Journal of Financial Economics 122 (2016) 21–41

Contents lists available at ScienceDirect

Journal of Financial Economics

journal homepage: www.elsevier.com/locate/jfec

Leverage dynamics over the business cycle☆

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ARTICLE INFO

Article history:
Received 19 November 2014
Revised 12 October 2015
Accepted 9 November 2015
Available online 28 July 2016

JEL Classification:
G32
G15

Keywords:
Empirical corporate finance
Capital structure dynamics
Business cycle variation

ABSTRACT

Surprisingly little is known about the business cycle dynamics of leverage. The existing evidence documents that target leverage evolves pro-cyclically either for all firms or financially constrained ones. In contrast, we show that, on average, target leverage ratios evolve counter-cyclically once cyclicality is measured comprehensively, accounting for variation in explanatory variables and model parameters. These counter-cyclical dynamics are robust to different subsamples of firms, data samples, empirical models of leverage, and definitions of leverage. There is a fraction of 10–25% of firms with pro-cyclical dynamics whose characteristics are consistent with counter-cyclical dynamics for loss-given-default and probability of default.

1. Introduction

The recent financial crisis and the following sharp economic recession have sparked substantial interest in the link between macroeconomic conditions and firms' financial structures. During recessions most of the main theoretical capital structure determinants experience significant shocks. For example, corporate cash flows drop for many firms and their effective corporate tax rates are reduced. This may give rise to demand variation of firms' optimal capital structure over the business cycle. Maybe equally important, capital market conditions also covary with macroeconomic conditions generating supply effects on optimal capital structure.[1] Moreover, demand and supply effects may be interacted by changing the link between corporate characteristics and optimal financial leverage. Documenting and understanding the relation between macroeconomic conditions and capital structure dynamics may therefore generate important insights about firms' financing decisions more generally.

From a theoretical point of view, the prediction of the business cycle effect on optimal financial leverage is ambiguous. In a standard economic environment with

☆ We particularly thank Johann Reindl and Zhe An for excellent research assistance. We are grateful to Indraneel Chakraborty (FIRS discussant), Sudipto Dasgupta (Asian FA discussant), Ning Gong (FIRN discussant), Vidhan Goyal, Uli Hege, Nadia Malenko (EFA discussant), Ron Masulis, Erwan Morellec, Timothy Riddiough (FMA Asia discussant), Norman Schuerhoff, David Sraer (AFA discussant), participants of the FMA Asia meetings (2011), Asian FA meetings (2011), the EFA meetings (2011), the AFA meetings (2012), the FIRS meetings (2012), the 4Nations Cup (2013), FIRN Corporate Finance Group meeting (2013), and seminars at the Vienna Graduate School of Finance, Bocconi, University of Melbourne, University of Illinois at Urbana-Champaign, NHH Bergen, Copenhagen Business School, HEC Paris, Stockholm University and University of Amsterdam. All errors are our responsibility.

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[1] For example, equity capital of financial intermediaries is reduced during recessions, asset market conditions may change influencing transactions costs of issuing various securities, or costs of financial distress might increase.

http://dx.doi.org/10.1016/j.jfineco.2016.07.001
0304-405X/

risk-neutral agents and constant risk-free rate, Hackbarth, Miao, and Morellec (2006) find that for their base parameters the value-maximizing leverage ratio is higher in a recession than in a boom. Thus, Hackbarth, Miao, and Morellec's (2006) model predicts counter-cyclical market leverage dynamics. In their framework, both the numerator (debt) and the denominator (present value of future cash flows) of the optimal market leverage ratio vary pro-cyclically, i.e., are larger during expansions than during recessions. As a consequence, the prediction for the dynamics of the market leverage ratio is ambiguous and depends on the cyclicality of borrowing relative to that of the present value of future cash flows. Hackbarth, Miao, and Morellec (2006) find, however, that for their model parameterizations the denominator effect always dominates the numerator effect resulting in counter-cyclical market leverage ratios.[2]

Bhamra, Kuehn, and Strebulaev (2010) provide a general equilibrium model of capital structure choice. In their model agents are risk-averse and recessions are periods of high marginal utilities and slower expected corporate cash-flow growth. In this framework, the risk-free rate of return is determined endogenously and turns out to vary pro-cyclically. This pro-cyclical variation in the risk-free rate of return contributes to a conclusion opposite to that of Hackbarth, Miao, and Morellec (2006). Moreover, Bhamra, Kuehn, and Strebulaev (2010) assume counter-cyclical loss-given-default (see also Shleifer and Vishny, 1992), which implies that firms borrow more during expansions than recessions. Overall, the numerator effect (pro-cyclical borrowing) dominates the denominator effect (pro-cyclical equity continuation value) in their model and the optimal market leverage ratio evolves pro-cyclically over the business cycle. In related work, Chen (2010) reaches the same conclusion of pro-cyclical market leverage dynamics.

None of the three theoretical models discussed above determines the dynamics of the leverage ratio analytically in closed form. As a consequence, even within each model's set of assumptions the theoretical predictions must be derived from specific parameter estimates. Thus, whether optimal leverage ratios evolve pro-cyclically or counter-cyclically remains largely an empirical question. However, empirical evidence on the cyclicality of corporate capital structures is scarce. There are only two directly relevant papers to the best of our knowledge. Korajczyk and Levy (2003) analyze the importance of macroeconomic variables to explain time-series variation in leverage ratios. Their main finding is that target leverage of financially unconstrained firms varies counter-cyclically with macroeconomic conditions while that of constrained firms shows pro-cyclical dynamics. Based on an (S, s) model of capital structure, Korteweg and Strebulaev (2013) propose a new econometric approach to analyze leverage dynamics. Using this framework, they report that target leverage evolves pro-cyclically over the business cycle. Taken together, the existing empirical studies conclude that firms' leverage tends to increase during economic booms, at least for financially constrained firms. The mixed theoretical predictions and the at least partly ambiguous empirical evidence motivate us to revisit the question of how optimal financial leverage evolves over the business cycle.

Our study differs in various ways from the above two empirical studies. The key innovation of our paper is related to the concept of leverage cyclicality. Both, Korajczyk and Levy (2003) and Korteweg and Strebulaev (2013), derive leverage cyclicality from the signs of coefficient estimates of macroeconomic variables related to recessions or a recession dummy. We will refer to this effect as the "direct effect"of the business cycle. It has the usual ceteris paribus interpretation of a firm that has otherwise the exact same characteristics but finds itself in a recession rather than an expansion. The advantage of the ceteris paribus approach is that it emphasizes the average effect that the business cycle exhibits on all firms independent from their characteristics. However, this approach ignores the effect of the business cycle on leverage determinants. Thus, this type of analysis and its implications are of limited use if one is interested in understanding overall business cycle dynamics of leverage. For example, growth opportunities are an important leverage determinant, capturing the agency conflict between shareholders and debtholders among other things. Growth opportunities, however, are also known to vary over the business cycle and, even more importantly, might do so differently across firms, as some firms' growth opportunities are more sensitive to business cycle fluctuations than others. Similarly, even if we ignore the cyclical patterns of firm characteristics, the relation between these variables and target leverage (i.e., the coefficients in our empirical models) could vary over the business cycle. Considering again the example of growth opportunities, the severity of the agency conflict between shareholders and debtholders could be different during recessions than during expansions. In a ceteris paribus analysis, however, there is no room to capture any of these effects.

Thus, we move away from the ceteris paribus approach in this paper and, in contrast, take the discussed additional channels explicitly into account. First, we explicitly recognize that firm characteristics, such as profitability, vary systematically over the business cycle. This variation is likely to affect optimal leverage and, thus, its cyclicality. One potential interpretation of the effects of changing firm characteristics is that they proxy for demand effects since changing firm characteristics will generally change firms' relative demand for debt and equity, even holding

[2] Levy and Hennessy (2007) also predict counter-cyclical dynamics using a general equilibrium model that analyzes the interplay between managers' personal portfolio choices and their firms' external financing policies. In their model, firms are controlled by entrenched managers who can expropriate firms' outside investors through diverting, with dead-weight costs, firms' cash flows and assets. They show optimal external financing features a tradeoff between risk-sharing against efficiency. To eliminate costly diversion, managers must maintain a substantial inside equity. However, given their equity stakes, risk-averse managers face under-diversification costs that are more pronounced in economic downturns. Therefore, during recessions managers issue debt and use the proceeds to repurchase external equity. On the contrary, managers' personal wealth increases in an economic boom and encourages them to issue equity to retire debt.

constant the conditions under which the capital markets supply these types of capital.[3]

Second, we also allow the relation between firm characteristics and optimal leverage to change over the business cycle. Specifically, we allow the coefficient estimates in our regressions to vary over the business cycle. One potential interpretation of such coefficient variation is that it captures supply effects. If suppliers of corporate debt capital are more constrained during recessions, their pricing of corporate debt may differ during different phases of the business cycle. For example, the tangibility of a borrower's assets may have a larger effect on the cost of corporate debt during a recession than during a boom.[4] An alternative interpretation of time-varying coefficients is that they proxy for shifts in the demand function for debt. For example, if firms with lots of tangible assets want to exploit their relative strength during recessions, they might demand more debt compared to expansionary periods.

In the remainder of the paper we will jointly label the effects of changing firm characteristics and changing relations between firm characteristics and leverage as "indirect effects." As explained above, any ceteris paribus analysis based exclusively on the coefficient estimates of macroeconomic variables (the "direct effects") ignores them. Whether they matter at all and how realized and target leverage evolve over the business cycle once both types of effects are considered represent the main questions that we focus on in the empirical analysis. Both approaches to study dynamics of leverage suffer from an important shortcoming, namely, that the analysis will most likely compare different firms during recessions and expansions. For example, in our framework the average/median firm during expansions will most likely not be identical to the one during recessions.

Given the ambiguity of both theoretical predictions and empirical evidence, a crucial goal of our analysis is to provide robust results. Since there is no agreement in the literature on the "correct"empirical specification of leverage dynamics, we apply the two most common empirical specifications for target leverage. Our main empirical model is based on fixed effects regressions for a subsample of actively refinancing firms. In robustness tests, we also look at partial adjustment models. In addition, we also distinguish two distinct data samples. While we focus on the standard US-based sample with quarterly observations throughout the paper, we also present results for an international sample with yearly accounting data and business cycle information from 18 countries. The international data enable us to distinguish different types of recessions, namely, such with and without contemporaneous banking crises.

Our main result is that observed and target leverage—for book as well as market values—evolve counter-cyclically over the business cycle. This result is very robust across different data samples, empirical models of target leverage, and leverage definitions. Interestingly, when we zoom into the cross-section of firms we find counter-cyclical dynamics for financially unconstrained as well as constrained firms, in contrast to Korajczyk and Levy (2003) who argue that constrained firms have pro-cyclical leverage dynamics. Nevertheless, at least 10% (25%) of the sample firms have pro-cyclical target (observed) leverage dynamics. These are firms that have, on average, higher market-to-book ratios and smaller fractions of tangible assets and tend to exhibit counter-cyclical dynamics for the loss-given-default (see, e.g., Shleifer and Vishny, 1992; Kim, 1998).

When we decompose leverage dynamics into different sources, we find that the direct effect of recessions (captured by the coefficient of the recession dummy) as well as the indirect effects (captured by the variation in model parameters and explanatory variables) play important roles.[5] Finally, we also document that it matters whether an economic recession is accompanied by a banking crisis or not: counter-cyclical dynamics are much more pronounced in the latter case.

Our paper also relates more generally to the literature studying leverage dynamics. While the predominant view in the literature is that leverage is rather stable and driven mostly by time-invariant determinants (e.g., Lemmon, Roberts, and Zender, 2008), more recent studies challenge this view (e.g., DeAngelo and Roll, 2015). We contribute to this discussion in two ways. First, we show substantial variation of target leverage ratios over the business cycle. Second, we document variation in the parameters governing leverage dynamics, i.e., variation in the coefficients measuring the impact of firm characteristics on target leverage. For example, the coefficient of the market-to-book ratio becomes much more negative during recessions than during expansions consistent with the interpretation that the debt overhang problems become more severe during recessions (see, e.g., Lamont, 1995; Occhino and Pescatori, 2015).

The rest of the paper is organized as follows: Section 2 motivates and explains the empirical strategy; Section 3 describes the data and the two samples that we analyze in this paper; Section 4 reports our main empirical results for the quarterly US-sample including a battery of robustness checks; Section 5 presents results for the international sample and different types of recessions; and Section 6 concludes.

[3] We are not the first ones to consider the time-variation of firm characteristics in this context. Although it is not a main focus of their analysis, Korteweg and Strebulaev (2013), in their Fig. 7, single out the impact of time-varying firm characteristics on leverage dynamics arising from their (*S, s*) model by fixing macroeconomic variables at their sample medians.

[4] For example, credit markets do not tighten up equally for all firms during recessions; instead, debt capital might become more expensive and harder to obtain for firms with little collateral. See, e.g., the macrofinance literature on debt capacity and collateral, e.g., Bernanke and Gertler (1989), Calomiris and Hubbard (1990), Gertler (1992), Greenwald and Stiglitz (1992), Shleifer and Vishny (1992), Holmstrom and Tirole (1997), Bernanke, Gertler, and Gilchrist (1996), and Kiyotaki and Moore (1997).

[5] Note that the relative importance of these sources in the decomposition of the counter-cyclical dynamics is model- and sample-dependent. In our opinion, this is not too surprising given that individual empirical specifications make very different assumptions on firms' adjustment toward target leverage. Similarly, results of the international sample might differ from the US-only sample due to country-specific effects.

2. Empirical design

In this section we provide a discussion of the link between firms' capital structure and the business cycle. In addition, we introduce the empirical specifications used to model target leverage and discuss our definition of cyclicality.

2.1. Capital structure and the business cycle

Tradeoff models (see, e.g., Fischer, Heinkel, and Zechner, 1989; Leland, 1994; Goldstein, Ju, and Leland, 2001) predict that it is optimal for firms to borrow more when they are subject to higher corporate taxes, lower debt issuance costs, lower bankruptcy costs, and lower profit volatility. In such models, the state variable process and the model parameters are constant through time. Thus, a business cycle can only be interpreted as negative shocks to the underlying state variable (e.g., the cash-flow process). Narrowly interpreted, once we control for all relevant firm characteristics that change with the business cycle, we should not find any other variables, such as the business cycle itself, explaining optimal financial leverage. The functional relation between model parameters and target leverage would remain constant over time. This is the case if there are no other frictions in the economy than those considered in the tradeoff models (e.g., effective tax rates, transactions costs, bankruptcy costs, etc.).

If one extends the tradeoff models to allow for some other frictions that vary with the business cycle, then the business cycle may have additional effects on optimal capital structure rather than those through changing firm characteristics. To capture such frictions, models, such as Hackbarth, Miao, and Morellec (2006), Bhamra, Kuehn, and Strebulaev (2010), and Chen (2010), tie the parameters of the underlying cash-flow process to macroeconomic conditions modeled by regime switching processes.[6] Furthermore, Bhamra, Kuehn, and Strebulaev (2010) and Chen (2010) allow the loss-given-default to vary over the business cycle. Hackbarth, Miao, and Morellec (2006) focus on constant loss-given-default in their main analysis, but examine the effect of counter-cyclical loss-given-default on the dynamics of corporate debt capacity in supplementary analyses.

While these models capture the business cycle primarily via an effect on firms' cash-flow processes, there are other channels, through which changing market frictions can affect firms' leverage choices. For example, it is likely that transactions costs associated with leverage adjustments vary over the business cycle and that these variations are different for different types of external financing (i.e., debt vs. equity). In such a broader interpretation of the tradeoff paradigm, target capital structures result from an interplay between firm characteristics and capital market supply effects.[7]

Interpreted even more broadly, capital market supply effects may include deviations of stock and bond prices from fundamental valuations. For example, in a survey, Graham and Harvey (2001) find that the majority of Chief Financial Officers (CFOs) state that the amount by which their stock is over- or undervalued plays an important role when deciding whether to issue equity or not. The effect of investors with limited rationality on financial markets has been analyzed theoretically, for example, by Fischer and Merton (1984), De Long, Shleifer, Summers, and Waldmann (1990), Morck, Shleifer, and Vishny (1990), Blanchard, Rhee, and Summers (1993), and Stein (1996).

According to this literature, firms can actively exploit misvaluations by timing their equity and debt issues. Firms find it optimal to issue more equity and, hence, lower their leverage ratio when equity market valuation levels are generally high and/or after a run-up in their stock price. Pagano, Panetta, and Zingales (1998), among others, provide some empirical evidence on such timing. Similarly, more corporate debt is issued when equity valuation levels are low and/or interest rates are low. Baker and Wurgler (2002), for example, show empirical evidence on the market timing view of capital structure dynamics. When deviations from fundamental valuation levels covary with the business cycle, then this gives rise to pro- or countercyclicality of leverage.

The above discussion shows that there are multiple channels through which the business cycle might affect firm leverage. Given that the goal of our study is to analyze their joint impact on leverage dynamics, our empirical design must be broad enough to capture business cycle effects coming from the various channels. This requires that the business cycle must be allowed to have effects on optimal capital structure through: (1) changing firm characteristics (i.e., firm-level leverage determinants), (2) changing effects of these characteristics on leverage, and (3) a recession dummy.

The empirical literature on leverage dynamics has focused on (3) and has drawn conclusions about the cyclicality of target leverage from interpreting the coefficients of recession dummies or macroeconomic variables. Instead, we argue that relying on the sign of such coefficients is not sufficient to draw conclusions about the cyclicality of leverage. A more comprehensive analysis would consider the difference between fitted values of target leverage during recessions and expansions, rather than on the sign of coefficients of specific explanatory variables. This will

[6] Precisely, Hackbarth, Miao, and Morellec (2006) multiply a firm's cash-flow process by a regime switching process that has a higher value during expansions than recessions. In Bhamra, Kuehn, and Strebulaev (2010), and Chen (2010), the growth and volatility parameters of a firm's cash-flow process and the aggregate consumption process are multiplied by regime switching processes.

[7] There are at least two potential channels, through which such "supply" effects can arise. First, raising external capital requires the services of intermediaries. The intermediaries' ability to provide these services may vary over time, for example, due to shocks that affect their capitalization. Such supply effects on the provision of debt capital have been explored, for example, by Holmstrom and Tirole (1997), Bernanke and Blinder (1992), Romer, Romer, Goldfeld, and Friedman (1990), Kashyap, Stein, and Wilcox (1993), or Leary (2009). Second, liquidity in the secondary markets for corporate securities may also change over the business cycle. Changing liquidity of secondary debt markets has been explored, for example, by Ericsson and Renault (2006), Duffie, Garleanu, and Pedersen (2007), and Hennessy and Zechner (2011).

automatically account for time-varying leverage determinants (see (1) above). However, this approach still assumes that the effect of explanatory variables on leverage is constant over the business cycle. To capture business cycle effects discussed in point (2) above in a parsimonious way we therefore allow the coefficients in our empirical specifications to be business-cycle-dependent (i.e., we distinguish coefficients during expansions and recessions). To the best of our knowledge, our paper is the first to account for all three channels above and to measure target leverage cyclicality accordingly.

2.2. Empirical models of target leverage

While empiricists largely agree on the set of variables that affect target leverage ratios, they propose different econometric models to estimate target leverage. In the literature, several dynamic tradeoff models require firms to buy back all existing debt, before new debt can be issued, usually at a proportional issue cost. This introduces a fixed-cost element for recapitalizations and implies that firms infrequently adjust their leverage. Thus, fixed costs of recapitalization imply that firms are usually not at their target leverage unless one observes a lumpy adjustment.

Our main empirical specification therefore accounts for costly leverage adjustments, as we estimate panel regressions for a refinancing subsample, in which we observe substantial leverage adjustments, instead of the entire sample. The existing literature (see, e.g., Hovakimian, Opler, and Titman, 2001; Korajczyk and Levy, 2003; Hovakimian, Hovakimian, and Tehranian, 2004; Leary and Roberts, 2005) suggests a 5% cutoff to define substantial capital structure adjustments. Similarly, we compute the net change in debt as the change in total debt from period $t-1$ to t and net change in equity as the difference between equity issuance and repurchases that occurred in period t. Next, we define the net change in capital structure as the difference between the net changes in debt and in equity. Last, a firm-quarter (firm-year) is classified as a refinancing observation and enters our refinancing subsample if we observe a net change in a firm's capital structure that is greater than 5% of last period's total assets. In principle, this estimation method rests on the assumption that firms' actual leverage ratios, on average, coincide with their targets when we observe substantial capital structure adjustments.[8]

More formally, we specify a firm's target leverage ratio, **Tlr**, as follows:

$$\mathbf{Tlr}_{i,t+1} = \beta_0 + \beta_0^{rec}\mathbf{1}_{t+1}^{rec} + \sum_s (\beta^s \mathbf{X}_i)\mathbf{1}_{t+1}^s,$$
$$s \in S \equiv \{rec, exp\}, \quad (1)$$

where $\mathbf{1}_t^{rec}(\mathbf{1}_t^{exp})$ is a dummy variable that equals one when there is a recession (an expansion) at time t and zero otherwise.[9] β_0^{rec} captures the direct effect of the business cycle on target leverage, while β^s reflects cycle-dependent coefficients. $\mathbf{X}_i$ is a vector of firm-level characteristics, i.e.,

$$\mathbf{X} = [sales, mtb, \ profit, tang, capx], \quad (2)$$

where *sales* is sales, *mtb* is market-to-book ratio, *profit* is profitability, *tang* is tangibility, and *capx* is capital expenditures.[10] All explanatory variables are lagged by one period following the literature. We elaborate more on firm characteristics in Section 3 and report detailed variable definitions in Appendix A (Table A.1).

However, even after an active capital structure adjustment, firms may not find it optimal or possible to move all the way to their target ratios in the presence of proportional or convex transactions costs (see, e.g., Fischer, Heinkel, and Zechner, 1989). This is also true if firms face both fixed and proportional transactions costs associated with capital structure adjustments (see Strebulaev, 2007). Alternatively, some authors, such as Brennan and Schwartz (1984), model capital structure as an impulse control problem where firms can issue or retire debt at some maximum rate to adjust leverage. All these models have in common that firms are usually not at their target leverage ratio and that recapitalizations move firms toward their target, but not all the way. Thus, we estimate dynamic partial adjustment capital structure models (DPACS-Models) that allow firms to partially move toward their targets over time.[11] The results from these models are discussed in the robustness section.

Following Fama and French (2002), we estimate a DPACS-Model which contemporaneously estimates time-varying target leverage ratios and the speed of adjustment with which actual leverage ratios move toward target leverage ratios. Specifically, we need to take into account that observed leverage, denoted by **lr**, may be different from target leverage. This yields the following econometric specification:

$$\mathbf{lr}_{i,t+1} - \mathbf{lr}_{i,t} = \sum_s \alpha^s \mathbf{1}_{t+1}^s (\mathbf{Tlr}_{i,t+1} - \mathbf{lr}_{i,t}) + e_{i,t+1}. \quad (3)$$

Substituting Eq. (1) into Eq. (3), rearranging, and simplifying gives the model we estimate

$$\begin{aligned}\mathbf{lr}_{i,t+1} = {} & (1-\alpha^{exp})\mathbf{lr}_{i,t}^{exp} + (1-\alpha^{rec})\mathbf{lr}_{i,t}^{rec} + \alpha^{exp}\beta^{exp}\mathbf{X}_i^{exp} \\ & + \alpha^{rec}\beta^{rec}\mathbf{X}_i^{rec} \\ & + (\alpha^{rec}\beta_0 + \alpha^{rec}\beta_0^{rec} - \alpha^{exp}\beta_0)\mathbf{1}_{t+1}^{rec} + \alpha^{exp}\beta_0 + e_{i,t+1},\end{aligned} \quad (4)$$

where we define $\mathbf{lr}_{i,t}^{exp} \equiv \mathbf{lr}_{i,t}\mathbf{1}_{t+1}^{exp}$ and $\mathbf{lr}_{i,t}^{rec} \equiv \mathbf{lr}_{i,t}\mathbf{1}_{t+1}^{rec}$. The same definition is applied to firm characteristics summarized in the **X** vector.

Estimating the DPACS-Model is econometrically challenging. Following Flannery and Hankins (2013) who evaluate different techniques, we use the Corrected Least Square Dummy Variable estimator (see Kiviet, 1995) and

[8] As a robustness test, we also evaluate a different definition of refinancing events following Danis, Rettl, and Whited (2014). Note, however, that their definition excludes leverage changes that are concurrent with large changes in assets.

[9] As shall become clear later, we estimate our target leverage for a US-only sample (main results) and an international sample (international extension). Therefore, our recession and expansion dummies are country-specific when dealing with the international sample.

[10] As a robustness test, we also include industrial mean leverage in the empirical leverage specification.

[11] See Chang and Dasgupta (2009) and Iliev and Welch (2010) for critical discussions of these models.

the System Generalized Method of Moments (GMM) estimator see Blundell and Bond (1998) for details and Roodman (2009) for an introduction to the estimation. When using System GMM to estimate the DPACS-Model, we control for contemporaneous firm characteristics and use their second and third lags as instruments. When estimating the Corrected Least Square Dummy Variable (LSDV) model, we follow the literature and control for lagged firm characteristics that are assumed to be exogenous (see, e.g., Kiviet, 1995; and Flannery and Hankins, 2013).

2.3. Target leverage cyclicality

In this section, we describe how we measure cyclicality of target leverage over the business cycle at the firm-level. While the approach is quite intuitive, it is novel and has not yet been explored in the literature.

Let us write **Tlr** as $\mathbf{Tlr}(\mathbf{X}, \mathbf{1}^{rec}, \mathbf{1}^{exp})$. This notation highlights the effects of firm characteristics and the business cycle on target leverage. Consider now an individual firm with time-varying firm characteristics $\mathbf{X}^{exp}$ and $\mathbf{X}^{rec}$ ($\mathbf{X}^{exp}$ and $\mathbf{X}^{rec}$ represent the time-series average firm characteristics during expansions and recessions). This firm's target leverage ratios in different macroeconomic states are given by

$$\mathbf{Tlr}^{exp} = \mathbf{Tlr}(\mathbf{X}^{exp}, \mathbf{1}^{exp} = 1, \mathbf{1}^{rec} = 0) = \beta_0 + \mathbf{X}^{exp}\beta^{exp}; \quad (5)$$

and

$$\mathbf{Tlr}^{rec} = \mathbf{Tlr}(\mathbf{X}^{rec}, \mathbf{1}^{exp} = 0, \mathbf{1}^{rec} = 1) = \beta_0 + \beta_0^{rec} + \mathbf{X}^{rec}\beta^{rec}. \quad (6)$$

Next, we define the cyclicality of target leverage over the business cycle as the difference between the target leverage ratios during expansions and recessions. This yields the following expression:

$$\Delta\mathbf{Tlr} = \mathbf{Tlr}^{rec} - \mathbf{Tlr}^{exp} = \beta_0^{rec} + \left(\mathbf{X}^{rec}\beta^{rec} - \mathbf{X}^{exp}\beta^{exp}\right). \quad (7)$$

Thus, our notion of cyclicality depends on the difference between estimated target leverage ratios during recessions and expansions. By looking at estimated target leverage ratios, we automatically incorporate the effects of (i) time-varying firm characteristics, (ii) time-varying coefficients, and (iii) the business cycle itself through a recession dummy. The combined effects of (i) and (ii) are captured by $\left(\mathbf{X}^{rec}\beta^{rec} - \mathbf{X}^{exp}\beta^{exp}\right)$ while β_0^{rec} measures (iii). This definition of cyclicality is very different from the one used in the literature, which only looks at the latter effect; specifically, at the sign of β_0^{rec}.

3. Data and samples

We estimate our empirical models using both the standard US sample (based on Compustat) and an international sample (based on Datastream and Worldscope). We do this to ensure that our results are robust and because each sample has advantages and disadvantages. The main advantage of the international sample is that it includes a relatively large number of recession observations because it covers 18 countries. However, its key disadvantage—especially, for a study analyzing dynamics—is that the data frequency is only yearly. In contrast, the US-only sample drawn from Compustat provides data at a quarterly frequency. Furthermore, it represents the most commonly used sample and, thus, facilitates comparisons across studies.

For the quarterly US-only sample, we use the National Bureau of Economic Research's (NBER) business cycle expansions and contractions to construct the business cycle variable for US firms. We define a recession dummy that equals one in NBER peak-to-trough recession quarters (more on this below). For the international sample, our source of business cycle data is Economic Cycle Research Institute's (ECRI) international cycle dates. We use the business cycle chronologies file that includes countries from America, Europe, Asia Pacific, Africa, and Middle East regions. We end up with 18 countries, ranging from developing to developed, for which we have information on both business cycle dates and firm-level variables. Specifically, these countries are: Australia, Austria, Brazil, Canada, France, Germany, India, Italy, Japan, Korea, Mexico, New Zealand, Spain, Sweden, Switzerland, Taiwan, the UK, and the US.[12] Note that the US is part of both samples.

We obtain quarterly firm-level balance sheet items from Compustat North American Quarterly files for the US-only sample. Our sample period ranges from 1984 to 2009. We use Datastream (Worldscope) to obtain annual firm-level accounting data for the international sample. Like the US-only sample, our international sample also covers the period of 1984 to 2009.[13]

We apply the following filters to the US-only and the international samples. Financial firms and utility firms are usually regulated and, hence, their leverage choices ought to be quite different from other industrial firms. For this reason and following the literature, we remove financial firms and utility firms. Moreover, we drop firm-quarter (firm-year) observations that meet any of the following conditions: (i) zero book value of total assets, (ii) zero market capitalization, (iii) negative cash, (iv) negative long-term debt, and (v) negative short-term debt. To avoid outliers, we remove very small firms that have average book values of total assets less than 10 million US dollars.[14] We further drop observations with (A) negative net sales and (B) net leverage ratio of less than −1.[15] We do allow firms, at some point in time, to be cash savers, i.e., carrying a negative net leverage ratio, rather than borrowers. However, we remove firm-quarter (firm-year) observations with net leverage ratios less than −1 because such firms hold a tremendous amount of cash relative to their other types of assets and, hence, are unlikely to be regular industrial firms.

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[12] Our business cycle data also cover China. However, in our subsequent analysis, we remove China from our database because there are no recessions during the sample period.

[13] In our sample some countries have shorter periods of data available than others. We do not have firms from all countries for all years between 1984 and 2009. However, our first observations are in 1984 and last observations are in 2009.

[14] We use Consumer Price Index (CPI) (year 2003 as the base year) and exchange rates to adjust our level variables, such as total assets and sales.

[15] Net leverage ratio refers to the ratio of total debt less cash plus short-term investments to market (book) value of total assets.

In our empirical analysis, we define the market leverage ratio as the ratio of total debt to market value of total assets. The market value of total assets is total assets (book value) less book equity plus market capitalization of equity. Similarly, we define the book leverage ratio as the ratio of total debt to total assets (book value). We remove firm-quarters (firm-years) with leverage ratios greater than one. In the robustness section we look at alternative leverage measures, namely, net market (book) leverage ratio that is defined as the ratio of total debt less cash and short-term investments to market (book) value of total assets.

Of particular importance for our analysis is the definition of the recession dummy. Specifically, we define a quarter of the US-only sample to be in a recession if it falls within an NBER peak-to-trough period. Similarly, for the yearly international sample we define that a firm-year is in a recession if a firm's entire fiscal year overlaps with a recession.[16]

We also control for other variables, which have been widely used in the literature, including the logarithm of net sales (*sales*), market-to-book ratio (*mtb*), operating income before depreciation to the book value of total assets ratio (*profit*), net PPE (property, plant, and equipment) to the book value of total assets ratio (*tang*), and capital expenditures to the book value of total assets ratio (*capx*). We winsorize *mtb* at the 95%-level, *sales, profit, tang*, and *capx* at the 1% and 99%-levels. Variable definitions are summarized in Appendix A.

Table 1 summarizes the descriptive statistics of the firms in our main samples. We report the summary statistics for US-only firm-quarters (Compustat sample) in Panel A. There are 281,949 expansionary firm-quarters and 46,395 recessionary firm-quarters. That is, about 14% of firm-quarters are in economic downturns. Panel B analyzes the sample of international firm-years (including US firm-years) based on Datastream. We note that there are 171,922 expansionary firm-years and 17,349 recessionary firm-years. Loosely speaking, we observe a recessionary observation in one out of 11 years.[17]

Firm characteristics seem to substantially and, in most cases, consistently vary over the business cycle for both samples. We document pro-cyclical dynamics of profitability (*profit*), market-to-book ratio (*mtb*), and corporate investments (*capx*). These patterns provide intuitive evidence that firms experience negative shocks during recessions. Hence, firms become less profitable, invest less, and their market values deteriorate relative to book values. On the contrary, firm size (*size*) tends to be counter-cyclical. One explanation of this observation is a compounding effect of two facts: (1) we have more recessions in recent years than in early ones and (2) firms tend to grow over time. Tangibility shows mixed results, as it experiences pro-cyclical dynamics in the quarterly US-only sample but counter-cyclical dynamics in the international sample. Note that we defer the discussion of leverage dynamics to Section 4.1, in which we will provide a detailed analysis.

Panel C provides some summary statistics on the refinancing events underlying our main empirical capital structure models. Roughly speaking, 18% of firm-quarters (33% of firm-years) are identified as significant capital structure changes in the quarterly US-only (yearly international) sample. Around 54% (50%) of these events correspond to leverage increases; the median number of adjustments is three (one) and the median number of time periods between two consecutive refinancing events is two quarters (1 year) in the US-only (international) sample.

4. Empirical results

In this section, we present our main empirical results based on the quarterly US-only sample. We start out by establishing stylized facts about the dynamics of observed book and market leverage. In a next step, we analyze the dynamics of target leverage. Target leverage, however, is not observed and needs to be estimated. We use the empirical model discussed in Section 2.2 for this purpose and also briefly investigate how coefficients vary over the business cycle. Most importantly, however, we address the question whether overall target leverage is pro-cyclical or counter-cyclical. Furthermore, we analyze the drivers of leverage dynamics distinguishing the "direct"effect of recessions, variation in firm characteristics, and variation in model parameters. Finally, we look beyond average effects and analyze the cross-sectional variation in leverage cyclicality. The last section summarizes the results from a battery of robustness tests.

4.1. Cyclicality of observed leverage

Table 2 summarizes the dynamics of observed leverage over the business cycle. To measure cyclicality at the firm-level, we compute the time-series average leverage in expansions (using observations in a 16-quarter event window around recessions) and recessions separately for each firm and then take the difference (*rec* minus *exp*). The results show counter-cyclical dynamics for the average firm, as market (book) leverage is 2.6% (1.3%) higher during recessions than during expansions. These differences are highly statistically significant. Fig. 1 complements these statistics, as it plots the average levels of book and market leverage during recessions and expansionary observations providing a more detailed representation of the dynamics around recessions. Not surprisingly, it confirms the counter-cyclical dynamics. Interestingly, we observe that market leverage stays high during several quarters following recessions but then drops substantially between quarters 5 and 8 post-recession. Panel A also provides further

[16] This definition is a relatively conservative way of identifying recessions. There are, however, two advantages: (i) the definition is most precise in aligning yearly firm data with recession information, and (ii) the definition requires that recessions last for at least 12 months and, thus, filters out "less severe"recessions.

[17] It is quite surprising that we find more recessionary observations in the quarterly US-only sample than in the yearly international sample. Note, however, that this is driven by the fact that the longest recession in the US during the sample period (December 2007 and June 2009) was late in the sample period when the number of firms included in the database was largest. In general, the variation in terms of economic recessions is much smaller in the US-only (three recessions during the sample period) than in the international sample (36 recessions during the sample period).

Table 1
Summary statistics.
This table reports summary statistics of leverage variables and firm characteristics used in the empirical models of leverage. Statistics are calculated for the Compustat sample of US firm-quarters (Panel A) and the Datastream sample of international firm-years (Panel B). Sales are measured in the units of thousands in Datastream and those of millions in Compustat. Panel C summarizes the descriptive statistics of the refinancing events for both the US-only and the international sample. Variable definitions are summarized in Appendix A. ∗∗∗, ∗∗, *or* ∗ *next to the means during recessions indicate that the mean of this variable is significantly different at the 1%, 5%, and 10% level from the one during expansions.*

Panel A: US-only sample (firm-quarters)

	All			Expansion			Recession			Rec.-Exp.
Variables	Mean	Std.	Obs.	Mean	Std.	Obs.	Mean	Std.	Obs.	Mean diff.
ml	0.178	0.181	328,344	0.176	0.178	281,949	0.191	0.196	46,395	0.015***
bl	0.231	0.209	328,344	0.231	0.207	281,949	0.230	0.216	46,395	−0.002*
nml	0.083	0.251	327,038	0.084	0.244	281,035	0.074	0.287	46,003	−0.010***
nbl	0.065	0.352	328,154	0.067	0.350	281,767	0.049	0.366	46,387	−0.017***
sales	3.762	2.148	328,344	3.733	2.134	281,949	3.940	2.223	46,395	0.208***
profit	0.019	0.057	328,344	0.020	0.056	281,949	0.011	0.062	46,395	−0.009***
mtb	1.833	1.156	328,344	1.863	1.164	281,949	1.649	1.082	46,395	−0.214***
tang	0.294	0.233	328,344	0.297	0.233	281,949	0.274	0.235	46,395	−0.023***
capx	0.018	0.022	328,344	0.018	0.022	281,949	0.015	0.020	46,395	−0.003***

Panel B: International sample (firm-years)

	All			Expansion			Recession			Rec.-Exp.
Variables	Mean	Std.	Obs.	Mean	Std.	Obs.	Mean	Std.	Obs.	Mean diff.
ml	0.198	0.182	189,271	0.192	0.179	171,922	0.252	0.201	17,349	0.060***
bl	0.232	0.193	189,271	0.229	0.192	171,922	0.255	0.202	17,349	0.026***
nml	0.091	0.242	188,566	0.089	0.238	171,325	0.107	0.278	17,241	0.017***
nbl	0.082	0.301	189,165	0.079	0.303	171,818	0.102	0.289	17,347	0.023***
sales	12.058	2.187	189,271	12.002	2.203	171,922	12.606	1.940	17,349	0.604***
profit	0.047	0.339	189,271	0.048	0.345	171,922	0.036	0.268	17,349	−0.012***
mtb	1.591	1.113	189,271	1.633	1.135	171,922	1.175	0.739	17,349	−0.458***
tang	0.303	0.219	189,271	0.301	0.221	171,922	0.316	0.201	17,349	0.014***
capx	0.058	0.065	189,271	0.059	0.066	171,922	0.046	0.053	17,349	−0.013***

Panel C: Refinancing summary statistics

Adjustment type	Number of adjustments	Percent of quarters	Median duration	Median adj. per firm	Issuance amount Mean	Issuance amount Median
US-only sample: main definition						
Leverage change	59,876	18.24	2	3	−0.006	0.055
Leverage increase	32,531	9.91	4	2	0.171	0.096
Leverage decrease	27,345	8.33	4	1	−0.216	−0.103
US-only sample: definition according to Danis, Rettl, and Whited (2014)						
Leverage increase	2,224	0.68	9	0	0.191	0.124
International sample: main definition						
Leverage change	63,374	33.48	1	1	−0.023	0.051
Leverage increase	31,904	16.86	2	0	0.251	0.123
Leverage decrease	31,470	16.63	2	1	−0.301	−0.123

details on the cross-sectional distribution of the firm-level cyclicality measure showing that leverage dynamics are pro-cyclical for a substantial fraction of the sample (at least 25%); the median firm, however, shows counter-cyclical dynamics for book (in this case, dynamics are counter-cyclical but close to zero) and market leverage.

In the following paragraphs, we will dig deeper into this cross-sectional variation. First, we split the sample into financially constrained and unconstrained firms using four different proxies. Specifically, we use the following three variables to classify firms into constrained and unconstrained firms following Kaplan and Zingales (1997), Almeida, Campello, and Weisbach (2004), Whited and Wu (2006), Acharya, Almeida, and Campello (2007), and Byoun (2008): (i) payout ratio, (ii) cash levels, and (iii) size. For each of these variables, we determine the (time-series) median for each firm and then assign individual firms to being financially unconstrained (constrained) if their median values are in the top (bottom) quartiles of the corresponding distribution.[18] Finally, we also condition on a fourth variable, namely, the existence of a rating for any of the three following instruments: a long-term issuer credit rating, a short-term issuer credit rating, or a subordinated debt rating. Here, the idea is that financially constrained

[18] In the case of cash holdings, we classify firms as unconstrained (constrained) if their median cash holdings are in the bottom (top) quartiles of the distribution (see Whited and Wu, 2006).

Table 2
Cyclicality of observed leverage.
This table reports the cross-sectional distribution of firm-level cyclicality for observed market (*ml*) and book leverage (*bl*) using observations in a 16-quarter event window around recessions for the US-only sample. Panel A includes all firms. Panel B classifies the firms as constrained (*size*25/*payout*25/*cash*75/*norating*) and unconstrained (*size*75/*payout*75/*cash*25/*rating*). In Panel C, we summarize differences in aggregated firm characteristics for firms with counter-cyclical (Ccyc) or pro-cyclical (Pcyc) observed leverage dynamics. Variable definitions are summarized in Appendix A.

Panel A: Firm-level cyclicality (all firms)

Leverage	Mean	Std.	Obs.	*p*-value	p5	p10	p25	p50	p75	p90	p95
ml	0.026	0.076	7,158	0.000	−0.074	−0.044	−0.008	0.010	0.060	0.119	0.164
bl	0.013	0.086	7,158	0.000	−0.105	−0.067	−0.022	0.000	0.041	0.102	0.156

Panel B: Firm-level cyclicality (cons. vs. uncons.)

size25 (cons.)

Leverage	Mean	Std.	Obs.	*p*-value	p5	p10	p25	p50	p75	p90	p95
ml	0.025	0.080	1,953	0.000	−0.084	−0.050	−0.009	0.004	0.054	0.124	0.171
bl	0.017	0.105	1,953	0.000	−0.122	−0.081	−0.025	0.000	0.044	0.132	0.204

size75 (uncons.)

Leverage	Mean	Std.	Obs.	*p*-value	p5	p10	p25	p50	p75	p90	p95
ml	0.026	0.065	1,539	0.000	−0.059	−0.036	−0.008	0.019	0.055	0.101	0.137
bl	0.011	0.065	1,539	0.000	−0.082	−0.054	−0.020	0.007	0.039	0.085	0.122

payout25 (cons.)

Leverage	Mean	Std.	Obs.	*p*-value	p5	p10	p25	p50	p75	p90	p95
ml	0.028	0.081	3,600	0.000	−0.083	−0.044	−0.006	0.007	0.062	0.130	0.174
bl	0.015	0.094	3,600	0.000	−0.115	−0.074	−0.020	0.000	0.043	0.113	0.180

payout75 (uncons.)

Leverage	Mean	Std.	Obs.	*p*-value	p5	p10	p25	p50	p75	p90	p95
ml	0.026	0.069	2,406	0.000	−0.067	−0.041	−0.007	0.014	0.056	0.109	0.150
bl	0.012	0.074	2,406	0.000	−0.088	−0.057	−0.020	0.002	0.040	0.092	0.135

cash25 (uncons.)

Leverage	Mean	Std.	Obs.	*p*-value	p5	p10	p25	p50	p75	p90	p95
ml	0.036	0.082	1,421	0.000	−0.090	−0.056	−0.010	0.031	0.083	0.135	0.172
bl	0.014	0.080	1,421	0.000	−0.109	−0.071	−0.024	0.010	0.050	0.104	0.145

cash75 (cons.)

Leverage	Mean	Std.	Obs.	*p*-value	p5	p10	p25	p50	p75	p90	p95
ml	0.012	0.054	1,914	0.000	−0.046	−0.021	−0.003	0.000	0.016	0.066	0.110
bl	0.007	0.084	1,914	0.000	−0.097	−0.054	−0.010	0.000	0.014	0.072	0.148

rating (uncons.)

Leverage	Mean	Std.	Obs.	*p*-value	p5	p10	p25	p50	p75	p90	p95
ml	0.032	0.079	2,237	0.000	−0.079	−0.047	−0.010	0.023	0.069	0.126	0.172
bl	0.013	0.082	2,237	0.000	−0.106	−0.072	−0.026	0.007	0.047	0.105	0.147

norating (cons.)

Leverage	Mean	Std.	Obs.	*p*-value	p5	p10	p25	p50	p75	p90	p95
ml	0.024	0.075	4,921	0.000	−0.074	−0.043	−0.007	0.005	0.054	0.116	0.161
bl	0.012	0.087	4,921	0.000	−0.103	−0.065	−0.021	0.000	0.036	0.101	0.162

Panel C: Aggregated firm characteristics for firms with counter or pro-cyclical leverage

	ml					
	Ccyc		Pcyc			
Variables	Mean	Obs.	Mean	Obs.	Diff. in mean	*p*-value
ml	0.218	4,288	0.163	2,487	0.055	0.000
cash	0.157	4,288	0.198	2,487	−0.041	0.000
size	3.804	4,288	3.522	2,487	0.282	0.000
mtb	1.708	4,288	1.836	2,487	−0.128	0.000
tang	0.288	4,288	0.284	2,487	0.004	0.482
rating	0.345	4,288	0.295	2,487	0.050	0.000
profit	0.012	4,288	0.011	2,487	0.001	0.583
payout	0.094	4,288	0.082	2,487	0.012	0.163
capx	0.016	4,288	0.016	2,487	0.000	0.773

(*continued on next page*)

Table 2 (*continued*)

	bl					
	Ccyc		Pcyc			
Variables	Mean	Obs.	Mean	Obs.	Diff. in mean	*p*-value
ml	0.214	3,619	0.179	3,156	0.035	0.000
cash	0.159	3,619	0.187	3,156	−0.028	0.000
size	3.764	3,619	3.627	3,156	0.138	0.006
mtb	1.738	3,619	1.775	3,156	−0.037	0.096
tang	0.291	3,619	0.281	3,156	0.010	0.066
rating	0.342	3,619	0.310	3,156	0.032	0.005
profit	0.011	3,619	0.011	3,156	0.000	0.957
payout	0.094	3,619	0.085	3,156	0.010	0.276
capx	0.016	3,619	0.016	3,156	0.000	0.702

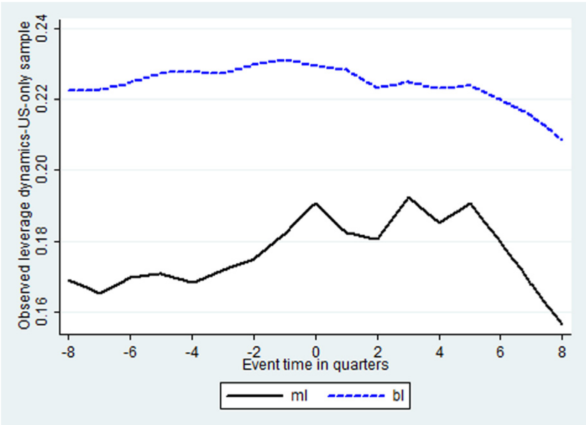

Fig. 1. Observed leverage dynamics—US-only sample. The graphs show the dynamics of average observed leverage ratios over the business cycle for the US-only sample. The event time is set to zero for recessions. The event window is 16 quarters, i.e., [−8, +8]. Market leverage (*ml*) is plotted in the solid line and book leverage (*bl*) in the dashed line.

firms do not have ratings while unconstrained firms do. Note that an important implication of these procedures to identify constrained and unconstrained firms is that we permanently assign a firm to being constrained or unconstrained; i.e., firms do not switch between these groups. This is necessary in our setup for consistency with the firm-level cyclicality measure. Panel B evaluates the dynamics of observed leverage over the business cycle for constrained and unconstrained firms. It shows consistently counter-cyclical dynamics for the average and the median firm across all measures of financial constraints, and for book and market leverage. Also, empirical distributions of firm-level cyclicality look rather similar across constrained and unconstrained firms.

In a next step, we split the sample by the sign of our firm-level cyclicality measure into pro-cyclical (negative sign) and counter-cyclical (positive sign) firms and then report average levels of characteristics of these firms. Panel C contains the detailed results. We find the following patterns: firms with pro-cyclical leverage ratios tend to have (i) lower market leverage, (ii) higher cash savings, (iii) smaller size, (iv) higher market-to-book ratios, (v) a smaller fraction of tangible assets, (vi) no ratings by Standard and Poor's (S&P), and (vii) lower, albeit not significantly, profitability. Even though one should not overinterpret these results for observed leverage, they seem to be consistent with an interpretation that firms with highly counter-cyclical dynamics for loss-given-default—small firms with few tangible assets and no ratings (see, e.g., Kim, 1998; Acharya, Bharath, and Srinivasan, 2007)—and probability of default feature pro-cyclical rather than counter-cyclical leverage dynamics. We will estimate target leverage in a next step, check whether its dynamics are different from the one for observed leverage, and then come back to the discussion of this interpretation.

4.2. Determinants of target leverage

The dynamics of observed leverage might not accurately reflect the dynamics of firms' optimal capital structures if market frictions prevent firms from immediately adjusting toward their optimal leverage levels. Following the large empirical literature studying corporate capital structures, we extract estimates of firms' target leverage from a subsample of refinancing firms (see Section 2.2 for details). In the robustness section, we show that our results are robust to an alternative definition of refinancing events and to estimating dynamic partial adjustment models. We extend these models such that coefficients are allowed to vary over the business cycle. In this section, we briefly characterize the resulting empirical models, analyze whether their coefficients vary across the business cycle, and provide some economic intuition.

Table 3 shows estimates of the empirical leverage models with business-cycle-dependent coefficients for market and book leverage. In the case of market leverage, we find that signs of coefficient estimates during expansions and recessions are mostly consistent with the literature, as we find significantly positive coefficients on size and tangibility and significantly negative coefficients on market-to-book ratios and profitability. Furthermore, we control for capital expenditures in the regressions and identify negative coefficients that are mostly insignificant in the case of market leverage.[19] Finally, we include a recession dummy

[19] Following Frank and Goyal (2009) and Leary and Roberts (2014), we also evaluate specifications that control for the industry median leverage. While the variable itself receives the expected, significantly positive coefficient, it has no material influence on the other coefficients and their dynamics. We also replicate all further results that depend on estimates

Table 3
Firm fixed-effects regressions using the refinancing sample. This table presents regression results for a firm fixed-effects model using refinancing observations. Our refinancing sample is based on Compustat North America quarterly data over a 26-year period from 1984 to 2009. The model includes a contemporaneous business cycle dummy (*rec*) and allows coefficients of lagged firm characteristics to vary over the business cycle. *p*-Values (in parentheses) are based on standard errors clustered at the firm level. Variable definitions are summarized in Appendix A. ****, **, * next to coefficients during recessions(rec) indicate that the coefficient is significantly different at the 1%, 5%, and 10% level from the one during expansions.*

Variables	*ml* Model 1	*bl* Model 2
sales_exp	0.011	0.008
	(0.000)	(0.000)
sales_rec	0.009	0.008
	(0.000)	(0.000)
mtb_lexp	−0.048	−0.020
	(0.000)	(0.000)
mtb_rec	−0.056***	−0.014**
	(0.000)	(0.000)
profit_lexp	−0.279	−0.330
	(0.000)	(0.000)
profit_rec	−0.253	−0.386
	(0.000)	(0.000)
tang_lexp	0.145	0.194
	(0.000)	(0.000)
tang_rec	0.153	0.198
	(0.000)	(0.000)
capx_lexp	−0.170	−0.051
	(0.000)	(0.257)
capx_rec	−0.036	0.084
	(0.707)	(0.451)
rec	0.038	−0.005
	(0.000)	(0.545)
cons	0.234	0.252
	(0.000)	(0.000)
Clustering	Firms	Firms
Firm-quarters	59,876	59,876
Firms	9,015	9,015
Adj. R^2	15.66%	4.39%

that is supposed to capture the direct effect of business cycle variation on firm leverage. It receives a positive and significant coefficient in the case of market leverage. Results look very similar for book leverage with the difference that the recession dummy does not receive a significant coefficient.

In contrast to the literature, we allow coefficients to vary across the business cycle in these specifications. The underlying motivation is that variation in these coefficients captures business-cycle effects on the link between firm characteristics and target leverage. As discussed above, we believe that one reasonable interpretation of such variation is the existence of supply effects, such as business cycle variation in transaction costs of issuing or repurchasing corporate securities, or changing lending policies of financial institutions.

Table 3 shows that coefficients vary across the business cycle. The coefficient on the market-to-book ratio, for example, becomes more negative during recessions compared to expansions in the case of market leverage. Such a pattern is consistent with the notion that the debt overhang problem that is often associated with the negative coefficient of the market-to-book ratio (see, for example, Myers, 1977; Goyal, Lehn, and Racic, 2002; Korteweg and Strebulaev, 2013) becomes more severe during recessions. This effect could be driven by the supply side, as creditors tend to become more constrained during recessions themselves and, in response, want to reduce their exposure to riskier—in the sense of firms with low book values and large but uncertain growth opportunities—firms. Occhino and Pescatori (2015) provide a detailed discussion of the interaction between the debt overhang problem and the business cycle.

The dynamics for coefficients on tangibility tell a similar story, as they are usually more positive during recessions than during expansions albeit not significantly in many cases. Again, this pattern is consistent with a supply effect, as creditors might put more emphasis on tangibility during recessions. This also relates back to the supply interpretation of the market-to-book effect discussed above, as debt overhang should be less of an issue if tangible assets are in place. Alternatively, based on a demand argument, firms with tangible assets in place might also be less interrupted in their business by recessions and, thus, use these periods of time for re-leveraging demanding more leverage during recessions.[20]

4.3. Target leverage cyclicality

The key empirical test of this paper is to study the dynamics of target leverage estimates over the business cycle. Thus, we first extract estimates of the overall, implied (unobserved) target leverage ratios from the models described in Table 3 and then analyze their dynamics. As discussed before, the literature to date has focused on the signs of coefficients of macroeconomic variables or recession dummies within empirical leverage models to address this question. Our approach, however, provides a complementary and in some sense broader assessment, as it includes the indirect effects (i.e., the variation in explanatory variables and coefficients) as well as the direct effect of recessions (i.e., coefficients of corresponding variables).

Table 4, Panel A, provides detailed summary statistics of firm-level measures of cyclicality for target book and market leverage. It shows counter-cyclical dynamics, as target market (book) leverage is 3.8% (1.7%) higher during recessions than during expansions for the average firm. These differences are all statistically significant. Fig. 2 provides a more detailed assessment of target leverage levels during recessions and surrounding expansionary observations (event time $t = 0$ is an observation during a recession; all

of target leverage using a model in which we also control for industry median leverage and find no noteworthy impact.

[20] Interestingly, the business cycle variation in coefficients is very dependent on the specific choice of empirical model. While differences are moderate and frequently not statistically significant for our main model based on the subsample of refinancing firms, they are predominantly large and highly statistically significant in the dynamic partial adjustment model that we will discuss briefly in the robustness section. This is not too surprising, in our opinion, as the employed empirical models differ considerably in their assumptions and the extent to which they account for market frictions and supply effects. Exploring these differences across models in more depth is, however, not the focus of this work.

Table 4
Cyclicality of target leverage.
This table reports the cross-sectional distribution of firm-level cyclicality for target market (*tml*) and book leverage (*tbl*) estimated from the specifications reported in Table 3. Panel A includes all firms. Panel B classifies the firms as constrained (*size*25/*payout*25/*cash*75/*norating*) and unconstrained (*size*75/*payout*75/*cash*25/*rating*). In Panel C, we summarize differences in aggregated firm characteristics for firms with counter-cyclical (Ccyc) or pro-cyclical (Pcyc) target leverage dynamics. Variable definitions are summarized in Appendix A.

Panel A: Firm-level cyclicality (all firms)											
Leverage	Mean	Std.	Obs.	*p*-value	p5	p10	p25	p50	p75	p90	p95
tml	0.038	0.048	3,181	0.000	−0.034	−0.012	0.017	0.036	0.057	0.090	0.119
tbl	0.017	0.029	3,181	0.000	−0.022	−0.012	0.001	0.013	0.030	0.051	0.070
Panel B: Firm-level cyclicality (cons. vs. uncons.)											
size25 (cons.)											
Leverage	Mean	Std.	Obs.	*p*-value	p5	p10	p25	p50	p75	p90	p95
tml	0.040	0.061	816	0.000	−0.061	−0.032	0.011	0.040	0.070	0.111	0.141
tbl	0.023	0.037	816	0.000	−0.028	−0.016	−0.001	0.018	0.043	0.071	0.089
size75 (uncons.)											
Leverage	Mean	Std.	Obs.	*p*-value	p5	p10	p25	p50	p75	p90	p95
tml	0.030	0.036	767	0.000	−0.023	−0.011	0.013	0.031	0.046	0.066	0.087
tbl	0.014	0.022	767	0.000	−0.016	−0.009	0.002	0.011	0.023	0.040	0.050
payout25 (cons.)											
Leverage	Mean	Std.	Obs.	*p*-value	p5	p10	p25	p50	p75	p90	p95
tml	0.043	0.056	1,408	0.000	−0.046	−0.017	0.018	0.040	0.066	0.110	0.140
tbl	0.022	0.034	1,408	0.000	−0.022	−0.011	0.002	0.016	0.038	0.065	0.083
payout75 (uncons.)											
Leverage	Mean	Std.	Obs.	*p*-value	p5	p10	p25	p50	p75	p90	p95
tml	0.033	0.040	1,147	0.000	−0.025	−0.006	0.016	0.033	0.049	0.074	0.097
tbl	0.014	0.025	1,147	0.000	−0.020	−0.012	0.001	0.011	0.025	0.043	0.054
cash25 (uncons.)											
Leverage	Mean	Std.	Obs.	*p*-value	p5	p10	p25	p50	p75	p90	p95
tml	0.034	0.029	780	0.000	−0.010	0.005	0.023	0.034	0.048	0.066	0.081
tbl	0.010	0.020	780	0.000	−0.019	−0.010	-0.001	0.008	0.018	0.031	0.044
cash75 (cons.)											
Leverage	Mean	Std.	Obs.	*p*-value	p5	p10	p25	p50	p75	p90	p95
tml	0.041	0.067	568	0.000	−0.061	−0.038	-0.004	0.044	0.078	0.123	0.150
tbl	0.029	0.037	568	0.000	−0.028	−0.015	0.005	0.026	0.048	0.074	0.093
rating (uncons.)											
Leverage	Mean	Std.	Obs.	*p*-value	p5	p10	p25	p50	p75	p90	p95
tml	0.034	0.040	1,133	0.000	−0.026	−0.008	0.016	0.032	0.049	0.073	0.100
tbl	0.014	0.025	1,133	0.000	−0.020	−0.012	0.001	0.011	0.024	0.043	0.055
norating (cons.)											
Leverage	Mean	Std.	Obs.	*p*-value	p5	p10	p25	p50	p75	p90	p95
tml	0.040	0.052	2,048	0.000	−0.042	0.014	0.017	0.039	0.062	0.097	0.126
tbl	0.019	0.031	2,048	0.000	−0.022	−0.012	0.001	0.014	0.033	0.057	0.076

Panel C: Aggregated firm characteristics for firms with counter or pro-cyclical leverage

	tml					
	Ccyc		Pcyc			
Variables	Mean	Obs.	Mean	Obs.	Diff. in mean	*p*-value
ml	0.223	2,721	0.130	460	0.093	0.000
cash	0.131	2,721	0.216	460	−0.084	0.000
size	3.802	2,721	3.421	460	0.381	0.001
mtb	1.702	2,721	2.510	460	−0.808	0.000
tang	0.296	2,721	0.255	460	0.042	0.000
rating	0.363	2,721	0.313	460	0.050	0.033
profit	0.015	2,721	0.007	460	0.008	0.012
payout	0.087	2,721	0.077	460	0.009	0.545
capx	0.017	2,721	0.017	460	0.000	0.938

(*continued on next page*)

Table 4 (*continued*)

	tbl					
	Ccyc		Pcyc			
Variables	Mean	Obs.	Mean	Obs.	Diff. in mean	*p*-value
ml	0.205	2,453	0.227	728	−0.022	0.002
cash	0.148	2,453	0.127	728	0.022	0.001
size	3.795	2,453	3.584	728	0.211	0.013
mtb	1.865	2,453	1.663	728	0.202	0.000
tang	0.290	2,453	0.291	728	−0.001	0.880
rating	0.358	2,453	0.349	728	0.009	0.640
profit	0.013	2,453	0.016	728	−0.003	0.169
payout	0.084	2,453	0.090	728	−0.006	0.639
capx	0.017	2,453	0.016	728	0.001	0.062

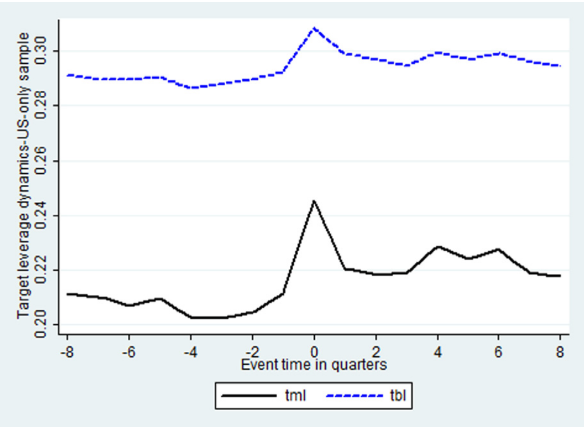

Fig. 2. Target leverage dynamics—US-only sample. The graphs show the dynamics of average target leverage ratios over the business cycle for the US-only sample. The event time is set to zero for recessions. The event window is 16 quarters, i.e., [−8, +8]. Target market leverage (*tml*) is plotted in the solid line and book leverage (*tbl*) in the dashed line.

other dates are observations during expansions). Consistent with the counter-cyclical dynamics, the average level of target market (book) leverage is 21.3% (29.3%) during expansionary observations and increases to 24.5% (30.8%) during recessions.

Panel A also illustrates that less than 25% of the sample firms feature pro-cyclical dynamics of target leverage. The median firm, for example, exhibits pronounced counter-cyclical dynamics having target market (book) leverage ratios that are 3.6% (1.3%) higher during recessions than during expansions. Interestingly, the share of firms with pro-cyclical leverage dynamics is considerably smaller in the case of target leverage than in the case of observed leverage.

Panel B reports detailed summary statistics of the firm-level cyclicality measure separately for financially constrained and unconstrained firms. We find that dynamics are consistently counter-cyclical for both constrained and unconstrained firms irrespective of the empirical proxy that we use to capture financial constraints. This is somewhat surprising, as one of the key results of Korajczyk and Levy (2003) is that the dynamics of leverage vary across constrained and unconstrained firms. In particular, they find pro-cyclical dynamics of target leverage for constrained firms.[21]

Panel C summarizes the results of an analysis, in which we determine first for each individual firm whether estimated target leverage dynamics are, on average, pro-cyclical or counter-cyclical during the sample period. Next, we calculate for each firm and each characteristic its time-series mean and then average these across the cross-section of firms included in each subsample of firms. For target market leverage we find the following patterns: firms with pro-cyclical leverage ratios tend to have (i) lower market leverage, (ii) higher cash savings, (iii) smaller size, (iv) higher market-to-book ratios, (v) smaller fraction of tangible assets, (vi) no ratings by S&P, and (vii) lower profitability. Note that all these differences are highly significant. Furthermore, they are consistent with the patterns that we observed for realized market and book leverage.[22]

As discussed before, one interpretation of these patterns is that firms with highly counter-cyclical dynamics for loss-given-default feature pro-cyclical rather than counter-cyclical target leverage dynamics, consistent with theoretical arguments provided in Chen (2010) and Strebulaev (2007).[23] Using an industry equilibrium model, Shleifer and Vishny (1992) show that the liquidation value of firm assets declines during economic downturns. Extending this idea to different types of firm assets, we expect that the decline in the liquidation value during recessions should be more pronounced for firms with high market-to-book ratios (i.e., firms with lots of growth options) and for firms with a smaller fraction of tangible assets.[24] Lenders to these firms will anticipate the more

[21] Korajczyk and Levy (2003), however, use a different approach to identify constrained firms and also allow firms to switch between being constrained and unconstrained. If we replicate their procedure for our sample and transform it into a static classification, we end up with a tiny sample of only 46 constrained firms. Importantly, however, we also find that target book and market leverage evolve counter-cyclically for these firms.

[22] Note that the patterns look different for target book leverage. One explanation for this divergence could be the lower explanatory power of our empirical model for book leverage: while we explain 15.7% of the variation in market leverage, we only explain 4.4% of the variation in book leverage.

[23] We would like to thank the referee for pointing this interpretation out to us.

[24] Kim (1998) provides corroborative support, as she documents for the contract drilling industry that recovery values are lower for less liquid assets than for liquid assets when the industry is distressed. Using data

counter-cyclical loss-given-default dynamics and, as a consequence, such firms' leverage dynamics will be more pro-cyclical. Similarly, it seems sensible to assume that small firms with lower profitability are relatively more exposed to negative economic shocks and, thus, feature counter-cyclical probabilities of default; again, resulting in pro-cyclical leverage dynamics.

Finally, an alternative explanation for pro-cyclical dynamics is related to agency problems, such as the debt overhang problem. As discussed above, the market-to-book ratio is frequently used as a proxy for the debt overhang problem. Thus, the result that firms with high market-to-book ratios tend to have pro-cyclical leverage dynamics is also consistent with the interpretation that the debt overhang problem becomes more severe during recessions. Along similar lines, conflicts of interests between shareholders and debtholders can be expected to be more pronounced during recessions, in general, and in particular, for firms that are small, hold less tangible assets, and are less profitable. Hence, such firms should exhibit pro-cyclical leverage dynamics.

The result that firms with pro-cyclical target leverage dynamics exhibit higher cash savings is surprising. Whited and Wu (2006) argue that the most financially constrained firms have the highest cash holdings due to precautionary savings motives; i.e., these firms understand that their investments are very sensitive to the availability of liquid assets and, thus, build up cash buffers. Consistent with this argument, these firms might also avoid an increase of leverage during recessions during which financially constrained firms are forced to cut back investment more than unconstrained ones (see, for example, Kiyotaki and Moore, 1997) and, thus, end up with pro-cyclical leverage dynamics. However, the levels of cash holdings that we observe for firms with pro-cyclical leverage dynamics are not particularly high compared to the empirical distribution of cash holdings in our sample. Furthermore, remember that in earlier analyses we explicitly analyzed whether firms with the highest cash holdings exhibit pro-cyclical leverage dynamics and found that this is not the case. Thus, we do not think that firms with pro-cyclical leverage dynamics tend to be financially constrained firms.

4.4. Drivers of target leverage cyclicality

An important question is what drives the counter-cyclicality of target leverage. We distinguish three potential sources: (i) the direct effect of the recession dummy, (ii) the time-variation in the parameters of the model, and (iii) the time-variation in firm characteristics. To address this question and to measure the importance of these three sources of variation we perform several tests.

Table 5 summarizes how each of these mechanisms affects target leverage over the business cycle. To assess the direct effect of recessions, we summarize the coefficients of the recession dummy for each empirical specification (Panel A). As pointed out before, this coefficient is statistically significant and positive in the case of market leverage and negative and statistically insignificant in the case of book leverage. Thus, our empirical models based on the refinancing sample suggest counter-cyclical or acyclical dynamics through the direct impact of recessions. This result is somewhat consistent with Korajczyk and Levy (2003) but at odds with Korteweg and Strebulaev (2013) who document a negative coefficient of the recession dummy in their empirical setup (we will come back to this in Section 4.5).

Next, we analyze the importance of variation in coefficient estimates. For this analysis, we eliminate variation in firm characteristics over the business cycle by holding them constant at their overall sample means. Then we use the business-cycle-dependent coefficient estimates of the empirical leverage models to calculate target market leverage ratios during expansions and recessions. To focus exclusively on the impact of variation in coefficient estimates of individual firm characteristics, we ignore the effect of the recession dummy and any fixed effects when calculating target leverage.[25] Panel B of Table 5 shows the corresponding results implying that target market leverage

Table 5
Sources of target leverage dynamics.
This table analyzes where the variation in target leverage is coming from for the quarterly US-only sample. We look at (i) the coefficient of the recession dummy; (ii) variation in model parameters (in this case target leverage is measured as the product of average firm characteristics and business-cycle-dependent regression coefficients); and (iii) variation in firm characteristics (in this case target leverage is calculated as the product of firm characteristics and constant, full-sample regression coefficients). The table reports levels of target market and book leverage during recessions and expansions as well as corresponding differences for the average firm. Note that we ignore any fixed effects in this analysis. The sample is based on the refinancing observations selected from Compustat North America quarterly data over a 26-year period from 1984 to 2009. Variable definitions are summarized in Appendix A.

Variables	*rec*	*exp*	Diff.	*p*-value
Panel A: Coefficient of the recession dummy				
tml	0.038		0.038	0.000
tbl	−0.005		−0.005	0.545
Panel B: Variation in model parameters				
tml	0.202	0.216	−0.014	0.000
tbl	0.311	0.295	0.017	0.000
Panel C: Variation in firm characteristics				
tml	0.225	0.215	0.010	0.000
tbl	0.298	0.294	0.004	0.000

on Swedish bankruptcy auctions, Thorburn (2000) documents a similar effect for a large sample of Swedish firms from various industries.

[25] In order to test whether the variation in leverage induced by the variation in coefficients is statistically significant, we implement the test in a slightly different way: for all observations we calculate implied target leverage when using coefficients estimated (i) from recessionary and (ii) from expansionary observations; then we take the differences, calculate means during recessions and expansions, and test whether these means are identical. This procedure ignores the estimation error in coefficients. *F*-tests, however, indicate that (i) expansion coefficients are jointly signif-

is 1.4 percentage points lower during recessions than during expansions due to coefficient variation. In the case of book leverage, the dynamics are reversed and coefficient variation implies counter-cyclical dynamics.

Finally, we reverse the experiment: i.e., allow the firm characteristics to vary across the business cycle but fix the coefficients.[26] Using these constant coefficient estimates together with average firm characteristics during expansions and recessions (see Table 1 for the detailed values), we find consistently for book and market leverage that target leverage dynamics are counter-cyclical.[27]

The variation of these results across book and market leverage is interesting. While in the case of market leverage the direct effect of recessions plays the most important role, it is the variation in model parameters that drives the dynamics of book leverage. Variation in firm characteristics is never the largest driver but consistently implies significantly counter-cyclical dynamics. Overall, these results emphasize the importance to explicitly account for all three drivers of leverage dynamics. Considering separately the effects of the recession dummy, the time-variation in the parameters of the model, and the time-variation in firm characteristics on target book and market leverage, we find that only one out of the six results points toward pro-cyclical dynamics.

4.5. Robustness tests (only for US-sample)

An important goal of this study is to comprehensively and robustly analyze leverage dynamics across the business cycle. To fulfill this goal we report results from extensive robustness tests in this section. Specifically, we evaluate whether our results are sensitive to (i) an alternative empirical model of target leverage (i.e., a dynamic partial adjustment model), (ii) a different definition of leverage that is net of cash (i.e., net market leverage and net book leverage), and (iii) an alternative definition of the refinancing events (following Danis, Rettl, and Whited, 2014). Throughout this section we mostly focus, in the interest of readability, on the analysis of the cyclicality of leverage over the business cycle, as this is our main result.

As discussed in more detail in Section 2.2, a popular set of empirical models to estimate target leverage are dynamic partial adjustment capital structure models (DPACS-Models) that allow firms to partially move toward their targets over time. These models are controversial, as their theoretical underpinnings are not very clear. In this section, we estimate such a model for market leverage using the full, quarterly sample of US firms. While we do not report detailed coefficient estimates of these partial adjustment models, we would like to emphasize some general observations.

Consistent with our expectation these models imply that the speed of adjustment toward target leverage ratios drops significantly during recessions consistent with the notion that frictions make it more costly for the average firm to refinance. Interestingly and in contrast to our main empirical models, the dynamic partial adjustment models show negative, partly significant, coefficients for the recession dummy, suggesting a pro-cyclical direct effect of recessions on target leverage. This result puts some perspective on the existing literature such as Korteweg and Strebulaev (2013). While we do not evaluate their precise specification, it is reassuring that we find a significantly negative coefficient in the case of the DPACS-Model, given that the DPACS-Model is, at least conceptually, most comparable to their empirical model.

Table 6, Panel A, summarizes average levels of target levels implied by the DPACS-Model separately for the two estimation techniques that we consider. Importantly, our result of counter-cyclical dynamics of target leverage also holds up in this case. Target leverage during recessions is either 9.2% or 7.5% higher during recessions than during expansions depending on the estimation technique. Finally, we also redo the decomposition of leverage dynamics over the business cycle into the direct effect, the effect coming from variation in firm characteristics, and the effect coming from variation in coefficients. In the case of the DPACS-Model and in contrast to the results for the simple fixed effects regressions based on the refinancing sample, the counter-cyclical dynamics are mostly driven by the change in coefficients.

Thus, while the result of counter-cyclical dynamics over the business cycle is robust to the empirical capital structure model, the dynamics of individual coefficient estimates and the importance of this time-variation for the overall leverage dynamics are ambiguous and model-dependent. This, however, should not come as a big surprise given that the empirical models reflect market frictions in very different ways.

So far, our main measures of leverage have been gross market and book leverage. In this robustness test, we study the dynamics of net leverage ratios where net market (book) leverage is calculated as gross market (book) leverage minus cash holdings (see, for example, Danis, Rettl, and Whited, 2014). Table 6, Panel B, summarizes the dynamics of observed and target leverage.[28] As before, we find counter-cyclical dynamics across the board. In terms of observed leverage, market (book) net leverage of the average firm seems to be 1.3% (2.5%) higher during recessions than during expansions. While the dynamics stay the same, the magnitudes increase to 2.9% (2.8%) in the case of target net leverage ratios. In general, these numbers are comparable to the ones for gross leverage indicating only a minor role of cash for these dynamics.

icant, (ii) recession coefficients are jointly significant, and (iii) recession coefficients are jointly significantly different from expansion coefficients.

[26] For reasons of brevity, we do not include a table with the detailed coefficient estimates. These can be obtained from the authors upon request. These constant coefficient estimates, however, are quantitatively very similar to the dynamic coefficient estimates summarized in Table 3.

[27] Again, we actually implement the test in a slightly different way such that we are able to run statistical tests. Specifically, we predict target leverage ratios using constant coefficients for all observations (excluding the recession dummy), then compute means during recessions and expansions, take the difference, and test for significance.

[28] When estimating target ratios for net leverage we rely again on our main empirical model, the fixed effects panel regression using the refinancing sample.

Table 6
Cyclicality of leverage—robustness checks.
This table provides robustness checks for the cross-sectional distribution of firm-level leverage cyclicality. Panel A reports the distribution of target leverage cyclicality when target leverage is estimated using a dynamic partial adjustment capital structure model (DPACS); we distinguish two different estimators—system GMM and corrected LSDV. Panel B summarizes firm-level cyclicality of observed and target leverage ratios net of cash. Panel C shows the distribution of firm-level cyclicality when target leverage is estimated using our main empirical model but using an alternative definition of refinancing events following Danis, Rettl, and Whited (2014). Variable definitions are summarized in Appendix A.

Panel A: Target leverage cyclicality (DPACS-Models)											
	Mean	Std.	Obs.	*p*-value	p5	p10	p25	p50	p75	p90	p95
System GMM	0.092	0.179	7,158	0.000	−0.149	−0.100	−0.023	0.073	0.180	0.300	0.406
Corrected LSDV	0.075	0.056	6,930	0.000	−0.006	0.016	0.044	0.072	0.101	0.135	0.168
Panel B: Observed and target net leverage cyclicality											
	Mean	Std.	Obs.	*p*-value	p5	p10	p25	p50	p75	p90	p95
nml	0.013	0.114	7,126	0.000	−0.169	−0.107	−0.037	0.015	0.069	0.133	0.183
nbl	0.025	0.126	7,158	0.000	−0.161	−0.103	−0.035	0.017	0.078	0.157	0.232
tnml	0.029	0.044	3,173	0.000	−0.038	−0.017	0.009	0.028	0.050	0.078	0.103
tnbl	0.028	0.058	3,180	0.000	−0.050	−0.028	−0.004	0.019	0.054	0.099	0.133
Panel C: Target leverage cyclicality (alternative refinancing definition)											
	Mean	Std.	Obs.	*p*-value	p5	p10	p25	p50	p75	p90	p95
tml	0.023	0.026	116	0.000	−0.021	−0.008	0.007	0.023	0.04	0.053	0.065
tbl	0.036	0.046	116	0.000	−0.038	−0.016	0.002	0.036	0.065	0.097	0.115

As a final robustness test, we look at an alternative definition of refinancing events following Danis, Rettl, and Whited (2014) who focus on pure exchange offers while we include significant capital structure changes which may be related to changes in assets (e.g., large (dis)investments), following Leary and Roberts (2005) among others. This difference has important implications, as their refinancing observations account for only 0.8% (1,583/194,051) of our total observations while we can draw on 18% (59,876/328,344) of the observations using our definition. Table 6, Panel C, summarizes the results for target market and book leverage and again finds counter-cyclical dynamics.

5. Yearly international sample and banking crises

So far, we have exclusively focused on results for the quarterly US-only sample, as the availability of quarterly data is an obvious advantage for identifying business cycle dynamics. In this section we introduce and evaluate a comprehensive international sample that has data available at the annual frequency (see Section 3 and Table 1 for details). Looking at this international data serves as another robustness test but, most importantly, also allows us to distinguish different types of recessions; in particular, those that also overlap with contemporaneous banking crises.

Before looking at a finer classification of recessions, we briefly replicate our main tests for the international sample. In terms of observed leverage, we find significant counter-cyclicality: market (book) leverage is, on average, 5.1% (2.4%) larger during recessions than during expansions (see Panel A of 8). Table 7, Panel A, then shows the estimates of the empirical leverage models with business-cycle-dependent coefficients for market and book leverage. Similar to the quarterly US-only sample, we find that signs of coefficient estimates during expansions and recessions are mostly consistent with the literature. We find significantly positive coefficients on size and tangibility and significantly negative coefficients on market-to-book ratios and profitability. The recession dummy that is supposed to capture the direct effect of business cycle variation on firm leverage receives a positive (negative) and significant (insignificant) coefficient in the case of market (book) leverage. Also, in terms of coefficient dynamics the international sample yields similar results indicating more negative coefficients for the market-to-book ratio and more positive coefficients for tangibility during recessions.

Importantly, if we use these models to extract estimates of target leverage for the international sample, we confirm our earlier results of counter-cyclical dynamics: target market (book) leverage is 5.5% (2.3%) higher during recessions than during expansions for the average firm and 5.7% (2.2%) higher for the median firm. Table 8, Panel A, provides the detailed results while Fig. 3 visualizes the dynamics around recessions. Thus, the results from the yearly international sample are fully consistent with our main results observed for the quarterly US-only sample. Interestingly, however, the fraction of firms with pro-cyclical target leverage dynamics drops to less than 10% in the international sample.

Next, we exploit the rich cross-section (in terms of countries and business cycle variation) of the international sample and extend our main empirical model to account for three possible states of the world—expansions, business cycle recessions that were also banking crises (*brec*), and business cycle recessions that were not banking crises (*rec*). The information on banking crises is taken from Carmen Reinhart's webpage (Reinhart and Rogoff, 2011). The goal of this extension is to learn more about the drivers of cyclicality and the interaction between the macro-economy and corporate finance. The additional dimension of banking crises, for example, might provide some indication about the role of supply effects, as we would expect that

Table 7

Firm fixed-effects regressions using the international refinancing sample. This table presents regression results for a firm fixed-effects model using refinancing observations. Our refinancing sample is based on Datastream yearly data covering 18 countries (including the US) over a 26-year period from 1984 to 2009. The model includes a contemporaneous business cycle dummy (*rec*) and allows coefficients of lagged firm characteristics to vary over the business cycle (Panel A). In Panel B, we split business cycle recessions into the ones with contemporaneous banking crises (*brec*) and those without banking crises (*rec*). *p*-Values (in parentheses) are based on standard errors clustered at the firm-level. Variable definitions are summarized in Appendix A. ***, **, * *next to coefficients during recessions (rec or brec) indicate that the coefficient is significantly different at the 1%, 5%, and 10% level from the one during expansions*. In Panel B, **bold** coefficients of business cycle recessions with banking crises (*brec*) indicate that these coefficients are significantly different (at least at the 10% level) from the corresponding coefficients during recessions without banking crises (*rec*).

Panel A: Two-state

	ml	*bl*
Variables	Model 1	Model 2
sales_lexp	0.018	0.014
	(0.000)	(0.000)
sales_rec	0.020	0.015
	(0.000)	(0.000)
mtb_lexp	−0.025	−0.013
	(0.000)	(0.000)
mtb_rec	−0.036***	−0.012
	(0.000)	(0.000)
profit_lexp	−0.026	−0.034
	(0.000)	(0.000)
profit_rec	−0.048**	−0.069*
	(0.000)	(0.001)
tang_lexp	0.059	0.069
	(0.000)	(0.000)
tang_rec	0.123***	0.098*
	(0.000)	(0.000)
capx_lexp	0.108	0.122
	(0.000)	(0.000)
capx_rec	0.042	0.064
	(0.444)	(0.306)
rec	0.029	−0.003
	(0.112)	(0.883)
cons	0.013	0.095
	(0.406)	(0.000)
Clustering	Firms	Firms
Firm-years	63,374	63,374
Firms	15,949	15,949
Adj. R^2	6.58%	2.32%

Panel B: Three-state

	ml	*bl*
Variables	Model 1	Model 2
sales_lexp	0.019	0.014
	(0.000)	(0.000)
sales_rec	0.015	0.013
	(0.000)	(0.000)
sales_brec	**0.020**	0.016
	(0.000)	(0.000)
mtb_lexp	−0.025	−0.013
	(0.000)	(0.000)
mtb_rec	−0.053***	−0.025**
	(0.000)	(0.000)
mtb_brec	**−0.030***	**−0.008**
	(0.000)	(0.036)
profit_lexp	−0.026	−0.034
	(0.000)	(0.000)
profit_rec	−0.085*	−0.144**
	(0.006)	(0.001)
profit_brec	−0.041*	**−0.059**
	(0.000)	(0.004)
tang_lexp	0.059	0.069
	(0.000)	(0.000)
tang_rec	0.068	0.074
	(0.009)	(0.006)
tang_brec	**0.143*****	0.108**
	(0.000)	(0.000)
capx_lexp	0.108	0.122
	(0.000)	(0.000)
capx_rec	0.275	0.335
	(0.019)	(0.015)
capx_brec	**−0.031****	**−0.020****
	(0.577)	(0.738)
rec	0.132	0.053
	(0.000)	(0.144)
brec	**0.012**	−0.013
	(0.557)	(0.590)
cons	0.013	0.095
	(0.412)	(0.000)
Clustering	Firms	Firms
Firm-years	63,374	63,374
Firms	15,949	15,949
Adj. R^2	6.65%	2.36%

(*continued on next page*)

the supply of capital through financial intermediaries is particularly affected in the *brec* state.

Table 7, Panel B, summarizes the results of the extended model for book leverage and market leverage. First, we observe significant differences in the coefficients of tangibility for both book leverage and market leverage. As discussed before, the coefficient of tangibility increases somewhat during recessions without banking crises relative to expansions. However, it more than doubles in the case of market leverage and also increases substantially for book leverage if there is a banking crisis during the recession. Thus, tangibility always has a positive impact on target leverage but this impact becomes much more important during recessions with banking crises. One possible interpretation of these patterns is that supply effects matter: during banking crises financial institutions are likely to be constrained and, in response, might put more weight on the existence of tangible assets in their loan decisions.

We also observe interesting dynamics in coefficients of capital expenditures. During expansions, the coefficients are positive and significant suggesting that capital expenditures are associated with increased target leverage. Interestingly, these positive coefficients nearly triple during economic recessions that are not accompanied by banking crises. This seems to suggest that in these states of the world firms with lots of capital expenditures have to rely even more on debt financing. In the case of recessions with banking crises, this picture changes completely, as coefficients become insignificant and slightly negative. Thus, in situations in which banks are in distress as well, the link between capital expenditures and firms' target leverage disappears.

Finally, when we look at the direct effects of different types of recessions on target leverage, we also find very different coefficient estimates. While the direct effects of

Table 8
Cyclicality of leverage—international sample and financial crises.
This table reports the cross-sectional distribution of firm-level leverage cyclicality across the business cycle for the international sample in Panel A. In Panel B, we distinguish two types of recessions—one with contemporaneous banking crises (*brec*) and one without (*rec*)—and summarize the cross-sectional distribution of firm-level leverage cyclicality. Variables *ml* and *bl* report cyclicality for observed market and book leverage while variables *tml* and *tbl* focus on target leverage ratios estimated using the models in Table 7. Variable definitions are summarized in Appendix A.

Leverage	Mean	Std.	Obs.	*p*-value	p5	p10	p25	p50	p75	p90	p95
Panel A: Firm-level cyclicality—two state											
ml	0.051	0.096	8,797	0.000	−0.069	−0.036	−0.001	0.031	0.092	0.171	0.229
bl	0.024	0.098	8,797	0.000	−0.105	−0.064	−0.015	0.011	0.058	0.125	0.184
tml	0.055	0.035	2,746	0.000	−0.006	0.019	0.042	0.057	0.072	0.088	0.102
tbl	0.023	0.024	2,746	0.000	−0.007	0.002	0.013	0.022	0.031	0.043	0.055
Panel B: Firm-level cyclicality—three state											
rec − exp											
Leverage	Mean	Std.	Obs.	*p*-value	p5	p10	p25	p50	p75	p90	p95
ml	0.053	0.092	4,900	0.000	−0.067	−0.032	0.000	0.038	0.099	0.168	0.214
bl	0.019	0.085	4,900	0.000	−0.097	−0.058	−0.016	0.01	0.054	0.105	0.149
tml	0.071	0.033	1,044	0.000	0.028	0.045	0.060	0.072	0.084	0.098	0.112
tbl	0.026	0.029	1,044	0.000	−0.009	0.002	0.014	0.025	0.036	0.050	0.064
brec − exp											
Leverage	Mean	Std.	Obs.	*p*-value	p5	p10	p25	p50	p75	p90	p95
ml	0.049	0.100	6,574	0.000	−0.077	−0.045	−0.004	0.027	0.095	0.176	0.237
bl	0.028	0.103	6,574	0.000	−0.111	−0.07	−0.017	0.011	0.068	0.141	0.203
tml	0.047	0.035	1,923	0.000	−0.012	0.009	0.031	0.048	0.065	0.085	0.100
tbl	0.021	0.024	1,923	0.000	−0.010	−0.001	0.010	0.020	0.029	0.045	0.058
brec − rec											
Leverage	Mean	Std.	Obs.	*p*-value	p5	p10	p25	p50	p75	p90	p95
ml	−0.001	0.097	2,698	0.650	−0.163	−0.106	−0.045	0.000	0.045	0.108	0.154
bl	0.016	0.094	2,698	0.000	−0.122	−0.077	−0.023	0.009	0.057	0.119	0.166
tml	−0.022	0.037	240	0.000	−0.074	−0.048	−0.035	−0.022	−0.005	0.009	0.016
tbl	−0.005	0.023	240	0.002	−0.042	−0.031	−0.015	−0.004	0.007	0.018	0.028

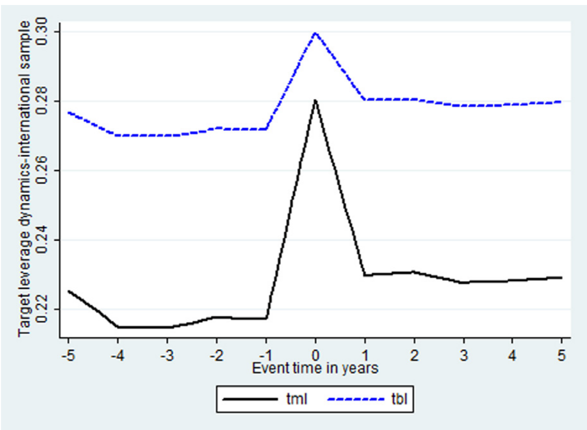

Fig. 3. Target leverage dynamics—international sample. The graphs show the dynamics of average target leverage ratios over the business cycle for the international sample. The event time is set to zero for recessions. The event window is 10 years, i.e., $[-5, +5]$. Target market leverage (*tml*) is plotted in the solid line and book leverage (*tbl*) in the dashed line.

recessions without banking crises are positive in terms of target leverage, implying counter-cyclical dynamics, they are insignificant and very small in the case of recessions with banking crises. One interpretation of this pattern is that debt is attractive during economic downturns as long as the banking industry is doing well. If the banking industry is in distress as well, this positive effect vanishes.

One immediate consequence of the discussion up to this point is that we expect leverage dynamics to be less counter-cyclical during recessions with banking crises. Table 8, Panel B, summarizes the corresponding results taking all effects into account and aggregating average levels of target leverage during expansions and recessions with and without banking crises. Consistent with our earlier results we find that target leverage is lower during expansions than during any of the two types of recessions for the average (and the median) firm indicating counter-cyclical dynamics. Confirming our expectation, we also find that target leverage is lower during recessions with banking crises than during recessions without banking crises. For the average firm, the difference is 2.2% (0.5%) for market (book) leverage. All these dynamics are significant for market and book leverage. These results suggest that supply effects, proxied by the health of the banking industry, matter for leverage dynamics.

6. Conclusion

Surprisingly little is known about the dynamics of leverage over the business cycle. Both theoretical predic-

Table A1
Variable definitions.

Variables	Acronym	Definition	Data source
Dependent variables			
Book leverage	*bl*	The total debt to total assets (book value) ratio	Compustat & Datastream
Market leverage	*ml*	The total debt to total assets (market value) ratio	Compustat & Datastream
Net book leverage	*nbl*	The total debt less cash and short-term investments to total assets (book value) ratio	Compustat & Datastream
Net market leverage	*nml*	The total debt less cash and short-term investments to total assets (market value) ratio	Compustat & Datastream
Independent variables			
Sales	*sales*	The natural logarithm of net sales	Compustat & Datastream
Market-to-book ratio	*mtb*	The market value of total assets to the book value of total assets ratio	Compustat & Datastream
Profitability	*profit*	The operating income before depreciation to the book value of total assets ratio	Compustat
		The earnings before interest, taxes, depreciation, and amortization (EBITDA) to the book value of total assets ratio	Datastream
Tangibility	*tang*	The net PPE to the book value of total assets ratio	Compustat & Datastream
Capital expenditures	*capx*	The capital expenditures to the book value of total assets ratio	Compustat & Datastream
Target leverage ratios			
Target book leverage	*tbl*	The fitted value of book leverage	Eq. (1)
Target market leverage	*tml*	The fitted value of market leverage	Eq. (1)
Target net book leverage	*tnbl*	The fitted value of net book leverage	Eq. (1)
Target net market leverage	*tnml*	The fitted value of net market leverage	Eq. (1)
Business cycle variables			
Recession dummy	*rec*	A dummy variable that equals one in NBER peak-to-trough recession quarters	NBER
		A dummy variable that equals one if a firm's entire fiscal year overlaps with a recession	ECRI
Expansion dummy	*exp*	A dummy variable that equals one less *rec*	NBER & ECRI
Recession with banking crises dummy	*brec*	A dummy variable that equals one if a recession was also a banking crisis	ECRI & Reinhart and Rogoff (2011)
Other variables			
Cash	*cash*	Cash and short-term investments	Compustat
Payout	*payout*	The cash dividends to operating income before depreciation ratio	Compustat
Size dummies	*size*75 (*size*25)	A dummy that equals one if a firm's median (time-series) *size* is in the top (bottom) *size*-quartile	Compustat
Cash dummies	*cash*75 (*cash*25)	A dummy that equals one if a firm's median (time-series) *cash* is in the top (bottom) *cash*-quartile	Compustat
Payout dummies	*payout*75 (*payout*25)	A dummy that equals one if a firm's median (time-series) *payout* is in the top (bottom) *payout*-quartile	Compustat
Rating dummies	*rating*	A dummy variable that equals one if there exists a rating for any of the following three instruments: a long-term issuer credit rating, a short-term issuer credit rating, or a subordinated debt rating	Compustat
	norating	A dummy variable that equals one less *rating*	Compustat

tions and empirical evidence are scarce, ambiguous, and strongly model-dependent. Importantly, the empirical literature so far has not analyzed the *overall* dynamics of (target) leverage; instead, it has only focused on the coefficients of recession dummies or macroeconomic variables in empirical models, which only capture the *marginal* effects.

This paper presents a comprehensive—in terms of firm samples, empirical specifications, sources of dynamics, and leverage definitions—empirical analysis of target leverage dynamics over the business cycle. We find strong support for counter-cyclical target and observed leverage for the average firm; i.e., realized and target leverage being higher during recessions than during expansions. Measuring realized or target leverage ratio dynamics, we are unable to find significant differences in cyclicality between constrained and unconstrained firms. In both cases, we find counter-cyclical dynamics. However, we also find that leverage dynamics are not counter-cyclical for all firms. There is a fraction of firms that experiences pro-cyclical dynamics. These firms also exhibit characteristics suggesting significantly counter-cyclical losses-given-default, consistent with pro-cyclical leverage.

We also offer some insights into the mechanisms driving the counter-cyclical dynamics of leverage. We distinguish between three channels: changing firm characteristics, changing model coefficients, and a direct business cycle effect. Empirically, we find that changing firm characteristics consistently and robustly contribute to the counter-cyclical behavior of target leverage across all empirical specifications. Coefficient variation is also an important source of leverage cyclicality. For example, asset tangibility has a more positive influence on target leverage during recessions whereas the effect of the market-to-book ratio becomes more negative.

Finally, we exploit an international sample to study leverage dynamics for two types of recessions—those that overlap with banking crises and those that do not. We find that leverage varies counter-cyclically for both types of recessions. However, as one would expect if banking crises proxy for supply shocks of debt capital, leverage dynamics are less counter-cyclical during recessions with contemporaneous banking crises.

A promising direction for future research is to improve our understanding of the cross-country variation of leverage dynamics. Even though all empirical results show counter-cyclical leverage dynamics for the average firm, we observe some interesting variation across the US-only and the international samples. Most importantly, leverage varies more and more distinctively in the international sample; i.e., peaks during recessions are more pronounced for observed and target leverage ratios. A better understanding of this variation across countries with different legal, tax, or governance environments could provide important insights about the determinants of firms' financial structures.

Appendix A

This appendix presents definitions of the variables used in the empirical analysis. The main data sources are Compustat, Datastream, and the National Bureau of Economic Research's (NBER) and Economic Cycle Research Institute's (ECRI) business cycle dates.

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