. Can the trade-off theory explain debt structure? Review of Financial Studies 20, 1389–1428.

Hackbarth, D., Mauer, D. C., 2011. Optimal Priority Structure, Capital Structure, and Investment. The Review of Financial Studies 25, 747–796.

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

Halling, M., Yu, J., Zechner, J., 2016. Leverage dynamics over the business cycle. Journal of Financial Economics 122, 21–41.

Halling, M., Yu, J., Zechner, J., 2020. Primary corporate bond markets and social responsibility, working Paper.

Hart, O., Moore, J., 1994. A Theory of Debt Based on the Inalienability of Human Capital. The Quarterly Journal of Economics 109, 841–879.

Heinkel, R., Zechner, J., 1990. The role of debt and perferred stock as a solution to adverse investment incentives. Journal of Financial and Quantitative Analysis 25, 1–24.

Holmstrom, B., Tirole, J., 1997. Financial intermediation, loanable funds, and the real sector. The Quarterly Journal of Economics 112, 663–691.

Hovakimian, A., Hovakimian, G., Tehranian, H., 2004. Determinants of target capital structure: The case of dual debt and equity issues. Journal of Financial Economics 71, 517–540.

Hovakimian, A., Opler, T., Titman, S., 2001. The debt-equity choice. The Journal of Financial and Quantitative Analysis 36, 1–24.

Ivashina, V., Scharfstein, D., 2010. Bank lending during the financial crisis of 2008. Journal of Financial Economics 97, 319 – 338.

John, K., Kaviani, M. S., Kryzanowski, L., Maleki, H., 2021. Do country-level creditor protections affect firm-level debt concentration? Review of Finance 25 (6), 1677–1725.

Johnson, S. A., 1997. An empirical analysis of the determinants of corporate debt ownership structure. Journal of Financial and Quantitative Analysis 32, 47–69.

Kiyotaki, N., Moore, J., 1997. Credit cycles. The Journal of Political Economy 105, 211–248.

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

Korteweg, A., Schwert, M., Strebulaev, I. A., 2020. Proactive capital structure adjustments: Evidence from corporate filings, working Paper, forthcoming in the Journal of Financial and Quantitative Analysis.

Leary, M. T., Roberts, M. R., 2005. Do firms rebalance their capital structures? The Journal of Finance 60, 2575–2619.

Li, L., Strahan, P. E., Zhang, S., 2020. Banks as Lenders of First Resort: Evidence from the COVID-19 Crisis. The Review of Corporate Finance Studies 9, 472–500.

Mian, A., Rao, K., Sufi, A., 2013. Household Balance Sheets, Consumption, and the Economic Slump. The Quarterly Journal of Economics 128, 1687–1726.

Morellec, E., Valta, P., Zhdanov, A., 2015. Financing investment: The choice between bonds and bank loans. Management Science 61, 2580–2602.

Park, C., 2000. Monitoring and structure of debt contracts. The Journal of Finance 55, 2157–2195.

Rajan, R. G., 1992. Insiders and outsiders: The choice between informed and arm's-length debt. The Journal of Finance 47, 1367–1400.

Rauh, J. D., Sufi, A., 2010. Capital structure and debt structure. Review of Financial Studies 23, 4242–4280.

Roberts, M. R., Sufi, A., 2009. Renegotiation of financial contracts: Evidence from private credit agreements. Journal of Financial Economics 93, 159–184.

Zhong, H., 2021. A dynamic model of optimal creditor dispersion. The Journal of Finance 76, 267–316.

Table 1 Stylized Facts: Corporate debt structure over the business cycle
This table reports summary statistics of debt variables for all firms (Panel A), firms with counter-cyclical leverage dynamics (Panel B), and firms with pro-cyclical leverage dynamics (Panel C). The basecase data represents a merged Compustat-Capital IQ sample of firm-quarters during the period 2001 to 2020. Reported statistics are based on an event window of four annual (i.e., four consecutive quarters and not calendar year) pre-recession periods and four annual post-recession periods. These annual observations are pooled as expansionary observations (*exp*). All observations during business cycle recessions are also pooled and labeled *rec*. The Data Section provides further details on the transformation of the quarterly data into annual event-time data. Variable definitions are summarized in Appendix A.

Panel A: All firms											
	exp & rec			*exp*			*rec*			*rec-exp*	
VARIABLES	mean	sd	N	mean	sd	N	mean	sd	N	mean	p-value
bl	0.289	0.203	30,546	0.284	0.201	24,808	0.308	0.212	5,738	0.024	0.00
ml	0.206	0.173	30,546	0.200	0.167	24,808	0.236	0.193	5,738	0.036	0.00
pd/at	0.134	0.158	30,546	0.131	0.157	24,808	0.146	0.165	5,738	0.015	0.00
md/at	0.141	0.172	30,546	0.143	0.172	24,808	0.136	0.174	5,738	-0.007	0.01
pd/(pd+md)	0.525	0.427	30,546	0.518	0.428	24,808	0.558	0.421	5,738	0.040	0.00
tl/at	0.077	0.134	30,546	0.076	0.133	24,808	0.082	0.138	5,738	0.006	0.00
dc/at	0.056	0.100	30,546	0.055	0.098	24,808	0.064	0.109	5,738	0.009	0.00
HHI	0.731	0.372	30,546	0.733	0.370	24,808	0.723	0.377	5,738	-0.010	0.07
Excl90	0.684	0.465	30,546	0.686	0.464	24,808	0.673	0.469	5,738	-0.013	0.05
Panel B: Firms with counter-cyclical leverage dynamics (*ccyc_bl* firms)											
	exp & rec			*exp*			*rec*			*rec-exp*	
VARIABLES	mean	sd	N	mean	sd	N	mean	sd	N	mean	p-value
bl	0.285	0.198	18,739	0.269	0.191	15,232	0.354	0.213	3,507	0.085	0.00
ml	0.205	0.170	18,739	0.190	0.160	15,232	0.270	0.195	3,507	0.080	0.00
pd/at	0.132	0.155	18,739	0.124	0.148	15,232	0.169	0.175	3,507	0.045	0.00
md/at	0.138	0.166	18,739	0.134	0.161	15,232	0.154	0.186	3,507	0.020	0.00
pd/(pd+md)	0.530	0.426	18,739	0.521	0.429	15,232	0.567	0.411	3,507	0.046	0.00
tl/at	0.074	0.129	18,739	0.070	0.124	15,232	0.094	0.148	3,507	0.024	0.00
dc/at	0.058	0.100	18,739	0.054	0.096	15,232	0.074	0.117	3,507	0.020	0.00
HHI	0.729	0.373	18,739	0.737	0.369	15,232	0.693	0.388	3,507	-0.044	0.00
Excl90	0.682	0.466	18,739	0.691	0.462	15,232	0.642	0.479	3,507	-0.049	0.00
Panel C: Firms with pro-cyclical leverage dynamics (*pcyc_bl* firms)											
	exp & rec			*exp*			*rec*			*rec-exp*	
VARIABLES	mean	sd	N	mean	sd	N	mean	sd	N	mean	p-value
bl	0.295	0.212	11,807	0.309	0.214	9,576	0.235	0.189	2,231	-0.074	0.00
ml	0.209	0.176	11,807	0.215	0.176	9,576	0.182	0.175	2,231	-0.033	0.00
pd/at	0.135	0.164	11,807	0.141	0.168	9,576	0.110	0.141	2,231	-0.031	0.00
md/at	0.147	0.181	11,807	0.157	0.187	9,576	0.108	0.148	2,231	-0.049	0.00
pd/(pd+md)	0.518	0.428	11,807	0.512	0.426	9,576	0.544	0.436	2,231	0.032	0.00
tl/at	0.082	0.142	11,807	0.086	0.147	9,576	0.063	0.118	2,231	-0.024	0.00
dc/at	0.054	0.100	11,807	0.055	0.102	9,576	0.048	0.092	2,231	-0.008	0.00
HHI	0.735	0.369	11,807	0.727	0.372	9,576	0.769	0.354	2,231	0.042	0.00
Excl90	0.687	0.464	11,807	0.678	0.467	9,576	0.722	0.448	2,231	0.044	0.00

Table 2 Firm characteristics

This table reports full sample means as well as differences in average firm characteristics between expansions and recessions in Panel A and differences in average firm characteristics between firms with counter-cyclical leverage dynamics (*ccyc_bl*) and those with pro-cyclical leverage dynamics (*pcyc_bl*) in Panel B. The basecase data represents a merged Compustat-Capital IQ sample of firm-quarters during the period 2001 to 2020. Reported statistics are based on an event window of four annual (i.e., four consecutive quarters and not calendar year) pre-recession periods and four annual post-recession periods. These annual observations are pooled as expansionary observations (*exp*). All observations during business cycle recessions are also pooled and labeled *rec*. The Data Section provides further details on the transformation of the quarterly data into annual event-time data. Variable definitions are summarized in Appendix A.

Panel A: Business cycle variations

	exp & *rec*			*exp*			*rec*			*rec-exp*	
VARIABLES	mean	sd	N	mean	sd	N	mean	sd	N	mean	p-value
size	4.493	2.291	30,546	4.551	2.274	24,808	4.238	2.346	5,738	-0.313	0.00
mtb	1.845	1.294	30,546	1.852	1.270	24,808	1.814	1.389	5,738	-0.038	0.06
profit	0.018	0.064	30,546	0.020	0.063	24,808	0.011	0.066	5,738	-0.009	0.00
tang	0.289	0.247	30,546	0.289	0.248	24,808	0.288	0.246	5,738	-0.001	0.88
capx	0.013	0.019	30,546	0.013	0.018	24,808	0.014	0.021	5,738	0.001	0.02
divpayer	0.334	0.472	30,546	0.343	0.475	24,808	0.295	0.456	5,738	-0.048	0.00
cash	0.141	0.177	30,546	0.139	0.174	24,808	0.152	0.192	5,738	0.013	0.00
rated	0.344	0.475	30,546	0.354	0.478	24,808	0.302	0.459	5,738	-0.052	0.00

Panel B: Different leverage dynamics

	ccyc_bl			*pcyc_bl*			*ccyc-pcyc*	
VARIABLES	mean	sd	N	mean	sd	N	mean	p-value
size	4.710	2.202	18,739	4.147	2.385	11,807	0.563	0.00
mtb	1.819	1.224	18,739	1.887	1.396	11,807	-0.068	0.00
profit	0.022	0.055	18,739	0.012	0.075	11,807	0.010	0.00
tang	0.289	0.243	18,739	0.288	0.254	11,807	0.001	0.78
capx	0.013	0.018	18,739	0.014	0.020	11,807	-0.001	0.00
divpayer	0.369	0.483	18,739	0.279	0.448	11,807	0.090	0.00
cash	0.131	0.165	18,739	0.158	0.194	11,807	-0.027	0.00
rated	0.360	0.480	18,739	0.320	0.467	11,807	0.040	0.00

Table 3 Multivariate regressions of market and private debt

This table presents multivariate regression results for firm fixed-effect panel models described in detail in Section 4. The sample consists of refinancing observations. The identification of refinancing observations is based on the merged Compustat-Capital IQ sample of firm-quarters during the period 2001 to 2020 and includes all periods in which either total leverage or any individual debt type exhibits a change of more than 5% of total assets. Target leverage dynamics are calculated using 4 annual pre- and post-recession observations. Regression models include a contemporaneous business cycle dummy (*rec*) and allow coefficients of lagged firm characteristics to vary over the business cycle (these coefficient estimates are not reported in the table for brevity). p-Values (in parentheses) are based on standard errors clustered at the firm level. Variable definitions are summarized in Appendix A. ****, **, * indicate significance at the 1%, 5%, and 10% level.*

Variables	*all firms* *md/at*	*ccyc_bl firms* *md/at*	*pcyc_bl firms* *md/at*	*all firms* *pd/at*	*ccyc_bl firms* *pd/at*	*pcyc_bl firms* *pd/at*
rec	-0.004	0.025**	-0.040***	0.018**	0.092***	-0.085***
	(0.617)	(0.010)	(0.001)	(0.019)	(0.000)	(0.000)
Firm char. & FEs	Yes	Yes	Yes	Yes	Yes	Yes
Observations	13,845	7,993	5,852	13,845	7,993	5,852
Number of firms	2,690	1,548	1,142	2,690	1,548	1,142
R-squared	0.196	0.198	0.182	0.056	0.091	0.037

Ev. window [-4, +4] Est. target ratios	*all firms* *tmd/at*	*ccyc_bl firms* *tmd/at*	*pcyc_bl firms* *tmd/at*	*all firms* *tpd/at*	*ccyc_bl firms* *tpd/at*	*pcyc_bl firms* *tpd/at*
rec & exp (1)	0.151	0.146	0.157	0.158	0.161	0.155
rec (2)	0.145	0.167	0.115	0.170	0.204	0.123
exp (3)	0.153	0.139	0.171	0.154	0.146	0.165
(2)-(3)	-0.008***	0.028***	-0.056***	0.015***	0.058***	-0.042***
p-value	0.000	0.000	0.000	0.000	0.000	0.000
((2)-(3))/(1)*100%	-5.31%	18.67%	-35.77%	9.78%	35.97%	-27.30%

Table 4 Multivariate regressions of debt concentration (HHI)

This table presents multivariate regression results for firm fixed-effect panel models described in detail in Section 4. The sample consists of refinancing observations. The identification of refinancing observations is based on the merged Compustat-Capital IQ sample of firm-quarters during the period 2001 to 2020 and includes all periods in which either total leverage or any individual debt type exhibits a change of more than 5% of total assets. Target leverage dynamics are calculated using 4 annual pre- and post-recession observations. Regression models include a contemporaneous business cycle dummy (*rec*) and allow coefficients of lagged firm characteristics to vary over the business cycle (these coefficient estimates are not reported in the table for brevity). *p*-Values (in parentheses) are based on standard errors clustered at the firm level. Variable definitions are summarized in Appendix A. ****, **, * indicate significance at the 1%, 5%, and 10% level.*

	all firms	*ccyc_bl firms*	*pcyc_bl firms*
Variables	*HHI*	*HHI*	*HHI*
rec	-0.036	-0.108***	0.049
	(0.130)	(0.001)	(0.188)
Firm char. & FEs	Yes	Yes	Yes
Observations	13,845	7,993	5,852
Number of firms	2,690	1,548	1,142
R-squared	0.096	0.097	0.094

Ev. window [-4, +4]	*all firms*	*ccyc_bl firms*	*pcyc_bl firms*
Est. target HHI	*tHHI*	*tHHI*	*tHHI*
rec & exp (1)	0.692	0.692	0.691
rec (2)	0.682	0.654	0.720
exp (3)	0.695	0.705	0.682
(2)-(3)	-0.013***	-0.051***	0.038***
p-value	0.000	0.000	0.000
((2)-(3))/(1)*100%	-1.94%	-7.37%	5.56%

Table 5 Multivariate regressions using long time series data

This table presents multivariate regression results for firm fixed-effect panel models described in detail in Section 4. The sample consists of refinancing observations. The identification of refinancing observations is based on the merged Compustat-Mergent sample of firm-quarters during the period 1980 to 2020 and includes all periods in which either total leverage or any individual debt type exhibits a change of more than 5% of total assets. Target leverage dynamics are calculated using 4 annual pre- and post-recession observations. Regression models include a contemporaneous business cycle dummy (*rec*) and allow coefficients of lagged firm characteristics to vary over the business cycle (these coefficient estimates are not reported in the table for brevity). p-Values (in parentheses) are based on standard errors clustered at the firm level. Variable definitions are summarized in Appendix A. ****, **, * indicate significance at the 1%, 5%, and 10% level.*

Panel A: Market and private debt regressions						
Variables	*all firms* *md/at*	*ccyc_bl firms* *md/at*	*pcyc_bl firms* *md/at*	*all firms* *pd/at*	*ccyc_bl firms* *pd/at*	*pcyc_bl firms* *pd/at*
rec	-0.014	-0.001	-0.020	0.004	0.096***	-0.106***
	(0.219)	(0.953)	(0.171)	(0.779)	(0.000)	(0.000)
Firm char. & FEs	Yes	Yes	Yes	Yes	Yes	Yes
Observations	18,864	11,411	7,453	18,864	11,411	7,453
Number of firms	1,421	834	587	1,421	834	587
R-squared	0.090	0.079	0.123	0.071	0.069	0.084

Ev. window [-4, +4] Est. target ratios	*all firms* *tmd/at*	*ccyc_bl firms* *tmd/at*	*pcyc_bl firms* *tmd/at*	*all firms* *tpd/at*	*ccyc_bl firms* *tpd/at*	*pcyc_bl firms* *tpd/at*
rec & exp (1)	0.105	0.107	0.104	0.251	0.252	0.251
rec (2)	0.115	0.137	0.083	0.257	0.296	0.200
exp (3)	0.103	0.101	0.108	0.250	0.243	0.261
(2)-(3)	0.012***	0.036***	-0.024***	0.006***	0.053***	-0.061***
p-value	0.000	0.000	0.000	0.000	0.000	0.000
((2)-(3))/(1)*100%	11.21%	34.01%	-23.65%	2.58%	20.86%	-24.47%

Panel B: HHI regressions			
Variables	*all firms* *HHI*	*ccyc_bl firms* *HHI*	*pcyc_bl firms* *HHI*
rec	0.018	-0.074	0.099**
	(0.578)	(0.120)	(0.027)
Firm char. & FEs	Yes	Yes	Yes
Observations	18,864	11,411	7,453
Number of firms	1,421	834	587
R-squared	0.282	0.282	0.284

Ev. window [-4, +4] Est. target HHI	*all firms* *tHHI*	*ccyc_bl firms* *tHHI*	*pcyc_bl firms* *tHHI*
rec & exp (1)	0.619	0.616	0.624
rec (2)	0.599	0.566	0.647
exp (3)	0.623	0.626	0.619
(2)-(3)	-0.024***	-0.060***	0.028***
p-value	0.000	0.000	0.001
((2)-(3))/(1)*100%	-3.91%	-9.69%	4.48%

Table 6 Three debt structure clusters

This table reports average debt ratios and firm characteristics for three debt structures. We follow Colla et al. (2013)'s method and obtain seven common debt structure clusters, which are either formed predominately by senior bonds and notes (SBN), term loans (TL), drawn credit (DC), or comprised of two debt sources (SBN+TL and SBN+DC), or even of subordinated and senior bonds and notes, term loans, and drawn credit (SUB+3). We then group these seven debt clusters into three debt structures: SBN, TLDC (TL, DC, TL+DC), and MIX (SBN+TL, SBN+DC, SUB+3). Variable definitions are summarized in Appendix A.

Debt structure	*Freq.*	*Percent*	*HHI*	*sbn/ttd*	*tl/ttd*	*dc/ttd*	*sub/ttd*	*cp/ttd*	*pd/(pd+md)*	*ml*	*bl*
SBN	9,888	32.37	0.860	0.938	0.022	0.021	0.006	0.011	0.043	0.187	0.283
TLDC	13,717	44.91	0.875	0.026	0.515	0.443	0.015	0.001	0.958	0.187	0.250
MIX	6,941	22.72	0.262	0.384	0.196	0.161	0.246	0.012	0.357	0.271	0.372
Total	30,546	100.00	0.731	0.403	0.283	0.242	0.064	0.007	0.525	0.206	0.289

Debt structure	*l_size*	*l_profit*	*l_mtb*	*l_tang*	*l_capx*	*l_divpayer*	*l_cash*	*l_rated*
SBN	5.234	0.018	1.981	0.303	0.014	0.466	0.161	0.553
TLDC	3.720	0.015	1.833	0.271	0.013	0.239	0.141	0.115
MIX	4.962	0.023	1.676	0.304	0.013	0.334	0.114	0.500
Total	4.493	0.018	1.845	0.289	0.013	0.334	0.141	0.344

Table 7 Transitions between debt structure clusters

This table has four panels. Panel A reports the transition matrix between three debt structure clusters from the pre-recession to the recession period. Panel B presents the results of multivariate multinomial logit regressions for transitions between debt structure clusters, conditioning on the lagged debt structure cluster. The dependent variables are categorical variables that indicate whether there is a transition from one debt structure to another. E.g., the estimation sample of Model (1) covers recession periods and three event-years prior to recession periods and includes firms with $l\_SBN = 1$. The base group is SBN2SBN that indicates a firm's debt structure is SBN in the current period and the period before (i.e., non-switching firms). The other two groups are SBN2MIX and SBN2TLDC (i.e., switching firms) that indicate a firm's debt structure is MIX and TLDC, respectively, in the current period and has been SBN in the period before. p-Values are reported in parentheses underneath coefficients. ****, **, * indicate conventional significance levels at the 1%, 5%, and 10% level.* Panel C reports average percentage change in firm characteristics of both non-switching and switching firms. For the two dummy variables - divpayer and rated - we report their average simple changes. Panel D shows the fraction of firms increasing an individual debt source. For both Panels C and D, we also test difference in means between a particular group of switching firms and the corresponding group of non-switching firms, e.g., SBN2MIX and SBN2TLC firms are, respectively, compared to SBN2SBN firms. ****, **, * next to the reported averages of switching firms indicate they are significantly different at the 1%, 5%, and 10% level from the average characteristics of non-switching firms.* Finally, TLDC2SBN is omitted in Panels C and D because its number of observations is too low (see Panel A). Variable definitions are summarized in Appendix A.

Panel A: Transition matrices						
lagged debt structure (cols)	SBN		TLDC		MIX	
debt structure (rows)	Freq.	Percent	Freq.	Percent	Freq.	Percent
SBN	880	77.19	44	2.77	98	13.59
TLDC	89	7.81	1,453	91.38	104	14.42
MIX	171	15.00	93	5.85	519	71.98
Total	1,140	100.00	1,590	100.00	721	100.00

Panel B: Multinomial logit regressions

	(1)		(2)		(3)	
	$l\_SBN = 1$		$l\_MIX = 1$		$l\_TLDC = 1$	
VARIABLES	SBN2MIX	SBN2TLDC	MIX2TLDC	MIX2SBN	TLDC2MIX	TLDC2SBN
rec	0.490***	0.647***	0.294**	-0.072	0.012	-0.171
	(0.000)	(0.000)	(0.026)	(0.571)	(0.927)	(0.337)
l_size	-0.084***	-0.220***	-0.186***	-0.008	0.062	-0.152***
	(0.003)	(0.000)	(0.000)	(0.857)	(0.152)	(0.003)
l_profit	-0.238	1.955	1.632	1.797	-0.937	0.814
	(0.790)	(0.103)	(0.310)	(0.283)	(0.413)	(0.610)
l_mtb	-0.141***	0.009	0.018	0.135***	0.030	0.126***
	(0.007)	(0.860)	(0.766)	(0.003)	(0.550)	(0.009)
l_tang	-0.737***	-1.352***	-0.562*	0.210	-0.582*	-0.109
	(0.002)	(0.000)	(0.065)	(0.457)	(0.065)	(0.815)
l_capx	13.575***	12.772***	6.883*	3.967	11.946***	4.860
	(0.000)	(0.000)	(0.074)	(0.315)	(0.000)	(0.311)
l_divpayer	-0.063	-0.359*	-0.433***	0.197*	-0.140	-0.069
	(0.582)	(0.055)	(0.004)	(0.086)	(0.287)	(0.723)
l_cash	-3.358***	-2.210***	-2.307***	0.744*	-1.299**	0.440
	(0.000)	(0.000)	(0.000)	(0.055)	(0.015)	(0.381)
l_rated	-0.417***	-1.690***	-0.565***	-0.064	1.018***	0.915***
	(0.001)	(0.000)	(0.000)	(0.608)	(0.000)	(0.000)
Constant	-0.637***	-0.702***	-0.383*	-2.069***	-3.053***	-3.282***
	(0.001)	(0.001)	(0.074)	(0.000)	(0.000)	(0.000)
Base group	SBN2SBN		MIX2MIX		TLDC2TLDC	
Observations	4,242		2,927		5,480	
pseudo R-squared	0.094		0.036		0.034	

Panel C: Percentage change in firm characteristics (from the last pre-recession to the recession period)

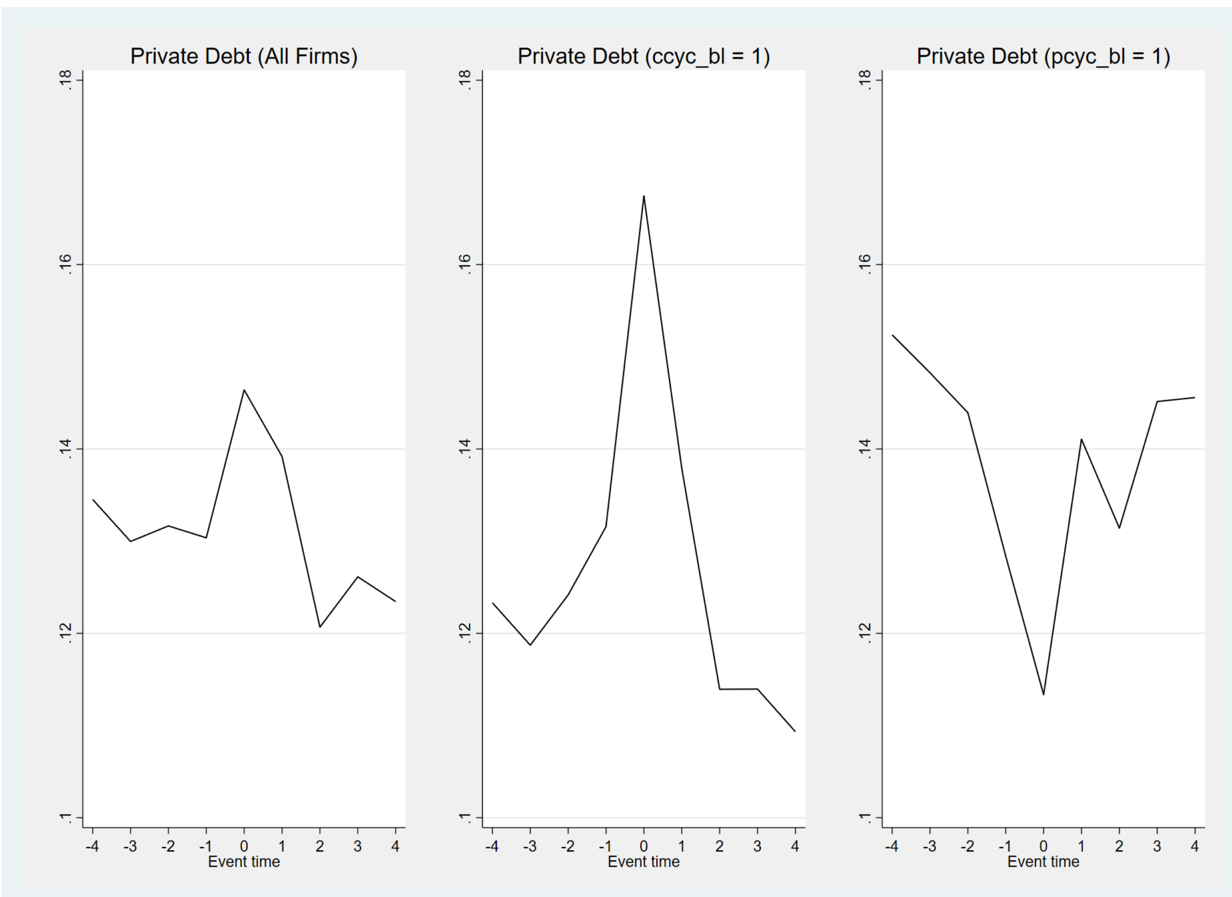
	SBN2SBN	SBN2MIX	SBN2TLDC	MIX2MIX	MIX2SBN	MIX2TLDC	TLDC2TLDC	TLDC2MIX
size	-0.593	-0.112	7.849	-1.562	-1.058	2.555***	-1.290	3.250**
profit	-14.221	-27.154	-49.172	-25.285	-36.343	-67.301**	-12.220	-19.411
mtb	-14.661	-23.805***	-34.601***	-15.466	-19.634	-30.628***	-17.348	-16.095
tang	-1.413	-0.169	-12.173*	-1.105	4.287**	0.942	-2.150	-2.814
capx	-31.901	-40.608	-42.473	-39.977	-76.491*	-44.747	-50.019	-70.482
divpayer	-0.023	-0.047	-0.045	-0.064	-0.020*	-0.019	-0.032	0.011*
cash	6.959	-38.020***	-51.873***	13.387	30.897**	-40.556***	4.981	51.988***
rated	0.002	0.018	-0.011	-0.006	0.000	0.000	0.000	0.022
bl	1.936	19.253***	18.699	0.625	-37.063***	2.830	-2.170	6.875*

Panel D: Fraction of firms increasing an individual debt source (from the last pre-recession to the recession period)

	SBN2SBN	SBN2MIX	SBN2TLDC	MIX2MIX	MIX2SBN	MIX2TLDC	TLDC2TLDC	TLDC2MIX
SBN	0.328	0.257*	0.090***	0.187	0.582***	0.096***	0.043	0.710***
TL	0.076	0.357***	0.584***	0.137	0.071**	0.577***	0.257	0.151***
DC	0.117	0.573***	0.461***	0.247	0.082***	0.490***	0.294	0.237
Total Debt	0.398	0.784***	0.596***	0.374	0.337	0.635***	0.428	0.645***

Figure 1: **The dynamics of observed market debt and private debt.** The graphs show the dynamics of market debt and private debt (scaled by total assets) over the business cycle. The basecase data represents a merged Compustat-Capital IQ sample of firm-quarters during the period 2001 to 2020. Reported statistics are based on an event window of four annual (i.e., not calendar year but four consecutive quarters) pre-recession periods (-4 to -1) and four annual post-recession periods (1 to 4). These annual observations are pooled as expansionary observations (*exp*). All observations during business cycle recessions (event time 0) are also pooled and labeled *rec*. The Data Section provides further details on the transformation of the quarterly data into annual event-time data. Variable definitions are summarized in Appendix A.

Panel A: Private debt



Panel B: Market debt

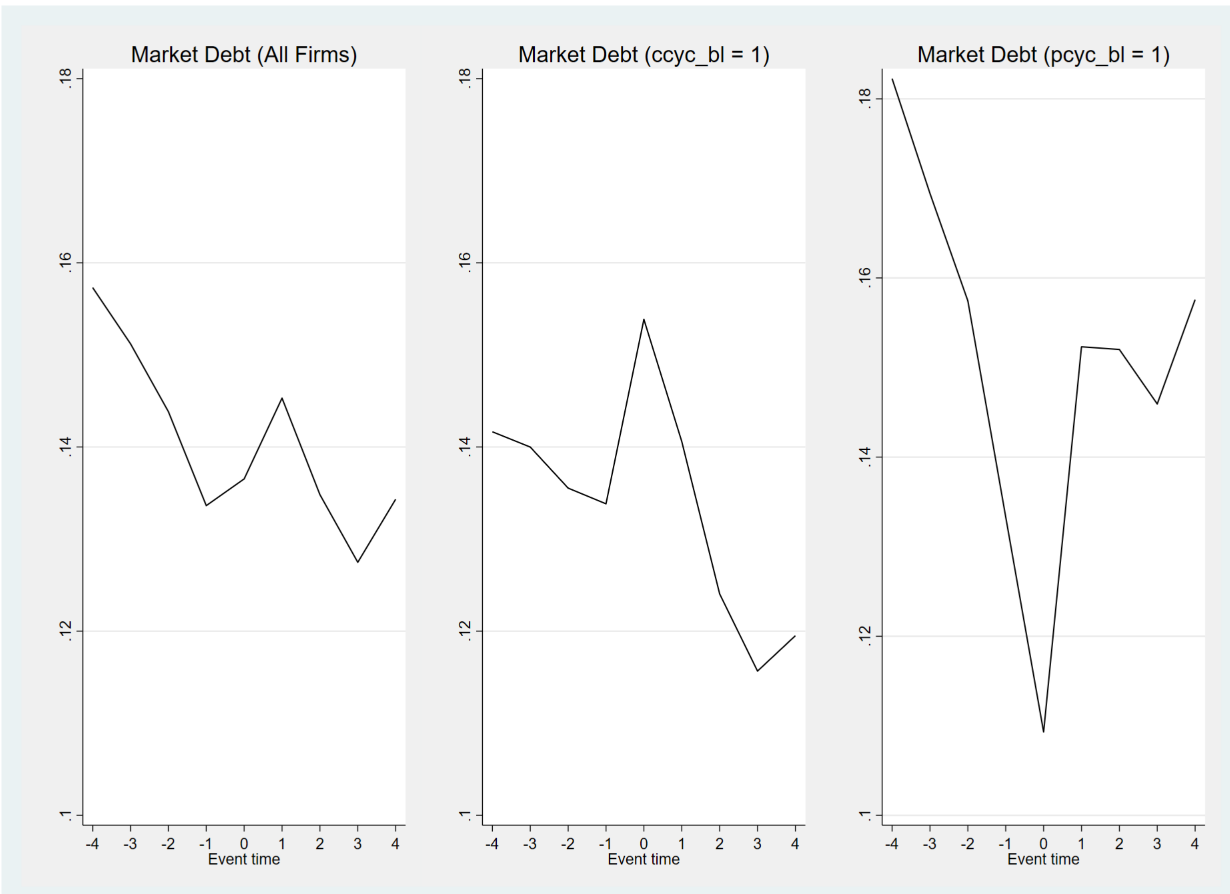
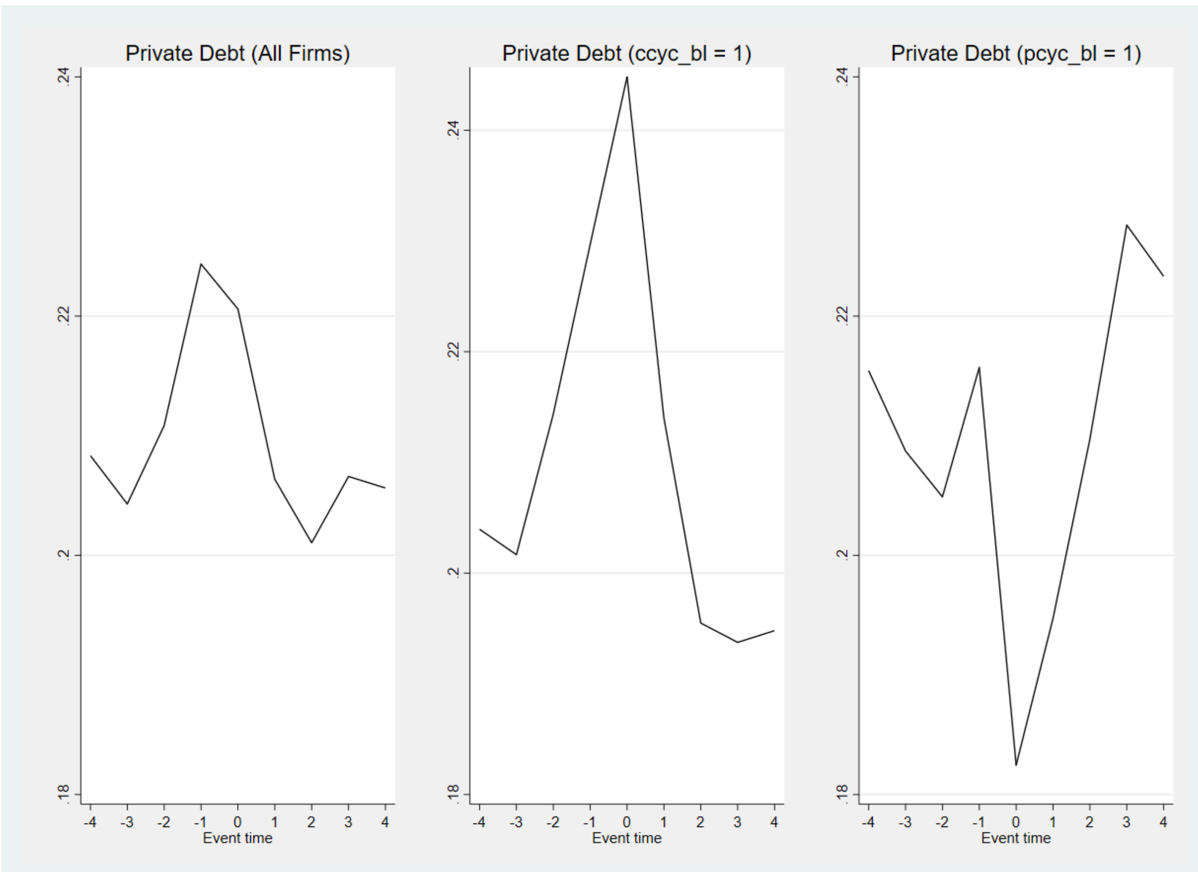


Figure 2: **The dynamics of observed market debt and private debt using long time-series data.** The graphs show the dynamics of market debt and private debt (scaled by total assets) over the business cycle. The data is the Mergent-Compustat sample of firm-quarters during the period 1980 to 2020. Reported statistics are based on an event window of four annual (i.e., not calendar year but four consecutive quarters) pre-recession periods (-4 to -1) and four annual post-recession periods (1 to 4). These annual observations are pooled as expansionary observations (*exp*). All observations during business cycle recessions (event time 0) are also pooled and labeled *rec*. The Data Section provides further details on the transformation of the quarterly data into annual event-time data. Variable definitions are summarized in Appendix A.

Panel A: Market debt

Panel B: Private debt



Internet Appendix for
"The Dynamics of Corporate Debt Structure"

ABSTRACT

This internet appendix has two sections. The first section consists of four subsections. In the first subsection we show that there there always exists a sufficiently small value of initial debt financing F_0^*, so that for $F_0 \leq F_0^*$ Prediction 2 holds. In the remaining three subsections we consider three extensions of the theory model and discuss their effects on business cycle predictions. That is, we assume (i) initial debt financing is done via market debt, or (ii) issuing market debt is associated with fixed costs, or (iii) the benefits of private debt come from monitoring, rather than from the ability to renegotiate, as is assumed in the paper. In the second section of this internet appendix, we report individual coefficient estimates related to Tables 4, 5, and 6 of the paper. We also replicate our main empirical results for a shorter event time window and for the full sample of observations (instead of the sample with refinancing observations).

IA.1 Theory Model Extensions

IA.1.1 The dynamics of debt concentration as F_0 becomes sufficiently small

Let $P/M \equiv (F_0 + F_P)/F_M$ be a shorthand notation for the private to market debt ratio. In Section 3 of the paper we show that strong firms choose $F_P = 0$ and $F_M = \Delta A$ and average firms choose $F_P > 0$ and $\Delta A > F_M > 0$ (see Appendix B of the paper for the expressions of F_P and F_M).

In summary,

$$P/M = \begin{cases} \frac{F_0}{\Delta A}, & \text{for strong firms,} \\ \frac{F_0+F_P}{F_M}, & \text{for average firms.} \end{cases}$$

As F_0 approaches zero, strong firms' P/M approaches zero and HHI approaches its maximum, which is one. In contrast, average firms' P/M remains strictly positive even as F_0 approaches zero and thus, their HHI is strictly less than one. By continuity, for firms that are strong in expansions and become average during recessions, debt concentration is pro-cyclical if F_0 is sufficiently small (i.e., sufficiently close to zero).

In the following, we provide more details about the relation between HHI and P/M. First, corporate debt concentration (HHI) is defined as

$$HHI = \frac{\left(\frac{F_0+F_P}{F_0+F_P+F_M}\right)^2 + \left(\frac{F_M}{F_0+F_P+F_M}\right)^2 - \frac{1}{2}}{1-\frac{1}{2}} = \left(\frac{1-\frac{F_0+F_P}{F_M}}{1+\frac{F_0+F_P}{F_M}}\right)^2 = \left(\frac{1-P/M}{1+P/M}\right)^2 \in [0,1].$$

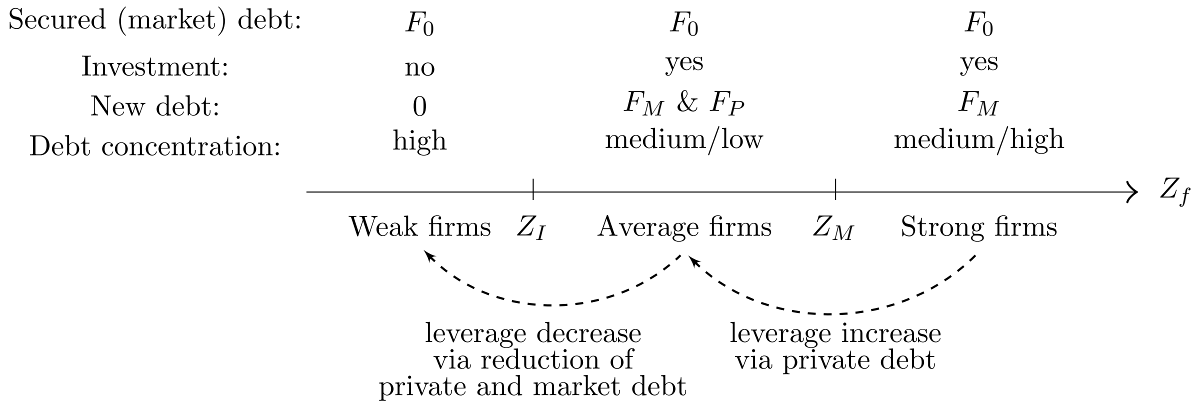
Second, it can be shown that

$$\frac{\partial HHI}{\partial P/M} < 0, \text{ if } P/M < 1,$$
$$\frac{\partial HHI}{\partial P/M} > 0, \text{ if } P/M > 1.$$

Moreover, HHI achieves its maximum, i.e., $HHI_{\max} = 1$, at $P/M = 0$ or as P/M approaches to infinity (i.e., $M/P = 0$) and attains its minimum, i.e., $HHI_{\min} = 0$, at $P/M = 1$. This is very intuitive because corporate debt structure is most-concentrated if firms use either private or market debt exclusively and is most-diversified if they use equal amounts of private and market debt.

IA.1.2 Funding Assets in Place with Secured Market Debt

In the main text, we assume that assets in place are funded by secured private debt. Here we consider an alternative setting in which secured market debt is used to fund assets in place. Our analysis of the optimal investment decisions and the optimal debt structure for the funding of the investment in the main text goes through because the equityholders' optimization problems are identical to the case in which the original assets in place were (partly) funded via riskless private debt. The following figure, which is the same as that in Section 3 except F_0 now becomes market debt, summarizes the optimal debt structure choice for firms with different strength.



As is clearly shown in the above figure, when recessions turn average firms to weak firms, their investment project is not viable and firms cease from borrowing, both market debt and private debt decrease. Thus, for these firms all three business cycle patterns (leverage, debt concentration, and private debt to assets ratio) in Prediction 3 hold.

When recessions turn strong firms into average firms, they increase their leverage and their reliance on private debt. That is, the leverage and private debt dynamics in Prediction 1 are not affected by funding assets in place with secured market debt either. Furthermore, their debt concentration dynamics become unambiguously pro-cyclical (Prediction 2).

IA.1.3 Fixed Issuance Cost of Market Debt

Our analysis in the main text focuses on the tradeoff between costs of financial intermediation and the flexibility to restructure debt in bad states of nature. We thereby ignore other features, such as informational frictions, which usually require firms to obtain certification by rating agencies or have their stocks listed on an exchange, before they can access the public debt markets. Placing a public debt issue among investors frequently involves additional expenses with some fixed-cost character, such as hiring an underwriter.

We therefore extend the base model to introduce a fixed cost C, associated with issuing market debt. The optimal debt structure choice looks similar to that of the base model except that all private debt financing can now emerge as an optimal choice. Intuitively, with the fixed cost of issuing market debt, the trade-off firms face when choosing their debt structure now involves issuance and bankruptcy costs of market debt versus the cost of financial intermediation.

We focus on the interesting case where $C < \rho \Delta A$.[27] Given this condition, it is clear that strong

[27] If $C \geq \rho \Delta A$, then market debt is dominated by private debt. In this case firms never choose market debt financing, regardless of the state of the business cycle.

firms with $\Delta CF(Z_f) \geq \Delta A$, i.e. firms that can fund the project via riskless bonds, still choose to borrow entirely via market debt.

Average firms (that is, firms with $\Delta CF(Z_f) < \Delta A$) must borrow using risky debt. Given the efficiency of debt restructuring implied by Assumption 2, all market debt financing is never optimal for these firms. Their optimal choice between all private debt and a mix of both types of debt is equivalent to minimizing:

$$\min(\rho\Delta A, \rho(\Delta A - \Delta CF(Z_f)) + C) = \rho(\Delta A - \Delta CF(Z_f)) + \min(\rho\Delta CF(Z_f), C). \qquad (23)$$

As a consequence, among average firms, those with a lower failure cash flow (relative to C) tend to switch to all private debt financing. More importantly, if a firm uses all private debt financing in expansions, this same firm would also use private debt financing in recessions because $\rho\Delta CF(L) < \rho\Delta CF(M) < C$. However, the converse does not always hold, that is, $\rho\Delta CF(M) > C$ does not always imply that $\rho\Delta CF(L) > C$.

We can indeed define a new cutoff value Z_P such that

$$CF(Z_P) = \frac{C}{\rho}$$

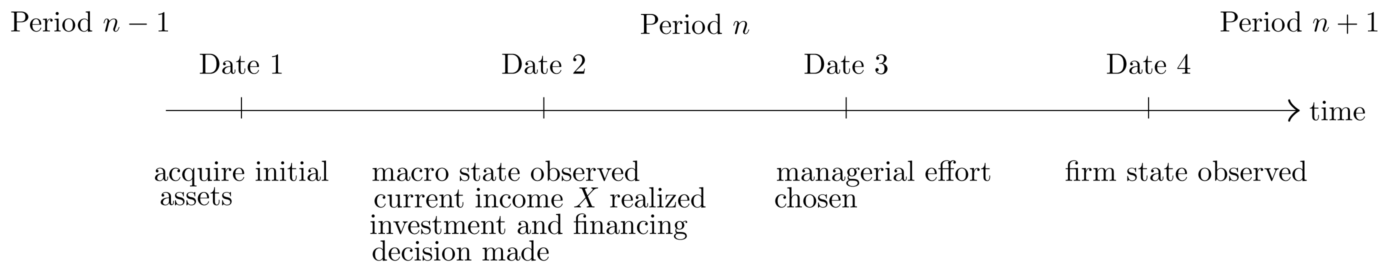
and focus on the interesting case where $Z_I < Z_P < Z_M$.[28]

In summary, with a fixed issuance cost, the business cycle patterns in Prediction 3 remain qualitatively the same. Our result, in Prediction 1, that private debt is more important in recessions becomes even stronger. The result that the debt concentration of strong firms decreases during recessions (as is provided in Prediction 2) also holds, provided that assets in place are funded via market debt and equity (the second condition of Prediction 2).

IA.1.4 A Model of Optimal Debt Structure Choice Based on Monitoring

This section shows that the predictions from the model in Section 3, which is based on debt renegotiation, can also be generated in a setting in which the benefits of private debt are due to incentives to monitor corporate borrowers. The following time-line summarizes the sequence of events.

[28] If $Z_P \leq Z_I$, then the extended model will essentially be identical to the model presented in the paper.



Each time period has four dates. On date 1, firms acquire assets A_0 and fund the acquisition with senior debt with face value F_0 and equity, as in the model in Section 3. The macro state is revealed and current income X is realized on date 2. We allow X to vary across firms and assume that it is lower during recessions. On the same date, firms must decide whether to realize an investment project and if they do, whether to fund it via private debt, market debt or a mix of both. The investment cost is I. On date 3, firm managers make an effort choice that affects the project's success probability, i.e.,

$$p = \begin{cases} p_H, & \text{if managerial effort is high;} \\ p_L < p_H, & \text{otherwise.} \end{cases}.$$

Firm managers enjoy private benefits B if low effort is chosen. On the final date, firm state is observed

$$CF = \begin{cases} R, & \text{if successful;} \\ 0, & \text{otherwise.} \end{cases}.$$

While the time-line above casts the model in terms of managerial effort choices, a low effort by the manager can also be interpreted as managers/equityholders tunneling some assets of the investment project to alternative uses, or altering the nature of the project so that it generates a private value of B to them and by doing so, reducing the success probability of the project from p_H to p_L.

Following Holmstrom and Tirole (1997), we assume that

$$p_H R > I > p_L R + B.$$

That is, the project's net present value (NPV) is positive for the high effort level and negative, even after including private benefits, for the low effort level. This allows us to solve for incentive compatible contracts.

Also, we can interpret the current income net of the senior debt repayment as the firm's internal source of funding. That is, $Y = X - F_0$ is the firm's net worth (cash on hand) that can be used to, partially, fund the investment project.

As stated in the time-line above, firms may fund the investment project with public debt, private debt or a mix of the two. The difference between the two alternative debt sources is due to their different ability to monitor the effort choice of the firm. By spending c, private lenders can reduce the private benefits from a low effort level from B to b. In contrast, public debtholders are dispersed and are assumed to be unable to engage in monitoring. Since private debtholders must break even in expectation, the promised payment to private debtholders must compensate them for the cost c. As in the model in Section 3, we assume that private lenders incur higher costs of intermediation, which they cover by charging an expected rate of return on their loans of ρ.

IA.1.4.1 All market debt funding by strong firms

If the project succeeds, it generates R. Denote the payment promised to debtholders by $R - R_b$, which leaves R_b for the equityholders (i.e., the borrower). The equityholders' optimization problem is given by

$$\max_{R_b} p_H R_b \tag{24}$$

s.t.

$$p_H R_b \geq p_L R_b + B,$$
$$p_H(R - R_b) + Y = I,$$

where the first (incentive compatibility) constraint ensures that the equityholders are better off if the manager exerts high effort and the second (individual rationality) constraint requires that debtholders break even in expectation, i.e. that the funds they provide to the firm, $I - Y$, equal to the expected value of their claim, $p_H(R - R_b)$. Note that this individual rationality constraint assumes that funds are raised via market debt, since private debtholders would require an expected rate of return of ρ. As in the model in Section 3, we hereby assume risk neutrality and normalize the riskless rate of interest to zero.

Form the incentive compatibility constraint it follows that $R_b \geq B/\Delta p$, where $\Delta p = p_H - p_L$. We will refer to $B/\Delta p$ as the minimum equity stake.

Thus, firms with

$$Y \geq Y_M \equiv I - p_H(R - B/\Delta p) \tag{25}$$

can fully fund the investment project with public debt. It is also optimal for such firms to issue market debt as the only source of external funds since the alternative would be to borrow from the more expensive private lenders. As in Section 3, we refer to these firms as "strong" firms.

IA.1.4.2 Mix of market and private debt financing by average firms

Firms with $Y < Y_M$ are unable to fund the investment with all market debt. Private lenders can help such firms secure funding through monitoring. Following Holmstrom and Tirole (1997), we assume that monitoring reduces the borrower's private benefits to $b < B$. As stated above, the cost of monitoring to private lenders is denoted by c. The borrower's optimization problem becomes

$$\max_{R_b, R_p} p_H R_b \tag{26}$$

s.t.

$$\begin{aligned} & p_H R_b \geq p_L R_b + b, \\ & p_H R_p - c \geq p_L R_p, \\ & \frac{1}{1+\rho} p_H R_p = D_p, \\ & p_H(R - R_b - R_p) + D_p + Y = I, \end{aligned}$$

where R_p is the private lenders' share of total cash flow (in the success state), the second inequality states that private lenders are better off monitoring the borrower, and D_p denotes the proceeds from the private debt issue.

Since private debt is more expensive than market debt, i.e., $\rho > 0$, it is optimal to set $R_p = c/\Delta p$. Consequently, $p_H R_p = \frac{p_H}{\Delta p} c > c$, so that private lenders can earn a positive net return after financing is arranged. At the financing stage, private lenders provide capital D_p to the borrower. D_p must be low enough, or equivalently, ρ must be high enough to ensure that private lenders prefer investing and monitoring the borrower. The minimum acceptable rate of return $\underline{\rho}$ is determined by the condition,

$$p_H c/\Delta p - c = \frac{1}{1+\underline{\rho}} \left(p_H c/\Delta p \right),$$

which implies $\underline{\rho} = \frac{\Delta p}{p_L}$. That is, if the actual discount rate equals $\rho = \underline{\rho}$, then private lenders extract exactly zero rent, after accounting for their monitoring cost. If $\rho > \underline{\rho}$, then private lenders would extract positive rents, possibly due to imperfect competition among private lenders.

The borrower's incentive compatibility constraint states that $R_b \geq b/\Delta p$ and thus, the minimum equity stake $b/\Delta p$ is strictly smaller than $B/\Delta p$ in the case of all market debt financing. The funding constraint becomes

$$Y \geq Y_I \equiv I - \left(p_H(R - (b+c)/\Delta p) + \frac{1}{1+\rho} \left(p_H c/\Delta p \right) \right). \tag{27}$$

Finally, if $Y_I \geq Y_M$, then monitoring is not on the equilibrium path. A necessary and sufficient condition for $Y_I < Y_M$ for all $\rho \geq \underline{\rho}$ is given by

$$c\Delta p < p_H(B - b).$$

We assume this condition is met. See Holmstrom and Tirole (1997) for a more detailed discussion.

In conclusion, whereas firms with $Y_I \leq Y < Y_M$ cannot to fund the project using only market debt (and internal capital), they can fund the project by raising both market and private debt. In accordance with the model in Section 3, we refer to these firms as "average" firms.

IA.1.4.3 Weak firms

Firms with $Y < Y_I$ are referred to as "weak". Weak firms are rationed, have no access to credit markets, and are unable to invest.

IA.1.4.4 Links between the two models.

Adding current income X to the final date cash flow (end of period n), the project cash flow becomes

$$CF = \begin{cases} X + R, & \text{if successful;} \\ X, & \text{otherwise.} \end{cases}.$$

If we further reinterpret $X = (A_0 + A)Z_f$ (i.e. the intermediate income equals the minimum cash flow in the model in Section 3 if the firm invests) and $R = (A_0 + A)(H - Z_f)$, then we recover the project's cash flow in Section 3. To simplify the analysis of this model of monitoring, we focus on the cross-sectional heterogeneity in X and let R be constant for all firms.

That is, in the model in the main text, we sort firms by Z_f, their cash flows in the bad state. In the above model featuring monitoring, we sort firms by $Y = X - F_0$, which is positively and linearly related to Z_f. It is straightforward to see that, except for a few technical differences, these two models generate the same predictions on the optimal debt structure choice for the cross-section of firms as long as current income X varies over the business cycle, i.e. drops in recessions, just as we assumed that Z_f in the model in Section 3 does.

IA.2 More Empirical Results and Robustness Checks

In the paper, we omit, for brevity, individual coefficient estimates of multivariate regressions reported in Tables 4, 5, and 6. We report individual coefficient estimates in Tables IA1, IA2, and IA5. We also replicate our main empirical results for a shorter event time window and for the full sample of observations (see Table IA3).

Table IA1 Multivariate regressions of market and private debt with firm fixed-effects

This table presents individual coefficient estimates of Table 4 in the paper. Variable definitions are summarized in Appendix A of the paper. ****, **, * indicate significance at the 1%, 5%, and 10% level.*

Variables	*all firms* *md/at*	*ccyc_bl firms* *md/at*	*pcyc_bl firms* *md/at*	*all firms* *pd/at*	*ccyc_bl firms* *pd/at*	*pcyc_bl firms* *pd/at*
exp_l_size	-0.000	-0.000	-0.001	0.004	0.002	0.003
	(0.956)	(0.952)	(0.793)	(0.145)	(0.498)	(0.582)
rec_l_size	-0.000	-0.004	0.002	0.004	-0.004	0.008*
	(0.976)	(0.410)	(0.668)	(0.185)	(0.265)	(0.077)
exp_l_mtb	0.001	-0.002	0.007**	-0.000	0.001	-0.001
	(0.539)	(0.405)	(0.026)	(0.888)	(0.749)	(0.852)
rec_l_mtb	0.001	0.001	0.005	-0.005**	-0.001	-0.006*
	(0.591)	(0.699)	(0.123)	(0.029)	(0.771)	(0.078)
exp_l_profit	-0.150***	-0.065	-0.183***	-0.052	0.021	-0.067
	(0.001)	(0.309)	(0.001)	(0.172)	(0.728)	(0.187)
rec_l_profit	-0.061	-0.021	-0.041	-0.111**	-0.068	-0.070
	(0.352)	(0.800)	(0.686)	(0.020)	(0.167)	(0.347)
exp_l_tang	0.030	0.008	0.018	0.014	0.015	-0.037
	(0.183)	(0.793)	(0.601)	(0.525)	(0.568)	(0.274)
rec_l_tang	0.019	-0.014	0.002	0.029	0.011	-0.013
	(0.427)	(0.666)	(0.954)	(0.205)	(0.701)	(0.721)
exp_l_capx	-0.158	-0.255*	-0.087	-0.189*	-0.238	-0.172
	(0.138)	(0.095)	(0.538)	(0.058)	(0.100)	(0.191)
rec_l_capx	-0.201	-0.042	-0.142	0.076	0.230	0.218
	(0.144)	(0.833)	(0.402)	(0.565)	(0.211)	(0.183)
exp_l_divpayer	-0.010*	-0.004	-0.019**	-0.003	0.001	-0.003
	(0.073)	(0.595)	(0.044)	(0.608)	(0.920)	(0.725)
rec_l_divpayer	-0.006	-0.009	-0.006	-0.002	-0.006	0.006
	(0.352)	(0.280)	(0.544)	(0.716)	(0.442)	(0.529)
exp_l_cash	0.031	0.036	0.042	-0.127***	-0.123***	-0.118***
	(0.178)	(0.242)	(0.180)	(0.000)	(0.000)	(0.000)
rec_l_cash	0.048*	0.128***	-0.018	-0.160***	-0.183***	-0.090***
	(0.074)	(0.000)	(0.612)	(0.000)	(0.000)	(0.001)
exp_l_rated	0.121***	0.123***	0.113***	-0.039***	-0.053***	-0.029**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.039)
rec_l_rated	0.116***	0.142***	0.074***	-0.028***	-0.055***	0.003
	(0.000)	(0.000)	(0.000)	(0.002)	(0.000)	(0.798)
rec	-0.004	0.025**	-0.040***	0.018**	0.092***	-0.085***
	(0.617)	(0.010)	(0.001)	(0.019)	(0.000)	(0.000)
Constant	-0.047***	-0.049**	-0.029	0.007	0.008	0.037
	(0.008)	(0.039)	(0.239)	(0.644)	(0.671)	(0.183)
Observations	13,845	7,993	5,852	13,845	7,993	5,852
Number of firms	2,690	1,548	1,142	2,690	1,548	1,142
R-squared	0.196	0.198	0.182	0.056	0.091	0.037

Table IA2 Multivariate regressions of debt concentration (HHI) with firm fixed-effects

This table presents individual coefficient estimates of Table 5 in the paper. Variable definitions are summarized in Appendix A of the paper. ****, **, * indicate significance at the 1%, 5%, and 10% level.*

Variables	*all firms* *HHI*	*ccyc_bl firms* *HHI*	*pcyc_bl firms* *HHI*
exp_l_bl	-0.273***	-0.289***	-0.237***
	(0.000)	(0.000)	(0.000)
rec_l_bl	-0.243***	-0.178***	-0.288***
	(0.000)	(0.000)	(0.000)
exp_l_size	-0.027***	-0.031***	-0.023**
	(0.000)	(0.000)	(0.012)
rec_l_size	-0.024***	-0.025***	-0.023**
	(0.000)	(0.005)	(0.028)
exp_l_mtb	0.011***	0.016***	0.006
	(0.005)	(0.003)	(0.330)
rec_l_mtb	0.018***	0.019**	0.015**
	(0.001)	(0.011)	(0.048)
exp_l_profit	0.030	-0.046	0.074
	(0.637)	(0.630)	(0.352)
rec_l_profit	0.072	-0.031	0.235
	(0.502)	(0.800)	(0.227)
exp_l_tang	-0.006	0.048	-0.049
	(0.916)	(0.473)	(0.563)
rec_l_tang	0.004	0.097	-0.115
	(0.937)	(0.177)	(0.213)
exp_l_capx	-0.230	-0.278	-0.128
	(0.306)	(0.364)	(0.701)
rec_l_capx	-0.539*	-0.495	-0.459
	(0.079)	(0.262)	(0.302)
exp_l_divpayer	0.005	0.022	-0.021
	(0.719)	(0.199)	(0.391)
rec_l_divpayer	-0.005	0.001	-0.013
	(0.793)	(0.972)	(0.660)
exp_l_cash	0.229***	0.252***	0.205***
	(0.000)	(0.000)	(0.002)
rec_l_cash	0.270***	0.371***	0.148*
	(0.000)	(0.000)	(0.057)
exp_l_rated	-0.100***	-0.112***	-0.090***
	(0.000)	(0.000)	(0.007)
rec_l_rated	-0.157***	-0.167***	-0.150***
	(0.000)	(0.000)	(0.000)
rec	-0.036	-0.108***	0.049
	(0.130)	(0.001)	(0.188)
Constant	0.199***	0.200***	0.188***
	(0.000)	(0.000)	(0.001)
Observations	13,845	7,993	5,852
Number of firms	2,690	1,548	1,142
R-squared	0.096	0.097	0.094

Table IA3 Robustness tests

This table presents two robustness tests for results reported in Tables 4 and 5 in the paper. First, we use a shorter event time window around recessions of one year (instead of four years used for the main results) and, second, we use the full, rather than refinancing, sample of observations. Panel A is on market and private debt and Panel B on debt concentration (HHI).

Panel A: Market and private debt ratios

A shorter event time window

Variables	*all firms* *md/at*	*ccyc_bl firms* *md/at*	*pcyc_bl firms* *md/at*	*all firms* *pd/at*	*ccyc_bl firms* *pd/at*	*pcyc_bl firms* *pd/at*
rec	-0.004	0.025**	-0.040***	0.018**	0.092***	-0.085***
	(0.617)	(0.010)	(0.001)	(0.019)	(0.000)	(0.000)
Firm char. & FEs	Yes	Yes	Yes	Yes	Yes	Yes
Observations	13,845	7,993	5,852	13,845	7,993	5,852
Number of firms	2,690	1,548	1,142	2,690	1,548	1,142
R-squared	0.196	0.198	0.182	0.056	0.091	0.037

Ev. window [-1, +1] Est. target ratios	*all firms* *tmd/at*	*ccyc_bl firms* *tmd/at*	*pcyc_bl firms* *tmd/at*	*all firms* *tpd/at*	*ccyc_bl firms* *tpd/at*	*pcyc_bl firms* *tpd/at*
rec & exp (1)	0.148	0.152	0.142	0.163	0.175	0.145
rec (2)	0.145	0.167	0.115	0.170	0.204	0.123
exp (3)	0.151	0.138	0.169	0.155	0.147	0.166
Diff: (2)-(3)	-0.006***	0.028***	-0.054***	0.015***	0.057***	-0.043***
p-value	0.000	0.000	0.000	0.000	0.000	0.000
Diff: ((2)-(3))/(1)*100%	-4.35%	18.68%	-37.86%	8.92%	32.26%	-29.58%

The full sample of observations

Variables	*all firms* *md/at*	*ccyc_bl firms* *md/at*	*pcyc_bl firms* *md/at*	*all firms* *pd/at*	*ccyc_bl firms* *pd/at*	*pcyc_bl firms* *pd/at*
rec	-0.012**	0.008	-0.038***	0.018***	0.081***	-0.070***
	(0.033)	(0.269)	(0.000)	(0.001)	(0.000)	(0.000)
Firm char. & FEs	Yes	Yes	Yes	Yes	Yes	Yes
Observations	30,546	18,739	11,807	30,546	18,739	11,807
Number of firms	4,081	2,400	1,681	4,081	2,400	1,681
R-squared	0.190	0.196	0.177	0.079	0.099	0.060

Ev. window [-4, +4] Est. target ratios	*all firms* *tmd/at*	*ccyc_bl firms* *tmd/at*	*pcyc_bl firms* *tmd/at*	*all firms* *tpd/at*	*ccyc_bl firms* *tpd/at*	*pcyc_bl firms* *tpd/at*
rec & exp (1)	0.141	0.137	0.148	0.134	0.132	0.136
rec (2)	0.137	0.156	0.108	0.144	0.168	0.106
exp (3)	0.142	0.133	0.157	0.131	0.123	0.144
Diff: (2)-(3)	-0.005***	0.023***	-0.049***	0.013***	0.045***	-0.037***
p-value	0.000	0.000	0.000	0.000	0.000	0.000
Diff: ((2)-(3))/(1)*100%	-3.60%	16.57%	-32.98%	9.52%	33.93%	-27.36%

Panel B: Debt concentration (HHI)			
A shorter event time window			
	all firms	*ccyc_bl firms*	*pcyc_bl firms*
Variables	*HHI*	*HHI*	*HHI*
rec	-0.036	-0.108***	0.049
	(0.130)	(0.001)	(0.188)
Firm char. and FEs	Yes	Yes	Yes
Observations	13,845	7,993	5,852
Number of firms	2,690	1,548	1,142
R-squared	0.096	0.097	0.094

Ev. window [-1, +1]	*all firms*	*ccyc_bl firms*	*pcyc_bl firms*
Est. target HHI	*tHHI*	*tHHI*	*tHHI*
rec & exp (1)	0.689	0.679	0.703
rec (2)	0.682	0.654	0.720
exp (3)	0.695	0.702	0.686
Diff: (2)-(3)	-0.014***	-0.048***	0.034***
p-value	0.000	0.000	0.000
Diff: ((2)-(3))/(1)*100%	-1.98%	-7.07%	4.81%

The full sample of observations			
	all firms	*ccyc_bl firms*	*pcyc_bl firms*
Variables	*HHI*	*HHI*	*HHI*
rec	-0.005	-0.042**	0.041*
	(0.751)	(0.035)	(0.076)
Firm characteristics and FEs	Yes	Yes	Yes
Observations	30,546	18,739	11,807
Number of firms	4,081	2,400	1,681
R-squared	0.121	0.120	0.123

Full event window [-4, +4]	*all firms*	*ccyc_bl firms*	*pcyc_bl firms*
Est. target HHI	*tHHI*	*tHHI*	*tHHI*
rec & exp (1)	0.731	0.729	0.735
rec (2)	0.723	0.694	0.770
exp (3)	0.733	0.737	0.727
Diff: (2)-(3)	-0.009***	-0.043***	0.043***
p-value	0.000	0.000	0.000
Diff: ((2)-(3))/(1)*100%	-1.29%	-5.92%	5.89%

Table IA4 Robustness tests: detailed coefficient estimates

This table presents individual coefficient estimates using the full sample of observations, corresponding to the robustness checks reported in Table IA3 of this internet appendix. Variable definitions are summarized in Appendix A of the paper. ****, **, * indicate significance at the 1%, 5%, and 10% level.*

Panel A: Market and private debt regressions

VARIABLES	*all* *md/at*	*ccyc_bl* *md/at*	*pcyc_bl* *md/at*	*all* *pd/at*	*ccyc_bl* *pd/at*	*pcyc_bl* *pd/at*
exp_l_size	-0.003	-0.002	-0.004	-0.002	-0.002	-0.001
	(0.296)	(0.565)	(0.329)	(0.468)	(0.427)	(0.795)
rec_l_size	-0.002	-0.004	-0.003	-0.001	-0.007***	0.005
	(0.430)	(0.286)	(0.529)	(0.732)	(0.006)	(0.219)
exp_l_mtb	0.001	-0.002	0.004*	0.000	-0.001	0.002
	(0.677)	(0.469)	(0.091)	(0.922)	(0.433)	(0.263)
rec_l_mtb	0.003	0.006**	0.001	-0.004***	-0.003	-0.003*
	(0.104)	(0.016)	(0.660)	(0.007)	(0.112)	(0.087)
exp_l_profit	-0.184***	-0.127***	-0.196***	-0.071**	-0.042	-0.072*
	(0.000)	(0.005)	(0.000)	(0.015)	(0.301)	(0.085)
rec_l_profit	-0.098**	-0.109	-0.020	-0.132***	-0.129***	-0.070
	(0.050)	(0.177)	(0.747)	(0.001)	(0.004)	(0.144)
exp_l_tang	0.015	0.002	0.014	0.003	-0.020	0.013
	(0.407)	(0.920)	(0.632)	(0.855)	(0.309)	(0.652)
rec_l_tang	0.025	0.009	0.013	0.009	-0.028	0.032
	(0.187)	(0.701)	(0.674)	(0.608)	(0.180)	(0.275)
exp_l_capx	-0.201***	-0.253**	-0.148	-0.135**	-0.059	-0.232**
	(0.008)	(0.016)	(0.165)	(0.047)	(0.522)	(0.017)
rec_l_capx	-0.379***	-0.209	-0.271*	0.060	0.227	0.171
	(0.001)	(0.227)	(0.050)	(0.558)	(0.108)	(0.186)
exp_l_divpayer	-0.008**	-0.006	-0.011	-0.009**	-0.009**	-0.006
	(0.046)	(0.219)	(0.159)	(0.013)	(0.040)	(0.347)
rec_l_divpayer	-0.004	-0.011*	0.003	-0.010**	-0.015***	-0.002
	(0.412)	(0.060)	(0.724)	(0.035)	(0.006)	(0.818)
exp_l_cash	0.009	0.005	0.018	-0.170***	-0.184***	-0.149***
	(0.565)	(0.774)	(0.500)	(0.000)	(0.000)	(0.000)
rec_l_cash	0.017	0.054**	0.010	-0.205***	-0.253***	-0.099***
	(0.344)	(0.025)	(0.682)	(0.000)	(0.000)	(0.000)
exp_l_rated	0.114***	0.107***	0.118***	-0.014**	-0.023***	-0.007
	(0.000)	(0.000)	(0.000)	(0.040)	(0.007)	(0.547)
rec_l_rated	0.110***	0.117***	0.094***	-0.013*	-0.025***	0.007
	(0.000)	(0.000)	(0.000)	(0.092)	(0.006)	(0.577)
rec	-0.012**	0.008	-0.038***	0.018***	0.081***	-0.070***
	(0.033)	(0.269)	(0.000)	(0.001)	(0.000)	(0.000)
Constant	-0.024	-0.027	-0.014	0.039***	0.045***	0.037*
	(0.102)	(0.174)	(0.504)	(0.001)	(0.002)	(0.070)
Observations	30,546	18,739	11,807	30,546	18,739	11,807
Number of firms	4,081	2,400	1,681	4,081	2,400	1,681
R-squared	0.190	0.196	0.177	0.079	0.099	0.060

Panel B: HHI regressions			
	all	*ccyc_bl*	*pcyc_bl*
VARIABLES	*HHI*	*HHI*	*HHI*
exp_l_bl	-0.340***	-0.341***	-0.330***
	(0.000)	(0.000)	(0.000)
rec_l_bl	-0.317***	-0.261***	-0.383***
	(0.000)	(0.000)	(0.000)
exp_l_size	-0.016***	-0.016**	-0.015**
	(0.001)	(0.016)	(0.031)
rec_l_size	-0.017***	-0.017**	-0.017**
	(0.001)	(0.014)	(0.018)
exp_l_mtb	0.010***	0.009***	0.012***
	(0.000)	(0.009)	(0.003)
rec_l_mtb	0.012***	0.012**	0.010*
	(0.002)	(0.017)	(0.062)
exp_l_profit	0.016	-0.092	0.101
	(0.756)	(0.240)	(0.110)
rec_l_profit	0.062	0.081	0.026
	(0.465)	(0.493)	(0.822)
exp_l_tang	0.017	0.006	0.034
	(0.662)	(0.910)	(0.574)
rec_l_tang	0.025	0.013	0.040
	(0.554)	(0.807)	(0.550)
exp_l_capx	-0.164	-0.262	-0.012
	(0.308)	(0.247)	(0.957)
rec_l_capx	-0.457*	-0.816**	-0.157
	(0.079)	(0.032)	(0.668)
exp_l_divpayer	-0.004	0.003	-0.018
	(0.732)	(0.824)	(0.356)
rec_l_divpayer	-0.004	0.001	-0.010
	(0.741)	(0.956)	(0.683)
exp_l_cash	0.283***	0.280***	0.284***
	(0.000)	(0.000)	(0.000)
rec_l_cash	0.281***	0.335***	0.212***
	(0.000)	(0.000)	(0.000)
exp_l_rated	-0.082***	-0.063***	-0.113***
	(0.000)	(0.006)	(0.000)
rec_l_rated	-0.115***	-0.110***	-0.121***
	(0.000)	(0.000)	(0.000)
rec	-0.005	-0.042**	0.041*
	(0.751)	(0.035)	(0.076)
Constant	0.138***	0.147***	0.123***
	(0.000)	(0.000)	(0.001)
Observations	30,546	18,739	11,807
Number of firms	4,081	2,400	1,681
R-squared	0.121	0.120	0.123

Table IA5 Multivariate regressions using long time series data

This table presents individual coefficient estimates of Table 6 in the paper. Variable definitions are summarized in Appendix A of the paper. ****, **, * indicate significance at the 1%, 5%, and 10% level.*

Panel A: Market and private debt regressions						
	all	*ccyc_bl*	*pcyc_bl*	*all*	*ccyc_bl*	*pcyc_bl*
VARIABLES	*md/at*	*md/at*	*md/at*	*pd/at*	*pd/at*	*pd/at*
exp_l_size	0.024***	0.028***	0.019***	-0.008***	-0.002	-0.016***
	(0.000)	(0.000)	(0.000)	(0.009)	(0.661)	(0.000)
rec_l_size	0.029***	0.031***	0.025***	-0.008**	-0.011**	-0.009*
	(0.000)	(0.000)	(0.000)	(0.018)	(0.015)	(0.051)
exp_l_mtb	-0.011***	-0.009***	-0.012**	-0.006*	-0.004	-0.008
	(0.000)	(0.010)	(0.016)	(0.085)	(0.410)	(0.189)
rec_l_mtb	-0.001	0.003	-0.007	-0.008*	-0.004	-0.013**
	(0.806)	(0.589)	(0.163)	(0.093)	(0.536)	(0.014)
exp_l_profit	-0.238***	-0.304***	-0.147*	-0.224***	-0.183**	-0.282**
	(0.000)	(0.000)	(0.052)	(0.004)	(0.039)	(0.034)
rec_l_profit	-0.473***	-0.503***	-0.369***	-0.229**	-0.071	-0.208*
	(0.000)	(0.000)	(0.000)	(0.036)	(0.604)	(0.090)
exp_l_tang	-0.051**	-0.087***	0.004	0.112***	0.125***	0.077**
	(0.013)	(0.001)	(0.896)	(0.000)	(0.000)	(0.044)
rec_l_tang	-0.055**	-0.099***	0.006	0.135***	0.156***	0.069
	(0.020)	(0.001)	(0.859)	(0.000)	(0.000)	(0.102)
exp_l_capx	-0.275***	-0.378***	-0.094	-0.107	0.017	-0.241
	(0.000)	(0.000)	(0.450)	(0.289)	(0.897)	(0.110)
rec_l_capx	-0.438***	-0.406**	-0.319**	-0.233	-0.253	0.249
	(0.001)	(0.042)	(0.037)	(0.190)	(0.289)	(0.247)
exp_l_divpayer	-0.007	-0.006	-0.009	-0.007	-0.008	-0.004
	(0.214)	(0.427)	(0.302)	(0.281)	(0.353)	(0.653)
rec_l_divpayer	-0.005	-0.003	-0.016	0.011	-0.002	0.022**
	(0.487)	(0.746)	(0.112)	(0.205)	(0.843)	(0.046)
exp_l_cash	0.038**	0.027	0.061**	-0.161***	-0.153***	-0.164***
	(0.039)	(0.228)	(0.043)	(0.000)	(0.000)	(0.000)
rec_l_cash	0.004	0.098**	-0.073**	-0.153***	-0.100**	-0.150***
	(0.897)	(0.042)	(0.042)	(0.000)	(0.018)	(0.000)
exp_l_rated	0.079***	0.070***	0.093***	-0.055***	-0.060***	-0.051***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
rec_l_rated	0.053***	0.055***	0.053***	-0.073***	-0.085***	-0.053***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
rec	-0.014	-0.001	-0.020	0.004	0.096***	-0.106***
	(0.219)	(0.953)	(0.171)	(0.779)	(0.000)	(0.000)
Constant	-0.016	-0.024	-0.016	0.324***	0.273***	0.390***
	(0.333)	(0.244)	(0.540)	(0.000)	(0.000)	(0.000)
Observations	18,864	11,411	7,453	18,864	11,411	7,453
Number of firms	1,421	834	587	1,421	834	587
R-squared	0.090	0.079	0.123	0.071	0.069	0.084

Panel B: HHI regressions			
	all	*ccyc_bl*	*pcyc_bl*
VARIABLES	*HHI*	*HHI*	*HHI*
exp_l_bl	-0.402***	-0.404***	-0.392***
	(0.000)	(0.000)	(0.000)
rec_l_bl	-0.356***	-0.246***	-0.480***
	(0.000)	(0.000)	(0.000)
exp_l_size	-0.079***	-0.075***	-0.084***
	(0.000)	(0.000)	(0.000)
rec_l_size	-0.088***	-0.080***	-0.094***
	(0.000)	(0.000)	(0.000)
exp_l_mtb	0.016**	0.020**	0.007
	(0.026)	(0.025)	(0.580)
rec_l_mtb	0.011	0.018	-0.003
	(0.246)	(0.164)	(0.818)
exp_l_profit	0.737***	0.807***	0.629***
	(0.000)	(0.000)	(0.000)
rec_l_profit	0.905***	0.862***	0.910***
	(0.000)	(0.001)	(0.000)
exp_l_tang	0.092*	0.146**	0.008
	(0.062)	(0.032)	(0.910)
rec_l_tang	0.060	0.133*	-0.059
	(0.319)	(0.100)	(0.480)
exp_l_capx	0.368*	0.356	0.391
	(0.064)	(0.166)	(0.192)
rec_l_capx	0.281	0.553	0.214
	(0.433)	(0.295)	(0.646)
exp_l_divpayer	-0.003	0.000	-0.007
	(0.839)	(0.995)	(0.723)
rec_l_divpayer	0.011	0.009	0.018
	(0.574)	(0.739)	(0.493)
exp_l_cash	-0.013	0.001	-0.041
	(0.776)	(0.989)	(0.573)
rec_l_cash	0.071	0.063	0.030
	(0.284)	(0.514)	(0.728)
exp_l_rated	-0.272***	-0.276***	-0.263***
	(0.000)	(0.000)	(0.000)
rec_l_rated	-0.238***	-0.234***	-0.241***
	(0.000)	(0.000)	(0.000)
rec	0.018	-0.074	0.099**
	(0.578)	(0.120)	(0.027)
Constant	1.225***	1.183***	1.288***
	(0.000)	(0.000)	(0.000)
Observations	18,864	11,411	7,453
Number of firms	1,421	834	587
R-squared	0.282	0.282	0.284