Dynamic Capital Structure under Managerial Entrenchment: Evidence from a Structural Estimation

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Abstract

This paper examines the impact of agency conflicts on corporate financing decisions. We first build a dynamic contingent claims model in which financing policy results from a trade-off between tax benefits, contracting frictions, and agency conflicts. In our setting, partially-entrenched managers set the firms’ payout and financing policies to maximize the present value of their rents. Shareholders can remove managers, but only at a cost. Our analysis demonstrates that entrenched managers issue less debt and rebalance capital structure less often than optimal for shareholders. We then use structural econometrics to provide firm-specific estimates of the degree of managerial entrenchment. We find that costs of control challenges of 2% of equity value on average are sufficient to resolve the low- and zero-leverage puzzles and explain the time series of observed leverage ratios. Our estimates of the agency costs also reveal that governance mechanisms significantly affect the value of control and firms’ financing decisions.

JEL Classification Numbers: G12; G31; G32; G34.
I. Introduction

Since the seminal paper by Jensen and Meckling (1976), economists have devoted much effort to studying the effects of agency conflicts on firms’ financing decisions. Because debt limits the flexibility of management (Jensen, 1986), a large fraction of this literature argues that managers do not always adopt capital structures that maximize shareholder wealth. This is particularly true when managers are not under the pressure of a disciplining force since, by definition, entrenched managers have discretion over their firm’s leverage choices. The capital structure of a firm should then be determined not only by real market frictions, such as taxes, bankruptcy costs or refinancing costs, but also by the degree of managerial entrenchment.

Empirical researchers have used an array of methods to examine the relation between managerial entrenchment and financing decisions. For example, Jung, Kim and Stulz (1996) identify security issue decisions that seem inconsistent with shareholder value maximization. Friend and Lang (1988), Mehran (1992) and Berger, Ofek, and Yermak (1997) find in cross-sectional studies that leverage levels are lower when CEOs do not face pressure from the market for corporate control. Berger, Ofek, and Yermak also find that leverage increases in the aftermath of shocks reducing managerial entrenchment. Garvey and Hanka (1999) find that firms protected by “second generation” state antitakeover laws substantially reduce their use of debt, and that unprotected firms do the reverse. Yet in another study, Kayhan (2005) confirms that entrenched managers prefer low leverage. Despite the substantial development of this literature, the magnitude of manager-shareholder conflicts and their effects on financing decisions remain open questions.

In this paper, we use observed corporate financing choices to infer the degree of managerial entrenchment and the effects of manager-shareholder conflicts on financing decisions. We begin by formulating a dynamic trade-off model that emphasizes the role of agency conflicts in shaping capital structure choices. The model features corporate and personal taxes, refinancing costs, and liquidation and renegotiation costs in default. In the model, each firm is run by a partially-entrenched manager who sets the firm’s payout and financing policies. Managers act in their own interests to maximize the present value of the cash flows they will take from the firm’s operations. However, the policy choices of the manager are constrained by the threat of control challenges by shareholders, who can replace the manager at a cost. In
this environment, we determine the optimal leveraging decision of managers and examine the
effects of managerial entrenchment on firms’ financing decisions. Several important results
follow from this analysis. First, we show how the various determinants of leverage interact
to determine capital structure choices. Second, we derive implications relating managerial
entrenchment to the firm’s target leverage and the pace and size of capital structure changes.
Third, we take the model to the data and provide firm-specific estimates of the degree of man-
gererial entrenchment. Fourth, we show that the separation between ownership and control
can explain why some firms issue little or no debt – low- and zero-leverage puzzles – despite
the known tax benefits of debt (see Graham, 2000, and Strebulaev and Yang, 2007) and why
leverage ratios exhibit robust time-series patterns (see Fama and French, 2002, Welch, 2004,

As in prior dynamic capital structure models, our analysis emphasizes the role of external
financing costs in affecting the time-series of leverage ratios. Due to capital market frictions,
firms are not able to keep their leverage at the target at all times. As a result, leverage is best
described not just by a number, the target, but by its entire distribution – including target
and refinancing boundaries. In contrast to prior work, our dynamic capital structure model
generates unique predictions relating managerial entrenchment to the debt level selected by
the manager, the frequency and size of capital structure changes, and the likelihood of default.
Notably, our model predicts that managerial entrenchment lowers the firm’s target leverage
and raises the debt issuance trigger. As a result, financial inertia becomes more pronounced
and the range of leverage ratios widens as managerial entrenchment increases.

The intuition underlying these predictions is that debt restructurings adversely affect the
manager’s rents as the benefits of restructuring accrue to shareholders. Cash distributions are
made on a pro rata basis to shareholders, so that when new debt is issued management gets
a small fraction of the distributions. Management’s stake in the firm, however, exceeds its
direct ownership due to entrenchment, rendering restructurings less favorable to management
than to shareholders. Debt also constrains managers by limiting the cash flows available as
hidden rents (as in Jensen, 1986, Hart and Moore, 1995, or Zwiebel, 1996). As a remedy,
entrenched managers restructure less frequently (lower refinancing trigger) and issue less debt
(lower target and default trigger) than optimal for shareholders.
The paper also provides new evidence on the relation between governance mechanisms and capital structure dynamics. Specifically, we use observed financing choices to provide firm-specific estimates of the degree of managerial entrenchment or, equivalently, the cost of control challenges. We exploit not only the conditional mean of leverage (as in a regression) but also distributional tails – in short, the conditional moments of the time-series distribution of leverage. Using structural econometrics, we find that costs of control challenges of 2% of equity value on average (1% at median) are sufficient to resolve the low- and zero-leverage puzzles and explain the time series of observed leverage ratios. The variation in agency costs across firms is sizeable. This suggests that while leverage ratios revert to the (manager’s) target leverage over time, the variation in agency conflicts leads to persistent cross-sectional differences in leverage ratios, consistent with Lemmon, Roberts, and Zender (2008).

To make the analysis of traditional capital structure determinants complete, we also introduce shareholder-debtholder conflicts in our setting. In the model, shareholders can renegotiate outstanding claims in default as in Fan and Sundaresan (2000). Our structural estimates reveal that the bargaining power of shareholders in default is close to the Nash solution. Hence, shareholders can extract substantial concessions from debtholders in default. However, while shareholder-debtholder conflicts tend to reduce leverage, we find that they have little quantitative impact on leverage levels and on their cross-sectional variation.

The analysis in the present paper relates to the literature that analyzes the relation between managerial discretion and financing decisions.\footnote{See Stulz (1990), Chang (1993), Hart and Moore (1994, 1995), Zwiebel (1996), Morellec (2004), or Barclay, Morellec, and Smith (2006). While this literature has provided a rich intuition on the effects of managerial discretion on financing decisions, it has been so far mostly qualitative, focusing on directional effects.} The paper that is closest to ours is Zwiebel (1996) in that it also builds a dynamic capital structure model in which financing and payout policies are selected by a partially-entrenched manager. However, while in Zwiebel’s model, firms are always at their target leverage, in our model refinancing costs create inertia and persistence in capital structure. Second, from a modeling perspective, this paper relates to the dynamic contingent claims models of Fisher, Heinkel, and Zechner (1989), Goldstein, Ju, and Leland (2001), or Strebulaev (2007). In this literature, conflicts of interest between managers and shareholders have been largely ignored (see however the static models of Morellec, 2004, or Lambrecht and Myers, 2008). Third, our model also relates to
the dynamic trade-off models of Hennessy and Whited (HW 2005, 2007). Their models feature a richer tax environment and consider the role of internally generated funds. However they do not allow for default (HW, 2005) and ignore manager-shareholder conflicts. Another important difference is that our model allows to derive a closed-form expression for the time series distribution of leverage ratios and to look at all statistical moments of the leverage distribution (including target leverage, refinancing frequency, and default probability) instead of focusing on a limited number of moments. Finally, our paper is related to the analysis in Lemmon et al. (2008) who find that traditional determinants of leverage (such as size, profitability, market-to-book, industry) account for relatively little of the variation in capital structure. Instead they show that the majority of the cross-sectional variation in capital structures is driven by an unexplained firm-specific determinant. Our analysis reveals that the heterogeneity in capital structure can be structurally related to a number of corporate governance mechanisms, providing an economic interpretation for their results.

This paper extends the literature on financing decisions in two important dimensions. First, we develop the first dynamic model of capital structure decisions that includes taxes, bankruptcy costs, refinancing costs, and manager-shareholder conflicts. This allows us to derive clear testable predictions regarding the effects of these various determinants of financing policies on target leverage and the pace and size of capital structure changes. Second, our analysis adds to the literature by providing firm-specific estimates of the degree of managerial entrenchment and of shareholders’ bargaining power in default, and by showing that the separation between ownership and control can explain the low- and zero-leverage puzzles as well as the dynamics of leverage ratios. To the best of our knowledge, our paper is the first to provide structural estimates of the magnitude of manager-shareholder conflicts and their effects on dynamic capital structure decisions.

The remainder of the paper is organized as follows. Section 2 describes the model. Section 3 discusses the data and our empirical methodology. Section 4 provides firm-specific estimates of manager-shareholder conflicts and relates these estimates to various corporate governance mechanisms. Section 5 concludes. Technical developments are gathered in Appendix A. In Appendix B, we show that the results of regressions on simulated data from our model are consistent with those reported in the empirical literature.
II. The Model

Most capital structure models make the simplifying assumption that managers choose capital structure in the interests of shareholders. Recent research, however, has explicitly recognized that managerial self interest can lead to financial policies that do not maximize shareholder wealth. This section presents a model that extends the contingent claims framework to incorporate the impact of manager-shareholder conflicts on dynamic capital structure choices.

A. Assumptions

The model closely follows Goldstein et al. (2001), Leland (1998), and Strebulaev (2007). Throughout the paper, assets are continuously traded in complete and arbitrage-free markets. The default-free term structure is flat with an after-tax risk-free rate \( r \), at which investors may lend and borrow freely. We consider an economy with a large number of heterogeneous firms indexed by \( i = 1, ..., N \). Firms are infinitely lived and have monopoly access to a set of assets, which are operated in continuous time. The firm-specific state variable is the cash flow generated by the operation of the firm’s assets, denoted by \( X_i \). This operating cash flow is independent of capital structure choices and governed, under the risk neutral probability measure, by the process:

\[
\begin{align*}
\text{d}X_{it} &= \mu_i X_{it} \text{d}t + \sigma_i X_{it} \text{d}Z_{it}, \quad X_{i0} > 0, \\
\end{align*}
\]  

(1)

where \( \mu_i < r \) and \( \sigma_i > 0 \) are constant parameters and \((Z_{it})_{t \geq 0}\) is a standard Brownian motion. Equation (1) implies that the growth rate of cash flows from operations is Normally distributed with mean \( \mu_i \) and standard deviation \( \sigma_i \), and that capital can be invested in new assets at any time \( t \in (0, \infty) \) and investment is perfectly reversible. To see this, assume that operation of the firm’s assets produces output with the production function \( F : \mathbb{R}_+ \to \mathbb{R}_+, \ F(k_t) = k_t^\gamma \), where \( \gamma \in (0, 1) \) and that capital depreciates at a constant rate \( \delta > 0 \). Define the firm’s after tax profit function \( f_{it} \) by

\[
f_{it} = \max_{k_t \geq 0} [(1 - \tau)c_i(X_{it}k_t^\gamma - \delta k_t) - rk_t].
\]

Solving this maximization problem for \( k_t \) and replacing \( k_t \) by its expression in the firm’s after-tax profit function gives \( f_{it} = (1 - \tau)c_i)Y_{it} \) where \((Y_{it})_{t \geq 0}\) is a (capacity-adjusted cash flow) shock governed by

\[
\text{d}Y_{it} = \mu_Y Y_{it} \text{d}t + \sigma_Y Y_{it} \text{d}W_t, \quad Y_{i0} = AX_{i0} > 0,
\]

where \( \mu_Y = \partial \mu_i + \vartheta(\vartheta - 1)\sigma_i^2/2, \sigma_Y = \partial \sigma_i, \) and \((A, \vartheta) \in \mathbb{R}_+^2 \) are constant parameters.
distributed with mean $\mu_i \Delta t$ and variance $\sigma_i^2 \Delta t$ over the time interval $\Delta t$ under the risk-neutral probability measure. It also implies that the mean growth rate of cash flows is $m_i \Delta t = (\mu_i + \beta_i \kappa) \Delta t$ under the physical probability measure, where $\beta_i \neq 0$ and $\kappa$ is the market risk premium.

Cash flows from operations are taxed at a constant rate $\tau_c$. As a result, firms may have an incentive to issue debt to shield profits from taxation. To stay in a simple time-homogeneous setting, we consider debt contracts that are characterized by a perpetual flow of coupon payments $c_i$ and a principal $P_i$. Debt is callable and issued at par. The firm’s initial debt structure remains fixed without time limit until either the firm goes into default or the firm calls its debt and restructures with newly issued debt. We consider that firms can adjust their capital structure upwards at any point in time by incurring a proportional cost $\lambda$, but that they can reduce their indebtedness only in default. A restructuring occurs if cash flows rise to a level $X_U (> X_0)$ prior to default. Default occurs if the cash flow shock falls to a level $X_B (< X_0)$ prior to the calling of debt. The values of $X_U$ and $X_B$ depend on the amount of debt outstanding in the current financing cycle. The personal tax rate on dividends $\tau^d$ and on coupon payments $\tau^i$ are identical for all investors. These features are shared with numerous other capital structure models, including Leland (1998), Goldstein, Ju, and Leland (2001), Hackbarth, Miao, and Morellec (2006), or Strebulaev (2007).

We are interested in building a model in which financing choices reflect not only the trade-off between the tax benefits of debt and contracting costs, but also agency conflicts. Agency conflicts between the manager and shareholders are introduced by considering that each firm is run by a partially-entrenched manager who sets the firm’s payout and financing policies. Managers act in their own interests to maximize the present value of the cash flows they receive from the firm’s operations. The manager’s policy choices are constrained by the threat of control challenges. Shareholders can replace the current manager at a cost. As in Lambrecht and Myers (2008) and Kühnen and Zwiebel (2008) (and in contrast to Stulz, 1990, Zwiebel, 1996, or Morellec, 2004), we do not assume that managers always want to expand. Rather, our model gives managers the possibility to capture cash flows within the limits imposed by the cost of control challenges.

\footnote{While in principle management can both increase and decrease future debt levels, Gilson (1997) finds that transaction costs discourage debt reductions outside of renegotiation.}
Specifically, we consider that the cost of control challenges implies that the firm’s net income is reduced by a constant factor $\phi$ after a control challenge.\(^4\) That is, the net payoff to investors when they take control is $\max[V^*(X,c) - B(X,c) - \phi F^*(X,c);0]$, where $\phi \in (0,1)$, $V^*(X,c)$ is the value of the firm under perfect shareholder protection (i.e. absent manager-shareholder conflicts), $B(X,c)$ is the value of outstanding debt, and $F^*(X,c)$ is the present value of the firm’s net income under perfect shareholder protection.\(^5\) In our analysis, $\phi$ represents the cost of a control challenge or, as shown below, the degree of managerial entrenchment. This cost must be interpreted as the cost that shareholders must face to replace the manager, due to the specific human capital of the manager, legal challenges, search costs, or any other type of replacement costs. In our model, the threat of a control challenge constrains the manager while the cost of control challenges $\phi$ creates the space for managerial rents. Our objective in this paper is to estimate the magnitude of $\phi_i$, $i = 1, \ldots, N$.

In addition to the cash flows they receive when the firm is in operation, shareholders may obtain a fraction of firm value in default. In the analysis that follows, we assume that default can lead either to liquidation or to renegotiation. We denote the proportional costs of renegotiation and liquidation by $\kappa$ and $\alpha$, respectively. Because liquidation is typically more costly than reorganization, there exists a positive surplus associated with renegotiation.\(^6\)

\(^4\)In the static version of our model, this specification implies that shareholders can realize a fraction $1 - \phi$ of equity value if they mobilize to remove management (see Appendix A.1). Hence this specification can be seen as the dynamic counterpart to Lambrecht and Myers (2008). While other specifications are possible, we show below that this specification is also similar to the one used in the law and finance literature, in which controlling shareholders can extract part of the firm cash flows as private benefits.

\(^5\)As in Lambrecht and Myers (2008), we do not allow for ex post renegotiation by considering that the manager is removed if he does not bring enough value to shareholders. Alternatively, our setup can be seen as one in which only single-period contracts are enforceable and the manager (who has all the bargaining power) offers in each period a contract to shareholders, as in Fudenberg et al. (1990) and Aghion and Bolton (1992). This contract must satisfy shareholders’ dynamic participation constraint, which evolves with the firm’s performance ($E(X,c) \geq \max[V^*(X,c) - B(X,c) - \phi F^*(X,c);0]$). The sequence of single-period contracts between the manager and shareholders can then be viewed as a single long-term contract that is implemented by this sequence (as in Fudenberg et al., 1990). In equilibrium, the dynamic participation constraint of shareholders is satisfied with equality at each date and the portion of total output that the manager appropriates is equal to the cost of control challenges.

\(^6\)In our model default always leads to renegotiation. The model can be extended to incorporate an exogenous probability of liquidation, as in Davydenko and Strebulaev (2007).
In our model, this surplus represents a fraction $\alpha - \kappa$ of the value of the firm’s assets in default. Following Fan and Sundaresan (2000), we consider a Nash bargaining game in default that leads to a debt-equity swap. We denote the bargaining power of shareholders by $\eta \in [0,1]$. Assuming that the renegotiation surplus is shared according to some sharing rule $\varpi$, the generalized Nash bargaining solution is simply given by $\varpi = \eta$, which implies that shareholders get a fraction $\eta(\alpha - \kappa)$ of the firm’s assets in default. In addition to the estimation of $\phi$, the paper also provides structural estimates of $\eta_i, i = 1, \ldots, N$.

B. Model Solution

In this section we solve for the financing policy selected by the manager. We do so in the following three steps. First, we determine the values of debt and equity, taking the firm’s financing and default policies as given. Second, we solve for the firm’s default policy, taking financing as given. Third, we derive the selected financing policy, that is the amount of debt issued and the call policy. In our model, the value of equity depends on the payout policy $p(X_t)$ selected by the manager, which in turn depends on the cost of control challenges. In the analysis that follows, consider that the manager captures a time-invariant fraction $\phi$ of net income as private benefits, so that the cash flows to shareholders at any time $t$ are given by $(1 - \phi)(1 - \tau_c)(X_t - c)$.\footnote{This tunneling of funds toward socially inefficient usage may take a variety of forms such as excessive salary, transfer pricing, employing relatives and friends who are not qualified for the jobs in the firm, and perquisites, just to name a few. Importantly, while we emphasize conflicts between managers and shareholders, our model is observationally equivalent to the models that emphasize agency conflicts between controlling and minority shareholders (see e.g. La Porta, Lopez-de Silanes, Shleifer, and Vishny, 2002, or Albuquerque and Wang, 2008), in which controlling shareholders face a convex cost function for cash diversion and extract part of the firm cash flows as private benefits at the expense of minority shareholders.} We show below that this payout policy is optimal and implies that the “control challenge constraint” is always binding (i.e. equity value equals $V^*(X, c) - B(X, c) - \phi F^*(X, c)$).

Consider first the valuation of corporate securities. In our model, the firm’s initial debt structure remains fixed until either the cash flow shock reaches $X_B$ and the firm goes into default or the cash flow shock reaches $X_U$ and the firm calls its debt. Let $e(X)$ denote the present value of the cash flows to shareholders over one financing cycle (i.e. for the period over which the firm does not change its debt policy). At each time $t$, shareholders receive
the cash flows from operations minus the coupon payment \( c \) to debtholders, the fraction of cash flows captured by the manager, and the taxes paid on corporate and personal income. As a result, the value of shareholders’ claim over one refinancing cycle is given by

\[
e(X) = \mathbb{E}^Q \left[ \int_t^T e^{-r(s-t)}(1 - \tau)(1 - \phi)(X_s - c)ds \big| X_t = X \right],
\]

where the tax rate \( \tau = 1 - (1 - \tau^c)(1 - \tau^d) \) reflects corporate and personal taxes, \( Q \) denotes the risk neutral probability measure and \( T = \inf \{ T_U, T_B \} \) with \( T_i = \inf \{ t \geq 0 : X_t = X_i \} \), \( i = U, B \). This expression gives the value of shareholders’ claim over one refinancing cycle as the present value of the cash flows they receive until either the firm increases its debt level to shield more profits from taxation or defaults on its debt obligations (i.e. until time \( T \)). Importantly, this value does not incorporate any of the cash flows that accrue to shareholders after a debt restructuring. These cash flows belong to the next financing cycle and will be incorporated in the total value of equity.

Denote by \( \xi \) and \( \nu \) the positive and negative roots of the quadratic equation \( \frac{1}{2} \sigma^2 \beta (\beta - 1) + \mu \beta - r = 0 \) and let \( \Pi(X) \) represent the present value of a perpetual stream of cash flows \((1 - \tau)(1 - \phi)X_t \) starting at \( X_t = X \):

\[
\Pi(X) = \mathbb{E}^Q \left[ \int_t^\infty e^{-r(s-t)}(1 - \tau)(1 - \phi)X_s ds \big| X_t = X \right] = (1 - \tau) \left( \frac{1 - \phi}{r - \mu} \right) X.
\]

In addition, let \( p_U(X) \) denote the present value of $1 to be received at the time of refinancing, contingent on refinancing occurring before default, and let \( p_B(X) \) denote the present value of $1 to be received at the time of default, contingent on default occurring before refinancing. Using this notation, we can write the solution to equation (2) as:

\[
e(X) = \Pi(X) - p_U(X) \Pi(X_U) - p_B(X) \Pi(X_B) - \frac{(1 - \tau)(1 - \phi)c}{r} [1 - p_U(X) - p_B(X)],
\]

where [see e.g. Revuz and Yor (1999, pp. 72) and Appendix A.3]

\[
p_B(X) = \frac{X^\xi - X^\nu X_U^{\xi - \nu}}{X_B^\xi - X_B^\nu X_U^{\xi - \nu}} \quad \text{and} \quad p_U(X) = \frac{X^\xi - X^\nu X_U^{\xi - \nu}}{X_U^\xi - X_U^\nu X_U^{\xi - \nu}}.
\]

Equation (4) incorporates only the cash flows that accrue to shareholders until date \( T \). In this expression, we have \( p_U(X) = 1 \) and \( p_B(X) = 0 \), for \( X \geq X_U \). Similarly, we have \( p_U(X) = 0 \)
and $p_B(x) = 1$, for $X = X_B$. That is, if the cash flow shock reaches $X_B$ or $X_U$, the firm changes its capital structure and starts a new financing cycle.

Consider next the total value of equity’s claim to cash flows from operations, denoted by $F(x)$. As discussed above, when the cash flow shock reaches $X_U$ prior to default, debt will be retired at par value and new debt will be issued. The time at which debt is called is termed a restructuring point. We show in Appendix A.1 that in the static model in which the firm cannot restructure, the default threshold $X_B$ is linear in the coupon payment $c$. In addition, the selected coupon rate $c$ is linear in $X$. This implies that if two firms $i$ and $j$ are identical except that $X_i^0 = \theta X_j^0$, then the selected coupon rate and default threshold satisfy $c_i = \theta c_j$ and $X_i^B = \theta X_j^B$, respectively, and every claim will be larger by the same factor $\theta$. For the dynamic model, this scaling feature implies that at the first restructuring point, all claims are scaled up by the same proportion $\rho \equiv X_U/X_0$ by which asset value has increased (i.e. it is optimal to choose $c^1 = \rho c^0$, $X_B^1 = \rho X_B^0$, $X_U^1 = \rho X_U^0$). Subsequent restructurings scale up these variables again by the same ratio. If default occurs prior to restructuring, firm value is reduced by a constant factor $\eta (\alpha - \kappa) \gamma$ with $\gamma \equiv X_B/X_0$, new debt is issued, and all claims are scaled down by the same proportion $\eta (\alpha - \kappa) \gamma$. As a result, we have over the region $X_B \leq X \leq X_U$:

$$F(X) = e(X) + p_U(X) \rho F(X_0) + p_B(X) \eta (\alpha - \kappa) \gamma F(X_0).$$  \hfill (5)

This equation shows that the value of shareholders’ claim over all financing cycles is equal to the cash flows they receive until the next restructuring plus the value of the cash flows they get after the restructuring (last two terms on the right hand side). Using this expression, we can solve for the total value of equity’s claim to cash flows from operating assets at the initial date:

$$F(X_0) = \frac{e(X_0)}{1 - p_U(X_0) \rho - p_B(X_0) \eta (\alpha - \kappa) \gamma}.$$  \hfill (6)

Since managers capture a fraction $\phi$ of net income, we also have that $F(X) \equiv (1 - \phi) F^*(X)$ where $F^*(X)$ is the total value of equity’s claim to cash flows from operations in the absence of manager-shareholder conflicts.

The same arguments apply to the valuation of corporate debt. Consider first the value $B(X)$ of the debt issued at time $t = 0$. Since the issue is called at par if the firm’s cash flows
reach $X_U$ before $X_B$, the current value of corporate debt satisfies at any time $t \geq 0$:

$$B(X) = b(X) + p_U(X) B(X_0),$$

(7)

where $b(X)$ represents the value of corporate debt over one refinancing cycle, i.e. ignoring the value of the debt issued after a restructuring or after default, and is given by

$$b(X) = \frac{(1 - \tau^c)}{r} [1 - p_U(X) - p_B(X)] + p_B(X) [1 - (\kappa + \eta (\alpha - \kappa))] t(X_B).$$

(8)

The first term on the right hand side of equation (8) represents the present value of the coupon payments accruing to debtholders until the firm defaults or restructures. The second term represents the cash flow to initial debtholders in default. Debtholders obtain the value of the firm’s assets minus the renegotiation costs and the fraction of the renegotiation surplus captured by shareholders.

As in the case of equity, the total value of corporate debt $D(X)$ includes not only the cash flows accruing to debtholders over one refinancing cycle, $b(X)$, but also the new debt that will be issued in default or at the time of a restructuring. As a result, the value of the total debt claim, incorporating all future coupon flows, is given by

$$D(X_0) = \frac{b(X_0)}{1 - p_U(X_0) \rho - p_B(X_0) \eta (\alpha - \kappa) \gamma}.$$  

(9)

This equation shows that, because the value of the firm’s assets is reduced by a constant factor $\eta (\alpha - \kappa) \gamma$ in default, so is the value of corporate debt that will be issued at that time.

Because flotation costs are incurred each time the firm adjusts its capital structure, the total value of the firm at the restructuring date is

$$V(X_0) = \frac{e(X_0) + b(X_0) - \lambda B(X_0)}{1 - p_U(X_0) \rho - p_B(X_0) \eta (\alpha - \kappa) \gamma}.$$  

(10)

Finally, since firm value satisfies $V(X) = E(X) + B(X)$, the total value of equity equals

$$E(X) = e(X) + p_U(X) [\rho V(X_0) - B(X_0)] + p_B(X) \eta (\alpha - \kappa) \gamma V(X_0).$$  

(11)

Denote by $V^*(X)$ the value of the firm when there are no manager-shareholder conflicts. The payout policy $p(X) = (1 - \phi)(1 - \tau^c)(X - c)$ implies that the manager captures the rents
\( \phi F^*(X) \). As a result, we have for any given financing policy that \( V^*(X) = V(X) + \phi F^*(X) \). This in turn implies that \( E(X) = V^*(X) - B(X) - \phi F^*(X) \), confirming our earlier claim that the aforementioned payout policy will be implemented by the manager.

Consider next the firm’s financing decisions. In this paper, we follow Zwiebel (1996), Morellec (2004), and Lambrecht and Myers (2008) by considering that the manager has decision rights over financing policy. When selecting the coupon payment \( c \) and the restructuring threshold \( X_U \), the objective of the manager is to maximize the value of its claims. In the analysis below, we assume that the manager owns a fraction \( \varphi \) of the firm’s equity and that the proceeds from the debt issue are distributed on a pro rata basis to shareholders. The present value of the manager’s cash flows, \( M(X) \), is given by the sum of the proceeds from the debt issue and the present value of the cash flows received once debt has been issued. As a result, we can express the value of the manager’s claims as

\[
M(X) = \varphi [E(X) + B(X)] + \phi F^*(X)
\]

or

\[
M(X) = \varphi V^*(X) + \phi (1 - \varphi) F^*(X).
\]

(12)

In equation (12), \( \varphi \) represents the fraction of the firm’s equity owned by the manager and \( \phi \) represents the fraction of the firm’s net income that can be captured by the manager.

When determining the firm’s financing policy, the objective of the manager is to choose \( \{c, \rho\} \) to maximize \( M(X) \), the present value of all cash flows received from the firm. Since \( F^*(X) \) decreases with \( c \), equation (12) implies that, whenever \( \phi > 0 \), the efficient choice of debt (optimal for shareholders) differs from the entrenchment choice (optimal for managers). In particular, the model predicts that the coupon payment decreases with \( \phi \) and that the debt level selected by the manager is lower than the debt level that maximizes firm value.

In addition, the model predicts that some firms will be unlevered despite the tax benefits of debt. Finally, the selected default threshold results from a tradeoff between continuation values outside of default and the values of claims in default. Our model implies that all claims are scaled down by the same factor in default so that the manager and shareholders agree on the firm’s default policy.\(^9\) The selected default threshold can then be determined by solving the smooth-pasting condition satisfied at \( X = \gamma X_0 \) as in Leland (1998).

\(^8\)In Appendix A.2, we show that if a control challenge occurred off-equilibrium, the replacement manager would implement the same financing policy as the incumbent.

\(^9\)This follows from the fact that manager-shareholder conflicts are unaffected by default and that managers...
C. Model Predictions

The comparative statics for the model with agency costs are reported in Table 1. Input parameter values for our base case environment are set as follows: the risk-free interest rate \( r = 4.21\% \), the initial value of the cash flow shock \( X_0 = 1 \) (normalized), the growth rate and volatility of the cash flow shock \( \mu = 1\% \) and \( \sigma = 25\% \), the corporate tax rate \( \tau^c = 35\% \), the tax rate on dividends \( \tau^d = 11.6\% \), the tax rate on coupon payments \( \tau^i = 29.3\% \), liquidation costs \( \alpha = 50\% \), renegotiation costs \( \kappa = 5\% \), shareholders’ bargaining power \( \eta = 50\% \), managerial ownership \( \varphi = 7\% \), and the cost of control challenges \( \phi = 1\% \). These parameter values are discussed in section III below.

Insert Table 1 Here

The numerical results reported in Table 1 show that managerial entrenchment affects the selected debt level, the refinancing trigger, and the default trigger – and hence the frequency of capital structure changes and the likelihood of default. Specifically, high (low) managerial entrenchment leads to low (high) leverage and less (more) capital structure rebalancings.

Figure 1 illustrates the comparative statics for the model-implied time-series distribution of leverage depending on various firm characteristics. Managerial entrenchment, measured by \( \phi \), lowers both the target leverage and the debt issuance trigger substantially while it raises the default trigger. As a result, the range of leverage ratios widens with the degree of managerial entrenchment.

Insert Figure 1 Here

The intuition underlying this result is simple. In the dynamic model, debt restructurings adversely affect the manager’s rents as the benefits of restructuring accrue to the shareholders. Cash distributions are made on a pro rata basis, so that when new debt is issued management gets a fraction \( \varphi \) of the distributions. Management’s stake in the firm, however, exceeds direct ownership \( \varphi \) due to entrenchment \( \phi \), rendering restructurings less favorable to management than to shareholders. Debt also constrains managers by limiting the cash flows available as stay in control after default. The latter assumption allows us to reflect the fact that managers stay in control after debt is renegotiated privately or after court supervised debt renegotiation under Chapter 11 of the U.S. bankruptcy code (see e.g. Gilson (1989) for empirical evidence).
hidden rents (as in Jensen, 1986, Zwiebel, 1996, or Morellec, 2004). As a remedy, entrenched managers issue less debt (lower target and default boundary) and restructure less frequently (higher refinancing trigger) than optimal for shareholders. We will use these properties of the time-series distribution of leverage to identify $\phi$ in the data.

By contrast, high bargaining power $\eta$ leads to accelerated default, as shareholders capture a larger fraction of the surplus in default. Higher bargaining power also results in costlier debt as bondholders anticipate shareholders’ strategic action in default and require a higher risk premium on corporate debt. An increase in the bargaining power of shareholders therefore decreases target leverage and the low and high restructuring bounds. As a result, the leverage distribution shifts to the left. However, the quantitative effect is limited.

Table 1 and Figure 1 also reveal that the cost of debt issuance affects predominantly the low leverage tail and leaves the target leverage ratio largely unaffected. Overall, refinancing costs have qualitatively similar effects as entrenchment on the distribution of leverage. The main difference is that refinancing costs have a smaller quantitative impact on the target leverage than managerial entrenchment. Finally, the volatility of cash flows impacts mainly the support of the distribution, with lower volatility narrowing the support (the option value of waiting to default or restructure being lower).

III. Empirical Analysis

In this section we take the model derived in Section II to the data. Our objective is to empirically assess whether agency conflicts can explain the low- and zero-leverage puzzles as well as the time series patterns in observed leverage ratios. Specifically, we use observed financing choices to obtain firm-specific estimates of the degree of managerial entrenchment (as reflected by $\phi$) and of shareholder’s bargaining power in default (as reflected by $\eta$). In a second stage, we also show how these estimates vary across firms and economic conditions.

The standard approach in the empirical capital structure literature is to specify in reduced form how cross-sectional determinants affect the conditional mean of leverage, including various proxies for internal and external governance mechanisms (see however Leary and Roberts, 2005). Observed leverage ratios, however, exhibit highly nonlinear behavior, including heteroskedasticity, asymmetry, fat tails, and truncation. These features are difficult to capture in
standard linear regression studies – rendering standard least-squares estimates inconsistent. An additional complication is that the target leverage ratio, the main quantity of economic interest in most studies, typically does not correspond to the (un)conditional mean of leverage that is estimated in a standard regression. Finally, debt-to-equity ratios generally represent the cumulative result of years of separate decisions. Hence, cross-sectional tests based on a single aggregate are likely to have low power (see also Welch, 2006).

In this paper we take a different route. Specifically, we exploit the structural restrictions of the dynamic model derived in Section II. Our objective is to estimate from real data the degree of managerial entrenchment (or equivalently the cost of control challenges) that best explains observed financing behavior (a similar approach is used for example in Hennessy and Whited, 2007). In a second stage, we examine whether these estimates are related to a number of variables reflecting the quality of a firm’s governance structure.

A. Estimation Strategy

Our identification strategy exploits the panel nature of the data and the model’s predictions for different moments of leverage. For an individual firm, the model implies a specific time-series behavior of the firm’s leverage ratio. The policy predictions include (but are not restricted to) the target leverage, the refinancing frequency, and the default probability. In addition to the time-series predictions, the model yields comparative statics of the leverage distribution that predict how leverage varies in the cross-section of firms. We exploit both types of predictions to identify the parameters in the data and to disentangle cross-sectional heterogeneity from the impact of inertia on leverage.

The structural estimation we perform is based on the Maximum Likelihood principle. (Simulated) maximum likelihood (SML) estimation of the model parameters is more efficient than the simulated method of moments techniques (used for instance in Hennessy and Whited, 2007), but it is often practically infeasible. In our setting SML is tractable since for the model described in Section II we can derive an explicit expression for the (conditional and stationary) distribution function of financial leverage (see Appendix A.3).

In the analysis, each firm $i$ is characterized by a set of parameters $\theta \in \Theta$ that determine the growth rate and volatility of the firm’s cash flows, the firm’s systematic risk exposure,
as well as the cost of control challenges and the bargaining power of shareholders in default.

The likelihood function $L$ of the parameters $\theta$ given the data is based on the probability of observing the leverage ratio $y_{it}$ for firm $i$ at date $t$. Assume there are $N$ firms in the sample and let $n_i$ be the number of observations for firm $i$. The observations within the same firm are correlated due to autocorrelation in the cash flow process. Across firms, the model parameters are allowed to vary with observable characteristics, denoted by $x_{it}$, and with an unobserved firm-specific effect $\epsilon_i$ that varies randomly, with distribution $f(\epsilon_i | \theta)$.

Given these assumptions, the joint probability of observing the leverage ratios $y_{it}$ for firm $i$ at time $t$ and the firm-specific unobserved effects $\epsilon_i$, given the observable characteristics $x_{it}$, for $t = 1, \ldots, n_i$, is given by

$$f(y_i, \epsilon_i | \theta, x_i) = f(y_i | \epsilon_i; \theta, x_i) f(\epsilon_i | \theta)$$

$$= \left( f(y_{i1} | \epsilon_i; \theta, x_i) \prod_{t=2}^{n_i} f(y_{it} | y_{it-1}, \epsilon_i; \theta, x_i) \right) f(\epsilon_i | \theta). \quad (13)$$

Integrating out the random effects from the joint likelihood $f(y, \epsilon | \theta, x) = \prod_{i=1}^{N} f(y_i, \epsilon_i | \theta, x_i)$, we obtain the marginal log-likelihood function (since the $\epsilon_i$ are drawn independently across firms from the distribution $f(\epsilon_i | \theta)$) as

$$\ln L(\theta; y, x) = \ln \int f(y, \epsilon | \theta, x) d\epsilon$$

$$= \sum_{i=1}^{N} \ln \int \left( f(y_{i1} | \epsilon_i; \theta, x_i) \prod_{t=2}^{n_i} f(y_{it} | y_{it-1}, \epsilon_i; \theta, x_i) \right) f(\epsilon_i | \theta) d\epsilon_i. \quad (14)$$

For the model described in Section II, explicit expressions for the stationary and conditional densities $f(y_{it} | \theta, x_i)$ and $f(y_{it} | y_{it-1}, \epsilon_i; \theta, x_i)$ can be derived (see Appendix A.3). We evaluate the integral in equation (14) using Monte Carlo simulations.\(^\text{10}\) The simulated maximum likelihood estimator is now defined as: $\hat{\theta} = \arg\max_{\theta} \ln L(\theta)$. This estimator answers the question: What magnitude of agency costs best explains observed financing patterns?

\(^{10}\)The empirical analog to the log-likelihood can be expressed as

$$\ln \mathcal{L}(\theta) = \sum_{i=1}^{k} \ln \frac{1}{S} \sum_{s_i=1}^{S} \left( f(y_{i1}^{s_i}; \theta, x_i) \prod_{t=2}^{n_i} \sum_{s_{it}=1}^{S} f(y_{it} | y_{it-1}, \epsilon^{s_{it}}_i; \theta, x_i) \right),$$

where $S$ is the number of random draws per firm and $\epsilon^{s_i}_i$ is the realization in draw $s_i$ for firm $i$. 16
B. Empirical Specification

The main focus of inference in the estimation is on the firm-specific estimates of the cost of control challenges $\phi$ of shareholders’ bargaining power in default, $\eta$. In the empirical implementation, the structural parameters characterizing $\phi$ and $\eta$ are defined as:

$$
\phi_{it} = h(\alpha_{\phi} + \epsilon_{\phi i}), \quad \text{and} \quad \eta_{it} = h(\alpha_{\eta} + \epsilon_{\eta i}),
$$

(15)

where $h = \Phi \in [0, 1]$ is the cumulative standard normal distribution function and the $\epsilon_i$ are bivariate random variables capturing the firm-specific unobserved heterogeneity.$^{11}$ For all firms $i = 1, \ldots, N$, the firm-specific random effects are distributed

$$
\begin{pmatrix}
\epsilon_{\phi i} \\
\epsilon_{\eta i}
\end{pmatrix}
\sim N\left(0, 
\begin{bmatrix}
\sigma_{\phi}^2 & \sigma_{\phi\eta} \\
\sigma_{\phi\eta} & \sigma_{\eta}^2
\end{bmatrix}
\right).
$$

(16)

Across firms, the $(\epsilon_{\phi i}, \epsilon_{\eta i})$ are assumed independent. This setup is sufficiently flexible to capture cross-sectional variation in the parameter values while imposing the model-implied structural restrictions on the domains of the parameters.

C. Data

Estimating the model derived in Section II requires merging data from various sources. We collect financial statements from Compustat, managerial compensation data from ExecuComp, stock price data from CRSP, analysts forecasts from I/B/E/S, governance data from IRRC (governance, directors and blockholders), and institutional ownership data from Thomson Financial. Following the literature, we remove all regulated (SIC 4900 – 4999) and financial firms (SIC 6000 – 6999). Observations with missing SIC code, total assets, market value, sales, long term debt, debt in current liabilities are also excluded from the final sample. In addition, we restrict our sample to firms that have total assets over 10 millions. As a result of these selection criteria, we obtain a panel dataset with 13,159 observations for 809 firms, for the time period between 1992 and 2004 at the quarterly frequency.

The main parameters describing the firm characteristics are $(m, \mu, \sigma)$. The Institutional Brokers’ Estimate System (I/B/E/S) provides analysts forecasts for the long-term growth

$^{11}$The transformation $h$ guarantees that the parameters stay in their natural domain. Alternatively, we have used the inverse logit transformation for $h$. The results are very similar and omitted.
rate. We proxy the firm-specific growth rate of cash flows by the mean long-term growth rate per industry, $\hat{m}_it$, where we use SIC level 2 to define industries. It is generally agreed that IBES consensus long-term growth rates are too optimistic compared to realized growth. In addition, Chan, Karceski, and Lakonishok (CKL, 2003) show that IBES also generates too much cross-sectional variation in growth rates. Following CKL (2003), we adjust for these two biases by using the following least-squares predictor for the long-term growth rate:

$$m_{it} = 0.007264043 + 0.408605737 \times \hat{m}_{it}.$$ 

Using data on IBES consensus forecasts in our sample we can predict actual growth rates using this linear specification. The estimates we obtain are in line with historical values reported in CKL (2003).

Stock returns are obtained from the Center for Research in Security Prices (CRSP) database. We use the Capital Asset Pricing Model (CAPM) to obtain an estimate of $\mu_{it}$. We obtain estimates of market betas from CRSP monthly equity returns. The firm- and time-specific estimates are based on 60 months rolling-window regressions. We then have the following specification for the “risk-neutral” growth rate of cash flows:

$$\mu_{it} = m_{it} - \hat{\beta}_{it} \hat{\kappa}_t,$$

where $\hat{\kappa}_t$ is the risk premium and $\hat{\beta}_{it}$ is a leverage-adjusted cash flow beta. To perform our empirical analysis, we also need an estimate of cash flow volatility. This volatility parameter can be written as

$$\sigma_{it} = \sigma_{it}^E \frac{\partial E_t}{\partial X_t} \frac{X_t}{E_t},$$

where $\sigma_{it}^E$ is the volatility of stock returns, $E_t$ is the stock price and $\frac{\partial E_t}{\partial X_t}$ is computed using the expression for equity derived in equation (11). For each firm, the volatility of equity is computed as the standard deviation of monthly equity returns over the past five years.

ExecuComp provides data on managerial compensation schemes, allowing us to measure the extent to which managerial incentives are aligned with shareholders’ interests (as reflected by the parameter $\varphi$ in our model). We construct firm-specific measures for the five highest paid executives. Following Core and Guay (1999), we construct the managerial delta, defined as the sensitivity of option value to a one percent change in the stock price. In addition, following Jensen and Murphy (1990), we construct a managerial incentives measure, defined as the change in managerial wealth per dollar change in the wealth of shareholders. Our incentives measure thus accounts for both a direct component, managerial share ownership, and an indirect component, the pay-performance sensitivity due to options awards. A detailed description of the managerial incentives measures is provided in Appendix A.5.
The remaining parameters are standard. The risk free rate is based on the yield curve of Treasury bonds. The risk premium is set to the consensus value of 6%. The relevant tax rates are based on estimates in Graham (1996). We use the mean over the sample period for the tax rate on dividends and interest income, $\tau_d$ and $\tau_i$, respectively. The tax rate on corporate income, $\tau_c$, is set to 35%. Gilson and Lang (1990) find that renegotiation costs represent a very small fraction of firm value. We thus fix renegotiation costs, $\kappa$, to 5% and check for robustness by varying $\kappa$ across specifications. Following Berger, Ofek, and Swary (1996), we define firm- and time-specific liquidation costs, $\alpha_{it}$, as:

$$\alpha_{it} = 1 - (\text{Tangibility}_{it} + \text{Cash}_{it})/\text{Total Assets}_{it}. \quad (17)$$

In equation (17), Berger, Ofek, and Swary (1996) estimate tangibility as $\text{Tangibility}_{it} = 0.715 \times \text{Receivables}_{it} + 0.547 \times \text{Inventory}_{it} + 0.535 \times \text{Capital}_{it}$.

The model is written in terms of debt issuance cost as a fraction of total debt outstanding ($\lambda$). Several empirical studies provide estimates for issuance costs as a function of the amount of debt issued. It is easy to show that in the model the cost of debt issuance as a fraction of the issue size is given by $\frac{\rho - 1}{\rho} \lambda$, where $\rho$ is the restructuring threshold multiplier. Since our estimates yield a mean value of 2 for $\rho$, we set the cost of debt issuance parameter to 1%. This produces a cost of debt issuance representing 2% of the issue size, corresponding to the upper range of the values found in the empirical literature (see e.g. Altinkhic and Hansen, 2000, and Kim, Palia, and Saunders, 2007). We also check for robustness by varying $\lambda$ across specifications.

Tables 2 and 3 provide detailed definitions and descriptive statistics for the variables of interest. Figure 2 plots the distribution of leverage across Compustat firms in our sample. Depending on the leverage measure, the peak of the distribution is between 0% and 20% and the distribution is highly skewed to the right. This illustrates that firms typically choose very low leverage ratios, but occasionally exhibit very high leverage ratios.
IV. Estimation Results

A. Dynamic Capital Structure without Agency Conflicts

The dynamic trade-off theory proposed by Fischer, Heinkel, and Zechner (1989) and Goldstein, Ju, and Leland (2001) is a competing explanation to the agency theory for the conservative leverage observed in the data. In particular, as illustrated by Figure 1, an increase in refinancing costs has similar effects as an increase in agency costs on the time-series distribution of leverage (it widens the support of the distribution and reduces its mean). Since the models mentioned above are nested in ours if we set $\phi_{it} = 0$ and $\eta_{it} = 0$, we can readily estimate the level of refinancing costs necessary to explain observed leverage choices using the procedure described in section III. Table 4 reports descriptive statistics for the predicted cost of debt issuance, $\hat{\lambda}_{it} = \mathbb{E}(\lambda_{it}|y_{it}, x_{it}; \theta)$, in the dynamic capital structure model without agency conflicts. We obtain the predicted values from an SML estimation in which $\phi_{it} = 0$, $\eta_{it} = 0$ and $\lambda_{it}$ is allowed to vary across firms as follows:

$$\lambda_{it} = h(\alpha_{\lambda} + \epsilon_{it}^{\lambda}),$$

where $\epsilon_{it}^{\lambda}$ is a firm-specific unobserved determinant of $\lambda_{it}$.

Panel A of Table 4 reports the structural estimates. White t-statistics are reported in parentheses. The mean debt issuance costs and the variance estimate for the random effects are economically and statistically significant. Panel B reports distributional characteristics of the predicted cost of refinancing. The panel shows that the cost of debt issuance would have to be in the order of 14% of the total debt outstanding (or 28% of the issue size), with median value at around 12% (or 24% of the issue size), to explain observed financing choices and the dynamics of leverage ratios. These numbers are unreasonably high and inconsistent with empirically observed values. Thus, while dynamic capital structure theories that ignore agency conflicts can reproduce qualitatively the financing patterns observed in the data (see Strebulaev, 2007), they do not provide a reasonable quantitative explanation for firms’ financing policies. In that respect, our results are in line with the recent study by LRZ (2008), who find that the traditional determinants of capital structure explain little of
the observed variation in leverage ratios. The next section investigates whether the dynamic trade-off theory augmented by agency costs performs better than the standard explanations exclusively based on financing frictions.

B. The Estimated Cost of Control Challenge and Bargaining Power

We now turn to the model with agency conflicts. Panel A of Table 5 provides estimates of the structural parameters underlying the empirical specification described in section III.B. The parameters representing the degree of managerial entrenchment and the bargaining power of shareholders in default are well identified in the data. The variance estimates for the random effects are economically and statistically significant. This suggests sizeable variation in the degree of managerial entrenchment and in the bargaining power of shareholders across firms. (In section D below we show that our measure of entrenchment is structurally related to a number of corporate governance mechanisms.) Moreover, the cross-sectional covariation between the degree of managerial entrenchment and shareholders’ bargaining power is negative, suggesting that shareholders can extract a greater surplus from bondholders in default when managers and shareholders’ interests are more aligned.12

Using the structural parameter estimates, we can construct firm-specific measures of the degree of managerial entrenchment and of shareholders’ bargaining power in default. In Appendix A.4, we show that the conditional expectations of the cost of control challenges \( \phi_{it} \) and shareholders’ bargaining power \( \eta_{it} \), given the data \((y_{it}, x_{it})\), satisfy:

$$
E[\phi_{it}|y_{it}, x_{it}; \theta] = \frac{\int_{\epsilon^\phi_{it}} \int_{\epsilon^\eta_{it}} h(\alpha^\phi + \epsilon^\phi_{it}, \epsilon^\eta_{it}, x_{it}; \theta) f(\epsilon^\phi_{it}, \epsilon^\eta_{it}|x_{it}; \theta) \, d\epsilon^\phi_{it} \, d\epsilon^\eta_{it}}{\int_{\epsilon^\phi_{it}} \int_{\epsilon^\eta_{it}} f(y_{it}|\epsilon^\phi_{it}, \epsilon^\eta_{it}, x_{it}; \theta) f(\epsilon^\phi_{it}, \epsilon^\eta_{it}|x_{it}; \theta) \, d\epsilon^\phi_{it} \, d\epsilon^\eta_{it}}, \tag{18}
$$

and

$$
E[\eta_{it}|y_{it}, x_{it}; \theta] = \frac{\int_{\epsilon^\phi_{it}} \int_{\epsilon^\eta_{it}} h(\alpha^\eta + \epsilon^\eta_{it}) f(y_{it}|\epsilon^\phi_{it}, \epsilon^\eta_{it}, x_{it}; \theta) f(\epsilon^\phi_{it}, \epsilon^\eta_{it}|x_{it}; \theta) \, d\epsilon^\phi_{it} \, d\epsilon^\eta_{it}}{\int_{\epsilon^\phi_{it}} \int_{\epsilon^\eta_{it}} f(y_{it}|\epsilon^\phi_{it}, \epsilon^\eta_{it}, x_{it}; \theta) f(\epsilon^\phi_{it}, \epsilon^\eta_{it}|x_{it}; \theta) \, d\epsilon^\phi_{it} \, d\epsilon^\eta_{it}}. \tag{19}
$$

12 In unreported tests, we find that the bargaining power of shareholders decreases with R&D or the firm’s market-to-book ratio and increases with asset size. These results are consistent with those of prior studies by Betker (1995) or Franks and Torous (1989). In Table 7 below, we show that these right-hand side variables have the opposite effects on the manager’s private benefits of control.
In these equations, \( f(y_{it}|\epsilon_i^\phi, \epsilon_i^\eta, x_{it}; \theta) \) is the distribution of leverage implied by the model and given in Appendix A.3, \( f(\epsilon_i^\phi, \epsilon_i^\eta|x_{it}; \theta) \) is a bivariate normal density, and \( \theta \) are the estimated parameters. Equations (18) and (19) provide estimates of the cost of control challenges and of shareholders’ bargaining power for each firm in our sample. We evaluate these expressions using Monte Carlo integration.

Figure 3 plots histograms of the predicted cost of control challenges, \( \hat{\phi}_{it} = \hat{E}[\phi_{it}|y_{it}, x_{it}; \theta] \), and the predicted bargaining power of shareholders in default, \( \hat{\eta}_{it} = \hat{E}[\eta_{it}|y_{it}, x_{it}; \theta] \), for each firm-quarter. The results reported in Figure 3 imply sizeable variation in the degree of managerial entrenchment across firms. Hence, while our dynamic capital structure model suggests that leverage ratios should revert to the (manager’s) target leverage over time, the differences in the degree of managerial entrenchment observed in Figure 3 should lead to persistent cross-sectional differences in leverage ratios.

Panel B of Table 5 reports summary statistics for the predicted values of \( \phi_{it} \) and \( \eta_{it} \) in the basic specification. We also report in brackets the cost of control challenges expressed as a fraction of equity value. As shown in the table, the mean (median) cost of control challenges is 2% of equity value (0.9%). Its distribution is strongly positively skewed and exhibits sizeable variance and kurtosis. The mean and median bargaining power of shareholders are 46%, close to the Nash solution. Given the magnitude of bankruptcy and renegotiation costs, this implies that shareholders can capture 20% of firm value on average by renegotiating outstanding claims in default. Importantly, the distribution of shareholders’ bargaining power is negatively skewed, and exhibits less variation and lower kurtosis than that of \( \phi_{it} \). Together with Table 1, this suggests that shareholders’ bargaining power in default explains little of the observed cross-sectional variation in leverage ratios.

Overall the results suggest that small conflicts of interests between managers and shareholders are sufficient to resolve the leverage puzzles identified in the empirical literature and to explain the time series of observed leverage ratios. This in turn suggests that the trade-off theory augmented with agency conflicts performs orders of magnitude better than the standard explanations based exclusively on financing frictions.
C. Robustness Checks

In Table 6 we perform a set of robustness checks. First, we vary the cost of debt issuance and set it to 0.75%. This produces a cost of debt issuance representing 1.5% of the issue size. Second, we set managerial incentives, $\phi$, equal to management’s equity ownership, neglecting option compensation. Third, we set the renegotiation cost of debt to 15% (Andrade and Kaplan (1997) estimate financial distress costs to be 10% to 20% of firm value). Fourth, we use the alternative definition of leverage and re-estimate the model.

The estimates reported in Table 6 exhibit similar features as in the base case. The parameters for the cost of control challenges are economically and statistically significant, and the cross-sectional variation in the bargaining power of shareholders is about three times the variation in the cost of control challenges. The correlation between the two parameters is negative in all four environments. Finally, the likelihood is the highest in the base case, corroborating our choice of parameters.

Panel B of Table 6 reports the predicted cost of control challenges, $\widehat{E}[\phi_{it}|y_{it}, x_{it}; \theta]$, and the predicted bargaining power of shareholders, $\widehat{E}[\eta_{it}|y_{it}, x_{it}; \theta]$ under the alternative specifications. As expected, the estimates of the degree of managerial entrenchment are larger under the alternative definition of leverage (which produces lower leverage ratios) and under the alternative ownership definition. The estimates are lower under larger restructuring and renegotiation costs since an increase in these costs lowers the predicted leverage ratios. The estimates of shareholders’ bargaining power are larger under the alternative definition of ownership and renegotiation costs and lower under the alternative definition of leverage and restructuring costs. Overall, the variation across specifications is small and the order of magnitude remains unchanged, suggesting that our measures are robustly estimated.

In Appendix B, we report additional tests based on data simulated from the model that provide further support for our dynamic capital structure model with agency conflicts. Specifically, we simulate a number of dynamic economies and replicate the empirical analysis conducted by various cross sectional capital structure studies. We show that the results of regressions on our simulated data are consistent with those reported in the empirical literature. The results are reported in Table 8 and discussed in Appendix B.
D. The Determinants of Entrenchment and Financing Decisions

Many studies have identified factors that purport to explain variation in corporate capital structures. However, as shown by LRZ (2008), little of the (cross-sectional and time-series) variation in observed capital structures is captured by traditional determinants of financing decisions (such as size, market-to-book, profitability). Instead, LRZ find that the majority of the variation in leverage ratios is driven by an unobserved firm-specific effect. This paper argues that one potential explanation for these findings is that managers have discretion over financing decisions, so that leverage ratios should be determined not only by real market frictions but also by the degree of managerial entrenchment. In this section, we provide a test of this hypothesis by examining which factors affect the firm-specific estimates of the degree of managerial entrenchment obtained in the structural estimation. We classify the determinants of entrenchment into three groups: governance mechanisms, firm characteristics, and economic conditions. The definition and construction of the dependent and explanatory variables is summarized in Table 2. Table 3 provides the sample-wide means and standard deviations of these variables.

To relate our estimates of the degree of managerial entrenchment (as reflected by \( \phi_{it} \)) to the firms’ governance structure, we employ data on various governance mechanisms provided by the Investor Responsibility Research Center (IRRC), Thomson Financial, and Execucomp. We use the IRRC data to construct the entrenchment index of Bebchuk, Cohen and Farell (2004), Eindex. The Eindex is based on six provisions describing shareholder rights: Staggered boards, limits to shareholder bylaw amendments, supermajority requirements for mergers, supermajority requirements for charter amendments, poison pills, and golden parachutes. One would expect firms with anti-takeover provisions (high Eindex) to have higher costs of control challenges and, hence, to issue less debt. We employ the Eindex of anti-takeover provisions to construct a simple binary variable “Eindex - Dictatorship”, which equals one if the Eindex is above its mean, and zero otherwise.\(^{13}\) Results based on the Gindex of Gompers, Ishii, and Metrick (2003) are similar and omitted.

\(^{13}\)Following Heckman’s (1979) approach to address endogeneity, we add the Inverse Mill’s Ratio to the regression specification. The coefficient is negative and statistically significant throughout, suggesting that anti-takeover provisions are endogenously determined. In unreported results, we find that “Eindex - Dictatorship” is negatively related to market-to-book and positively to firm size, and varies by industry.
IRRC also provides data on blockholder ownership, an important determinant of private benefits of control. In the analysis, we use both the total holdings of blockholders and the holdings of independent blockholders as governance indicators. As argued by Shleifer and Vishny (1986), the existence of large independent shareholders makes a takeover or a proxy contest easier. Thus, we expect the cost of control challenges to be negatively correlated with this measure. Institutional ownership is another important governance mechanism. We collect data on the institutional ownership share from Thomson Financial’s 13f filings.

We build two proxies for internal board governance – board independence and board committees. These two measures are motivated by the SOX Act. Board independence represents the proportion of independent directors reported in IRRC. Board committees is the sum of four dummy variables capturing the existence and independence (more than 50% of committee directors are independent) of audit, compensation, nominating, and corporate governance committees.

In addition to these corporate governance variables, we include in our regressions standard control variables for other firm attributes. To control for company profitability, we use the return on assets (ROA), defined as EBITDA divided by total assets at the start of the year. We measure firm size as the natural log of sales. Two variables are included to measure the uniqueness of assets: R&D (R&D expenses divided by total assets) and tangibility (PP&E net divided by total assets). Last, a natural proxy for CEO entrenchment and power is the tenure of the CEO. We obtain data on this measure from Execucomp.

Table 7 reports estimation results from Fama-MacBeth regressions of the predicted degree of entrenchment, $\hat{\phi}_{it}|y_{it}, x_{it}; \theta]$, expressed in basis points, on the various explanatory variables. As robustness check, we vary the sample, regression specification, and estimation method across the different columns in Table 7. Most of the control variables have signs in line with accepted theories and, to conserve space, we confine our discussion to those variables related to the hypothesis about the relation between managerial entrenchment and leverage. The general pattern, which is robust across specification, is that the coefficients on governance variables are significant and have sign that are consistent with economic intuition. This suggests that our structural estimates indeed measure managerial entrenchment.
The results in Table 7 show that external governance mechanisms, represented by institutional ownership and outside blockholder ownership, are negatively related to managerial entrenchment (and the costs of control challenges), suggesting that independent outside monitoring of management is effective. The coefficients suggest that a one standard deviation increase in institutional (outside blockholder) ownership is associated with a decrease of 31 (17) basis points in the cost of control challenges. Anti-takeover provisions are another important mechanism in governing corporate control. The coefficient on “Eindex - Dictatorship” is positive and significant.14 This is consistent with the notion that anti-takeover provisions lead to greater entrenchment.

Internal governance mechanisms are captured in Table 7 by managerial characteristics and characteristics of the board of directors. CEO tenure intuitively proxies for CEO entrenchment. Across specifications, we consistently find a positive relation of CEO tenure with entrenchment. Not surprisingly, board independence – proxied by the number of independent directors or by the existence of independent audit, compensation, nominating, and corporate governance committees – is negatively related to the cost of control challenges. This is consistent with the intuition that a more independent board of directors is a stronger monitor of management. The coefficient estimates suggest that entrenchment in firms with independent boards is 54 basis points lower than in comparable firms.

The relation between entrenchment and managerial delta, a proxy for managerial incentive alignment, is U-shaped and on average positive. This is consistent with the incentives versus entrenchment literature (see Claessens, Djankov, Fan, and Lang, 2002).15 The positive relation on average suggests that executive pay and managerial entrenchment (hidden pay) are complementary compensation mechanisms (see Kuhnen and Zwiebel, 2008).

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14 We have run the regressions also with dummy “Gindex - Dictatorship”. The coefficient estimates are also positive but mostly insignificant. The estimates are omitted for brevity and available upon request. This result is in line with recent evidence by Bates, Becher, and Lemmon (2008), which “challenges the common perception that these factors [included in the index], independently or as indexed, provide a reliable proxy for managerial entrenchment or a firm’s exposure to the market for corporate control.”

15 One would expect leverage ratios to increase with managerial ownership so long as debt in the firm’s capital structure increases shareholder wealth. However, to the extent that managerial ownership protects management against outside pressures (Stulz, 1988), one expects the cost of control challenge to increase (and leverage to decrease) with managerial ownership.
Last, Table 7 reveals that managerial entrenchment increases with growth opportunities and intangibles (positive coefficient on market-to-book ratio, negative on asset tangibility). Not surprisingly, the proportion of diverted cash flows decreases with firm size. Economic conditions also affect the magnitude of manager-shareholder conflicts. The slope of the yield curve and the credit spread are positively related to managerial entrenchment.

Overall, two facts emerge from this analysis. First, we find that our estimates of the degree of managerial entrenchment are related to a number of corporate governance mechanisms. Variables associated with stronger monitoring have negative connections with our firm-specific estimates of the cost of control challenges. Institutional ownership, board structure, and anti-takeover provisions have the largest impact on managerial entrenchment and, hence, on capital structure decisions. Second, the $R^2$ from a regression of entrenchment on a number of firm-specific and governance variables is 42%, highlighting the importance of accounting for governance and entrenchment in empirical capital structure tests.

V. Conclusion

This paper develops a structural model to estimate the magnitude of conflicts of interests between managers, shareholders, and bondholders and their effects on financing decisions. We build a dynamic contingent claims model in which financing policy results from a trade-off between tax shields, contracting frictions, and agency conflicts. In our setting, managers do not act in the best interest of shareholders but pursue private benefits at the expense of shareholders. Managers have discretion over financing and dividend policies. Shareholders can remove the manager at a cost. This threat of a control challenge limits managerial entrenchment. Our analysis demonstrates that entrenched managers issue less debt and rebalance capital structure less often than optimal for shareholders.

The paper also provides new evidence on the relation between governance mechanisms and capital structure dynamics. We use observed financing choices to infer firm-specific estimates of the degree of managerial entrenchment or, equivalently, the cost of control challenges. We find that costs of control challenges of 2% of equity value on average (1% at median) are sufficient to resolve the low- and zero-leverage puzzles and explain the time series of observed leverage ratios. Our estimates of the agency costs vary with variables that one expects to
determine managerial incentives. External and internal governance mechanisms significantly affect the value of control and firms’ financing decisions.

To make the analysis of traditional capital structure determinants complete, we also examine the effects of shareholder-debtholder conflicts on financing decisions. In the model, shareholders can renegotiate outstanding claims in default as in Fan and Sundaresan (2000). Our structural estimates reveal that the bargaining power of shareholders in default is 46% on average, close to the Nash solution. Hence, shareholders can extract substantial concessions from debtholders in default. However, while shareholder-debtholder conflicts tend to reduce leverage, we find that they have little quantitative impact on leverage levels and on their cross-sectional variation.

Finally, our analysis also shows that costs of debt issuance would have to be in the order of one quarter of the amount issued to explain observed financing choices. Thus, while dynamic capital structure theories that ignore agency conflicts can qualitatively reproduce the financing patterns observed in the data, they do not provide a reasonable quantitative explanation for firms’ financing policies. Overall the evidence suggests that part of the heterogeneity in capital structures documented in Lemmon, Roberts, and Zender (2008) may be driven by the observed variation in the governance structure of firms.
Appendix A: Proofs and Data Definitions

A.1 Scaling Property

We denote the values of equity and corporate debt by $E(X)$ and $B(X)$ respectively and assume that the net payoff to outside investors when they take control of the levered firm is $(1 - \phi) \max[V(X) - B(X); 0]$. Assuming that the firm has issued debt with coupon payment $c$, the cash flow accruing to shareholders over each interval of time of length $dt$ under the conjectured payout policy is: $(1 - \tau)(1 - \phi)(X - c)dt$. In addition to this cash flow, shareholders receive capital gains of $E[dE]$ over each time interval. The required rate of return for investing in the firm’s equity is $r$. Applying Itô’s lemma, it is then immediate to show that the value of equity satisfies for $X > X_B$:

$$rE = \frac{1}{2} \sigma^2 X^2 \frac{\partial^2 E}{\partial X^2} + \mu X \frac{\partial E}{\partial X} + (1 - \tau)(1 - \phi)(X - c).$$

The solution of this equation is

$$E(X) = AX^\xi + BX^\nu + \Pi(X) - (1 - \tau)(1 - \phi)\frac{c}{r},$$

where $\Pi(X)$ is defined in (3) and $\xi$ and $\nu$ are the positive and negative roots of the equation $\frac{1}{2}\sigma^2y(y-1)+\mu y-r=0$. This ordinary differential equation is solved subject to the following two boundary conditions:

$$E(X)|_{X=X_B} = \eta(\alpha - \kappa) \Pi(X_B), \text{ and } \lim_{X\to\infty} \left[\frac{E(X)}{X}\right] < \infty.$$

The first condition equates the value of equity with the cash flow to shareholders in default. The second condition is a standard no-bubble condition. In addition to these two conditions, the value of equity satisfies the smooth pasting condition:

$$\frac{\partial E}{\partial X}|_{X=X_B} = \eta(\alpha - \kappa) \Pi(X_B) \text{ at the endogenous default threshold (see Leland (1994)).}$$

Solving this optimization problem yields the value of equity in the presence of manager-shareholder conflicts as

$$E(X, c) = \Pi(X) - \frac{(1 - \tau)(1 - \phi)c}{r} - \left\{[1 - \eta(\alpha - \kappa)] \Pi(X_B) - \frac{(1 - \tau)(1 - \phi)c}{r}\right\} \left(\frac{X}{X_B}\right)^\nu.$$

In these equations, the tax rate $\tau = 1 - (1 - \tau^c)(1 - \tau^d)$ reflects both corporate and personal taxes and the default threshold $X_B$ satisfies

$$X_B = \frac{\nu}{\nu - 1} \frac{r - \mu}{r} \frac{c}{1 - \eta(\alpha - \kappa)}.$$

Taking the trigger strategy $X_B$ as given, the value of corporate debt satisfies in the region for the cash flow shock where there is no default

$$rB = \frac{1}{2} \sigma^2 X^2 \frac{\partial^2 B}{\partial X^2} + \mu X \frac{\partial B}{\partial X} + (1 - \tau^i)c.$$
This equation is solved subject to the standard no-bubbles condition \( \lim_{X \to \infty} B(X) = c/r \) and the value-matching condition \( B(X) |_{X = X_B} = [1 - \kappa - \eta (\alpha - \kappa)] \Pi (X_B) \). Solving this valuation problem gives the value of corporate debt as

\[
B(X, c) = \frac{(1 - \tau)}{r} c - \left\{ \frac{(1 - \tau)}{r} c - [1 - \alpha + (1 - \eta)(1 - \phi)(\alpha - \kappa)] \Pi (X_B) \right\} \left( \frac{X}{X_B} \right)^\nu .
\]

Using the above expressions for the values of corporate securities, it is immediate to show that the present value \( M(X) \) of the cash flows that the manager gets from the firm satisfies:

\[
M(X) = [\varphi + \phi (1 - \varphi)] \Pi(X) + \frac{(1 - \tau)}{r} c - \left[ \frac{(1 - \tau)}{r} c + \zeta \Pi(X_B) \right] \left( \frac{X}{X_B} \right)^\nu ,
\]

where \( \zeta = \varphi \kappa + \phi [1 - (1 - \varphi \eta)(\alpha - \kappa)] \) measures the net cost of default for the manager (including the reduction in managerial rents occurring at the time of default). Plugging the expression for the default threshold in the manager’s value function \( M(X) \), it is immediate to show that \( M(X) \) is concave in \( c \). As a result, the selected coupon payment can be derived using the first order condition:

\[
\frac{\partial M(X_0)}{\partial c} = 0. \] Solving this FOC yields

\[
c = X_0 \left( \frac{\nu - 1}{\nu} \right) r \left[ 1 - \eta (\alpha - \kappa) \right] \left[ 1 - \nu - \frac{1 - \tau}{1 - \tau} \left( 1 - \eta (\alpha - \kappa) \right) \right] \frac{\nu \zeta}{1 - \nu} .
\]

These expressions demonstrate that in the static model the default threshold \( X_B \) is linear in \( c \). In addition, the selected coupon rate \( c \) is linear in \( X \). This implies that if two firms \( i \) and \( j \) are identical except that \( X^i_0 = \theta X^j_0 \), then the optimal coupon rate and default threshold \( c^i = \theta c^j \) and \( X^i_B = \theta X^j_B \), and every claim will be larger by the same factor \( \theta \).

**A.2 Off-Equilibrium Restructurings**

Index by \( n \) the managers over the lifetime of the firm. Assume that the cost of a control challenge in round \( n \) is proportional to the present value of cash flows \( F^*_n(X) \) and equal to

\[
Cost_n(X) = (\phi_n - \phi_{n+1}) F^*_n(X),
\]

where \( \phi_n, n \in \mathbb{N} \), are constant coefficients. For the cost to be positive, we require \( 0 < \phi_{n+1} < \phi_n < 1 \). If the cost coefficient \( \phi_n \) decreases by a constant fraction \( \delta \) every round, we can also write \( Cost_n(X) = \phi_n \delta F^*(X) \). In general, an increase in managerial ownership implies a better alignment of managers’ incentives with shareholders’ interests as well as an increased cost of removing management. To capture this intuition, we let the cost of collective action be proportional to managerial ownership (relative to ownership by outsiders) in the following way:

\[
\phi_n = \chi \frac{\varphi_n}{1 - \varphi_n} \text{ for all } n,
\]
In the following we derive the time-series distribution of the leverage ratio.

### A.3 Time-Series Distribution of Leverage

In the following we derive the time-series distribution of the leverage ratio. The leverage ratio \( y_t \) being a monotonic function of the interest coverage ratio \( x_t = X_t / c_t \), we can write \( y_t = L(x_t) \) with \( L : \mathbb{R}^+ \to \mathbb{R}^+ \) and \( L' < 0 \). The process for \( x_t \) follows a Brownian Motion with drift \( \mu \) and volatility \( \sigma \), that is regulated at both the lower boundary \( x_B \) and the upper boundary \( x_U \). The process \( x_t \) is reset to the target level \( x_S \in (x_B, x_U) \) whenever it reaches either \( x_B \) or \( x_U \). The target leverage ratio can be expressed as \( L(x_S) \). Denote the restructuring date by \( \tau = \min(\tau_B, \tau_U) \), where for \( i = B, U \) the random variable \( \tau_i \) is defined by \( \tau_i = \inf \{ t \geq 0 : x_t = x_i \} \). Let \( f_x(x) \) be the density of the interest coverage ratio. The density of leverage can be written in terms of \( f_x \) and the Jacobian of \( L^{-1} \) as follows:

\[
f_y(y) = f_x(L^{-1}(y)) \left| \frac{\partial}{\partial y} L^{-1}(y) \right| = f_x(L^{-1}(y)) \left( \frac{\partial y}{\partial L^{-1}(y)} \right)^{-1}.
\]  

To compute the time-series distribution of leverage, we need the functional form of the density of the interest coverage ratio \( f_x \). The latter can be determined as follows.
1. Stationary density

To determine $f_x$ we first need to derive the distribution of occupation times of the process $x_t$ in closed intervals of the form $[x_B, x]$, for any $x \in [x_B, x_U]$. For every Borel set $B \in \mathcal{B}(\mathbb{R})$, we define the occupation time of $B$ by the Brownian motion $B$ up to time $t$ as

$$\Gamma_t ([x_B, x]) \triangleq \int_0^t 1_B (Z_s) \, ds = \text{meas} \{ 0 \leq s \leq t : Z_s \in B \}$$

where meas denotes Lebesgue measure. We will be interested in the occupation time of the closed interval $[x_B, x_U]$ by the interest coverage ratio $x$ given by $\Gamma_t ([x_B, x])$. Let $G (x, x_0)$, with initial value $x_0$ equal to the target value $x_S$ for the interval $[x_B, x]$, be defined by:

$$G (x, x_0) = \mathbb{E}_{x_0}^Q [\Gamma_t ([x_B, x])].$$

Using the strong Markov property of Brownian motion, we can write

$$G (x, x_0) = \mathbb{E}_{x_0}^Q \left[ \int_0^\infty 1_{[x_B, x]} (x_s) \, ds \right] - \sum_{i,j=U,B,i\neq j} \mathbb{E}_{x_0}^Q [1_{\tau_i < \tau_j}] \mathbb{E}_{x_i}^Q \left[ \int_0^\infty 1_{[x_B, x]} (x_s) \, ds \right].$$

To compute $G (x, x_0)$, we will use the following lemma (Karatzas and Shreve (1991) pp. 272).

**Lemma 1** If $f : \mathbb{R} \to \mathbb{R}$ is a piecewise continuous function with

$$\int_{-\infty}^{+\infty} |f (x + y)| e^{-|y|\sqrt{2}\gamma} \, dy < \infty; \forall x \in \mathbb{R},$$

for some constant $\gamma > 0$, and $(Z_t, t \geq 0)$ is a standard Brownian motion, then the resolvent operator of Brownian motion, $K_\gamma (f) \equiv \mathbb{E} [\int_0^\infty e^{-\gamma t} f (Z_t) \, dt]$, equals

$$K_\gamma (f) = \frac{1}{\sqrt{2\gamma}} \int_{-\infty}^{+\infty} f (y) e^{-|y|\sqrt{2}\gamma} \, dy.$$

Let $b = \frac{1}{\sigma} (\mu - \frac{\sigma^2}{2})$, $\vartheta = -\frac{2b}{\sigma}$, and $h(x, y) = \ln(x/y)$. Using the above Lemma, we obtain after simple but lengthy calculations the following expression for the occupation time measure (similar calculations can be found e.g. in Morellec, 2004):

$$G (x, x_0) = \left\{ \begin{array}{ll}
\frac{1}{2\vartheta} \left[ e^{\vartheta h(x_0, x)} - e^{\vartheta h(x_0, x_B)} \right] - \rho_B \ln \left( \frac{x}{x_B} \right) - \rho_U \left[ e^{\vartheta h(x_U, x)} - e^{\vartheta h(x_U, x_B)} \right], & \text{for } x \leq x_0, \\
\frac{1}{2\vartheta} \left[ 1 - e^{\vartheta h(x_0, x_B)} \right] + \rho_B \ln \left( \frac{x_B}{x_0} \right) - \rho_U \left[ e^{\vartheta h(x_U, x)} - e^{\vartheta h(x_U, x_B)} \right], & \text{for } x > x_0,
\end{array} \right.$$  

where

$$p_B = \frac{x^0_B - x^\vartheta_U}{x^0_B - x^\vartheta_U} \quad \text{and} \quad p_U = \frac{x^\vartheta_U - x^\vartheta_B}{x^\vartheta_U - x^\vartheta_B}. \quad (23)$$

The stationary density function of the interest coverage ratio $x_t$ is now given by

$$f_x (x) = \frac{\vartheta}{\partial_x} G (x, x_0) \frac{G (x, x_0)}{G (x_U, x_0)}. \quad (24)$$
2. Conditional density

To implement our empirical procedure, we also need to compute the conditional distribution of leverage at time $t$ given its value at initial date 0 (in the data we observe leverage ratios at quarterly frequency). To determine this conditional density, we first compute the conditional density of the interest coverage ratio $x_t = \frac{X_t}{c_t}$ at time $t$ given its value $x_0$ at time 0, $P(x_t \in dx | x_0)$, and then apply the transformation (21). For ease of exposition, introduce the regulated arithmetic Brownian motion $W_t = \frac{1}{\sigma} \ln(x_t)$ with initial value $w = \frac{1}{\sigma} \ln(x_0)$, drift $b = \frac{1}{\sigma}(\mu - \frac{\sigma^2}{2})$ and unit variance, and define the upper and lower boundaries as $H = \frac{1}{\sigma} \ln(x_U)$ and $L = \frac{1}{\sigma} \ln(x_B)$, respectively. Denote the first exit time of the interval $(L, H)$ by $\tau_{L,H} = \inf\{t \geq 0 : W_t \notin (L, H)\}$.

The conditional distribution $F_x$ of the interest coverage ratio $x$ is then related to that of the arithmetic Brownian motion $W$ by the following relation:

$$F_x(x| x_0) = P(W_t \leq \frac{1}{\sigma} \ln(x)| W_0 = w).$$

Given that the interest coverage ratio is reset to the level $x_S$ whenever it reaches the boundaries, $W$ is regulated at $L$ and $H$, with reset level at $S = \frac{1}{\sigma} \ln(x_S)$ and we can write its dynamics as

$$dW_t = bt + dZ_t + 1_{\{W_t = L\}} (S - L) + 1_{\{W_t = H\}} (S - H).$$

We would like to compute the cumulative distribution function of the process $W$ at some horizon $t$:

$$G(w, y, t) \equiv P(W_t \leq y|w) = E_w[1_{\{W_t \leq y\}}], \quad (w, y, t) \in [L, H]^2 \times (0, \infty).$$

Rather than trying to compute this probability directly, consider its Laplace transform in time (for notational convenience we drop the dependence of $L$ on $\lambda$):

$$\mathbb{L}(w, y) = \int_0^\infty e^{-\lambda t} G(w, y, t)dt = \int_0^\infty e^{-\lambda t} E_w[1_{\{W_t \leq y\}}]dt = E_w \left[ \int_0^\infty e^{-\lambda t} 1_{\{W_t \leq y\}} dt \right].$$

The second equality in (27) follows from the boundedness of the integrand and Fubini’s theorem. Since the process is instantly set back at $S$ when it reaches either of the barriers, we must have that

$$\mathbb{L}(H, y) = \mathbb{L}(L, y) = \mathbb{L}(S, y) \text{ for all } y.$$  

Now let $W^0_t = w + bt + Z_t$ denote the unregulated process. Using the Markov property of $W$ and the fact that $W$ and $W^0$ coincide up to the first exit time of $W^0$ from the interval $[L, H]$, we deduce that the function $\mathbb{L}$ satisfies

$$\mathbb{L}(w, y) = \Psi(w, y) + \mathbb{L}(S, y)\Phi(w),$$

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where we have set

\[ \Psi(w, y) = \mathbb{E}_w \left[ \int_0^{T_{L,H}} e^{-\lambda t} 1_{\{w \leq y\}} \, dt \right] \quad \text{and} \quad \Phi(w) = \mathbb{E}_w \left[ e^{-\lambda T_{L,H}} \right]. \]

Setting \( w = S \) and solving for \( L(S, y) \) we obtain

\[ L(S, y) = \Psi(S, y) - \Phi(S). \quad (30) \]

Plugging this back into the equation for \( L \) shows that the desired boundary condition is satisfied.

We now have to solve for \( \Phi \) and \( \Psi \). The Feynman-Kac formula shows that the function \( \Psi \) is the unique bounded and a.e. \( C^1 \) solution to the second order differential equation

\[ \frac{1}{2} \frac{\partial^2}{\partial w^2} \Psi(w, y) + b \frac{\partial}{\partial w} \Psi(w, y) - \lambda \Psi(w, y) + 1_{\{w \leq y\}} = 0 \quad (31) \]

on the interval \((H, L)\) subject to the boundary condition \( \Psi(H, y) = \Psi(L, y) = 0 \). Solving this equation, we find that the function \( \Psi \) is given by

\[ \Psi(w, y) = \begin{cases} \Lambda(w) + A_L(y) \Delta_L(w), & \text{if } w \in [L, y], \\ A_H(y) \Delta_H(w), & \text{if } w \in [y, H], \end{cases} \quad (32) \]

where we have set

\[ \Lambda(w) = \frac{1}{\lambda} \left[ 1 - e^{(v+b)(L-w)} \right], \quad \text{and} \quad \Delta_{L,H}(w) = e^{(v-b)w} \left[ 1 - e^{2v(L,H)-w} \right], \quad (33) \]

with \( v = v(\lambda) = \sqrt{b^2 + 2\lambda} \). Because the function \( 1_{\{w \leq y\}} \) is (piecewise) continuous, the function \( \Psi(w, y) \) is piecewise \( C^2 \) (see Theorem 4.9 pp. 271 in Karatzas and Shreve, 1991).

Therefore, \( \Psi(w, y) \) is \( C^0 \) and \( C^1 \) and satisfies the continuity and smoothness conditions at the point \( w = y \). This gives

\[ \Lambda(y) + A_L \Delta_L(y) = A_H \Delta_H(y), \quad \text{and} \quad \Lambda'(y) + A_L \Delta'_L(y) = A_H \Delta'_H(y). \]

Solving this system of two linear equations, we obtain the desired constants as

\[ A_L = A_L(y, \lambda) = \frac{\Lambda(y) \Delta'_H(y) - \Lambda'(y) \Delta_H(y)}{\Delta_H(y) \Delta'_L(y) - \Delta_L(y) \Delta'_H(y)}, \quad (34) \]

\[ A_H = A_H(y, \lambda) = \frac{\Lambda(y) \Delta'_L(y) - \Lambda'(y) \Delta_L(y)}{\Delta_H(y) \Delta'_L(y) - \Delta_L(y) \Delta'_H(y)}. \quad (35) \]

Let us now turn to the computation of \( \Phi \). The Feynman-Kac formula shows that the function \( \Phi \) is the unique bounded and a.e. \( C^1 \) solution to the second order differential equation

\[ \frac{1}{2} \Phi''(w) + b \Phi'(w) - \lambda \Phi(w) = 0 \quad (36) \]

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on the interval \((H, L)\) subject to the boundary condition \(\Phi(H) = \Phi(L) = 1\). Solving this equation, we find that the function \(\Phi\) is given by

\[
\Phi(w) = B_L \Delta_L(w) + B_H \Delta_H(w),
\]

where

\[
B_L = B_L(\lambda) = -\frac{e^{(\nu+b)H}}{e^{2\nu L} - e^{2\nu H}}, \quad \text{and} \quad B_H = B_H(\lambda) = \frac{e^{(\nu+b)L}}{e^{2\nu L} - e^{2\nu H}}.
\]

The conditional density function \(g(w, y, t) = \frac{\partial}{\partial y} G(w, y, t)\) can be obtained by differentiating the Laplace transform (27) with respect to \(y\). We obtain

\[
\frac{\partial}{\partial y} \Lambda(w, y) = \int_0^\infty e^{-\lambda t} g(w, y, t) dt
= \frac{\partial}{\partial y} \Psi(w, y) + \frac{\Phi(w)}{1 - \Phi(S)} \frac{\partial}{\partial y} \Psi(S, y),
\]

where

\[
\frac{\partial}{\partial y} \Psi(w, y) = \begin{cases} A'_L(y) \Delta_L(w), & \text{if } w \in [L, y], \\
A'_H(y) \Delta_H(w), & \text{if } w \in [y, H]. \end{cases}
\]

and

\[
A'_L(y) = \left( \frac{A_H(y) \Delta_H''(y) - A_L(y) \Delta_L''(y) - \Lambda''(y)}{\Delta_H(y) \Delta_L'(y) - \Delta_L(y) \Delta_H'(y)} \right) \Delta_H(y),
\]

\[
A'_H(y) = \left( \frac{A_H(y) \Delta_H''(y) - A_L(y) \Delta_L''(y) - \Lambda''(y)}{\Delta_H(y) \Delta_L'(y) - \Delta_L(y) \Delta_H'(y)} \right) \Delta_L(y).
\]

The last step involves the inversion of the Laplace transform (39) for \(g(w, y, t)\) using standard numerical methods.

3. Jacobian of \(L^{-1}\)

Quasi-market leverage is defined by

\[
y_t \equiv \frac{D(X_0)}{D(X_0) + E(X_t)},
\]

where the book value of debt equals \(D(X_0)\) and the market value of equity at time \(t\) for \(X_t = X\) is given by equation (11). We now have

\[
\frac{\partial y_t}{\partial L^{-1}(y_t)} = -D(X_0) \left[D(X_0) + E(X)\right]^{-2} \frac{\partial E(X)}{\partial X},
\]

with

\[
\frac{\partial E(X)}{\partial X} = \frac{\partial e(X)}{\partial X} + \left[ \frac{X_U}{X_0} V(X_0) - D(X_0) \right] \frac{\partial p_U(X)}{\partial X} + \frac{X_B}{X_0} (\alpha - \kappa) V(X_0) \frac{\partial p_U(X)}{\partial X}.
\]
A.4 Predictions of the Structural Parameters

Leverage is denoted \( y_{it} \), the explanatory variables are \( x_{it} \) and the parameter vector is \( \theta \); subscript \( i \) refers to a firm and \( t \) to a date. Conditional expectations of shareholders’ bargaining power given the data \((y_{it}, x_{it})\) satisfy:

\[
\mathbb{E}[\eta_{it}|y_{it}, x_{it}; \theta] = \mathbb{E}[h(\alpha_{i\eta} + \epsilon_{i\eta})|y_{it}, x_{it}; \theta] \\
= \int_{\epsilon_i^\phi}^{\epsilon_i^\eta} \int_{\epsilon_i^\phi}^{\epsilon_i^\eta} h(\alpha_{i\eta} + \epsilon_{i\eta}) f(\epsilon_{i\phi}, \epsilon_{i\eta}|y_{it}, x_{it}; \theta) d\epsilon_{i\phi} d\epsilon_{i\eta} \\
= \int_{\epsilon_i^\phi}^{\epsilon_i^\eta} \int_{\epsilon_i^\phi}^{\epsilon_i^\eta} h(\alpha_{i\eta} + \epsilon_{i\eta}) \frac{f(\epsilon_{i\phi}, \epsilon_{i\eta}|y_{it}; \theta)}{f(y_{it}|x_{it}; \theta)} d\epsilon_{i\phi} d\epsilon_{i\eta} \\
= \frac{\int_{\epsilon_i^\phi}^{\epsilon_i^\eta} \int_{\epsilon_i^\phi}^{\epsilon_i^\eta} h(\alpha_{i\eta} + \epsilon_{i\eta}) f(y_{it}|\epsilon_{i\phi}, \epsilon_{i\eta}, x_{it}; \theta) f(\epsilon_{i\phi}, \epsilon_{i\eta}|x_{it}; \theta) d\epsilon_{i\phi} d\epsilon_{i\eta}}{\int_{\epsilon_i^\phi}^{\epsilon_i^\eta} \int_{\epsilon_i^\phi}^{\epsilon_i^\eta} f(y_{it}|\epsilon_{i\phi}, \epsilon_{i\eta}, x_{it}; \theta) f(\epsilon_{i\phi}, \epsilon_{i\eta}|x_{it}; \theta) d\epsilon_{i\phi} d\epsilon_{i\eta}},
\]  

(42)

where \( f(y_{it}|\epsilon_{i\phi}, \epsilon_{i\eta}, x_{it}; \theta) \) is given by (21) and \( f(\epsilon_{i\phi}, \epsilon_{i\eta}|x_{it}; \theta) \) is a bivariate normal distribution. The conditional expectation of the manager’s private benefits of control satisfies a similar expression with \( \eta \) replaced by \( \phi \). Given parameter estimates for \( \theta \) obtained in a first stage SML estimation, the expression in (42) can be evaluated using Monte-Carlo integration.

One can show that these conditional expectations are unbiased. Let \( z_{it} \) be omitted explanatory variables. Then

\[
\mathbb{E}[g_{it}|y_{it}, x_{it}, z_{it}; \theta] = \mathbb{E}[g_{it}|y_{it}, x_{it}; \theta] + \epsilon_{it},
\]

where \( g \in \{\phi, \eta\} \) with the following moment condition on the error \( \epsilon_{it} \):

\[
\mathbb{E}(\epsilon_{it}|y_{it}, x_{it}; \theta) = \mathbb{E}(\mathbb{E}(g_{it}|y_{it}, x_{it}, z_{it}; \theta) - \mathbb{E}(g_{it}|y_{it}, x_{it}; \theta)|y_{it}, x_{it}; \theta) \\
= \mathbb{E}(\mathbb{E}(g_{it}|y_{it}, x_{it}, z_{it}; \theta)|y_{it}, x_{it}; \theta) - \mathbb{E}(\mathbb{E}(g_{it}|y_{it}, x_{it}; \theta)|y_{it}, x_{it}; \theta) \\
= 0.
\]

A.5 Data Definitions

1. Managerial pay-performance sensitivity \textit{delta}

We compute the \textit{delta} – the sensitivity of the option value to a change in the stock price – based on the Black-Scholes (1973) formula for European call options, as modified to account for dividend payouts by Merton (1973):

\[
\text{Call} = Se^{-dT}N(Z) - Xe^{-rT}N(Z - \sigma T^{1/2}),
\]

where \( Z = \left[ \ln (S/X) + (r - d + \sigma^2/2) T \right] / (\sigma T^{1/2}) \), \( S \) is the price of the underlying stock, \( X \) the exercise price of the option, \( T \) the time-to-maturity of the option in years, \( r \) the risk-free
interest rate, $d$ the expected dividend yield on the underlying stock, $\sigma$ expected stock return volatility, and $N$ is the standard normal probability distribution function.

We follow the methodology of Core and Guay (1999) to compute $\delta$. There are four type of securities: new option grants, previous unexercisable options, previous exercisable options and portfolio of stocks. In order to avoid double counting of the new option grants, the number and realizable value of previous unexercisable options is reduced by the number and realizable value of new option grants. If the number of new option grants is greater than the number of previous unexercisable options, then the number and realizable value of previous exercisable options is reduced by the difference between the number and realizable value of new option grants and previous exercisable options.

Managerial delta is computed as the sum of $\delta$ of new option grants, $\delta$ of previous unexercisable options, $\delta$ of previous exercisable options and $\delta$ of portfolio of stock where we define:

1. **New option grants:** $S$, $K$, $T$, $d$, and $\sigma$ are available from ExecuComp. The risk-free rate $r$ is obtained from the Federal Reserve, where we use one-year bond yield for $T = 1$, two-year bond for $2 \leq T \leq 3$, five-year bond yield for $4 \leq T \leq 5$, seven year bond yield for $6 \leq T \leq 8$ and ten-year bond yield for $T \geq 9$.

2. **Previous unexercisable options:** $S$, $d$, $\sigma$ and $r$ are obtained as explained above. The strike price $K$ is estimated as: [$\text{stock price} - (\text{realizable value/number of options})$]. Time-to-maturity, $T$, is estimated as one year less than time-to-maturity of new option grants or nine years if no new grants are made.

3. **Previous exercisable options:** $S$, $d$, $\sigma$ and $r$ are obtained as explained above. The strike price $K$ is estimated as: $K = [\text{stock price} - (\text{realizable value/number of options})]$. Time-to-maturity, $T$, is estimated as three years less than the time-to-maturity of unexercisable options or six years if no new grants are made.

4. **Portfolio of stocks:** $\delta$ is estimated by the product of the number of stocks owned and one percent of stock value.

2. **Managerial incentive alignment $\varphi$**

Managerial incentives are defined as the change in managerial wealth per dollar change in the wealth of shareholders. Incentives are thus composed of a direct component, managerial ownership and an indirect component, the pay-performance sensitivity generated by options awards. Following Jensen and Murphy (1990), we define managerial incentives, $\varphi$, as:

$$\varphi = \varphi^E + \delta \frac{\text{shares represented by options awards}}{\text{shares outstanding}},$$

where $\varphi^E$ represents managerial ownership and $\delta$ is computed as above.
Appendix B: Simulated Evidence

The objective of this Appendix is to analyze the cross-sectional properties of leverage ratios in our dynamic economy with agency conflicts. We follow the simulation approach of Berk, Green and Naik (1999) and Strebulaev (2007) among others. Specifically, we simulate a number of dynamic economies and replicate the empirical analysis conducted by cross-sectional capital structure studies. One important innovation in this section is that we base our simulation on the parameter estimates of section IV instead of using “calibrated” parameter values as in previous studies.\footnote{In fact Strebulaev (2007, pp. 1763) notes “An important caveat is that for most parameters of interest, there is little evidence permitting precise estimation of sampling distributions or even their ranges [...] Overall then, the parameters used in the simulations must be regarded as ad hoc and approximate.”}

The simulation procedure is defined as follows. The initial input parameter values are based on the structural estimation of section IV. The cost of control challenges, $\phi$, and bargaining power of shareholders, $\eta$, are determined by a single draw of the unobserved heterogeneity random effect. At date zero all firms are at their target leverage. We then simulate 75 years of quarterly data. The first 40 years of data are dropped in order to minimize the impact of initial conditions. The resulting dataset represents a single simulated economy. We run the tests analyzing the cross-sectional properties of leverage ratios on this simulated economy. Finally, we simulate 1,000 economies, each characterized by a different draw of the unobserved heterogeneity random effect. The results that we report are means over those 1,000 economies. We now turn to the comparison of the results of regressions on simulated data to the results of empirical cross-sectional research.

B.1 Leverage Inertia

We start by investigating the link between capital structure and stock returns. Welch (2004) documents that firms do not rebalance their capital structure in order to offset the mechanistic effect of stock price movements on firms’ leverage ratios. He shows that for short horizons the dynamics of leverage ratios are solely determined by stock returns. While this effect attenuates with time, it still remains the main driving force behind leverage ratio changes.

We investigate to what extent this mechanistic effect is reflected in our model. To do so, we replicate Welch’s analysis on the simulated data. We run a Fama-MacBeth regression of leverage on past leverage and the implied debt ratio (IDR). The IDR indicates how much leverage should be if no corporate issuance takes place, or how much leverage should change only due to changes in equity. More formally, we estimate the following model:

$$L_t = \alpha_0 + \alpha_1 L_{t-k} + \alpha_2 IDR_{t-k,t} + \epsilon_t$$

where $L$ is the Leverage ratio and $k$ denotes the time horizon in years. In this equation, $IDR$ is the implied debt ratio that comes about if the firm does not issue debt or equity (and let
leverage ratios change with stock price movements). If $\alpha_1$ is equal to 1, firms perfectly offset stock price movements by issuing debt or equity. If $\alpha_2$ is equal to 1, firms do not readjust their capital structure at all following stock price movements.

Our results are reported in Panel A of Table 8. We observe that the estimates based on the simulated data from our model closely match Welch’s estimates based on real data. For 1 year time horizon, the ADR coefficient is close to 1. For longer time-horizons, this coefficient is monotonically decreasing.

### B.2 Mean Reversion in Leverage

Mean-reversion is another well documented pattern of leverage ratios [see Fama and French (2002) and Flannery and Rangan (2006)]. Following Fama and French (2002), we perform a Fama-MacBeth estimation of the partial-adjustment model:

$$L_t - L_{t-1} = \alpha + \lambda_1 TL_{t-1} + \lambda_2 L_{t-1} + \epsilon_t$$

where $L$ is Leverage and $TL$ is firm’s Target Leverage. If $\lambda_1$ is equal to 1, firms perfectly readjust leverage to the target. If $\lambda_2$ is equal to -1, firms are completely inactive. The partial-adjustment model predicts that $\lambda_1$ and $\lambda_2$ are equal in absolute value and measures the speed of adjustment by $\lambda_1$. In this specification, $TL$ is determined in a preliminary step by estimating the following equation

$$L^m = a_0 + a_1 \pi^m + a_2 \sigma + a_3 \alpha + a_4 \eta + a_5 \varphi + a_6 \phi + \epsilon$$  \hspace{1cm} (43)

where $L$ is the leverage ratio, $\pi$ is profitability and remaining independent variables are firm specific characteristics. In our setup, profitability is defined as: $\pi_t = [X_t + \Delta A_t] / A_{t-1}$, where $X$ is cash flows from operation and $A$ is the book value of assets. Following Strebulaev (2007), we assume that the book value of assets and cash flows from operation have the same drift under the physical measure.

Our results are reported in Panel B of Table 8. We observe that leverage is mean-reverting at the speed of 10% per year, which roughly corresponds to the average mean-reversion coefficient reported by Fama-French (2002) (7% for dividend payers and 15% for non-dividend payers). As in Fama and French, the average slopes on lagged leverage are similar in absolute value to those on target leverage and are therefore consistent with the partial adjustment model.
References


Table 1: Comparative statics for the dynamic model.

Table 1 reports the main comparative statics of the dynamic model regarding the firm’s financing and default policies, the recovery rate in default, corporate spreads and the tax benefit of debt (TAD). The TAD is defined as the percentage increase in firm value due to the tax savings associated with debt financing. Input parameter values are set as in the base case environment.

<table>
<thead>
<tr>
<th>Quasi-Market Leverage at</th>
<th>Target</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Restructuring</td>
<td>Target</td>
<td>Default</td>
<td>Spread</td>
<td>Recovery</td>
<td>TAD</td>
<td></td>
</tr>
<tr>
<td>------------------------</td>
<td>--------</td>
<td>-----------------</td>
<td>--------</td>
<td>----------</td>
<td>--------</td>
<td></td>
</tr>
<tr>
<td>Benchmark</td>
<td>12.85</td>
<td>27.80</td>
<td>87.53</td>
<td>125.23</td>
<td>42.22</td>
<td>8.77</td>
</tr>
<tr>
<td>$\lambda = 0.0025$</td>
<td>14.96</td>
<td>27.20</td>
<td>87.42</td>
<td>130.55</td>
<td>42.39</td>
<td>9.40</td>
</tr>
<tr>
<td>$\lambda = 0.0075$</td>
<td>11.33</td>
<td>27.95</td>
<td>87.63</td>
<td>120.45</td>
<td>42.04</td>
<td>8.23</td>
</tr>
<tr>
<td>$\phi = 0.005$</td>
<td>20.54</td>
<td>37.11</td>
<td>86.23</td>
<td>208.19</td>
<td>46.06</td>
<td>11.69</td>
</tr>
<tr>
<td>$\phi = 0.015$</td>
<td>2.74</td>
<td>10.13</td>
<td>89.41</td>
<td>35.11</td>
<td>37.51</td>
<td>1.74</td>
</tr>
<tr>
<td>$\varphi = 0.05$</td>
<td>4.18</td>
<td>13.33</td>
<td>89.08</td>
<td>47.89</td>
<td>38.24</td>
<td>3.35</td>
</tr>
<tr>
<td>$\varphi = 0.10$</td>
<td>18.16</td>
<td>34.49</td>
<td>86.65</td>
<td>180.32</td>
<td>44.78</td>
<td>10.92</td>
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<tr>
<td>$\eta = 0.25$</td>
<td>15.06</td>
<td>32.45</td>
<td>94.09</td>
<td>129.45</td>
<td>42.30</td>
<td>10.49</td>
</tr>
<tr>
<td>$\eta = 0.75$</td>
<td>10.65</td>
<td>23.16</td>
<td>80.17</td>
<td>120.41</td>
<td>41.94</td>
<td>7.07</td>
</tr>
<tr>
<td>$\alpha = 0.45$</td>
<td>13.34</td>
<td>28.83</td>
<td>89.05</td>
<td>126.22</td>
<td>42.25</td>
<td>9.16</td>
</tr>
<tr>
<td>$\alpha = 0.55$</td>
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<td>26.77</td>
<td>85.97</td>
<td>124.22</td>
<td>42.17</td>
<td>8.39</td>
</tr>
<tr>
<td>$\kappa = 0.00$</td>
<td>15.02</td>
<td>31.81</td>
<td>85.39</td>
<td>151.33</td>
<td>46.44</td>
<td>10.53</td>
</tr>
<tr>
<td>$\kappa = 0.10$</td>
<td>11.41</td>
<td>25.01</td>
<td>89.36</td>
<td>109.13</td>
<td>38.72</td>
<td>7.62</td>
</tr>
<tr>
<td>$\tau_c = 0.30$</td>
<td>1.02</td>
<td>5.75</td>
<td>89.15</td>
<td>19.74</td>
<td>39.16</td>
<td>0.13</td>
</tr>
<tr>
<td>$\tau_c = 0.40$</td>
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<td>36.21</td>
<td>86.69</td>
<td>207.66</td>
<td>42.13</td>
<td>17.43</td>
</tr>
<tr>
<td>$\mu = 0.005$</td>
<td>12.73</td>
<td>27.55</td>
<td>87.80</td>
<td>134.14</td>
<td>41.58</td>
<td>7.64</td>
</tr>
<tr>
<td>$\mu = 0.015$</td>
<td>12.99</td>
<td>28.07</td>
<td>87.24</td>
<td>117.30</td>
<td>42.71</td>
<td>10.37</td>
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<tr>
<td>$\sigma = 0.20$</td>
<td>16.12</td>
<td>32.03</td>
<td>86.19</td>
<td>80.85</td>
<td>47.26</td>
<td>9.22</td>
</tr>
<tr>
<td>$\sigma = 0.30$</td>
<td>10.61</td>
<td>24.66</td>
<td>88.58</td>
<td>179.14</td>
<td>38.24</td>
<td>8.62</td>
</tr>
</tbody>
</table>
Table 2: Data Definitions.

Table 2 presents definitions and source of data used.

<table>
<thead>
<tr>
<th>Variable (Data Source)</th>
<th>Variable Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Financial Indicators (Compustat):</strong></td>
<td></td>
</tr>
<tr>
<td>Book debt</td>
<td>Liabilities total (item 181) + Preferred stock (item 10) - Deferred taxes (item 35)</td>
</tr>
<tr>
<td>Book debt II</td>
<td>Long term debt (item 9) + Debt in current liabilities (item 34)</td>
</tr>
<tr>
<td>Book equity</td>
<td>Assets total (item 6) - Book debt</td>
</tr>
<tr>
<td>Book equity II</td>
<td>Assets total (item 9) - Book debt II</td>
</tr>
<tr>
<td>Leverage</td>
<td>Book Debt/(Assets total (item 6) - Book equity + Market value (item 25 * item 6))</td>
</tr>
<tr>
<td>Leverage II</td>
<td>Book Debt II/(Assets total (item 6) - Book equity II + Market value (item 25 * item 6))</td>
</tr>
<tr>
<td>Return on assets</td>
<td>(EBIT (item 18) + Depreciation (item 14))/Assetstotal (item 6)</td>
</tr>
<tr>
<td>Market-to-Book</td>
<td>(Market value (item 25 * item 6) + Book debt)/Assetstotal (item 6)</td>
</tr>
<tr>
<td>Tangibility</td>
<td>Property, plant and equipment total net (item 8)/Assetstotal (item 6)</td>
</tr>
<tr>
<td>Size</td>
<td>log(Sales net (item 12))</td>
</tr>
<tr>
<td>R&amp;D</td>
<td>Research and development expenses (item 46)/Assetstotal (item 6)</td>
</tr>
<tr>
<td><strong>Earnings Growth (I/B/E/S):</strong></td>
<td></td>
</tr>
<tr>
<td>EBIT growth rate</td>
<td>Mean analysts forecast for long-term growth rate per SIC-2 industry</td>
</tr>
<tr>
<td><strong>Volatility and Beta (CRSP):</strong></td>
<td></td>
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<tr>
<td>Equity volatility</td>
<td>Standard deviation of monthly equity returns overpast 5 years</td>
</tr>
<tr>
<td>Market model beta</td>
<td>Market model regression beta on monthly equity returns over past 5 years</td>
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<tr>
<td><strong>Executive Compensation (ExecuComp):</strong></td>
<td></td>
</tr>
<tr>
<td>Managerial incentives</td>
<td>see Appendix C</td>
</tr>
<tr>
<td>Managerial ownership</td>
<td>Shares owned/Shares outstanding for the 5 highest paid executives</td>
</tr>
<tr>
<td>Managerial delta</td>
<td>see Appendix C</td>
</tr>
<tr>
<td>CEO tenure</td>
<td>Current year - year became CEO</td>
</tr>
<tr>
<td>EBIT growth rate II</td>
<td>5-year least squares annual growth rate of operating income before depreciation</td>
</tr>
<tr>
<td><strong>Blockholders (IRRC blockholders):</strong></td>
<td></td>
</tr>
<tr>
<td>Blockholder ownership</td>
<td>Fraction of stock owned by outside blockholders</td>
</tr>
<tr>
<td><strong>Directors (IRRC directors):</strong></td>
<td></td>
</tr>
<tr>
<td>Board independence</td>
<td>Number of independent directors/Total number of directors</td>
</tr>
<tr>
<td>Board committees</td>
<td>Sum of 4 dummy variables for existence of independent (more that 50% of committee directors are Independent) audit, compensation, nominating and corporate governance committee</td>
</tr>
<tr>
<td><strong>Anti-Takeover Provisions (IRRC governance):</strong></td>
<td></td>
</tr>
<tr>
<td>Eindex</td>
<td>6 anti-takeover provisions index by Bebchuk, Cohen, and Farell (2004)</td>
</tr>
<tr>
<td><strong>Institutional Ownership (Thompson Financial):</strong></td>
<td></td>
</tr>
<tr>
<td>Institutional ownership</td>
<td>Fraction of stock owned by institutional investors</td>
</tr>
<tr>
<td><strong>Economy indicators (FED):</strong></td>
<td></td>
</tr>
<tr>
<td>Term Premium</td>
<td>Difference between 10 year and 1 year Government bond yield</td>
</tr>
<tr>
<td>Default Premium</td>
<td>Difference between corporate yield spread (all industries) of Moody’s BAA and AAA rating</td>
</tr>
</tbody>
</table>
Table 3 presents descriptive statistics for the main variables used in the estimation. The sample is based on Compustat quarterly Industrial files, ExecuComp, CRSP, I/B/E/S, IRRC governance, IRRC blockholders, IRRC directors, and Thompson Financial. Table 2 provides a detailed definition of the variables.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean</th>
<th>S.D.</th>
<th>25%</th>
<th>50%</th>
<th>75%</th>
<th>Obs</th>
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</thead>
<tbody>
<tr>
<td>Leverage (y)</td>
<td>0.32</td>
<td>0.20</td>
<td>0.16</td>
<td>0.29</td>
<td>0.46</td>
<td>13,159</td>
</tr>
<tr>
<td>Leverage II (y)</td>
<td>0.20</td>
<td>0.19</td>
<td>0.04</td>
<td>0.16</td>
<td>0.31</td>
<td>13,159</td>
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<tr>
<td>EBIT Growth Rate ((\bar{m}))</td>
<td>0.20</td>
<td>0.06</td>
<td>0.15</td>
<td>0.19</td>
<td>0.23</td>
<td>13,159</td>
</tr>
<tr>
<td>EBIT Volatility ((\bar{\sigma}))</td>
<td>0.29</td>
<td>0.13</td>
<td>0.19</td>
<td>0.26</td>
<td>0.35</td>
<td>13,159</td>
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<tr>
<td>CAPM Beta ((\bar{\beta}))</td>
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<td>0.51</td>
<td>0.70</td>
<td>1.01</td>
<td>1.34</td>
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<tr>
<td>Liquidation Costs ((\bar{\alpha}))</td>
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<td>0.12</td>
<td>0.45</td>
<td>0.50</td>
<td>0.58</td>
<td>13,159</td>
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<td><strong>Financial Characteristics:</strong></td>
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<tr>
<td>Return on Assets</td>
<td>4.47</td>
<td>2.41</td>
<td>2.93</td>
<td>4.19</td>
<td>5.69</td>
<td>13,159</td>
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<tr>
<td>Market-to-Book</td>
<td>2.05</td>
<td>1.27</td>
<td>1.23</td>
<td>1.64</td>
<td>2.39</td>
<td>13,159</td>
</tr>
<tr>
<td>Tangibility</td>
<td>0.34</td>
<td>0.22</td>
<td>0.16</td>
<td>0.28</td>
<td>0.47</td>
<td>13,159</td>
</tr>
<tr>
<td>Firm Size</td>
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<td>4.74</td>
<td>5.50</td>
<td>6.35</td>
<td>13,159</td>
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<tr>
<td>R&amp;D</td>
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<td>0.80</td>
<td>0.00</td>
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<td>0.00</td>
<td>13,159</td>
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<tr>
<td><strong>Ownership Structure:</strong></td>
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<td></td>
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<tr>
<td>Institutional Ownership</td>
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<td>0.62</td>
<td>0.73</td>
<td>11,727</td>
</tr>
<tr>
<td>Blockholder Ownership</td>
<td>0.09</td>
<td>0.13</td>
<td>0.00</td>
<td>0.00</td>
<td>0.16</td>
<td>13,159</td>
</tr>
<tr>
<td><strong>Managerial Characteristics:</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Managerial Incentives ((\phi))</td>
<td>0.07</td>
<td>0.09</td>
<td>0.02</td>
<td>0.04</td>
<td>0.08</td>
<td>13,159</td>
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<tr>
<td>Managerial Ownership ((\phi_E))</td>
<td>0.05</td>
<td>0.08</td>
<td>0.00</td>
<td>0.01</td>
<td>0.05</td>
<td>13,159</td>
</tr>
<tr>
<td>Managerial Delta</td>
<td>7.13</td>
<td>13.00</td>
<td>1.11</td>
<td>2.88</td>
<td>7.20</td>
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<td>CEO Tenure</td>
<td>8.67</td>
<td>8.78</td>
<td>2.42</td>
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<td>11.90</td>
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<td><strong>Anti-Takeover Provisions:</strong></td>
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</tr>
<tr>
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</tr>
<tr>
<td>Board Independence</td>
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<td>3.00</td>
<td>6,504</td>
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<td><strong>Economy indicators:</strong></td>
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<td></td>
</tr>
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<td>Term Premium</td>
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<td>0.01</td>
<td>0.00</td>
<td>0.01</td>
<td>0.02</td>
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<td>Default Premium</td>
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<td>0.00</td>
<td>0.01</td>
<td>0.01</td>
<td>0.01</td>
<td>13,159</td>
</tr>
</tbody>
</table>
Table 4: **Firm-Specific Predictions of Refinancing Cost in a Dynamic Capital Structure Model Without Managerial Entrenchment.**

Table 4 presents estimation results of the cost of refinancing in a dynamic capital structure model without agency conflicts ($\phi_{it} = 0$ and $\eta_{it} = 0$). The structural parameters characterizing the cost of refinancing, $\lambda$, are defined as:

$$\lambda_{it} = h(\alpha_{\lambda} + \epsilon_{\lambda})$$

where $h = \Phi \in [0, 1]$ is the standard normal cumulative distribution function and $\epsilon \sim \mathcal{N}(0, \sigma_{\lambda}^2)$. Panel A reports the parameter estimates. White t-statistics are reported in parenthesis. Panel B reports distributional characteristics of the predicted, model-implied cost of refinancing, $\hat{\lambda}_{it} = \hat{E}(\lambda_{it}|y_{it}, x_{it}; \theta)$.

**Panel A: Parameter estimates**

<table>
<thead>
<tr>
<th>Coef.</th>
<th>t-Stat</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\alpha_{\lambda}$</td>
<td>-2.06 (-20.42)</td>
</tr>
<tr>
<td>$\sigma_{\lambda}$</td>
<td>0.28 (8.93)</td>
</tr>
</tbody>
</table>

Log-likelihood: -33,081
Observations: 13,159

**Panel B: Firm-specific refinancing cost**

<table>
<thead>
<tr>
<th>Mean</th>
<th>S.D.</th>
<th>Skewness</th>
<th>Kurtosis</th>
<th>5%</th>
<th>25%</th>
<th>50%</th>
<th>75%</th>
<th>95%</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\hat{\lambda}$</td>
<td>0.142</td>
<td>0.107</td>
<td>1.137</td>
<td>4.64</td>
<td>0.01</td>
<td>0.056</td>
<td>0.124</td>
<td>0.203</td>
</tr>
</tbody>
</table>
Table 5: Structural Estimates: Model Parameters.

The structural parameters characterizing the cost of collective action, \( \phi \), and the bargaining power of shareholders, \( \eta \), are defined as:

\[
\begin{align*}
\phi_{it} &= h(\alpha_{\phi} + \epsilon_{\phi}^i), \\
\eta_{it} &= h(\alpha_{\eta} + \epsilon_{\eta}^i),
\end{align*}
\]

where \( h = \Phi \in [0, 1] \) is the standard normal cumulative distribution function and \( \epsilon \) is a bivariate normal random variable capturing firm-specific unobserved heterogeneity,

\[
\begin{pmatrix}
\epsilon_{\phi}^i \\
\epsilon_{\eta}^i
\end{pmatrix}
\sim N(0, \begin{bmatrix}
\sigma_{\phi}^2 & \sigma_{\phi\eta} \\
\sigma_{\phi\eta} & \sigma_{\eta}^2
\end{bmatrix}).
\]

Across firms \( i \), \( (\epsilon_{\phi}^i, \epsilon_{\eta}^i) \) are assumed independent. Panel A reports the parameter estimates. White t-statistics are reported in parenthesis. Panel B reports distributional characteristics of the predicted, model-implied cost of collective action, \( \hat{\phi}_{it} = \hat{E}(\phi_{it}|y_{it}, x_{it}; \theta) \), and the predicted bargaining power of shareholders, \( \hat{\eta}_{it} = \hat{E}(\eta_{it}|y_{it}, x_{it}; \theta) \). The cost of collective action expressed as a fraction of equity value, \( \hat{E}(\phi_{it}F^*_it/E_{it}|y_{it}, x_{it}; \theta) \), are reported in brackets.

**Panel A: Parameter estimates**

<table>
<thead>
<tr>
<th>Coef.</th>
<th>t-Stat</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \alpha_{\phi} )</td>
<td>-2.76 (-56.00)</td>
</tr>
<tr>
<td>( \alpha_{\eta} )</td>
<td>-0.21 (-18.65)</td>
</tr>
<tr>
<td>( \sigma_{\phi} )</td>
<td>0.90 (178.57)</td>
</tr>
<tr>
<td>( \sigma_{\eta} )</td>
<td>1.23 (60.09)</td>
</tr>
<tr>
<td>( \sigma_{\phi\eta} )</td>
<td>-0.16 (-8.85)</td>
</tr>
<tr>
<td>Log-likelihood</td>
<td>-39,803</td>
</tr>
<tr>
<td>Observations</td>
<td>13,159</td>
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</tbody>
</table>

**Panel B: Firm-specific cost of collective action & bargaining power of shareholders**

<table>
<thead>
<tr>
<th>Mean</th>
<th>S.D.</th>
<th>Skewness</th>
<th>Kurtosis</th>
<th>5%</th>
<th>25%</th>
<th>50%</th>
<th>75%</th>
<th>95%</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \hat{\phi} )</td>
<td>0.019</td>
<td>0.026</td>
<td>2.591</td>
<td>10.728</td>
<td>0.000</td>
<td>0.002</td>
<td>0.010</td>
<td>0.024</td>
</tr>
<tr>
<td></td>
<td>[0.020]</td>
<td>[0.029]</td>
<td>[3.034]</td>
<td>[14.959]</td>
<td>[0.000]</td>
<td>[0.002]</td>
<td>[0.009]</td>
<td>[0.026]</td>
</tr>
<tr>
<td>( \hat{\eta} )</td>
<td>0.457</td>
<td>0.159</td>
<td>0.035</td>
<td>3.552</td>
<td>0.163</td>
<td>0.379</td>
<td>0.462</td>
<td>0.538</td>
</tr>
</tbody>
</table>
Table 6: Robustness: Alternative Leverage Measure & Renegotiation Costs.

This table reports parameter estimates for the model in Table 5 under alternative specifications. Panel A reports the parameter estimates. White t-statistics are reported in parenthesis. Panel B reports distributional characteristics of the predicted, model-implied cost of collective action, \( \hat{\phi}_{it} = \hat{E}(\phi_{it}|y_{it}, x_{it}; \theta) \), and the predicted bargaining power of shareholders, \( \hat{\eta}_{it} = \hat{E}(\eta_{it}|y_{it}, x_{it}; \theta) \). The cost of collective action expressed as a fraction of equity value, \( \hat{E}(\phi_{it} F^*_it/E_{it}|y_{it}, x_{it}; \theta) \), are reported in brackets.

### Panel A: Parameter estimates

<table>
<thead>
<tr>
<th></th>
<th>( \lambda = 0.75% )</th>
<th>( \varphi = \varphi^E )</th>
<th>( \kappa = 15% )</th>
<th>( y = \text{Leverage II} )</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Coef. t-Stat</td>
<td>Coef. t-Stat</td>
<td>Coef. t-Stat</td>
<td>Coef. t-Stat</td>
</tr>
<tr>
<td>( \alpha_\phi )</td>
<td>-2.71 (-48.49)</td>
<td>-2.82 (-48.80)</td>
<td>-3.73 (-58.94)</td>
<td>-2.49 (-91.85)</td>
</tr>
<tr>
<td>( \alpha_\eta )</td>
<td>-0.41 (-17.12)</td>
<td>-0.59 (-12.62)</td>
<td>-0.28 (-9.13)</td>
<td>-0.47 (-16.59)</td>
</tr>
<tr>
<td>( \sigma_\phi )</td>
<td>1.20 (104.34)</td>
<td>1.39 (55.24)</td>
<td>1.82 (41.36)</td>
<td>1.36 (88.80)</td>
</tr>
<tr>
<td>( \sigma_\eta )</td>
<td>0.97 (172.51)</td>
<td>1.43 (27.37)</td>
<td>3.08 (18.85)</td>
<td>0.81 (46.82)</td>
</tr>
<tr>
<td>( \sigma_{\phi \eta} )</td>
<td>-0.04 (-6.35)</td>
<td>-0.69 (-10.35)</td>
<td>-2.86 (-12.41)</td>
<td>-0.42 (-13.82)</td>
</tr>
<tr>
<td>Log-likelihood</td>
<td>-40,620</td>
<td>-41,297</td>
<td>-39,884</td>
<td>-104,034</td>
</tr>
<tr>
<td>Observations</td>
<td>13,159</td>
<td>13,159</td>
<td>13,159</td>
<td>13,159</td>
</tr>
</tbody>
</table>

### Panel B: Firm-specific cost of collective action & bargaining power of shareholders

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>S.D.</th>
<th>Skewness</th>
<th>Kurtosis</th>
<th>5%</th>
<th>25%</th>
<th>50%</th>
<th>75%</th>
<th>95%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Restructuring cost ( \lambda = 0.75% )</td>
<td>( \hat{\phi} )</td>
<td>0.032</td>
<td>0.042</td>
<td>2.053</td>
<td>7.764</td>
<td>0.000</td>
<td>0.002</td>
<td>0.015</td>
<td>0.047</td>
</tr>
<tr>
<td></td>
<td>( \hat{\eta} )</td>
<td>0.402</td>
<td>0.139</td>
<td>0.510</td>
<td>4.146</td>
<td>0.171</td>
<td>0.330</td>
<td>0.395</td>
<td>0.461</td>
</tr>
<tr>
<td></td>
<td>( \hat{\phi} )</td>
<td>[0.034]</td>
<td>[0.046]</td>
<td>[2.110]</td>
<td>[8.306]</td>
<td>[0.000]</td>
<td>[0.002]</td>
<td>[0.013]</td>
<td>[0.051]</td>
</tr>
<tr>
<td></td>
<td>( \hat{\eta} )</td>
<td>[0.390]</td>
<td>[0.107]</td>
<td>[0.466]</td>
<td>[3.439]</td>
<td>[0.110]</td>
<td>[0.285]</td>
<td>[0.381]</td>
<td>[0.478]</td>
</tr>
<tr>
<td>Alternative ownership measure ( \varphi^E )</td>
<td>( \hat{\phi} )</td>
<td>0.036</td>
<td>0.048</td>
<td>2.119</td>
<td>8.316</td>
<td>0.000</td>
<td>0.001</td>
<td>0.015</td>
<td>0.053</td>
</tr>
<tr>
<td></td>
<td>( \hat{\eta} )</td>
<td>0.390</td>
<td>0.170</td>
<td>0.466</td>
<td>3.439</td>
<td>0.110</td>
<td>0.285</td>
<td>0.381</td>
<td>0.478</td>
</tr>
<tr>
<td></td>
<td>( \hat{\phi} )</td>
<td>[0.038]</td>
<td>[0.053]</td>
<td>[2.202]</td>
<td>[9.017]</td>
<td>[0.000]</td>
<td>[0.001]</td>
<td>[0.015]</td>
<td>[0.058]</td>
</tr>
<tr>
<td></td>
<td>( \hat{\eta} )</td>
<td>[0.390]</td>
<td>[0.170]</td>
<td>[0.466]</td>
<td>[3.439]</td>
<td>[0.110]</td>
<td>[0.285]</td>
<td>[0.381]</td>
<td>[0.478]</td>
</tr>
<tr>
<td>Renegotiation cost ( \kappa = 15% )</td>
<td>( \hat{\phi} )</td>
<td>0.037</td>
<td>0.061</td>
<td>2.566</td>
<td>9.854</td>
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<td>0.001</td>
<td>0.009</td>
<td>0.044</td>
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<tr>
<td></td>
<td>( \hat{\eta} )</td>
<td>0.440</td>
<td>0.233</td>
<td>0.062</td>
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<td>0.048</td>
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<td>0.460</td>
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<tr>
<td>Alternative measure of leverage II</td>
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<td>9.086</td>
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<td>0.004</td>
<td>0.033</td>
<td>0.087</td>
</tr>
<tr>
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<td>( \hat{\eta} )</td>
<td>0.372</td>
<td>0.133</td>
<td>0.575</td>
<td>3.986</td>
<td>0.155</td>
<td>0.296</td>
<td>0.362</td>
<td>0.433</td>
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</table>
Table 7: The Determinants of Managerial Entrenchment.

Table 7 summarizes parameter estimates from a regression on various determinants of cost of collective action. The dependent variable are the predicted values of managerial entrenchment, \( \hat{E}(\phi_{it}|y_{it},x_{it};\theta) \), expressed in basis points. In columns (1)-(3) we report estimation results from Fama-MacBeth regressions. Fama-MacBeth standard errors are reported in parenthesis. The base specification (1) utilizes the entire sample. Missing values are imputed with zero and dummy variables that take a value of one for missing values are included in the regression. Specifications (2) and (3) use only observations with no missing data items. In specification (3) we drop the variables with the most missing values from the regression. As robustness test, specification (4) is setup (1) with estimates obtained from pooled OLS with White standard errors, adjusted for firm clustering, in parenthesis.

<table>
<thead>
<tr>
<th></th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
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</thead>
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<td><strong>Institutional Ownership</strong></td>
<td>-123.35***</td>
<td>64.28</td>
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<td>-139.84***</td>
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<tr>
<td></td>
<td>(37.08)</td>
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<td>(51.63)</td>
</tr>
<tr>
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<td>3.49***</td>
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<tr>
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<td>(0.34)</td>
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<td></td>
<td>(0.81)</td>
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<tr>
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<td>-301.55***</td>
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<td>(84.92)</td>
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<tr>
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<td>(20.57)</td>
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<td>-3.50</td>
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<tr>
<td></td>
<td>(2.50)</td>
<td>(4.68)</td>
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<td>(7.25)</td>
</tr>
<tr>
<td><strong>Eindex - Dictatorship</strong></td>
<td>316.56***</td>
<td>625.99***</td>
<td>515.14***</td>
<td>300.35***</td>
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<tr>
<td></td>
<td>(63.51)</td>
<td>(165.60)</td>
<td>(98.58)</td>
<td>(87.46)</td>
</tr>
<tr>
<td><strong>Tenure</strong></td>
<td>3.62***</td>
<td>3.83***</td>
<td>4.58***</td>
<td>3.28***</td>
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<td></td>
<td>(0.41)</td>
<td>(0.76)</td>
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<td>(0.89)</td>
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<td><strong>Managerial Delta (Quartile 1)</strong></td>
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<td>(18.86)</td>
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<td>(25.73)</td>
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<td>2.64***</td>
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<td>(1.02)</td>
<td>(0.59)</td>
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<td>(0.82)</td>
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<td><strong>Return on Assets</strong></td>
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<td>(4.73)</td>
<td>(3.72)</td>
<td>(3.03)</td>
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<tr>
<td><strong>M/B</strong></td>
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<td>68.68***</td>
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<td>(8.70)</td>
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<tr>
<td><strong>R&amp;D</strong></td>
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<td></td>
<td>(4.37)</td>
<td>(7.07)</td>
<td>(3.01)</td>
<td>(10.00)</td>
</tr>
<tr>
<td><strong>Term Premium</strong></td>
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<td></td>
<td></td>
<td>2.41</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(6.12)</td>
</tr>
<tr>
<td><strong>Default Premium</strong></td>
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<td></td>
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<td>66.42**</td>
</tr>
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<td>(29.99)</td>
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<tr>
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<td>8,035</td>
<td>13,159</td>
</tr>
<tr>
<td><strong>R²</strong></td>
<td>0.42</td>
<td>0.44</td>
<td>0.50</td>
<td>0.23</td>
</tr>
</tbody>
</table>
Table 8: Leverage Inertia & Mean-Reversion.

Panel A reports parameter estimates from Fama-MacBeth regressions on leverage in levels. The basic specification is as follows:

\[ L_t = \alpha_0 + \alpha_1 L_{t-k} + \alpha_2 IDR_{t-k,t} + \epsilon_t, \]

where \( L \) is the Leverage ratio, \( IDR \) is the Implied Debt Ratio and \( k \) is the time horizon. Coefficients reported are means over 1,000 simulated datasets. Below our estimated coefficients we report the coefficients on IDR in Welch (2004) and Strebulaev (2007). Panel B reports parameter estimates from Fama-MacBeth regressions on leverage changes. The basic specification is as follows:

\[ L_t - L_{t-1} = \alpha + \lambda_1 TL_{t-1} + \lambda_2 L_{t-1} + \epsilon_t, \]

where \( L \) is the Leverage ratio and \( TR \) is the Target Leverage Ratio. In the first specification, \( TL \) is determined in a prior stage by running a cross-sectional regression of leverage on various determinants. In the second specification, \( TL \) is set to the model implied target leverage ratio. Coefficients are means over 1,000 simulated datasets.

Panel A: Leverage inertia

<table>
<thead>
<tr>
<th>Lag k in years</th>
<th>1</th>
<th>3</th>
<th>5</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td>IDR_{t-k,t}</td>
<td>1.02</td>
<td>0.89</td>
<td>0.79</td>
<td>0.61</td>
</tr>
<tr>
<td>L_{t-k}</td>
<td>-0.05</td>
<td>0.04</td>
<td>0.12</td>
<td>0.26</td>
</tr>
<tr>
<td>Constant</td>
<td>0.01</td>
<td>0.03</td>
<td>0.04</td>
<td>0.06</td>
</tr>
<tr>
<td>( R^2 )</td>
<td>0.96</td>
<td>0.90</td>
<td>0.85</td>
<td>0.76</td>
</tr>
</tbody>
</table>

IDR_{t-k,t} coefficients in the literature

| Welch (empirical values) | 1.01 | 0.94 | 0.87 | 0.71 |
| Strebulaev (calibrated values) | 1.03 | 0.89 | 0.79 | 0.59 |

Panel B: Leverage mean-reversion

<table>
<thead>
<tr>
<th>Two-stage TL</th>
<th>Model-implied TL</th>
</tr>
</thead>
<tbody>
<tr>
<td>( TL_{t-1} )</td>
<td>0.10</td>
</tr>
<tr>
<td>( L_{t-1} )</td>
<td>-0.10</td>
</tr>
<tr>
<td>Constant</td>
<td>0.00</td>
</tr>
<tr>
<td>( R^2 )</td>
<td>0.05</td>
</tr>
</tbody>
</table>
Figure 1: Comparative Statics: Firm-Specific Leverage Distribution.

Figure 1 shows comparative statics for the time-series distribution of financial leverage. We vary the cost of collective action \( \phi \), shareholders' bargaining power \( \eta \), and the refinancing cost \( \lambda \) from the base case \((\phi, \eta, \lambda) = (0.05, 0.25, 0.05)\).
Figure 2: **Empirical Leverage Distribution.**

Figure 2 plots the empirical distribution of financial leverage. The solid line uses the standard definition of financial leverage. The dashed line corresponds to the alternative definition of leverage. Table 2 provides a detailed definition of the variables. The data are quarterly observations on industrial firms from Compustat between 1992 and 2004.
Figure 3: **Firm-Specific Predictions of Shareholders’ Cost of Collective Action and Bargaining Power.**

Figure 3 shows histograms of the predicted cost of collective action, $\hat{E}(\phi_{it}|y_{it}, x_{it}; \theta)$, and the predicted shareholders’ bargaining power, $\hat{E}(\eta_{it}|y_{it}, x_{it}; \theta)$, in the dynamic capital structure model. The prediction is based on a structural estimate of the model’s parameters. The histograms plot the predicted parameters for each firm-quarter.