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Cash flows and leverage adjustments ☆

Michael Faulkender [a], Mark J. Flannery [b], Kristine Watson Hankins [c], Jason M. Smith [c,*]

[a] Robert H. Smith School of Business, University of Maryland at College Park, United States
[b] Graduate School of Business, University of Florida, United States
[c] Gatton College of Business and Economics, 550 South Limestone Street, University of Kentucky, Lexington, KY 40506, United States

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ABSTRACT

Recent research has emphasized the impact of transaction costs on firm leverage adjustments. We recognize that cashflow realizations can provide opportunities to adjust leverage at relatively low marginal cost. We find that a firm's cashflow features affect not only the leverage target, but also the speed of adjustment toward that target. Heterogeneity in adjustment speeds is driven by an economically meaningful concept: adjustment costs. Accounting for this fact produces adjustment speeds that are significantly faster than previously estimated in the literature. We also analyze how both financial constraints and market timing variables affect adjustments toward a leverage target.

1. Introduction

Do firms have leverage targets? How quickly do they approach these targets? What are the drivers of the targets? What are the impediments to achieving those targets?

We are not the first to ask these questions, and the literature contains little consensus on the correct answers. Recent studies include Leary and Roberts (2005), Flannery and Rangan (2006), Huang and Ritter (2009), and Frank and Goyal (2009). While Welch (2004) is the obvious exception, almost all research in this arena concludes that firms do have targets, but that the speed with which these targets are reached is unexpectedly slow. This has moved the literature toward a search for the source(s) of adjustment costs. For example, Fisher, Heinkel, and Zechner (1989) argue that firms will adjust leverage only if the benefits of doing so more than offset the costs of reducing the firm's deviation from target leverage. Altinkiliç and Hansen (2000) present estimates of security issuance costs, and others have modeled the impact of transaction costs on observed leverage patterns (e.g., Strebulaev, 2007; Shivdasani and Stefanescu, 2010; Korajczyk and Levy, 2003). Leary and Roberts (2005) derive optimal leverage adjustments when transaction costs have fixed or variable components.

However, the cost of adjusting leverage depends not only on explicit transaction costs, but also on the firm's incentive to access capital markets for other reasons. Profitable investment opportunities will drive some firms to raise external funds, and leverage can be adjusted by choosing between the issuance of debt vs. equity. Other firms (cash cows) routinely generate cash beyond the value of their profitable investment opportunities and may eventually distribute that cash to stakeholders. Leverage can change by choosing to repay debt vs.

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* Corresponding author. Tel.: +1 859 257 2774.
E-mail address: jason.smith@uky.edu (J.M. Smith).

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repurchasing shares or paying dividends. In short, any sort of capital market access can be used to adjust leverage, if the firm wishes to do so. A firm's cash flow realization can substantially affect the cost of making a leverage adjustment, regardless of whether the firm is raising or distributing external funds. Firms not otherwise transacting with the market face a higher adjustment cost. Two stylized examples illustrate the joint effect of adjustment costs and cash flows on observed leverage adjustments.

First, consider a firm with a constant target leverage ratio and high costs of accessing external capital markets. It starts out with leverage below its target (optimal) level and would enhance value by closing the gap. In one year, its cash flow realization is near zero and it has few investment opportunities. In the subsequent year, its cash flow falls well below the amount needed to fund all valuable investment opportunities. If accessing external capital markets entails transaction costs, this firm is much more likely to adjust its leverage in the second year. Yet its market access costs have not changed between these two years. Second, consider two firms, both of which are under-levered and wish to move closer to their leverage targets. Firm A faces low costs of accessing external markets, but rarely does so because its operating cash flows are usually sufficient to fund its valuable investment opportunities, but little more. Adjusting Firm A's leverage would require a "special" trip to the capital markets, and the associated costs would be offset only by the benefits of moving closer to target leverage. Firm B has higher access costs than Firm A, but its operating cash flows are much more volatile. In some years, Firm B's investment opportunities are so great that funding them requires external capital. In other years, Firm B has large excess cash flows, which it finds optimal to distribute to its stakeholders. While engaging in those capital market transactions, this firm can simultaneously adjust its leverage at relatively low marginal cost. We might therefore observe that the firm with higher adjustment costs (Firm B) nonetheless adjusts its capital structure more frequently than Firm A.

Both of these examples indicate that a firm's cash flow situation may substantially affect its net incentive to move toward a target leverage ratio, if it cares about such things. This effect is in addition to the role the various components of cash flow may have on the target leverage ratio itself. Some previous researchers have investigated the impact of these adjustment cost proxies on target leverage or the choice of securities to issue (e.g., Hovakimian, Opler, and Titman, 2001; Korajczyk and Levy, 2003; Leary and Roberts, 2005). However, we are the first to interact adjustment speed measures with cash flows, and thus evaluate the joint effect of transaction costs and cash flow needs on firms' adjustments toward target.[1]

Accounting for a firm's cash flow realization provides significantly different interpretations from what has been documented in the literature. We estimate that firms with cash flow realizations near zero close 23–26% of the gap between actual and target leverage ratios each year. This adjustment speed resembles those reported previously in the literature (e.g., Lemmon, Roberts, and Zender, 2008; Huang and Ritter, 2009). However, firms with cash flows significantly exceeding their leverage deviation exhibit adjustment speeds in excess of 50%. This number rises to greater than 70% if the firm is over-levered. The magnitudes of these estimated parameters indicate that cash flow realizations have a first-order effect on firms' convergence toward target leverage ratios. By showing that adjustments toward target leverage vary with the marginal cost of implementing leverage changes, we provide empirical evidence consistent with the widely used partial adjustment model. Ignoring cash flows therefore imposes an inappropriate constraint on adjustment speeds in typical partial adjustment models of financial leverage. Our results are robust to alternative measures of cash flow, the incorporation of firms' beginning-of-period cash position into the cash flow calculation, and alternative estimates of the firm target leverage levels.

Our results also bear on the recent evidence that randomly generated leverage adjustments can yield empirical results that resemble leverage-targeting and partial adjustment behavior (e.g., Chang and Dasgupta, 2009; Iliev and Welch, 2010). Chang and Dasgupta (2009, p. 1794) conclude that for identifying target behavior, "Looking at leverage ratios is not enough, and even possibly misleading." These studies impose the same adjustment speed on all sample firms.[2] One of our contributions is to identify ex ante firms that are likely to make larger leverage adjustments based on characteristics other than their leverage preferences (if any). The resulting evidence confirms the performance of a partial adjustment model in a more refined environment than studies that estimate the same adjustment speed across all sample firms. Moreover, the large estimated adjustment speeds differ greatly in economic significance from the adjustment speeds generated by the Chang and Dasgupta (2009) simulations.

With our specification in place, we then investigate the impact of financial constraints and market timing on adjustment speeds. Financially constrained firms may find it expensive (or impossible) to issue securities that would move them toward their target leverage ratios (Korajczyk and Levy, 2003). Similarly, firms' security issuances or redemptions may reflect market timing or asset mispricing effects in addition to a potential desire to move toward target leverage. For instance, an over-levered firm that considers its shares to be overvalued will see an adjustment toward target leverage via an equity issuance as low cost. However, if that same firm were under-levered, it may choose to become even more under-levered if the perceived benefit of issuing

[1] In part, this assumption reflects the fact that few researchers estimate capital structure models with endogenous investment decisions. Exceptions include Brennan and Schwartz (1984), Whited and Hennessy (2005), Titman and Tsyplakov (2007), and DeAngelo, DeAngelo, and Whited (2011).

[2] Pesaran and Smith (1995) show that pooling dynamic panels with varying adjustment speeds can lead to incorrect coefficient estimates.

mispriced equity exceeds the marginal value of approaching target leverage.

We find that market conditions and indicators of financial constraint (high access costs) both affect leverage adjustment speeds. Financial constraints have nearly an order of magnitude larger effect than market timing considerations. The relative accessibility of markets generates significant variation in the costs firms face when approaching capital structure adjustments. Although market timing effects do alter capital structure adjustments on the margin (the effects are statistically significant), the economic magnitudes cannot explain the slow adjustment speeds estimated from broad samples.

The paper is organized as follows. Section 2 presents some basic empirical models of corporate leverage, describes data sources, and explains how we compute target leverage ratios for each firm-year. We illustrate some distinguishing features of our approach in Section 3, including the importance of distinguishing between under- and over-levered firms' leverage adjustments. Section 4 introduces the paper's major innovation. We explain why operating cash flows affect a firm's cost of making leverage adjustments, and modify a standard partial adjustment model to reflect the interaction between a firm's cash flow needs and its capital structure adjustments. The resulting estimated adjustment speeds are substantially larger than previous estimates in the literature. We analyze the robustness of our results in Section 5. Section 6 then extends the model in Section 4 to test whether financial constraints and market conditions affect adjustment speeds. We find that adjustment speeds vary plausibly with both cross-sectional and intertemporal variables, supporting our partial adjustment model of capital structure adjustment. The final section summarizes results and discusses their implications for capital structure theories.

2. Basic leverage models and data

A standard partial adjustment model of firm capital structure estimates a regression of the form[3]

$$L_{i,t}-L_{i,t-1} \equiv \frac{D_{i,t}}{A_{i,t}}-\frac{D_{i,t-1}}{A_{i,t-1}} = \lambda(L^*_{i,t}-L_{i,t-1})+\tilde{\epsilon}_{i,t}, \tag{1}$$

where $D_{i,t}$ is the firm's outstanding debt at time t, $A_{i,t}$ is the firm's outstanding book assets at time t, $L_{i,t}$ is contemporaneous leverage, $L_{i,t-1}$ is lagged leverage, and $L^*_{i,t}$ is the estimated target leverage ratio, given firm characteristics at $t-1$. The typical sample firm closes λ percent (per time period) of the gap between its target leverage and its beginning-of-period leverage. This "lambda" value is commonly called the firm's "speed of adjustment" toward target.

Note that specification (1) assumes that a firm's adjustment starts from the prior period's leverage, $L_{i,t-1}$. Absent any active capital structure adjustments, however, leverage will change from $L_{i,t-1}$, when the firm posts its annual income to its equity account. An active adjustment requires that the firm access capital markets in some way, even if only to pay dividends. Likewise, only active adjustments entail transaction costs, so therefore, tests of target adjustment models should focus on active adjustments. We revise (1) to separate a firm's leverage change into a passive, mechanical component and an active adjustment:

$$L_{i,t}-L^p_{i,t-1} = \gamma(L^*_{i,t}-L^p_{i,t-1})+\tilde{\epsilon}_{i,t}, \tag{2}$$

where

$$L^p_{i,t-1} \equiv \frac{D_{i,t-1}}{A_{i,t-1}+NI_{i,t}}$$

and NI_t is equal to net income during the year ending at time t. Leverage at t would be $L^p_{i,t-1}$ if the firm engages in no net capital market activities. The left-hand side of (2) therefore equals the firm's active "adjustment" toward target capital structure change.

We follow previous researchers in studying leverage decisions for all Compustat firms with the exception of financial firms (Standard Industrial Classification (SIC) 6000–6999) and utilities (SIC 4900–4999), for the time period 1965–2006. Using the combination of annual Compustat and Center for Research in Security Prices (CRSP) data, we estimate a partial adjustment model that specifies the target capital ratio as depending on the firm characteristics employed by Flannery and Rangan (2006). Although previous studies have used both market-valued and book-valued equity measures, we concentrate on book leverage because decomposing the active and passive pieces is more straightforward.[4] To reduce the effect of outliers, all ratios are winsorized at the first and ninety-ninth percentiles. Table 1 defines all variables and presents summary statistics.

Both regressions (1) and (2) rely on an estimated target leverage, $L^*_{i,t}$. The most challenging aspect of estimating either regression is constructing an estimate of the firm's target leverage. Many recent papers estimate target leverage concurrently with the speed of adjustment toward target, as in (2). For reasons that will become more clear below in Section 6.1, we estimate a target first; then (1) or (2) can be estimated by ordinary least squares (OLS) with bootstrapped standard errors.

The recent literature on firm leverage models concludes that allowing for incomplete adjustment is important, and that firm fixed effects are required to capture unobserved firm-level heterogeneity (Flannery and Rangan, 2006; Lemmon, Roberts, and Zender, 2008). We begin by estimating a partial adjustment model of leverage for all sample firms, using the restriction that $L^*_{i,t} = \beta X_{i,t-1}$:

$$L_{i,t} = \gamma\beta X_{i,t-1}+(1-\gamma)L_{t,t-1}+\epsilon_{i,t}, \tag{3}$$

where β is a coefficient vector to be estimated concurrently with γ and $X_{i,t-1}$ includes:

a firm fixed effect,

[3] See Flannery and Rangan (2006), Lemmon, Roberts, and Zender (2008), and Huang and Ritter (2009).

[4] Substituting market- for book-valued leverage measures yields similar results, as suggested by the first two columns of Table 2.

Table 1
Summary statistics.

Table 1 characterizes the mean, median, and standard deviation for all of the variables. The sample contains all Compustat firms supplemented with data from Center for Research in Security Prices (CRSP) with the exception of financial firms (Standard Industrial Classification (SIC) 6000–6999) and utilities (SIC 4900–4999), for the time period 1965–2006. In Panels A and B, the mean under-levered and mean over-levered values also are provided. Over- and under-levered are not reported in panel C because the variables used to estimate targets and the targets are estimated on the full sample (except when the Rated variable is included in calculating targets, then the sample is restricted to after 1985), over and under are not reported for this panel. Book and Market targets are estimated using the methodology presented in Section 2. Book dev is the book target less the book leverage from the previous year. Book active dev is the book target less the book leverage adjustment which is defined as the previous period's total debt divided by the sum of the previous period's book assets plus net income for the current period. Book leverage adjustment is capped at two to reduce the effect of extreme income realizations. Market dev is the market target less the market leverage from the previous year. Cash flow is defined as operating income before depreciation less total taxes less interest expense normalized by the previous period's book assets less industry capital expenditures. Industry capital expenditures is defined as the Fama-French industry-year average capital expenditures normalized by the previous period's book assets. DevLarger is one if when the absolute value of Book active dev is greater than the absolute value of Cash flow and zero otherwise. Sign is one if the firm is over-levered and -1 otherwise. ExcessDev is DevLarger multiplied by the difference of the absolute value of Book dev less the absolute value of Cash flow. Overlap, $|Dev| > |CF|$ is DevLarger multiplied by the absolute value of Cash flow. Overlap, $|CF| > |Dev|$ is $(1-\text{DevLarger})$ multiplied by the absolute value of Book dev. ExcessCF is $(1-\text{DevLarger})$ multiplied by the difference of the absolute value of Cash flow less the absolute value of Book dev. *Baa* is the average Baa yield for the period between $t-1$ and t. MBDiff is the firm market-to-book less the Fama and French (1997) industry average market-to-book. IndMB is the Fama and French (1997) industry average market-to-book ratio. Ln(Basset) is the natural log of book assets in the previous year. Rated is one if the firm has bond rating and zero otherwise. Div equals one if the firm paid dividends in the previous year and zero otherwise. Book lev is total debt normalized by the book value of assets. EBIT_TA is the income before extraordinary items plus interest expense plus income taxes all normalized by total assets. MB is the sum of book liabilities and the market value of equity normalized by total assets. DEP_TA is depreciation and amortization normalized by total assets. LnTA is the natural log of total assets deflated by the consumer price index to 1983 dollars. FA_TA is net property, plant, and equipment normalized by total assets. R&D_TA is research and development expense normalized by total assets. R&D_Dum is equal to one if research and development expense is greater than zero and zero otherwise. Industry median is the annual median target for the Fama and French (1997) industry.

	Mean	Median	St. Dev.	Under levered	Over levered
Panel A: Targets and deviations from target					
Book target	0.276	0.246	0.211	0.320	0.234
Book dev	0.033	0.016	0.174	0.137	−0.105
Book active dev	0.030	0.019	0.181	0.134	−0.117
Market target	0.329	0.275	0.274	0.375	0.287
Market dev	0.064	0.032	0.234	0.201	−0.138
Cash flow	−0.040	−0.007	0.197	−0.040	−0.052
ExcessDev	0.016	0.000	0.114	0.067	−0.056
Overlap, $\|Dev\| > \|CF\|$	0.008	0.000	0.071	0.036	−0.032
Overlap, $\|CF\| > \|Dev\|$	0.006	0.000	0.084	0.032	−0.030
ExcessCF	0.018	0.000	0.137	0.049	−0.045
Panel B: Market timing and financial constraint variables					
Baa	9.397	8.623	2.473	9.505	9.328
MBDiff	0.000	−0.246	1.557	0.015	−0.090
IndMB	1.858	1.728	0.667	1.835	1.848
Ln(Basset)	4.707	4.512	2.105	4.657	4.855
Rated	0.215	0.000	0.411	0.206	0.249
Div	0.592	1.000	0.491	0.607	0.580
Panel C: Firm characteristics used in target leverage calculation					
Book lev	0.253	0.228	0.216		
Market lev	0.276	0.218	0.249		
EBIT_TA	0.036	0.088	0.620		
MB	1.701	1.044	2.998		
DEP_TA	0.047	0.038	0.062		
LnTA	18.200	18.046	2.106		
FA_TA	0.316	0.265	0.227		
R&D_TA	0.038	0.000	0.118		
R&D_Dum	0.125	0.000	0.331		
Industry median	0.220	0.215	0.139		

EBIT_TA=(Income before extraordinary items+Interest expense+Income taxes)/Total assets,

MB=(Book liabilities plus market value of equity)/Total assets,

DEP_TA=Depreciation and amortization/Total assets,

LnTA=ln(Total assets deflated by the consumer price index to 1983 dollars),

FA_TA=Net property, plant, and equipment/Total assets,

R&D_TA=Research and development expense/Total assets (missing R&D expenses are treated as zero),

R&D_Dum=1 if Research and development expense =0, else zero, and

Ind_Median Leverage=Median debt ratio for the firm's Fama and French (1997) industry.

This sort of dynamic panel model entails some important estimation issues (Nickell, 1981; Baltagi, 2008), which several econometric techniques have been designed to

Table 2
Baseline adjustment speeds.
Table 2 presents the results from a regression analysis where the dependent variable is the change in book leverage in column 1, the change in the market leverage in column 2, and the change in book leverage restricted to active adjustments only in column 3 all of which are defined in Table 1. Standard errors are bootstrapped to account for generated regressors. *p*-Values are reported in parentheses.
***, **, and * represent significance at the one percent, five percent, and ten percent levels, respectively.

$$L_{i,t}-L_{i,t-1} \equiv \frac{D_t}{A_t}-\frac{D_{t-1}}{A_{t-1}} = \lambda(L^*_{i,t}-L_{i,t-1})+\tilde{\varepsilon}_{i,t}$$

$$L_{i,t}-L^p_{i,t-1} = \gamma(L^*_{i,t}-L^p_{i,t-1})+\tilde{\varepsilon}_{i,t}$$

	ΔBook lev	ΔMkt lev	ΔActive book lev
Book dev	0.219*** (0.000)		
Market dev		0.223*** (0.000)	
Book active dev			0.316*** (0.000)
N	131,062	130,785	131,058
Adj. R^2	0.135	0.193	0.285

address. Flannery and Hankins (2011) conclude that the Blundell and Bond (1998) system Generalized Method of Moments (GMM) estimation method generally provides adequate estimates. We estimate (3) via Blundell and Bond's system GMM and compute $\widehat{L}^*_{i,t}$. Eqs. (1) and (2) can then be estimated using OLS, with bootstrapped standard errors to account for the generated regressor (Pagan, 1984).

Estimation results for (3) correspond closely to estimates presented previously in the literature for both market- and book-valued leverage measures, and for brevity are not presented.[5]

3. Initial estimation results

Table 2 reports the results from estimating the basic regression models. The first two columns report estimates for (1), using book- and market-valued leverage, respectively. Book-valued (market-valued) leverage yields an annual adjustment speed of 21.9% (22.3%). These results closely resemble previous estimated adjustment speeds (e.g., Lemmon, Roberts, and Zender, 2008). Consistent with most of the existing literature, the implied adjustment speeds are very similar between market and book values. The third column of Table 2 estimates a baseline adjustment speed using our measure of active leverage in Eq. (2). The estimated adjustment speed rises to 31.6% for this measure of active leverage adjustment. One reason for this increase may be that the median firm has positive net income and is under-levered. Absent active leverage adjustments, the median firm tends to become even more under-levered, so when a firm does actively adjust its capital structure, our alternative measure of "starting" leverage gives the firm some credit toward undoing the effect of positive net income. This portion of adjustment is not captured in specification (1). Given our interest in how cash flows affect (costly) active leverage adjustments and the empirical effect of using $L^p_{i,t-1}$ as the firm's starting point in adjusting leverage, we continue with it throughout the rest of the paper.

Our second refinement to the basic specification (1) eliminates the symmetry between under- and over-levered firms. Previous researchers have generally assumed that all firms adjust their leverage ratios at the same rate, with DeAngelo, DeAngelo, and Whited (2011) being one notable exception. However, one can readily imagine reasons why optimal adjustments vary asymmetrically across firms.[6] Even if adjustment costs were equal for under- and over-levered firms, the benefits may be asymmetrical. Under-levered firms forego tax benefits of leverage and have little concern with financial distress costs. Yet potential financial distress costs loom quite large for over-levered firms. There is no theoretical reason why the net tax benefit minus expected financial distress costs should be symmetrical around the firm's optimal leverage ratio, and therefore no reason to maintain that the absolute distance from target leverage fully captures a firm's incentives to adjust. Korteweg (2010) estimates that below the firm's optimal leverage ratio, the value function of the firm relative to further reductions has a rather flat slope. In contrast, when the firm is over-levered, the value of the firm declines significantly as leverage increases further.

[5] Targets estimated from the entire sample period (1965–2006) are used in all our reported results except Table 6 when rating data are available only from 1986 to 2006. We also included additional variables to explain target leverage in some instances, but our results are not sensitive to such changes. See Section 5 below.

[6] For example, Korajczyk and Levy (2003) provide evidence that the leverage adjustments made by constrained and unconstrained firms differ.

Table 3
Baseline adjustment speeds with decomposition.

Table 3 presents the results from a regression analysis where the dependent variable is the change in book leverage restricted to active adjustment. Columns 1 and 3 represents firm-years with leverage below target leverage while columns 2 and 4 represents firm-years with leverage above target. Variable definitions and the sample description are contained in Table 1. *p*-Values are reported in parentheses.

***, **, and * represent significance at the one percent, five percent, and ten percent levels, respectively.

$$L_{i,t}-L^{p}_{i,t-1} = \{[\gamma_1(|Dev|-|CF|)+\gamma_2|CF|]*DevLarger + [\gamma_3|Dev|+\gamma_4(|CF|-|Dev|)]*(1-DevLarger)]\} *Sign+\tilde{\epsilon}_{i,t}$$

ExcessDev $\equiv (|Dev|-|CF|)*DevLarger$
Overlap, $|Dev| > |CF| \equiv |CF|*DevLarger$
Overlap, $|CF| > |Dev| \equiv |Dev|*(1-DevLarger)$
ExcessCF $\equiv (|CF|-|Dev|)*(1-DevLarger)$
$DevLarger=1$ if $|Dev| > |CF|$, otherwise$=0$
$Sign=1$ if the firm is over-levered and$=-1$ otherwise

	ΔActive book lev		ΔActive book lev	
	Under lev.	Over lev.	Under lev.	Over lev.
Book active dev	0.298***	0.564***		
	(0.000)	(0.000)		
ExcessDev			0.229***	0.264***
			(0.000)	(0.000)
Overlap, $\|Dev\| > \|CF\|$			0.269***	0.903***
			(0.000)	(0.000)
Overlap, $\|CF\| > \|Dev\|$			0.515***	0.693***
			(0.000)	(0.000)
ExcessCF			−0.007	0.002
			(0.293)	(0.805)
P($\gamma_1=\gamma_2$) *F* value			6.590	918.270
Probability $\gamma_1=\gamma_2$			(0.010)	(0.000)
N	75,187	51,997	75,042	51,880
Adj. R^2	0.271	0.489	0.307	0.536

The left half of Table 3 reports the results of estimating the base model (2) separately for over-levered and under-levered firms. The estimated adjustment speeds are strikingly different: 29.8% per year for under-levered firms vs. 56.4% for over-levered firms.[7] On its face, this result suggests that over-levered firms have either greater benefits or lower costs of adjusting toward their target leverage ratios. This result is consistent with Hovakimian (2004), who finds that movements toward target leverage ratios are more prominent for over-levered firms. We build on that finding by showing that it is the firm's cash flow realization that enables the timing and extent of that debt reduction. Understanding when and by how much firms move toward their target leverage ratio is one of the primary contributions of our work.

Given the significant differences in adjustment speeds between under- and over-levered firms, all of our subsequent specifications will be estimated separately for these two subsamples. As an added benefit, we shall see in Section 6 that estimating separate models for over- and under-levered firms aids our interpretation of how market timing variables affect convergence to target leverage.

4. The effect of cash flow on capital market adjustment costs

Our third- and most important-modification to the standard partial adjustment model (1) recognizes that a firm's operating cash flow (CF) may affect the cost of making leverage adjustments. CF has two potential effects on leverage adjustment. First, CF needs accommodated in the market create a low-cost opportunity to adjust leverage. If a firm needs to raise external funds and has a leverage target, it can choose to issue debt or equity

[7] A similar result is reported by Byoun (2009), whose regression specification examines changes in a firm's outstanding debt under various cash flow conditions. Our estimates differ from Byoun's along two important dimensions. First, his specification ignores explicit changes in outstanding equity, and thus cannot detect changes in leverage, but only changes in the "numerator," outstanding debt. Second, our specifications use continuous variables for cash flow and deviation from target leverage to make inferences about variable adjustment costs, while Byoun uses a dummy variable to indicate whether the firm's cash flow is positive or negative.

according to whether it is under- or over-levered. Likewise, a firm with high positive cash flow will tend to distribute funds to investors, but it can affect leverage by choosing to pay down either debt or equity. The sign of cash flow does not matter, just its absolute value. Second, if firms confront a fixed cost of accessing capital markets, they are more likely to make leverage adjustments when part of the fixed market access cost is borne by the firm's need to accommodate its cash flow imbalances.

We define a firm's operating cash flow (or financing deficit) as

$$CF_{i,t} = \frac{OIBD_{i,t} - T_{i,t} - Int_{i,t}}{A_{i,t-1}} - Industry\_CapEx_t, \tag{4}$$

where $OIBD_{i,t}$ is operating income before depreciation, $T_{i,t}$ is the total taxes allocated on the income statement, $Int_{i,t}$ is the interest paid, $Industry\_CapEx_t$ is the mean value of capital expenditures in year t (deflated by lagged book assets) for all Compustat firms in firm i's Fama and French (1997) industry, and $A_{i,t-1}$ is the value of total assets for the fiscal year ending at $t-1$.

The first three terms in (4) are included in standard measures of a firm's financing deficit, beginning with Shyam-Sunder and Myers (1999). Some prior researchers have subtracted out the firm's actual capital expenditures to yield its external financing requirement. Instead, we proxy for the firm's investment opportunity set with $Industry\_CapEx_t$. A firm's observed expenditures reflect both the firm's investment opportunity set *and* its decision to access financial markets. The latter could be correlated with a firm's leverage gap, leading us to employ $Industry\_CapEx_t$ as an instrument.

We expect that firms with high *absolute CF* are more likely to make leverage adjustments, if leverage targets mean anything to them. As a first approximation, the *CF*'s *sign* does not matter. Consider first a firm for which large investment opportunities generate a negative *CF*. If the net present value of these investment opportunities exceeds the cost of accessing financial markets, the firm will raise external funds and any transactions related to leverage adjustment can be made "free" of that fixed access cost. Even if the investment opportunities are insufficient to warrant market access on their own, the combination of investment and leverage benefits might justify the cost of capital market access. Analogously, a firm with a large positive *CF* will consider distributing excess funds to the market by repurchasing either shares or debt, according to its leverage gap.

We can learn something about the costs of adjusting capital structure by comparing the size of a firm's $CF_{i,t}$ to its scaled deviation from target leverage:

$$Dev_{i,t} = L^*_{i,t} - L^p_{i,t-1}. \tag{5}$$

A firm whose $|Dev|$ exceeds its $|CF|$ can make a leverage adjustment up to $|CF|$ at low cost because the market access costs are shared between the benefits of approaching target capital structure and the funding/distribution of realized cash flow. However, a leverage gap beyond $|CF|$ will be closed only if the marginal cost of additional capital market transactions is sufficiently low. Unless variable cost is zero, we expect that the firm's adjustment speed toward target will be faster for $|Dev|$ up to $|CF|$ than beyond that point.

Next, consider a firm whose $|CF|$ exceeds $|Dev|$. This firm has sufficient funding needs (or excess cash to return to stakeholders) to reach its leverage target by choosing appropriately between debt and equity transactions. In other words, the firm can simultaneously close its leverage gap and resolve its cash flow needs. We therefore anticipate that firms with such large (absolute) cash flows will make large movements to close $|Dev|$. In the absence of variable adjustment costs, this coefficient might approach unity. However, for the $|CF|$ beyond the initial $|Dev|$, the firm's debt-equity choice should preserve the (attained) target leverage, and hence, we expect no systematic change in leverage from this sort of "excess" cash flow.

This intuitive discussion has divided *CF* and *Dev* into four segments:

ExcessDev $\equiv (|Dev| - |CF|) * DevLarger$

Overlap, $|Dev| > |CF| \equiv |CF| * DevLarger$

Overlap, $|CF| > |Dev| \equiv |Dev| * (1 - DevLarger)$

ExcessCF $\equiv (|CF| - |Dev|) * (1 - DevLarger)$

$DevLarger = 1$ if $|Dev| > |CF|$, otherwise$=0$. The first three variables decompose leverage deviation into the part that exceeds $|CF|$ and two parts that "overlap" $|CF|$. The fourth variable, "ExcessCF" measures cash flow needs beyond those required to close the leverage deviation completely. If these segments involve different costs of adjusting leverage, we should generalize (2) into a modified partial adjustment model:

$$\begin{aligned} L_{i,t} - L^p_{i,t-1} = \{ & [\gamma_1(|Dev| - |CF|) + \gamma_2 |CF|] * DevLarger \\ & + [\gamma_3 |Dev| + \gamma_4(|CF| - |Dev|)] * (1 - DevLarger)\} \\ & * Sign + \tilde{\varepsilon}_{i,t}, \end{aligned} \tag{6}$$

where $Sign = 1$ if the firm is over-levered and $= -1$ otherwise.[8] Eq. (6) is designed to identify leverage adjustments that are relatively inexpensive to undertake. γ_2 and γ_3 measure the firm's propensity to adjust leverage when its cash flow situation makes these adjustments easiest to undertake.[9] Assuming that firms wish to move toward their target leverage ratios, γ_2 and γ_3 should be quite large:

- When the $|Dev|$ exceeds the $|CF|$, all of $|CF|$ is available to adjust leverage toward target.
- When $|CF|$ exceeds $|Dev|$, the firm's cash flow needs permit it to attain target leverage.

With zero variable transaction costs, γ_1 should equal γ_2: once any fixed cost of accessing the external market has been incurred, the firm should close $|Dev|$ equally with CF-related funds or with transactions aimed solely at closing $|Dev|$. However, positive variable costs will leave $\gamma_1 < \gamma_2$ because transactions aimed exclusively at closing

[8] This sign adjustment accounts for the fact that the dependent variable is signed, while the explanatory variables are all positive by construction.

[9] Firms with $DevLarger = 0$ will tend to be closer to their target leverage than the firms with $DevLarger = 1$. Therefore, we (weakly) anticipate that $\gamma_3 > \gamma_2$.

$|Dev|$ provide fewer benefits. γ_4 should also be small: a firm with Excess $|CF|$ can attain its target leverage in the course of fulfilling its CF needs, so further transactions should leave leverage undisturbed. In summary, we hypothesize that $\gamma_3 \approx \gamma_2 > \gamma_1 > \gamma_4$.

As an example, consider a firm that is under-levered by 5% of its (lagged) total assets and has a cash flow deficit equal to 8% of its lagged total assets. The partial adjustment model predicts that the first five percentage points of the cash flow deficit (corresponding to the value of the γ_3 variable in (6)) will be raised in the form of debt, which would generate $\gamma_3 = 1$. What about the remaining 3% of the cash flow deficit? Assuming that the firm finds it more costly to liquidate assets than raise capital and does not have sufficient internal liquidity, it would raise the additional 3% of assets according to its target leverage ratio. For instance, if the firm's target leverage ratio were 40% and the initial debt issuance (the 5%) has attained that leverage, 1.2 percentage points of the remaining 3% financing need would be raised as debt and the other 1.8 percentage points raised as equity. As a result, we hypothesize that this marginal *CF* will leave leverage unaffected, on average. That is, the coefficient on γ_4 will be near zero. Now, reverse the numbers in our example: make the firm under-levered by 8% of its (lagged) total assets, with a cash flow deficit equal to 5% of its lagged total assets. The firm is again predicted to close the first 5% of the leverage deficit with a debt issuance ($\gamma_2 = 1$). What about the remaining 3% of *Dev*? With a high marginal (variable) transaction cost, the firm will do nothing to close this part of the deviation. On the other hand, with sufficiently low variable costs, it would raise the additional 3% of assets in the form of debt (given that the fixed access cost has already been paid). The higher the variable cost, the closer to zero γ_1 is predicted to be.

Estimation results for (6) are presented in the right half of Table 3, separately for under-levered and over-levered firms. Our hypothesized rank ordering of estimated γ coefficients holds in both subsamples. When cash flows are large (in absolute value), the leverage adjustments (γ_2, γ_3) are also large. The typical over-levered firm devotes between 69% and 90% of its cash flow realization to capital transactions that close the gap between actual and target leverage, compared to 27–52% for under-levered firms. In Table 3, the benefits of removing excess leverage apparently exceed the benefits of moving toward target leverage from below. Note that leverage adjustments are significantly smaller for the ExcessDev, which suggests that capital market transactions involve at least some variable transaction costs. Finally, the insignificant coefficients on ExcessCF indicate that firms make no systematic leverage changes once they have eliminated their deviation from target.

Table 4 refines the *CF* variables' definition (4) to reflect a firm's ability to buffer the effects of volatile cash flows by holding liquid "cash" assets. The cash flow definition in (4) ignores accumulated cash balances, yet such balances can separate cash flow realizations from the need to access external capital markets (e.g., Opler, Pinkowitz, Stulz, and Williamson, 1999; Almeida, Campello, and Weisbach, 2004). We explore two specifications for incorporation of cash balances by revisiting the definition of *CF* (4) and re-estimating (6). First, the cash position is added to the numerator of (4). Estimation results in the first and third columns of Table 4 reveal some changes in estimated adjustment speeds, but the main results remain unchanged from the right half of Table 3: firms close a significant portion of their target leverage differential when the adjustment cost is shared with addressing the cash flow realization. The adjustment speed is considerably smaller when the adjustment cost is only offset by the benefits from approaching target leverage: the hypothesis that $\gamma_1 = \gamma_2$ is rejected. Another way to incorporate cash balances into our measure of *CF* is to recognize some of a firm's cash may be required for operating liquidity. We do this by replacing the firm's beginning-of-period cash position (in (4)) with an estimate of its excess cash position, measured as the firm's beginning-of-period of cash less the beginning-of-period Fama and French (1997) industry average cash level, normalized by size. The results in columns 2 and 4 of Table 4 are nearly identical to those found using the firm's total cash position.

We conclude two things from Table 4. First, leverage adjustment costs are important in determining how much firms adjust. Otherwise, cash flow realizations would not have a first-order effect on the extent of leverage adjustment shown above. Second, adjustment costs appear to have at least one variable component. If the cost were entirely fixed, once the firm absorbs the fixed cost associated with addressing its cash flow realization, it should adjust all the way to its target. This would generate γ_1 and γ_2 coefficients that do not significantly differ from each other.

5. Robustness

Our results are robust to alternative measures of target leverage and to variations of our cash flow measures. Because Korajczyk and Levy (2003) find that leverage levels vary with macroeconomic conditions, we re-estimate our target leverage ratios with year dummies to allow time series variation at the macroeconomic level to alter firms' target leverage positions for the corresponding fiscal year. Using these alternative targets, we re-estimate Eq. (6) and report the results in the two columns of Table 5 labeled "I." Comparing the results to those found in the right half of Table 3 indicates that allowing leverage to change with movements in the macroeconomy does not alter the effect of cash flow realizations on leverage adjustment speeds.

We make three further adjustments to our definition of the firm's cash flow realization (Eq. (4)), and report the results in columns II, III, and IV, respectively, of Table 5. First, we subtract the change in working capital, recognizing that short-term assets and liabilities can serve as alternative sources and uses of cash. Second, we subtract the cash dividends paid in the previous fiscal year, on the assumption that firms view their dividend stream as a committed use of cash similar to a required interest payment to debt holders (Graham and Harvey, 2001). Third, if firms have debt maturing in the current fiscal

Table 4
Alternative definition of operating cash flows (Eq. (4)).
Table 4 presents the results from estimating (6) for alternative measures of operating cash flow, separately for firm-years in which leverage is less than vs. greater than target leverage. Columns 1 and 3 add the firm's beginning-of-period cash holdings to the numerator of *CF* in (4). Columns 2 and 4 add estimated excess cash to the numerator of (4). Standard errors are bootstrapped to account for generated regressors. Variable definitions and the sample description are contained in Table 1. *p*-Values are reported in parentheses.
***, **, and * represent significance at the one percent, five percent, and ten percent levels, respectively.

$$L_{i,t}-L^{p}_{i,t-1} = \{[\gamma_1(|Dev|-|CF|)+\gamma_2|CF|]*DevLarger + [\gamma_3|Dev|+\gamma_4(|CF|-|Dev|)]*(1-DevLarger)]\} *Sign+\tilde{\varepsilon}_{i,t}$$

ExcessDev $\equiv (|Dev|-|CF|)*DevLarger$
Overlap, $|Dev|>|CF| \equiv |CF|*DevLarger$
Overlap, $|CF|>|Dev| \equiv |Dev|*(1-DevLarger)$
ExcessCF $\equiv (|CF|-|Dev|)*(1-DevLarger)$
$DevLarger=1$ if $|Dev|>|CF|$, otherwise$=0$
$Sign=1$ if the firm is over-levered and $=-1$ otherwise

	Under levered		Over levered	
	Beg. cash	Excess cash	Beg. cash	Excess cash
ExcessDev	0.183*** (0.000)	0.164*** (0.000)	0.439*** (0.000)	0.363*** (0.000)
Overlap, $\|Dev\|>\|CF\|$	0.461*** (0.000)	0.472*** (0.000)	0.800*** (0.000)	0.814*** (0.000)
Overlap, $\|CF\|>\|Dev\|$	0.324*** (0.000)	0.342*** (0.000)	0.454*** (0.000)	0.527*** (0.000)
ExcessCF	0.001 (0.631)	0.016*** (0.000)	−0.005* (0.074)	0.000 (0.957)
P($\gamma_1=\gamma_2$) *F* value	169.020	211.960	169.090	346.830
Probability $\gamma_1=\gamma_2$	(0.000)	(0.000)	(0.000)	(0.000)
N	75,042	75,040	51,876	51,876
Adj. R^2	0.286	0.295	0.502	0.510

year, they will need to refinance that maturing debt unless their operating cash flow is sufficiently positive. Tapping external capital markets to refinance existing debt will also lower the cost a firm incurs from approaching target leverage. Therefore, we subtract short-term debt (Compustat data 34—debt in current liabilities) to arrive at our third alternative measure of cash flow. The results are extremely robust and consistent with our prior results. Very rapid adjustment speeds on the two Overlap variables indicate that *CF* needs substantially reduce the cost of adjusting leverage. The smaller coefficients on ExcessDev are consistent with the hypothesis that leverage adjustment costs include a variable component.[10]

Finally, fixed adjustment costs would lead firms to make separate decisions about whether to access the capital market and how much to change leverage, conditional on access. We therefore estimated (6) as part of an endogenous choice (Heckman) model, in which the first (probit) model explains which firms "accessed" capital markets in the form of sufficiently large changes in their outstanding debt and/or equity.[11] We then estimate (6) only for firms that accessed the market, and include the inverse Mills' ratio as an additional explanatory variable. Untabulated results indicate that firms are more likely to access external capital markets when they have larger $|CF|$ or larger $|Dev|$, consistent with the existence of a fixed access cost. The second-stage (regression model (6)) results were very similar to those reported in Table 3.

6. Financial constraints and market timing

A growing literature suggests that the ability to tap capital markets varies across firms and the cost of adjusting leverage may differ between financially "constrained" and "unconstrained" firms (e.g., Korajczyk and Levy, 2003). For example, Faulkender and Petersen (2006) show that access to the public bond market enables a firm

[10] In untabulated results, we simultaneously make all three adjustments and the results mirror those reported here. These results are available upon request.

[11] As suggested by Strebulaev (2007), we hereby estimate an adjustment model only for firms that are most likely to have adjusted. This approach resembles Leary and Roberts (2005), who utilize a hazard function to characterize capital market accessing decisions. Hovakimian, Opler, and Titman (2001), Korajczyk and Levy (2003), and Huang and Ritter (2009) also estimate security choice models for samples of firms that actually made large capital structure adjustments.

Table 5
Robustness.

Table 5 presents the results from estimating (6) separately for over- and under-levered firms. Column I reports the adjustment speed coefficient for each of the four decompositions when the targets are calculated with year dummy variables to control for macroeconomic conditions. Column II reports the adjustment coefficients when the baseline measure of free cash flow (4) is adjusted by subtracting the change in net working capital. Column III reports the adjustment coefficients when the baseline measure of free cash flow is adjusted by subtracting the previous period's dividends. Column IV reports the adjustment coefficients when the baseline measure of free cash flow is adjusted by subtracting debt in current liabilities. All adjustment additions have the same normalization as the baseline free cash flow measure (beginning-of-period book assets). Variable definitions and the sample description are contained in Table 1. *p*-Values are reported in parentheses.

***, **, and * represent significance at the one percent, five percent, and ten percent levels, respectively.

$$L_{i,t}-L^{p}_{i,t-1} = \{[\gamma_1(|Dev|-|CF|)+\gamma_2|CF|]*DevLarger +[\gamma_3|Dev|+\gamma_4(|CF|-|Dev|)]*(1-DevLarger)]\}*Sign+\tilde{\varepsilon}_{i,t}$$

ExcessDev $\equiv(|Dev|-|CF|)*DevLarger$
Overlap, $|Dev|>|CF|\equiv|CF|*DevLarger$
Overlap, $|CF|>|Dev|\equiv|Dev|*(1-DevLarger)$
ExcessCF $\equiv(|CF|-|Dev|)*(1-DevLarger)$
$DevLarger=1$ if $|Dev|>|CF|$, otherwise$=0$
$Sign=1$ if the firm is over-levered and $=-1$ otherwise

	Under levered				Over levered			
	I	II	III	IV	I	II	III	IV
ExcessDev	0.229***	0.187***	0.230***	0.209***	0.263***	0.327***	0.265***	0.339***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Overlap, $\lvert Dev\rvert>\lvert CF\rvert$	0.269***	0.325***	0.267***	0.224***	0.902***	0.792***	0.902***	0.795***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Overlap, $\lvert CF\rvert>\lvert Dev\rvert$	0.521***	0.458***	0.519***	0.457***	0.700***	0.750***	0.691***	0.613***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
ExcessCF	−0.006	0.005	−0.008	0.043***	0.004	0.027***	0.001	−0.070***
	(0.396)	(0.297)	(0.252)	(0.000)	(0.547)	(0.000)	(0.919)	(0.000)
N	75,042	62,216	75,042	75,042	51,880	43,756	51,880	51,880
Adj. R^2	0.308	0.247	0.308	0.323	0.536	0.519	0.535	0.510

to be more levered, particularly when there are shocks to credit markets (Leary, 2009). As is customary in the literature, we have included two measures of financial constraints in estimating target leverage (size and rating). But financial constraints could also affect a firm's ability to adjust toward its target leverage. Indeed, one might define ''better'' capital market access as lower costs of moving toward target leverage. While some researchers have shown that financial constraints and market conditions influence firms' security issuance choices (Hovakimian, Opler, and Titman, 2001; Korajczyk and Levy, 2003; Leary and Roberts, 2005), none has incorporated those measures into estimated speeds of adjustment. We now modify our basic model by examining how firm and financial market characteristics affect adjustment speeds.

Researchers have also concluded that transitory market conditions–''market timing'' opportunities–influence security choices in ways that might permanently affect a firm's capital structure (Baker and Wurgler, 2002; Korajczyk and Levy, 2003; Huang and Ritter, 2009). We find it equally plausible that market timing considerations affect a firm's short-term incentives to close a leverage gap.[12] For example, consider an over-levered firm that may retire some of its outstanding debt. This inclination would likely be reinforced if corporate bond yields were temporarily high (making debt prices low), but it might be delayed if yields were considered temporarily low. So this firm would be more likely to engage in a greater adjustment toward target leverage as bond yields rise.[13] Another over-levered firm might be planning to issue shares. Bond rates may be less relevant for this firm, but it would be particularly anxious to issue equity if its share price seems to be temporarily high. The value of this mispricing opportunity will affect how much to adjust toward target leverage, and the effect on capital structure will persist until the firm finds it worthwhile to again modify its capital structure. We therefore hypothesize

[12] Our results are based on targets calculated without year dummies. However, they are robust to the inclusion of year dummies, which should subsume much of the intertemporal variation in macroeconomic conditions.

[13] Graham and Harvey (2001) find survey evidence that Chief Financial Officers try to issue bonds when interest rates are relatively low.

that capital structure adjustment speeds should respond to some of the market timing variables previously identified in the literature as affecting leverage levels.

6.1. Modifications to the partial adjustment model

Combining a state-dependent adjustment speed with a firm-specific target involves some important econometric adaptations. One might initially consider estimating a separate regression like (6) for the time periods with high vs. low values for the variable(s) affecting adjustment speed. However, multiple estimations of (6) would fail to impose a consistent model of target leverage (including firm fixed effects) across those specifications.

We can generalize our basic dynamic panel model by specifying that the *i*th firm's adjustment speed at time *t* depends on a variable of interest, $Z_{k,t}$:

$$L_{i,t}-L^{p}_{i,t-1}=(\gamma_0+\gamma_{1k}Z_{k,t})(L^{*}_{i,t}-L^{p}_{i,t-1})+\tilde{\epsilon}_{i,t}. \quad (7)$$

As above, proxies for the target values $L^{*}_{i,t-1}$ are generated from (3). The $Z_{i,t}$ include both "financial constraint" variables and "market timing" variables.

1. Financial constraints are likely to reflect cross-sectional variation in the costs and benefits of adjusting firm leverage. Therefore, we should see that for the same deviation from target leverage and the same cash flow realization, highly constrained and less constrained firms adjust their capital structure differently. We use three financial constraint proxies:
   - $Size=\ln(Basset_{i,t-1})$.
   - $Divs=1$ if the firm paid dividends in year $t-1$, zero otherwise.
   - $Rated=1$ if the firm has a bond rating, zero otherwise.

   Following Faulkender and Wang (2006) and Almeida, Campello, and Weisbach (2004), among others, a firm's ability to access capital markets is likely to vary with size (ln(*Basset*)). To the extent that access costs have a fixed component, a larger firm will find it worthwhile to incur that fixed cost more often than a smaller firm. Dividend payers are thought to have relatively unconstrained access to capital markets; if not, they would retain the funds they generate rather than pay dividends. Firms that are rated should have relatively lower costs of accessing financial markets. We examine differences in capital structure adjustment speeds for all three measures.
2. Market timing variables measure financial market conditions that may affect a firm's interest in accessing the capital markets at a specific time. We use three market timing proxies:
   - Baa=Average Baa yield for the year between $t-1$ and t.
   - $IndMB$=Average industry MB.
   - $MBDiff$=Firm MB − IndMB.

A temporarily high *Baa* rate might discourage firms from issuing new debt (Graham, 1996), which may reduce leverage adjustment speeds for under-levered firms. However, the same high *Baa* rate may encourage adjustment by firms wishing to retire outstanding debt (at a discount). Likewise, the firm's market-to-book ratio relative to that of the industry may affect firms' interest in accessing capital markets (consistent with Baker and Wurgler, 2002, among others), but the effect would differ according to whether the firm was planning to issue or to redeem shares.

We estimate the following regression specification separately for over- and under-levered firms:

$$\begin{aligned}L_{i,t}-L^{p}_{i,t-1}=\sum_{k=1}^{3}\{&(\gamma_1+\gamma_{1k}Z_{k,t})(|Dev|-|CF|)*DevLarger\\&+(\gamma_2+\gamma_{2k}Z_{k,t})*|CF|*DevLarger\\&+(\gamma_3+\gamma_{3k}Z_{k,t})*|Dev|*(1-DevLarger)\\&+(\gamma_4+\gamma_{4k}Z_{k,t})(|CF|-|Dev|)*(1-DevLarger)\}*Sign+\tilde{\epsilon}_{i,t}.\end{aligned} \quad (8)$$

To ease economic interpretation, the four continuous variables (*Size*, *Baa* rate, *MB Diff*, and *IndMB*) are normalized to have mean zero and standard deviation of one. This permits easy calculations of the effects of changes in the *Z* values on adjustment speed. Table 6 reports estimation results for the three financial constraint interactions and Table 7 reports analogous results for the three market timing interactions.

6.2. Financial constraints results

Under-levered firms are described in the first four columns of Table 6 and over-levered firms are in the last four columns.[14]

Consider first the under-levered firms. The "base" estimates correspond to a firm with Div=0, Rated=0, and (because the variable has been normalized) Size at the sample mean. We find that larger firms adjust less quickly than smaller ones, despite the fact that (theoretically) they should be less sensitive to fixed transaction costs. It thus appears that larger, under-levered firms enjoy lower benefits of increasing leverage. However, the other two indicators of financial constraint carry significantly positive coefficients, implying faster adjustment by less constrained firms. A bond rating more than doubles the adjustment speed associated with an overlap between $|Dev|$ and $|CF|$. (See rows (b) and (c).) It also increases by nearly one-half the speed with which ExcessDev is closed (row (a)). As expected, Rated has no effect on ExcessCF adjustments in row d, because these CF are relevant only after the firm has attained its target debt ratio. The Div variables' coefficients similarly indicate faster adjustment for less constrained firms, but the estimated effects are much more modest.

[14] Because rating information is available only after 1985, the regressions in Table 6 include dates from 1986–2006. The results in Table 6 use target proxies computed by estimating (3) over the 1986–2006 sample period. Very similar findings result if we utilize target estimates based on the full sample period (1965–2006). Moreover, our results in Tables 6 and 7 are qualitatively unaffected by adding the financial constraint or market timing variables to determinants of target leverage in (3).

Table 6
Financial constraint interactions.

Table 6 presents the results from estimating (6) separately for over- and under-levered firms. The Base column represents the adjustment speed coefficient for each of the four decompositions while each other column is the interaction of each decomposition with the column header variable. The interactions proxy for a firm's degree of financial constraint. Each continuous interaction variable is transformed to a standard normal variable prior to the interaction. The interaction variable definitions are: *Div*=one if the firm paid dividends in year $t-1$ and zero otherwise, $Size=\ln(Basset_{i,t-1})$, and *Rated*=1 if the firm has a bond rating and zero otherwise. Variable definitions and the sample description are contained in Table 1. *p*-Values are reported in parentheses.

***, **, and * represent significance at the one percent, five percent, and ten percent levels, respectively.

$$L_{i,t}-L^p_{i,t-1} = \sum_{k=1}^{3}\{(\gamma_1+\gamma_{1k}Z_{k,t})(|Dev|-|CF|)*DevLarger+(\gamma_2+\gamma_{2k}Z_{k,t})*|CF|*DevLarger+(\gamma_3+\gamma_{3k}Z_{k,t})*|Dev|*(1-DevLarger)+(\gamma_4+\gamma_{4k}Z_{k,t})(|CF|-|Dev|)*(1-DevLarger)\}*Sign+\tilde{\epsilon}_{i,t}$$

ExcessDev $\equiv(|Dev|-|CF|)*DevLarger$
Overlap, $|Dev|>|CF| \equiv |CF|*DevLarger$
Overlap, $|CF|>|Dev| \equiv |Dev|*(1-DevLarger)$
ExcessCF $\equiv(|CF|-|Dev|)*(1-DevLarger)$
$DevLarger=1$ if $|Dev|>|CF|$, otherwise=0
$Sign=1$ if the firm is over-levered and $=-1$ otherwise

	Under levered				Over levered			
	Base	Div	Size	Rated	Base	Div	Size	Rated
(a) ExcessDev	0.204***	0.013	0.007	0.090***	0.420***	−0.149***	0.008	−0.040
	(0.000)	(0.385)	(0.460)	(0.000)	(0.000)	(0.000)	(0.675)	(0.383)
(b) Overlap, $\|Dev\|>\|CF\|$	0.199***	0.063*	−0.061***	0.253***	0.878***	−0.139***	−0.080***	−0.300***
	(0.000)	(0.054)	(0.003)	(0.000)	(0.000)	(0.003)	(0.002)	(0.000)
(c) Overlap, $\|CF\|>\|Dev\|$	0.242***	0.036	−0.200***	0.391***	0.750***	−0.287***	−0.037	−0.263***
	(0.000)	(0.415)	(0.000)	(0.000)	(0.000)	(0.000)	(0.263)	(0.001)
(d) ExcessCF	0.007	0.036*	−0.002	0.019	−0.006	0.007	−0.037***	0.009
	(0.572)	(0.059)	(0.824)	(0.597)	(0.605)	(0.676)	(0.002)	(0.803)
N	40,756				30,528			
Adj. R^2	0.324				0.611			

The over-levered subsample results (in the right half of Table 6) again indicate much faster base adjustment speeds than characterize the under-levered firms. We see again that larger firms adjust less quickly, although the effects are smaller than for under-levered firms. We see that firms with better access to financing (Div=1, Rated=1) adjust statistically and economically less rapidly. Constrained firms act quickly to eliminate excess leverage. For example, firms with overlapping cash flow and deviation (rows (b) and (c)) adjust between 75% and 87.8% if they do not pay any dividends, are average-sized, and have no rating. However, a dividend-payer that is one standard deviation above the mean size and has a rating adjusts towards target leverage at an annual rate between 35.9% (0.878 _ 0.139 _ 0.080 _ 0.300) and 16.3% (0.750 _ 0.287 _ 0.037 _ 0.263). Better financial market access reduces a firm's concern about excessive leverage.

Overall, financial constraints significantly change the speed of adjustment towards target leverage in a highly asymmetrical fashion. Constrained firms adjust more slowly than unconstrained firms when they are under-levered, but more quickly when they are over-levered. Financial constraints affect leverage adjustment speeds so greatly that they can reverse the usual finding (from Table 3) that under-levered firms adjust less rapidly than over-levered firms. When cash flow overlaps the leverage deviation (rows (b) and (c) in Table 6), an unconstrained over-levered firm adjusts less (35.9% or 16.3%, respectively) than does a similar-sized, unconstrained under-levered firm (45.4% or 46.9%).

The results in Table 6 indicate the importance of recognizing financial constraints when studying capital adjustments, and re-emphasize the value of estimating differential adjustment processes for under- vs. over-levered firms in a sample.

6.3. Market timing results

We start our examination of the role of market timing with the under-levered firms in the first four columns of Table 7. These firms should be issuing debt or retiring equity to close their leverage gaps. The Base case estimates in the first column of Table 7 correspond closely to those in the right half of Table 3. Consistent with our hypothesis, a higher interest rate environment and higher equity valuations decrease the speed with which under-levered firms will adjust their leverage ratios. However, the magnitudes of the change in adjustment speed are considerably smaller than the results we estimated for the effects of financial constraints. A decrease in the *Baa* rate

Table 7
Timing interactions.
Table 7 presents the results from estimating (6) separately for over- and under-levered firms. The Base column represents the adjustment speed coefficient for each of the four decompositions while each other column is the interaction of each decomposition with the column header variable. The interactions proxy for a firm's degree of market timing affect. Each continuous interaction variable is transformed to a standard normal variable prior to the interaction. The interaction variable definitions are: *Baa*=average Baa yield for the year between $t-1$ and t, *IndMB*=Average industry MB, and *MBDiff*=Firm MB−IndMB. Variable definitions and the sample description are contained in Table 1. *p*-Values are reported in parentheses.
***, **, and * represent significance at the one percent, five percent, and ten percent levels, respectively.

$$L_{i,t}-L^p_{i,t-1} = \sum_{k=1}^{3}\{(\gamma_1+\gamma_{1k}Z_{k,t})(|Dev|-|CF|)*DevLarger+(\gamma_2+\gamma_{2k}Z_{k,t})*|CF|*DevLarger +(\gamma_3+\gamma_{3k}Z_{k,t})*|Dev|*(1-DevLarger)+(\gamma_4+\gamma_{4k}Z_{k,t})(|CF|-|Dev|)*(1-DevLarger)\} *Sign+\tilde{\varepsilon}_{i,t}$$

ExcessDev $\equiv(|Dev|-|CF|)*DevLarger$
Overlap, $|Dev|>|CF|\equiv|CF|*DevLarger$
Overlap, $|CF|>|Dev|\equiv|Dev|*(1-DevLarger)$
ExcessCF $\equiv(|CF|-|Dev|)*(1-DevLarger)$
DevLarger=1 if $|Dev|>|CF|$, otherwise=0
Sign=1 if the firm is over-levered and =−1 otherwise

	Under levered				Over levered			
	Base	Avg. Baa rate	MB diff	Ind MB	Base	Avg. Baa rate	MB diff	Ind MB
(a) ExcessDev	0.231***	−0.015***	−0.013	−0.021***	0.277***	0.042***	0.029	0.056***
	(0.000)	(0.001)	(0.252)	(0.000)	(0.000)	(0.001)	(0.137)	(0.000)
(b) Overlap, $\|Dev\|>\|CF\|$	0.271***	−0.020**	0.018	−0.014	0.805***	−0.005	0.016*	0.087***
	(0.000)	(0.043)	(0.153)	(0.216)	(0.000)	(0.763)	(0.061)	(0.000)
(c) Overlap, $\|CF\|>\|Dev\|$	0.357***	−0.118***	0.052***	−0.031**	0.611***	0.024	0.020*	0.099***
	(0.000)	(0.000)	(0.000)	(0.025)	(0.000)	(0.128)	(0.060)	(0.000)
(d) ExcessCF	0.009	0.019**	0.009***	0.004	−0.001	−0.018**	0.006	0.001
	(0.252)	(0.011)	(0.008)	(0.493)	(0.908)	(0.018)	(0.271)	(0.848)
N	74,577				51,451			
Adj. R^2	0.340				0.547			

of one standard deviation increases the adjustment speed for firms with ample cash flow by (row (c)) 11.8%, from 35.7% to 47.5% (35.7% −1*(−11.8%)). For firms with insufficient cash flow to close their leverage gap (row (b)), the increase in adjustment speed resulting from a one-standard-deviation decrease in the *Baa* rate is 2.0%, from 27.1% to 29.1%. Similarly, higher industry valuations decrease the adjustment speed of the firm needing to raise its leverage, but these magnitudes are small.

The latter four columns of Table 7 report results for over-levered firms, which will be retiring debt or issuing shares to close their leverage gaps. For these firms, the effect of higher interest rates is limited, but higher equity valuations should make it more enticing to adjust toward target leverage. When industry and firm valuations are high (one standard deviation above the mean, respectively), the speed of adjustment increases from 80.5% to 90.8% (0.805+0.016+0.087) when cash flow is insufficient to cover the leverage deficit, and from 61.1% to 73.0% (0.611+0.020+0.099) when cash flow is sufficient to enable an over-levered firm to completely close its leverage gap (row (c)). These percentages are large in magnitude and the differences arising from variation in market valuations are statistically and economically significant. It also makes sense that firms that will primarily engage in equity-increasing transactions are more sensitive to equity valuations than to debt market measures when determining the portion of their leverage gap to close.

In sum, the results in Table 7 mostly provide intuitive results about the impact of market conditions on adjustment speeds. Under-levered firms move less quickly toward higher target leverage levels when interest rates are high. Over-levered firms appear to increase their speed of adjustment significantly due to higher equity valuations. These results are consistent with market conditions altering the cost of capital structure adjustment, at least temporarily.

7. Summary and conclusion

Most previous evaluations of corporate capital structure have estimated a single regression model for all firms, yielding some relatively low estimates of how keen firms are to attain their target leverage ratios. Slow adjustments could also reflect the presence of adjustment costs as suggested by Fisher, Heinkel, and Zechner (1989), Leary and Roberts (2005), and Strebulaev (2007). Firms will optimally adjust their capital structures only when the benefits of adjustment are high or the costs of adjustment are particularly low. Some researchers split the sample into subsamples of financially ''constrained'' vs. ''unconstrained'' firms to reflect presumed differences in the speed of adjustment toward target capital ratios. Yet conventionally measured transaction costs provide only part of the calculation; firms with other reasons to access capital markets can adjust their leverage with relatively low marginal costs, regardless of whether their transaction costs are high or low. We show here that cash flows substantially affect the endogenous decision to adjust leverage. Our regression specifications capture this effect by interacting a firm's cash flow measures with its deviation from target leverage. By recognizing the interactive effects of cash flow and leverage deviations, we estimate quite large adjustment speeds for firms confronting low costs of leverage adjustment. Plausible variations in estimated adjustment speeds provide support for the partial adjustment model of target leverage.

Our estimates demonstrate that firms with large (positive or negative) operating cash flow make more aggressive changes in their capital ratios. Consistent with the hypothesis that the cost of accessing external capital markets importantly affects observed leverage, firms with high absolute cash flows and high absolute leverage deviations make larger capital structure adjustments than firms with similar leverage deviations but cash flow realizations near zero. In other words, leverage adjustments are more likely to be made when adjustment costs are ''shared'' with transactions related to the firm's operating cash flows. This is particularly true of over-levered firms, which close roughly 80% of their leverage gap when they are transacting for cash flow purposes. Under-levered firms generally close about 39% of their leverage gaps, suggesting that the benefits of increasing leverage may be smaller than the benefits of decreasing it. This asymmetry between over- and under-levered firms should be incorporated into empirical studies of corporate leverage.

We find that financial constraints affect the speed with which firms adjust toward target leverage ratios. Firms that pay dividends or have a credit rating adjust substantially faster than constrained firms when they are under-levered, and relatively slower when they are over-levered. Likewise, larger firms adjust excess leverage more slowly, consistent with the costs of excess leverage being smaller for larger firms. We also examined the analogous effects of market variables on adjustment. Under-levered firms, which should retire equity, close less of their leverage gap when share prices are high (relative to book). Analogously, over-levered firms close substantially more of their leverage gaps when share prices are high. However, these effects are much less important than the measured effect of financial constraints on firm adjustment speeds.

Overall, our empirical results are consistent with the trade-off hypothesis of capital structure: firms have targets, and wish to return to those targets when costs make it optimal to do so. Partial adjustment models yield theoretically sensible results about how a firm's characteristics and market conditions affect observed leverage adjustments. The benefits and costs of adjustment vary with the sign of the firm's leverage gap (over-levered firms generally adjust more quickly), its operating cash flow, its investment opportunities, its access to capital markets, and some elements of market conditions. Further research should continue to investigate the underlying determinants of adjustment costs and benefits across different sorts of firms, incorporating the potentially compounding effects of cash flow realizations and the differences between over- and under-levered firms.

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