Financing Constraints and Capital Structure*

Jie Yang
McDonough School of Business
Georgetown University†

This version: March 2011

Abstract

I construct a structural model in which firms maximize value by choosing the amount of capital to invest and the amount of debt to issue. In the model, firms face constraints that restrict them from issuing equity and unsecured debt. Using GMM to estimate the model and conditioning on firm characteristics, I find financing constraint measures that are consistent with characteristics and financing behavior believed of constrained firms. I define an overall measure for being financially constrained when firms are restricted in both debt and equity financing. Finally, I find that the limiting constraint is the debt, rather than equity, restriction due to firm concerns over preserving financial slack.

*I am grateful to Jules van Binsbergen, Bob Chirinko, Ron Gallant, John Graham, Adriano Rampini, David Robinson, Lukas Schmid, Jason Sturgess, and seminar participants at Duke University and Georgetown University for their valuable comments. All remaining errors are my own.

†Washington, DC 20057. Email: jy44@georgetown.edu.

1 Introduction

In the world of Modigliani and Miller (1958), corporate financial structures are independent of real investment decisions and the choice between debt and equity is irrelevant. When frictions exist that create a wedge between the cost of external capital and the cost of internal capital, firms may no longer be able to fund all profitable investment projects. Additionally, when these frictions cause the cost of external debt to deviate from the cost of external equity, the capital structure choice and investment decisions are no longer mutually independent. Frictions in the market can lead to circumstances in which the irrelevance of capital structure no longer hold and the capital structure decision itself interacts with the broader environment of corporate investment.

In this paper, I study the role of financing constraints on the relationship between corporate investment and capital structure decisions. By financing constraints, I refer specifically to the subset of frictions that restrict firms from accessing capital markets. In order to understand the impact of financing constraints on corporate decisions, two important questions must be asked: what is the theoretical relationship between financing constraints and corporate decisions and, based on observed choices, do firms behave as if they face financing constraints (and if so, what are the implied characteristics and magnitudes of the constraints)?

To address these questions, I introduce and estimate a structural model of capital investment that extends the neoclassical investment framework in Whited (1992) and Whited and Wu (2006) to include two financing constraints: one that restricts equity issuance and one that restricts debt issuance. Two main features distinguish the model. First, I allow the investment decision to impact debt capacity and second, I allow for firm-specific interest rates on debt. These two features add a capital structure dimension to the model by creating a wedge between the cost of external equity and the cost of external debt. This endogenizes the capital investment and capital structure decisions of the firm, requiring both to be jointly and simultaneously (rather than sequentially) determined.

In my model, firms maximize value by choosing the amount of capital to invest and the amount of debt to issue. Firms are faced with two financing constraints: 1) a dividend non-negativity constraint that restricts them from issuing equity and 2) a debt capacity constraint that restricts them from issuing debt. The Lagrange multiplier on the first constraint measures the shadow value of issuing equity and the Lagrange multiplier on the second constraint measures the shadow value of issuing debt. These shadow values capture the marginal value added to the firm from relaxing the constraints to issuing an additional unit of equity or debt, respectively. The higher the shadow values, the more constrained the firm from accessing funds for investment. The first order conditions from the structural model provide the Euler equations necessary to estimate the model and obtain coefficients on the shadow values of the two financing constraints.

I find that the shadow values of both financing constraints on issuing equity and issuing debt are positive and significant, providing evidence that both constraints are important to corporate investment and financing decisions. Furthermore, my estimation framework allows me to parameterize the two constraints conditional on firm-specific characteristics. I find that the financing constraints relate to firm characteristics in ways that are intuitively sensible (e.g., illiquidity of equity increases the financing constraint to issuing equity and collateral decreases the financing constraint to issuing debt, etc). I test the financing predictions of the model related to debt issuances, equity issuances, debt reductions, and equity reductions and find results consistent with observed capital structure behavior. Specifically, the firms with high equity constraints and low debt constraints are more likely to issue debt; firms with low equity constraints are more likely to issue equity.

Having estimated two separate financing constraint measures for debt and equity, I collapse the two quantities into one overall financial constraint measure. Firms are defined to be overall financially constrained if they are restricted in obtaining both debt and equity today. This gives me three metrics for financing constraints: one for equity financing, one for debt financing, and an overall measure that combines the first two separate measures. I sort on these three measures and find that the limiting constraint is the constraint on debt issuance. In other words, the firm's financing decision is driven by its constraints on contemporaneous capital structure. This provides evidence that, all else equal, firms care about preserving their debt capacity and financial slack. This is precisely due to optimal capital investment being impacted by financing considerations. Specifically, capital investment requires funds today but increases next period's debt capacity. Vice versa, if the firm chooses to defer investment, they preserve financial slack today, but forego profits in the future.

Numerous papers examine financial constraints and the effects they have on corporate policies. Fazzari, Hubbard, and Petersen (1988), Kaplan and Zingales (1997), and others consider financing constraints through the relationship between investment and cash flow sensitivity. Kaplan and Zingales (1997), Cleary (1999), and Whited and Wu (2006) use empirical analysis to explain and identify financially constrained firms based on firm-specific characteristics. Lamont, Polk, and Saò-Requejo (2001), Whited and Wu (2006), Gomes, Yaron, and Zhang (2006), and Livdan, Sapriza, and Zhang (2009) consider whether financial constraints are priced in the equity market. Most of this literature emphasizes the effects that constraints on external financing have on investment decisions while shutting down the capital structure decision. Yet, the vast capital structure literature indicates that the type of financing and therefore the type of financing constraint matters. For example, Myers' (1977) debt overhang story suggests that using debt prevents firms from making positive NPV investments. Jensen and Meckling (1976)'s agency cost story and Jensen's (1986) theory of free cash flow suggests that leverage can discipline management to limit personal consumption and empire building through its monitoring benefits.

This paper makes three primary contributions. First, I introduce and empirically estimate a model that endogenizes the investment and financing decisions through two separate financing constraints on equity and debt. This allows me to provide a theoretical relationship between financing constraints and corporate decisions. In doing so, I disentangle the intertemporal investment decision into two financing considerations: intertemporal equity financing and contemporaneous capital structure. Second, I provide empirical indices for measuring the financing constraint ratio to issuing equity, issuing debt, and an overall measure that incorporates the financing constraints of both equity and debt. Third, I provide evidence that my model captures observed corporate financing behavior in ways that are consistent with extant literature. Furthermore, I find that between the intertemporal equity financing constraint ratio and the contemporaneous debt to equity constraint ratio, firms act as if the latter is the limiting constraint. Specifically, firms care about financial flexibility and preservation of financial slack (as measured by the debt capacity). This is consistent with Kisgen (2006) and Faulkender and Petersen (2006). Kisgen (2006) finds that credit ratings affect capital structure decisions due to their usefulness in providing access to capital markets and their consideration by investors in providing external funds. Faulkender and Petersen (2006) show evidence that firms with access to public debt markets use more leverage use in their capital structure. Similarly, the CFO survey findings of Graham and Harvey (2001) find that financial flexibility is the top consideration by financial managers in their determination of capital structure.

This paper builds upon previous work. Whited (1992) develops a model that links financing constraints to investment and finds that an Euler equation that accounts for financing constraints fares better than one without financing constraints. Whited and Wu (2006) extends Whited (1992) by estimating the intertemporal (equity) financing constraint and exploring whether this constraint measure is priced in the equity market. My model differs from Whited (1992) and Whited and Wu (2006) in that I include both the intertemporal equity financing constraint ratio and the contemporaneous capital structure constraint. This allows me to distinguish and estimate two separate measures for the constraint on equity and the constraint on debt and explore the relative importance between the two. Hennessey and Whited (2005) model dynamic capital structure and investment decisions in a general equilibrium framework that features taxation, corporate savings, and path dependency of optimal capital structure. Calibrating and simulating their model, the authors find that corporate leverage choice is path dependent and there are no target leverage ratios. Like Hennessey and Whited (2005), my model finds that preservation of financial slack is an important consideration for the firm. I differ from Hennessey and Whited (2005) in that in my framework there is an optimal leverage ratio and optimal capital investment, both of which are influenced by the tradeoff between profits from investment and preservation of financial flexibility. In addition, I differ from Hennessey and Whited in focus. Hennessey and Whited (2005) explore debt dynamics through a general equilibrium framework whereas I study the impact of financing constraints on investment and financing decisions. Given our different foci, it is reassuring our results are consistent. My simplified framework allows me to calculate analytical first order conditions that I use as moment conditions in GMM estimation. This allows me to directly capture the shadow values of financing constraints and map them to firm characteristics. Finally, Rampini and Viswanathan (2010) develop an unified model of financing based on the dependence of tangible assets as collateral. Consistent with their paper, my model also includes the features that firms have incentive to preserve their debt capacity due to effects on future cash flow opportunities and that low capital firms result in low debt financing. While Rampini and Viswanathan focus on theory, ultimately, my paper focuses on the empirical estimation of a structural model that links investment and financing decisions through the existence of financing frictions.

The rest of the paper is organized as follows. Section 2 introduces the general theoretical framework and the role of financing constraints within the model. Section 3 discusses the parametrization, identification, and data used in the estimation of the model. Section 4 discusses the results from the estimation of the model and financing constraint measures. Section 5 tests the implications of the model and the validity of the financing constraint indices. I also propose an overall financing constraint measure and examine the impact of the two individual constraint measures against the overall measure. Finally, section 6 concludes.

2 Model

Extending the neoclassical investment framework in Whited (1992) and Whited and Wu (2006), I introduce a dynamic structural model of capital investment that features two financing constraints: one that restricts access to external equity and one that restricts access to non-secured debt.

The objective of the firm is to maximize the expected present value of its dividend stream, by choosing the next period capital investment, $K_{i,t+1}$ and debt issuance, $B_{i,t+1}$. That is, each firm, i, solves the following optimization problem:

$$V_{i,0} = \max_{K_{i,t+1},B_{i,t+1}} E_{i,0} \sum_{t=0}^{\infty} M_{0,t} D_{i,t}, \tag{1}$$

where $E_{i,0}$ is the expectation operator for firm i based on the information set at time 0. $M_{0,t}$ is the stochastic discount factor between time 0 and time t. $D_{i,t}$ is the value of the dividends for firm i at time t. Implicit in the model is the assumption that all debt (and interest) are paid off at the end of each period to creditors and all net cash flows are paid out as dividends at the end of each period to investors.

The firm's maximization problem follows three identities. First, dividends in each period, $D_{i,t}$, are defined as

$$\begin{aligned} D_{i,t} \equiv &(1-\tau_{i,t})[\pi(K_{i,t},\nu_{i,t}) - \phi(K_{i,t},I_{i,t})] - I_{i,t} - [1 + R(K_{i,t},B_{i,t})]B_{i,t} + B_{i,t+1} \\ &+ \tau_{i,t}[\delta_{i,t}K_{i,t} + R(K_{i,t},B_{i,t})B_{i,t}], \end{aligned} \tag{2}$$

where $\tau_{i,t}$ is the marginal corporate tax rate that the firm faces. π is the firm's operating profit as a function of capital stock at the beginning of period t, $K_{i,t}$, and a shock the firm faces during the period, $\nu_{i,t}$. ϕ is the adjustment cost to capital as a function of $K_{i,t}$ and the amount of investment over the period, $I_{i,t}$; ϕ is convex in $I_{i,t}$. $R_{i,t}$ is the interest rate applicable to the firm's debt as a function of $K_{i,t}$ and debt at the beginning of period t, $B_{i,t}$. $\delta_{i,t}$ is the depreciation rate of capital over period t. Profits are shielded from taxes via depreciation of capital and interest payments on debt as expressed by the last term in equation (2).
Second, the per period investments are defined as

$$I_{i,t} \equiv K_{i,t+1} - (1-\delta_{i,t})K_{i,t}. \tag{3}$$

Third, firm-specific interest rates on debt are defined as

$$R_{i,t} \equiv r_t + \omega(K_{i,t},B_{i,t}) + r_t\omega(K_{i,t},B_{i,t}) \tag{4}$$

where r_t is the riskfree rate, ω is the firm-specific cost as a function of $K_{i,t}$ and $B_{i,t}$; total debt interest payment, RB, is convex in $B_{i,t}$.

This last identity warrants a brief discussion. In the model, debt is issued each period and repaid the next period along with interest. Although the debt is repaid in full and therefore default-free, I assume the lender cannot costlessly collect repayment due to default prevention or agency costs that require monitoring of the debt and enforcement of repayment.[1] In essence, an additional firm-specific cost is incurred to prevent the firm from defaulting. This additional cost is passed along from the lender to the firm and is captured in the model by $\omega(K_{i,t}, B_{i,t})$.[2] As more debt is issued relative to the amount of pledgable capital stock, or collateral, the costlier it is to monitor and to enforce repayment. Due to collateral restrictions discussed below, in equilibrium, the firm will always repay the debt in full, but at a cost above the riskfree rate.

In addition to the three identities above, the firm's maximization problem is also subject to two financing constraints. First, firms are restricted from access to external equity. This non-negative dividends, or solvency, constraint, is given by:

$$D_{i,t} \geq 0. \tag{5}$$

Let λ be the Lagrange multiplier on this condition. When dividends hit this lower boundary, instead of paying out, the firm would like to issue equity but is restricted from doing so.[3] That is, λ measures the shadow value of an additional unit of external equity financing, or the shadow cost from not being able to obtain an additional unit of external equity financing. In other words, λ captures the implicit degree of being financially constrained in equity.

Second, firms face a debt repayment constraint that is conditional upon the firm's ability to collateralize its capital stock. To the extent that a firm can only collateralize θ of its capital stock and therefore can only secure that amount of its debt repayment, this constraint represents the present value of the firm's capacity to honor its debt.

$$(1 + \omega(K_{i,t+1}, B_{i,t+1}))B_{i,t+1} \leq \theta_{i,t} K_{i,t+1}.$$

When $\theta_{i,t}$ represents the firm's ability to liquidate its capital, the debt is default-free. This

[1]Jensen and Meckling (1976) suggest that managers take excessively risky projects when leverage is high, requiring the need for incurring monitoring costs to prevent bankruptcy. An alternative interpretation is that due to limited enforcement there is costly repossession of capital (Rampini and Viswanathan, 2010).

[2]Given firm-specific costs, in order for the lender to participate in the market, it must be that

$$E\left[-B_{i,t} + M_{t-1,t}(1 + R_{i,t})B_{i,t} - M_{t-1,t}\tilde{\omega}(K_{i,t}, B_{i,t})B_{i,t}\right] = 0.$$

Assuming that $E[M_{t-1,t}] = \frac{1}{1+r_t}$, gives

$$1 + R_{i,t} = 1 + r_t + \tilde{\omega}(K_{i,t}, B_{i,t}).$$

Defining $\omega(K_{i,t}, B_{i,t}) \equiv E[M_{t-1,t}\tilde{\omega}(K_{i,t}, B_{i,t})]$ and rearranging the terms derives equation (4).

[3]Equation (5) shuts down external equity financing. However, all implications and math go through if some fixed, exogenous amount of external equity is allowed; that is if 0 is changed to some negative constant.

constraint can be rewritten to represent the debt capacity of the firm:

$$B_{i,t+1} \leq \theta_{i,t} K_{i,t+1} - \omega(K_{i,t+1}, B_{i,t+1}) B_{i,t+1}. \tag{6}$$

In other words, the firm's capacity for debt is equal to amount of capital it can collateralize net of firm-specific monitoring or enforcement costs. Let γ be the Lagrange multiplier on this condition. When firms hit the upper boundary enforced by the constraint, i.e., when firms have reached their debt capacity, they would like to issue more debt but are prevented from doing so. That is, γ is the shadow value of an additional unit of debt financing and captures the implicit degree of being financially constrained in debt.[4]

It is worthwhile to highlight the importance of two distinct features of the model: the firm-specific interest rates in equation (4) and the debt constraint that is endogenous to the capital stock in equation (6). In models with cross-sectionally constant borrowing rates and exogenous equity and debt constraints, the firm first determines its optimal capital investment and then either invests optimally when unconstrained or the maximum allowed by debt and equity restrictions. By including a debt constraint that is endogenous to the capital stock, the capital budgeting and capital structure decisions are no longer mutually independent. As described below, there is an additional benefit to capital investment - creating more financial slack directly through each unit of capital investment or indirectly through reduced borrowing rates. Together with firm-specific borrowing rates and marginal tax rates, each firm has an optimal amount of debt to issue, resulting in separable identification between debt and equity financing, establishing the relevance of capital structure.

Using the three identities in equations (2), (3), and (4), and the two financing constraints in equations (5) and (6), the firm chooses the next period capital level, $K_{i,t+1}$, and debt issuance, $B_{i,t+1}$, that maximizes the firm's objective function in equation (1).

Maximizing, the first order condition with respect to $K_{i,t+1}$ is:

$$\begin{aligned} E_t \Bigg\{ M_{t,t+1} \Bigg\{ \frac{(1+\lambda_{i,t+1})}{(1+\lambda_{i,t})} \frac{(1-\tau_{i,t+1})}{(1-\tau_{i,t})} \Bigg[\pi^K_{i,t+1} - \phi^K_{i,t+1} + \frac{1}{1-\tau_{i,t+1}} - \delta_{i,t+1} + (1-\delta_{i,t+1})\phi^I_{i,t+1} \\ - (1+r_{t+1})\omega^K_{i,t+1} B_{i,t+1} \Bigg] \Bigg\} + \frac{\gamma_{i,t}}{(1+\lambda_{i,t})} \frac{1}{(1-\tau_{i,t})} \left[\theta_{i,t} - \omega^K_{i,t+1} B_{i,t+1} \right] \Bigg\} = \phi^I_{i,t} + \frac{1}{1-\tau_{i,t}} \end{aligned} \tag{7}$$

where $M_{t,t+1} \equiv \frac{M_{0,t+1}}{M_{0,t}}$ is the one period stochastic discount factor between time t and $t+1$.

[4]Note that ω is the real cost incurred from monitoring or enforcement of collateral; whereas γ is a financing cost due to restricted access to the debt market beyond the debt capacity.

For notational ease, let $\pi_{i,t+1}^K \equiv \frac{\partial \pi_{i,t+1}(K_{i,t+1},\nu_{i,t+1})}{\partial K_{i,t+1}}$, which is the marginal product of capital. Similarly, $\phi_{i,t+1}^K \equiv \frac{\partial \phi_{i,t+1}(K_{i,t+1},I_{i,t+1})}{\partial K_{i,t+1}}$ and $\phi_{i,t+1}^I \equiv \frac{\partial \phi_{i,t+1}(K_{i,t+1},I_{i,t+1})}{\partial I_{i,t+1}}$ are the marginal cost of investment with respect to capital and investment, respectively. Finally, $\omega_{i,t+1}^K \equiv \frac{\partial \omega(K_{i,t},B_{i,t})}{\partial K_{i,t}}$ is the marginal interest rate with respect to existing capital, and $\omega_{i,t+1} \equiv \omega(K_{i,t+1}, B_{i,t+1})$.

Equation (7) is the Euler equation that sets the expected marginal benefit (left hand side) equal to the marginal cost (right hand side) of making a capital investment today. The firm will invest today if the benefits from doing so exceed the costs; otherwise, the firm will defer the investment decision. The cost of investment today is the (tax-adjusted) unit price of capital plus the marginal adjustment cost of new capital. The benefit of investment today translates into an increase in the expected marginal product of capital tomorrow, a decrease in marginal adjustment costs of capital tomorrow, and an increase in marginal debt capacity today. Thus, the investment decision depends upon the stochastic discount factor, $M_{t,t+1}$, and three idiosyncratic factors: the relative marginal tax rates, the intertemporal equity constraint ratio, and contemporaneous debt-to-equity constraint ratio.

The relative marginal tax rate factor, $\frac{1-\tau_{i,t+1}}{1-\tau_{i,t}}$, is associated with the risk in changing marginal tax rates. The marginal tax rates change when the expected profitability, and therefore the expected amount of taxable income, change. If the expected marginal tax rate tomorrow is higher than the marginal tax rate today, $\frac{1-\tau_{i,t+1}}{1-\tau_{i,t}} < 1$, each dollar of profit tomorrow is less valuable since less of it is retained. The firm would want to defer any investment spending to the next period, holding all else equal. When there are no financing constraints, that is when $\lambda_{i,t}$, $\lambda_{i,t+1}$, and $\gamma_{i,t}$ all equal zero, only the stochastic discount factor and relative tax rates drive the investment decision.

When financing constraints exist, the investment decision depends additionally on both the intertemporal equity financing constraint ratio and the contemporaneous debt-to-equity constraint ratio. The ratio of the intertemporal shadow values of equity financing, $\frac{1+\lambda_{i,t+1}}{1+\lambda_{i,t}}$, measures the risk in changes to the firm's degree of being constrained from equity financing tomorrow relative to being constrained from equity financing today. If the expected shadow cost of obtaining equity financing tomorrow is less expensive than that of today, $\frac{1+\lambda_{i,t+1}}{1+\lambda_{i,t}} < 1$, each dollar of using equity today is more costly than tomorrow and the firm will defer investment to the next period, holding all else constant.

On the other hand, the contemporaneous debt-to-equity constraint ratio, $\frac{\gamma_{i,t}}{1+\lambda_{i,t}}$, drives the decision between debt and equity choice, i.e., the capital structure decision. In the model, capital investment affects the capital structure decision through direct and indirect effects on debt capacity, i.e., the marginal effects on financial slack. Each additional unit of capital directly adds θ to the debt capacity and also has an indirect effect through a reduced cost of monitoring or enforcement, $\omega^K B$. As debt becomes more constrained relative to equity, the firm becomes more concerned with its availability of financial flexibility and has additional incentive to invest using equity in order to expand its debt capacity and preserve its financial slack.[5]

The first order condition with respect to $B_{i,t+1}$ is:

$$E_t \left\{ M_{t,t+1} \left\{ \frac{(1+\lambda_{i,t+1})}{(1+\lambda_{i,t})} \frac{(1-\tau_{i,t+1})}{(1-\tau_{i,t})} \left[1 + R_{i,t+1} + (1+r_{t+1})\omega^B_{i,t+1} B_{i,t+1} + \frac{\tau_{i,t+1}}{1-\tau_{i,t+1}} \right] \right\} + \frac{\gamma_{i,t}}{(1+\lambda_{i,t})} \frac{1}{(1-\tau_{i,t})} \left[1 + \omega^B_{i,t+1} B_{i,t+1} + \omega_{i,t+1} \right] \right\} = \frac{1}{1-\tau_{i,t}} \tag{8}$$

where $\omega^B_{i,t+1} \equiv \frac{\partial \omega(K_{i,t}, B_{i,t})}{\partial B_{i,t}}$ is the marginal interest rate with respect to existing debt.

Equation (8) is the Euler equation that sets the expected marginal cost (left hand side) equal to the marginal benefit (right hand side) of issuing debt today. The firm will issue debt today when the benefits of doing so exceed the costs. The benefit of issuing debt is the after-tax value on each marginal dollar of debt financing obtained today. The cost of issuing debt is the increase in marginal interest payment tomorrow and a decrease in marginal debt capacity today. Like the capital investment decision, the capital structure decision depends upon the stochastic discount factor, relative marginal tax rates, the intertemporal equity financing constraint ratio, and the contemporaneous capital structure constraint ratio.

When the expected marginal tax rate tomorrow is high relative to today, the cost of interest payments in the next period are lower due to the increased value of the tax shield from interest deduction, i.e., the benefits to using debt are higher, prompting the firm to issue more debt today. When equity financing is more constrained in the next period relative to equity today, all else equal, internal funds are more valuable in the next period due to the difficulty in obtaining equity. When using debt, the relatively more valuable internal funds from next period are used to repay the debt and interest, increasing the cost of debt. As a result, the firm issues less debt today. Finally, each additional unit of debt directly decreases the debt capacity one-to-one and indirectly decreases the debt capacity through increased interest rates. When debt financing is more constrained relative to equity, concerns about availability of financial slack is more pressing and each additional unit of debt becomes costlier from the perspective of maintaining financial flexibility.

Together, the two Euler equations (7) and (8) provide the theoretical framework to jointly determine corporate investment and capital structure decisions. They dictate the relationship between the intertemporal equity constraint ratio and the contemporaneous

[5] Financial slack is defined as having access to cash or spare debt capacity.

debt-to-equity constraint ratio. The former ratio, $\frac{1+\lambda_{i,t+1}}{1+\lambda_{i,t}}$, represents the degree of being constrained in equity in the next period relative to the current equity environment today and equals 1 when the firm is unconstrained; the latter ratio, $\frac{\gamma_{i,t}}{1+\lambda_{i,t}}$, represents the degree of being constrained in debt today relative to the current equity environment and equals 0 when the firm is unconstrained. A complementary interpretation of the two financing constraint ratios is that Λ and Γ represent the weights that firms put on cash flow (equity) considerations and financial flexibility (debt) considerations, respectively. It is important to mention that due to the Markovian nature of the model, only the *relative* financing constraints matter for the firm optimization problem. That is, the model depends upon the financial constraint of equity tomorrow *relative* to equity today and the financial constraint of debt today *relative* to equity today, treating the financial constraint on issuing equity today as the base case against which corporate decisions are made.[6]

3 Model Estimation

3.1 Parametrization of the Model

In order to estimate the model in Section 2, I make the following simplifying assumptions to parameterize the model.

First, I assume that $E[M_{t,t+1}] = \frac{1}{1+r_{t+1}}$.

Following the extant literature such as Whited and Wu (2006), I define the marginal product of capital as,

$$\pi_{i,t}^K = \frac{Y_{i,t} - \mu C_{i,t}}{K_{i,t}}$$

where $Y_{i,t}$ is the firm's output, $C_{i,t}$ is the operating costs, and μ is the cost markup factor.

Using the standard form for adjustment cost of capital, I define

$$\phi(K_{i,t}, I_{i,t}) = \left[\frac{1}{2}a_1\left(\frac{I_{i,t}}{K_{i,t}}\right)^2 + \frac{1}{3}a_2\left(\frac{I_{i,t}}{K_{i,t}}\right)^3\right]K_{i,t}.$$

Parallel to the adjustment cost of capital, I define the functional form for the firm-specific

[6] In other words, the firm decides whether to issue debt today or defer the investment to the next period based on the current equity financing environment. If the environment in the next period does not change from the current environment, then firms will not change their investment and financing behaviors.

portion of the interest rate as

$$\omega(K_{i,t}, B_{i,t}) = \frac{1}{2}b_1\left(\frac{B_{i,t}}{K_{i,t}}\right) + \frac{1}{3}b_2\left(\frac{B_{i,t}}{K_{i,t}}\right)^2.$$

This has the feature that monitoring or enforcement costs are higher when more leverage is issued; this cost is mitigated by having more capital stock which can be used as collateral, alleviating the need for monitoring and enforcement of repayment. That is, total interest payment on debt is

$$R_{i,t}B_{i,t} = \left[r_t + \frac{1}{2}b_1(1+r_t)\left(\frac{B_{i,t}}{K_{i,t}}\right) + \frac{1}{3}b_2(1+r_t)\left(\frac{B_{i,t}}{K_{i,t}}\right)^2\right]B_{i,t}.$$

3.2 GMM

To estimate the parameters of Euler equations (7) and (8), I use generalized method of moments (GMM).

Incorporating the parameterizations assumed above and removing the expectations operator, equation (7) can be rewritten as

$$\begin{aligned} M_{t,t+1}\Bigg\{&\frac{(1+\lambda_{i,t+1})}{(1+\lambda_{i,t})}\frac{(1-\tau_{i,t+1})}{(1-\tau_{i,t})}\left[\frac{Y_{i,t+1}-\mu C_{i,t+1}}{K_{i,t+1}} + \left[\frac{1}{2}a_1\left(\frac{I_{i,t+1}}{K_{i,t+1}}\right)^2 + \frac{2}{3}a_2\left(\frac{I_{i,t+1}}{K_{i,t+1}}\right)^3\right] + \frac{1}{1-\tau_{i,t+1}}\right. \\ &\left.-\delta_{i,t+1} + (1-\delta_{i,t+1})\left[a_1\left(\frac{I_{i,t+1}}{K_{i,t+1}}\right) + a_2\left(\frac{I_{i,t+1}}{K_{i,t+1}}\right)^2\right] + (1+r_{t+1})\left[\frac{1}{2}b_1\left(\frac{B_{i,t+1}}{K_{i,t+1}}\right)^2 + \frac{2}{3}b_2\left(\frac{B_{i,t+1}}{K_{i,t+1}}\right)^3\right]\right]\Bigg\} \\ &+ \frac{\gamma_{i,t}}{(1+\lambda_{i,t})}\frac{1}{(1-\tau_{i,t})}\left[\theta_{i,t} + \frac{1}{2}b_1\left(\frac{B_{i,t+1}}{K_{i,t+1}}\right)^2 + \frac{2}{3}b_2\left(\frac{B_{i,t+1}}{K_{i,t+1}}\right)^3\right] - a_1\left(\frac{I_{i,t}}{K_{i,t}}\right) - a_2\left(\frac{I_{i,t}}{K_{i,t}}\right)^2 - \frac{1}{1-\tau_{i,t}} = \epsilon^K_{i,t+1} \end{aligned} \quad (9)$$

where $\epsilon^K_{i,t+1}$ is the error term associated with the Euler equation of $K_{i,t+1}$.

Similarly, equation (8) can be rewritten as

$$\begin{aligned} M_{t,t+1}\Bigg\{&\frac{(1+\lambda_{i,t+1})}{(1+\lambda_{i,t})}\frac{(1-\tau_{i,t+1})}{(1-\tau_{i,t})}\left[(1+r_{t+1})\left[1 + b_1\left(\frac{B_{i,t+1}}{K_{i,t+1}}\right) + b_2\left(\frac{B_{i,t+1}}{K_{i,t+1}}\right)^2\right] + \frac{\tau_{i,t+1}}{1-\tau_{i,t+1}}\right]\Bigg\} \\ &+ \frac{\gamma_{i,t}}{(1+\lambda_{i,t})}\frac{1}{(1-\tau_{i,t})}\left[1 + b_1\left(\frac{B_{i,t+1}}{K_{i,t+1}}\right) + b_2\left(\frac{B_{i,t+1}}{K_{i,t+1}}\right)^2\right] - \frac{1}{1-\tau_{i,t}} = \epsilon^B_{i,t+1} \end{aligned} \quad (10)$$

where $\epsilon^B_{i,t+1}$ is the error term associated with the Euler equation of $B_{i,t+1}$. Implicit in equations (7) and (8) is the assumption that $E_t[\epsilon^Z_{i,t+1}] = E_t[\epsilon^B_{i,t+1}] = 0$, providing first moment conditions for GMM estimation.

Following standard GMM procedure, moment conditions are obtained by interacting the error terms from equations (9) and (10) with a set of instruments. Following Arellano and Bond (1991), for instruments, I use lagged levels of all variables in the model and to remove fixed effects, I take the first difference of equations (9) and (10). Let $\epsilon \equiv \{\epsilon^K, \epsilon^B\}$. Let K be number of instruments, then there are a total of 2*(T-2)*K number of equations in the estimation. For a given set of instrumental variables, z, the moment conditions are defined as

$$E_{t-1}[(\epsilon_{i,t+1} - \epsilon_{i,t}) \otimes z_{i,t-1}] = 0. \tag{11}$$

3.3 Financial Constraints

To estimate the financial accessibility of a firm, I parameterize the intertemporal equity financing constraint ratio, $\frac{1+\lambda_{i,t+1}}{1+\lambda_{i,t}}$, and the contemporaneous debt to equity financing constraint ratio, $\frac{\gamma_{i,t}}{1+\lambda_{i,t}}$. For notational ease and clarity of interpretation, let $1 + \Lambda_{i,t+1} \equiv \frac{1+\lambda_{i,t+1}}{1+\lambda_{i,t}}$, and $\Gamma_{i,t} \equiv \frac{\gamma_{i,t}}{1+\lambda_{i,t}}$. Recall that $\frac{1+\lambda_{i,t+1}}{1+\lambda_{i,t}} = 1$ for an unconstrained firm. Thus, $\Lambda_{i,t+1} \equiv \frac{\lambda_{i,t+1}-\lambda_{i,t}}{1+\lambda_{i,t}}$ and $\Gamma_{i,t}$ represent the degree of equity and debt constraints relative to today's equity situation, respectively.

I parameterize $\Lambda_{i,t+1}$ and $\Gamma_{i,t}$ using firm characteristics:

$$\begin{aligned}\Lambda_{i,t+1} = {} & l_1\text{LTA}_{i,t} + l_2\text{DDIV}_{i,t} + l_3\text{COL}_{i,t} + l_4\text{LEV}_{i,t} + l_5\text{INDLEV}_{i,t} \\ & + l_6\text{CF}_{i,t} + l_7\text{CFVOL}_{i,t} + l_8\text{CASH}_{i,t} + l_9\text{LIQV}_{i,t} + l_{10}\text{ILLIQ}_{i,t} \\ & + l_{11}\text{ANEST}_{i,t} + l_{12}\text{BTM}_{i,t}\end{aligned} \tag{12}$$

and

$$\begin{aligned}\Gamma_{i,t} = {} & g_1\text{LTA}_{i,t} + g_2\text{DDIV}_{i,t} + g_3\text{COL}_{i,t} + g_4\text{LEV}_{i,t} + g_5\text{INDLEV}_{i,t} \\ & + g_6\text{CF}_{i,t} + g_7\text{CFVOL}_{i,t} + g_8\text{CASH}_{i,t} + g_9\text{LIQV}_{i,t} + g_{10}\text{ILLIQ}_{i,t} \\ & + g_{11}\text{ANEST}_{i,t} + g_{12}\text{BTM}_{i,t}\end{aligned} \tag{13}$$

where LTA is the log of total assets, DDIV is a dummy variable for dividend paying firms, COL is the ratio of collateralizable assets (plants, property, and equipment and inventory) of the firm to total assets, LEV is the ratio of long term debt to total assets, INDLEV is the amount of long term debt of the firm's 3-digit SIC industry to the total assets of the industry, CF is the ratio of cash flows to total assets as a measure of profitability, CFVOL is the three year cash flow volatility (normalized by the mean of the cash flows in those three years) as a measure of firm risk, CASH is the ratio of cash holdings to total assets, LIQV is the liquation ratio of the firm's book equity to total book equity, ILLIQ is the bid-ask spread on the firm's stock normalized by the stock price as a measure for illiquidity of equity, ANEST is the number of analyst estimates made for the period as a measure of information asymmetry, and BTM is the ratio of book equity to market equity as a measure for growth opportunities. This set of variables have been shown in the literature to influence capital structure (e.g., Frank and Goyal, 2009). Each variable, except DDIV, is standardized (demeaned and divided by the standard deviation). Thus, each coefficient in $\Lambda_{i,t+1}$ and $\Gamma_{i,t}$ carries a one standard deviation interpretation. In each specification, both $\Lambda_{i,t+1}$ and $\Gamma_{i,t}$ are parameterized using the same firm characteristics in year t. This allows the analysis to indicate the significant characteristics that matter for each constraint ratio.

3.4 Data and Summary Statistics

Corporate financial statement data are obtained from Standard & Poors COMPUSTAT annual database for fiscal years of 1980 to 2007.[7] Marginal tax rates are provided courtesy of John Graham (2000).[8] Prices and returns data are obtained from the CRSP database from 1980 to 2008. Number of analyst forecasts are obtained from Thompson's I/B/E/S database from 1980 to 2008.

Although most, if not all, distressed firms are likely to be constrained from the capital market, it does not follow that most constrained firms are likely to be distressed (e.g., young, small firms). To isolate the influence of financial constraints from the effects of financial distress, I remove financially distressed firms. To this extent, I remove all firm-years with negative book asset value, common equity, sales, capital stock, liquidation values, or dividends. Such firms either have unreliable COMPUSTAT data are likely to be distressed or severely unprofitable. Next, I delete all firms in the financial and insurance, utilities, and public administration industries. Following the literature, I then delete all firms that are involved in substantial M&A activity, defined as acquisitions amounting to over 15 percent of total assets. Finally, I remove outliers defined as firm-year observations that are in the first and 99th percentile tails for any variables.

Additionally, I make two model specific requirements on the sample. First, since the

[7]This implies actual reporting dates of June 1980 through May 2008.

[8]Graham (2000) simulates marginal tax rates for firms in the COMPUSTAT database. The simulated marginal tax rates measure the tax savings associated with deducting the next dollar of interest considering the probability the firm is in tax paying status in any given state of the world, combined with the tax code features that allow firms to move losses through time.

model uses default-free debt financing, I drop all firm-year observations which have Altman (1968) ZSCORE's in the bottom quartile.[9] Second, since the model captures relative financing constraints and uses lagged instruments, I require firms in the sample to have at least three consecutive years of data for all variables used in the estimation. This results in a sample of 25,204 firm-year observations which are spanned by 3,764 firms over the fiscal years 1982 to 2007. Table 1 presents the summary statistics for all relevant variables of the model. Appendix A provides detailed definitions for all variables used in the analysis.

4 Estimation Results

As described above, I estimate the model in Section 2 using GMM. At time t, the firm decides how much capital to invest and how much debt to issue. In the model, these decisions are based on the restrictiveness of $\Lambda_{i,t+1} \equiv \frac{1+\lambda_{i,t+1}}{1+\lambda_{i,t}}$, the intertemporal equity financing constraint ratio, and $\Gamma_{i,t} \equiv \frac{\gamma_{i,t}}{1+\lambda_{i,t}}$, the contemporaneous debt to equity financing constraint ratio.

4.1 Financing Constraints

The parameterizations of $\Lambda_{i,t+1}$ and $\Gamma_{i,t}$ given in equations (12) and (13), respectively, allow me to describe financing constraints as a function of firm characteristics. However, before estimating equations (12) and (13), I first explore whether financing constraints are important to the big picture. To do this, I initially estimate the model by parameterizing $\Lambda_{i,t+1} \equiv l_0$ and $\Gamma_{i,t} \equiv g_0$. This allows me to capture the overall mean effect of the two financing constraint ratios and whether they are significant and binding on average. Table 2 provides results from the initial GMM estimation of the model.

Column (i) of Table 2 provides the estimated parameters of the model under the assumption that financing constraints do not exist ($\Lambda_{i,t+1} \equiv 0$ and $\Gamma_{i,t} \equiv 0$). The markup factor (μ) is approximately 1.5, the cost adjustment parameters (a_1 and a_2) indicate a convex adjustment cost function,[10] and the firm-specific interest rate parameters (b_1 and b_2) reflect a convex total interest payment function.[11] Column (ii) estimates the model under the assumption that debt issuance is unrestricted ($\Gamma_{i,t} \equiv 0$), but allows equity financing to be constrained. This results in a coefficient on l_0 of -0.027. This implies that when debt financing is unrestricted, on average, the equity constraint is not binding. Column (iii) estimates the

[9] Altman's (1968) ZSCORE is a firm-specific measure that captures the health of the firm's debt through its estimated probability of default. The higher the ZSCORE, the lower the probability of default.

[10] Adjustment cost of capital is convex in $I_{i,t}$ when $a_1 > max\{-a_2\frac{I_{i,t}}{K_{i,t}}, -2a_2\frac{I_{i,t}}{K_{i,t}}\}$.

[11] Similar to the adjustment cost of capital, the total interest payment is convex in $B_{i,t}$ when $b_1 > max\{-b_2\frac{B_{i,t}}{K_{i,t}}, -2b_2\frac{B_{i,t}}{K_{i,t}}\}$.

model under the assumption that equity issuance is unrestricted ($\Lambda_{i,t+1} \equiv 0$), but allows debt issuance to be constrained. This results in a positive coefficient on g_0 of 0.009. This implies that when equity is unrestricted, firms behave as if they face very low (potentially economically insignificant, though statistically significant) debt constraints (compared to equity constraints).

Finally, column (iv) estimates the model under the assumption that there may be financing constraints on both equity issuance and debt issuance. The coefficient on l_0 is -0.082 and the coefficient on g_0 is 0.111. This suggests that on average, equity constraints are not binding, however debt constraints are binding.

4.2 Full Estimation Results

Now, I parameterize $\Lambda_{i,t+1}$ and $\Gamma_{i,t}$ as specified in equations (12) and (13), respectively. This allows me to condition upon and control for firm characteristics in the two financing constraint ratios. The firm characteristics are standardized to have a mean of zero and a standard deviation of one. The results from GMM estimation of the model are presented in Table 3.

Table 3 shows that the intertemporal equity constraint ratio, $\Lambda_{i,t+1}$, decreases with firm size (LTA), liquidation value of equity (LIQV), and number of analysts (ANEST), and increases when firms pay dividends (DDIV), with the level of debt in the industry (INDLEV), cash holdings (CASH), the bid-ask spread of equity (ILLIQ), and the book-to-market ratio (BTM). That is, large growth firms able to liquidate more of its assets can expect to face lower constraints to equity financing in the next period. On the other hand, illiquid firms that large amounts of cash and pay dividends in an industry with high leverage can expect to be more constrained in equity in the following period.

In addition, the contemporaneous debt to equity constraint ratio, $\Gamma_{i,t}$, decreases with firm size (LTA), collateral (COL), industry level of long-term debt (INDLEV), cash holdings (CASH), illiquidity of stock (ILLIQ), and book-to-market ratio (BTM), and increases when paying dividends (DDIV), with cash flow (CF), high liquidation value of equity (LIQV) and the number of analysts (ANEST). That is, large value firm with large amounts of tangible assets to pledge and cash holdings in an industry that supports large amounts of debt usage face lower constraints to debt financing all else equal.

Although the estimation allows the data to dictate the direction, magnitude, and significance of certain firm characteristics on $\Lambda_{i,t+1}$ and $\Gamma_{i,t}$, most of the results are consistent with prior literature. For example, firm size and dividend paying status affect both financing constraint ratios similarly. Large firms face lower constraints to debt financing and expect lower financing constraints in the next period relative to the current equity environment due to having lower information asymmetry. For smaller firms, delaying investment to the next period is costly both in terms of cash flow growth and debt capacity growth. Although some literature use payment of dividends as indication of being financially unconstrained (Kaplan and Zingales, 1997; Cleary, 1999; etc), it has been argued that dividend policies are sticky (Brav, et al, 2004) and firms are punished in the market for cutting or canceling payments (Michaely, Thaler, and Womack, 1995), leading to dividend payments being another commitment on cash flow. All else equal, this commitment on future cash flow competes for interest payment on debt and reduces availability of cash flow in the future, leading to increased financing constraint on both debt and equity. Finally, large cash holdings may be a signal of poor managerial use of funds, lack of profitable investments projects, or indication of high expected financing constraints that require large amounts of cash holdings (Opler, et al, 1999; Almeida, Campello, and Weisbach, 2004), leading to expectations of being constrained in the future. On the other hand, having cash on hand means having available funds to pay off debt and interest and adds directly to financial flexibility. These reasons influence the debt environment favorably. The results from the estimation indicate that although there are fundamentals that affect the overall investment and financing environment of the firm similarly, the two financing constraints capture separate and distinct differences and influences between equity and debt and captures several findings in the literature.

5 Financing Constraints and Financing Behavior

Using the coefficients from the GMM estimation in Table 3 and firm characteristics, I can create an index for $\Lambda_{i,t+1}$, given by,

$$\begin{aligned}\Lambda_{i,t+1} = & -0.246 * LTA_{i,t} + 0.035 * DDIV_{i,t} + 0.035 * INDLEV_{i,t} + 0.021 * CASH_{i,t} - 0.024 * LIQV_{i,t} \\ & + 0.064 * ILLIQ_{i,t} - 0.054 * ANEST_{i,t} + 0.050 * BTM_{i,t}\end{aligned} \tag{14}$$

and for $\Gamma_{i,t}$, given by,

$$\begin{aligned}\Gamma_{i,t} = & -0.091 * LTA_{i,t} + 0.047 * DDIV_{i,t} - 0.033 * COL_{i,t} - 0.032 * INDLEV_{i,t} + 0.014 * CF_{i,t} \\ & - 0.023 * CASH_{i,t} + 0.033 * LIQV_{i,t} + 0.064 * ILLIQ_{i,t} + 0.029 * ANEST_{i,t} - 0.014 * BTM_{i,t}\end{aligned} \tag{15}$$

where each firm characteristic is standardized to have a mean of zero and a standard deviation of one, except dividend paying status (DDIV) and number of analysts (ANEST). I calculate these two indices on the full COMPUSTAT sample for firms with non-missing firm characteristics. Table 4, panel A provides the summary statistics for the two indices based on equations (14) and (15). As noted above, the indices have a relative interpretation since both constraints are normalized by the current equity environment (constraints to issuing equity today). This relative interpretation is convenient as it allows me to directly measure firm sensitivities to the financing constraints. For example, if Firm A has a higher $\Lambda_{i,t+1}$ than Firm B, then it means that Firm A is more sensitive to its intertemporal equity financing constraint than Firm B even if Firm B might have a higher absolute level of $\lambda_{i,t+1}$. (Indeed, although potentially useful and interesting, level values have no direct interpretation here since at the same level of financing constraints, Firm A may find it more or less restrictive than Firm B given their current financing situations.)

5.1 Financing Predictions

To test empirically whether the two estimated financing constraint indices, Λ and Γ, indeed represent being constrained in equity and debt, respectively, and to test the predictions of the model, I run a probit analysis of corporate financing behavior on Λ and Γ, according to

$$Pr(X = 1)_{i,t+1} = \beta_0 + \beta_1 \Lambda_{i,t+1} + \beta_2 \Gamma_{i,t} + \varepsilon \tag{16}$$

where X is a binary variable for whether the firm has made a: A) pure equity issuance, B) pure debt issuance, C) pure equity reduction, or D) pure equity reduction between time t and $t+1$. I use lagged versions of the financing constraints and observe whether the respective constraints have impact on the probability that the firm will issue equity or debt over the next period. (Recall that although $\Lambda_{i,t+1}$ uses a subscript of $t+1$, it uses firm characteristics at time t.) Table 5 presents these results.

Firms fund their investment decisions by using equity and debt and choosing the cheapest financing option that they can access. Firms are less likely to issue equity in the next period when they expect to be constrained tomorrow relative to today. Panel A of Table 5 shows that high $\Lambda_{i,t+1}$ firms are indeed less likely to issue equity after controlling for $\Gamma_{i,t}$. Although high $\Gamma_{i,t}$ firms are also less likely to issue equity, after controlling for $\Lambda_{i,t+1}$ the result disappears. In other words $\Lambda_{i,t+1}$ absorbs all of the predictive power for whether a firm will issue equity in the next period.

Panel B of Table 5 shows that high $\Gamma_{i,t}$ firms are indeed less likely to issue debt. Furthermore, high $\Lambda_{i,t+1}$ firms are less likely to issue debt as well. Both $\Gamma_{i,t}$ and $\Lambda_{i,t+1}$ remain negative and significant when included in the probit analysis together. That is, firms' debt issuance decisions are sensitive to both types of financing constraints; while the equity issuance decisions are only sensitive to being equity constrained. This provides the first evidence that firms may be more sensitive about debt than equity, as will be discussed in Section 5.2.2.

Firms not only issue equity and debt, but also repurchase shares and pay down debt. Firms reduce their equity and debt in order to preserve financial slack, improve their financial flexibility, lower interest, and adjust their capital structure to optimal ratios. In order to do so, firms must have available funds or not be constrained from raising necessary funds. If a firm is constrained financially, then it will be prevented from reducing their equity and debt positions.[12] Panel C of Table 5 presents the results for equity reductions. High $\Lambda_{i,t+1}$ firms and high $\Gamma_{i,t}$ are less likely to repurchase equity, although the findings are not statistically significant. This suggests that repurchasing shares and other equity reduction behaviors are not driven by financial constraint status. Finally, panel D of Table 5 presents the results for debt reductions. Both high $\Gamma_{i,t}$ and high $\Lambda_{i,t+1}$ firms are less likely to pay down debt when constrained. However in a multivariate analysis, only $\Gamma_{i,t}$ loads negatively and significantly. This supports the idea that constrained firms find it hard to create slack by paying down debt.

5.2 Overall Financing Constraints

In the previous section, the results indicate that the two financing constraint measures, $\Lambda_{i,t+1}$ and $\Gamma_{i,t}$, more or less capture financing behaviors believed of equity or debt constrained firms. However, due to firm-specific interest rates, high $\Gamma_{i,t}$ firms need not be high $\Lambda_{i,t+1}$ firms. That is, firms that are debt constrained today (relative to equity today) need not be equity constrained tomorrow. I sort $\Lambda_{i,t+1}$ and $\Gamma_{i,t}$ each individually into three bins: {LOW, MED, HIGH}. Table 4, panel B reports the frequency distribution based on this sorting. The correlation between $\Lambda_{i,t+1}$ and $\Gamma_{i,t}$ is 62.38%. That is, while it is likely that being more debt constrained today indicates that firms may be equity constrained tomorrow, it is not a deterministic relationship. In fact, 2,435 firm-year observations are equity constrained, but not debt constrained and 4,182 firm-year observations are debt constrained, but not equity constrained. To capture these firms that are truly constrained, I propose an overall financing constraint measure, $FC_{i,t}$ that combines the two individual constraint measures, by

$$FC_{i,t} \equiv \Lambda_{i,t+1} + \Gamma_{i,t}. \tag{17}$$

[12] The model in the paper assumes that all funds are raised externally for the purpose of investment. However, if a firm is constrained from investment, then it will be constrained from adjusting their capital structure.

The firm is overall constrained if $FC_{i,t}$ is high. This overall financing constraint measure incorporates the discount factor on equity tomorrow relative to equity today and the discount factor on debt capacity relative to equity today. Relative to the equity position today (at the end of time t), firms face two financing situations: the possibility of being constrained in debt now and the possibility of being constrained tomorrow. A firm is constrained if both of these situations are in effect. If $FC_{i,t}$ is high, the firm is more likely to be in both situations than when $FC_{i,t}$ is low. Column (iv) of Table 5 presents the results from the probit analysis on this overall financing constraint measure. As expected, a firm that is overall constrained will be less likely to engage in any capital structure adjustments. Altogether, this gives me three financing constraint measures: two separate measures for equity and debt, and the overall measure that incorporates both measures.

5.2.1 One-way Sorts

Table 6 sorts the three financing constraint measures independently into three bins (LOW, MED, HIGH) and compares the firm characteristics of financially unconstrained firms (LOW) against those of financially constrained firms (HIGH). To the extent that credit ratings and equity rankings are important statistics in determining the firm's worthiness of receiving debt and equity, respectively, there should be a relationship between the credit ratings and financial constraints. I create a measure for credit rating by grouping the S&P long term credit rating into ten categories. For example, AAA firms are recorded as a value of 1; AA+, AA, AA- firms are recorded as value of 2, A+,A,A- firms are recorded as a value of 3, and so on. Similarly, I create a measure for equity rating by grouping S&P's ranking on equity into nine groups with A+ firms receiving a value of 1, A firms receiving a value of 2, A- firms receiving a value of 3, and so on. In both these variables, a higher value means a worse rating. Furthermore, there is a distinction between firms that have a rating versus firms that do not. Firms without ratings are typically thought to be poor quality firms. Firm size is a popular measure for financially constrained firms. Total assets, TA, measure firm size. Market capitalization, MKEQT, measures total equity position of the firm and total long term debt, LTD, measures total debt position of the firm. Additionally, firms that pay dividends are also expected to be financially unconstrained in the literature. Binsbergen, Graham, and Yang (2010) estimate the equilibrium leverage usage for firms and calculate the total deadweight loss from deviating from that equilibrium. Financially constrained firms should be farther from their equilibrium leverage or face higher costs to being away from equilibrium.[13] Next, I check whether firms that are more financially constrained are indeed

[13] See Binsbergen, Graham, and Yang (2010). The logic follows that firms perceive themselves as more constrained by equity or debt financing concerns when they would like to invest or be at a particular capital

investing less due to unavailability of funds. I/A is capital expenditure over total book assets. R&D reflects the total investment in research and development, R&D /A controls for firm size, and R&D growth examines the one-period growth in R&D funding. Similarly, cash flow, cash flow / A, and cash flow growth reflects the level of cash flow, the ratio of cash flow to assets, and the one-period growth in cash flows, respectively. Finally, capital structure adjustments such as equity issuance, debt issuance, equity reduction, and debt reductions are examined.

The first three columns of Table 6 sort on the overall financing constraint measure, $FC_{i,t}$. As expected, the results indicate that, compared to unconstrained firms, constrained firms have worse credit ratings, equity rankings, and are less likely to have ratings. Furthermore, constrained firms have lower total assets, market capitalization, and long term debt. That is, constrained firms are smaller in asset size and have smaller equity and debt positions. Additionally, constrained firms tend to be dividend paying firms and face higher costs for not operating at the equilibrium leverage indicated by the Binsbergen, Graham, and Yang (2010) model. Next, constrained firms do invest less, with an investments to asset ratio of 5.3%, compared to the 7.7% investments to asset ratio of unconstrained firms. Likewise, constrained firms invest less in research and development in levels. However, R&D expenses as a ratio of assets is increasing and R&D growth appears level for constrained and unconstrained firms. Constrained firms are also more likely to have lower cash flows and low or negative cash flow growth. Finally, constrained firms issue less debt, pay back less debt, and repurchase less equity, but issue more equity. These findings are largely consistent with characteristics believed of financially constrained firms and validates $FC_{i,t}$ as measuring overall financial constraints. The middle three columns of Table 6 sort on $\Lambda_{i,t+1}$ and the last three columns sort on $\Gamma_{i,t}$. They follow the same patterns observed with $FC_{i,t}$.

5.2.2 Two-way Sorts

To further examine the impact of $\Lambda_{i,t+1}$ and $\Gamma_{i,t}$ on investment and the overall financing constraint, $FC_{i,t}$, I perform two-way conditional sorts on the three financing constraint measures and present them in Table 7. In particular, I look at the mean of capital expenditure (I/A), and the means of the three financing constraint measures.

In panel A of Table 7, I first sort $\Lambda_{i,t+1}$ (across the columns) into three bins (LOW, MED, and HIGH). Then, within each bin I sort on $\Gamma_{i,t}$ (down the rows). The first block of results in panel A presents the mean investment to asset ratio for each bin. Within each

structure, but cannot. Firms that face low costs to being out of equilibrium should either be close to it or the cost is not high enough for firms to be too concerned.

$\Lambda_{i,t+1}$ bin (i.e., controlling for the status of being equity constrained), as we move from the LOW to HIGH $\Gamma_{i,t}$ firms, not surprisingly, investment to assets decrease. However, as we move from the LOW to HIGH $\Lambda_{i,t+1}$ bins, LOW $\Gamma_{i,t}$ firms appear to have almost constant investments between the LOW and MED bins and only slightly decreasing in the HIGH bin. However, HIGH $\Gamma_{i,t}$, are firms increasingly prohibited from investment across $\Lambda_{i,t+1}$ bins. These results make intuitive sense in that despite being constrained in equity, being unconstrained in debt allows them flexibility to invest. It is when both equity and debt are constrained that firms can no longer invest. This suggest that the limiting factor on investment is the debt constraint and not the equity constraint.

The second block of results present the mean values of $\Lambda_{i,t+1}$. By construction, $\Lambda_{i,t+1}$ increases across the columns. However, the values are only slightly increasing down the rows. This confirms that the correlation between $\Lambda_{i,t+1}$ and $\Gamma_{i,t}$ is not perfect; indeed recall that the correlation between the two measures is only 62.38%, as shown in Table 4. The third block of results present the mean values of $\Gamma_{i,t}$. By construction, $\Gamma_{i,t}$ increases down the rows and, by the positive correlation with the intertemporal equity constraint, is increasing across the columns. The last block of results present the mean values of $FC_{i,t}$, the overall financing constraint.

Since two-way sorts are sensitive to the order of sorting, in panel B of Table 7, I first sort on $\Gamma_{i,t}$ and then on $\Lambda_{i,t+1}$. As we move from the LOW to HIGH $\Gamma_{i,t}$ bins, notice that the relationship between $\Lambda_{i,t+1}$ and I/A changes. Within the LOW $\Gamma_{i,t}$ bin, as we move from the LOW to HIGH $\Lambda_{i,t+1}$ bin, firms actually increase their investments slightly or remain relative constant (HIGH-LOW difference of +0.003). Within the MED $\Gamma_{i,t}$ bin, as we move from low to high equity constrained firms, firms decrease their investment slight or again remain for the most part constant (HIGH-LOW difference of -0.004). It is only within the HIGH $\Gamma_{i,t}$ bin that we see a decrease in investments as firms become more equity constrained (HIGH-LOW difference of -0.012). This indicates that when firms are not debt constrained, being equity constrained alone is not binding. It is only when firms are debt constrained that being equity constrained is additionally constraining.

The results in panels A and B of Table 7 suggest two things: 1) being equity constrained does carry additional information not in $\Gamma_{i,t}$ and both contribute to being overall constrained, and 2) investment is decreasing when firms become debt constrained regardless of the status of equity constraints, but investments decrease as equity constraints increase only when firms are already debt constrained. This confirms the implication that debt constraints are the limiting constraint. That is, when the relative debt to equity constraint is not binding, the intertemporal equity constraint ratio does not bind. However, when $\Gamma_{i,t}$ is binding, $\Lambda_{i,t+1}$

does add additional pressure to the overall constraint. In summary, the limiting financing constraint that firms face is the contemporaneous debt to equity constraint ratio ($\Gamma_{i,t}$), not the intertemporal equity constraint ratio ($\Lambda_{i,t+1}$ or $\Lambda_{i,t+1}$). These results indicate that all else equal, preserving debt capacity and financial slack is a major corporate concern since debt is the last resort security. That is, when debt is constrained, firms act as if they are constrained overall, yet when equity is constrained, firms can still turn to debt. The financial slack story adds insight on why empirically firms use less debt than hypothesized based on tax benefits. That is, a model with debt capacity restrictions and financial slack considerations appear to describe the observed financing behaviors of firms fairly well.

6 Conclusion

The link between financing constraints and investment is a well studied one, as is the link between investment and capital structure. However, existing literature tends to focus on one or the other or remains on a theoretical discussion. This paper attempts to empirically study both effects jointly and measures the financing constraint for intertemporal equity financing and contemporaneous debt to equity financing. Firm specific financing constraint measures are empirically estimated using GMM based on a structural model with equity and debt restrictions. The resulting measures are used to examine firm financing behavior. I find that the estimated financing constraint measures capture observed corporate financing behavior. Using the two financing constraint measures for debt and equity, I propose an overall constraint measure that captures features expected of financially constrained firms. I find that between the intertemporal equity constraint ratio and the contemporaneous capital structure constraint ratio, the latter is the limiting constraint faced by firms due to a concern for preserving financial slack. A model with separate financing constraints for equity and debt provides an explanation of observed capital structure decisions by capturing corporate concerns for preserving financial slack. This suggests that the driving factor of being financially constrained is restrictions to debt and the two may be synonymously linked.

Subsequent work involves taking several novel and natural directions. First, the results in the paper have clear policy implications. Directives that expand (contract) debt capacities and promote (hinder) efficient management of financial flexibility can be explored for their impacts on capital structure and investment choices both at the government and corporate levels. Studying such policy effects would contribute to more efficient financial dynamics among and within firms. Second, the debate between whether firms follow an optimal leverage ratio or the pecking order theory is ongoing. My model provides a potential explanation of capital structure under a tradeoff theory framework that can exhibit pecking order for certain firms. Specifically, firms that are not sensitive to debt capacity may act according to pecking order theory and firms that are sensitive to debt capacity may act according to the static tradeoff theory. It would be interesting to test various capital structure theories under the framework in my model. Finally, a number of papers in the financial constraints literature asks the question whether financing constraints are priced in the equity market and find mixed results. Likewise a number of papers in the capital structure literature asks the question whether leverage ratios explain returns, also with mixed results. The finding in this paper suggest that these are not two separate empirical puzzles, but one underlying puzzle. The endogeneity and potential substitutability between not only debt and equity but also investing today versus tomorrow could be confounding the results seen in the literature.

References

Almeida, H., Campello, M., and M. Weisbach, 2004, The Cash Flow Sensitivity of Cash, *Journal of Finance*, 59, 1777-1804.

Altman, E., 1968, Financial Ratios, Discriminant Analysis, and the Prediction of Corporate Bankruptcy, *Journal of Finance*, 23, 4, 589-609.

van Binsbergen, J.H., Graham, J.R., and J. Yang, 2010, The Cost of Debt, *Journal of Finance*, 65, 6.

Brav, Alon, John R. Graham, Campbell R. Harvey, and Roni Michaely, 2005, Payout policy in the 21st century, *Journal of Financial Economics* 77, 483-527.

Cleary, S., 1999, The Relationship between Firm Investment and Financial Status, *Journal of Finance*, 54, 2, 673-692.

Fama, E. and K. French, 2002, Does the Source of Capital Affect Capital Structure? *Review of Financial Studies*, 19, 45-75.

Faulkender, M. and M.A.A. Petersen, 2006, Does the Source of Capital Affect Capital Structure? *Review of Financial Studies*, 19, 45-75.

Fazzari, S.M., R.G. Hubbard, and B.C. Petersen, 1988, Financing constraints and coporate investment, *Brookings Papers on Economic Activity*, 1, 141-206.

Frank, Murray Z., and Vidhan K. Goyal, 2009, Capital structure decisions: Which factors are reliably important?, *Financial Management* 38, 1-37.

Gomes, J.F., Yaron, A., and L. Zhang, 2006, Asset Pricing Implications of Firms' Financing Constraints, *Review of Financial Studies*, 19, 1321-1356.

Graham, J.R., and C. Harvey, 2001, The Theory and Practice of Corporate Finance: Evidence from the Field, *Journal of Financial Economics* 60, 187-243.

Graham, J.R., 2000, How big are the tax benefits of debt? *Journal of Finance*, 55, 1901-1941.

Hennessey C. and T. Whited, 2005, Debt Dynamics, *Journal of Finance*, 60, 1129-1165.

Jensen, M.C., 1986, The Agency Costs of Free Cash Flow: Corporate Finance and Takeovers, *American Economic Review*, 76, 2, 323-329.

Jensen, M.C. and W.H. Meckling, 1976, Theory of the Firm: Managerial behaviour, agency costs and ownership structure, *Journal of Financial Economics*, 4, 305-360.

Kaplan, S. and L. Zingales, 1997, Do Financing Constraints Explain Why Investment is Correlated with Cash Flow, *Quarterly Journal of Economics*, 112, 169-215.

Kisgen, D.J., 2006, Credit Ratings and Capital Structure, *Journal of Finance*, 61, 1035-1072.

Korajczyk, R.A. and A. Levy, 2003, Capital Structure Choice: Macroeconomic Conditions and Financial Constraints, *Journal of Financial Economics*, 68, 1.

Livdan, D., Sapriza, H., and L. Zhang, 2009, Financially Constrained Stock Returns, *Journal of Finance*, 64, 1827-1862.

Michaely, R., Thaler, R., and K. Womack, 2000, Price Reactions to Dividend Initiations and Omissions: Overreaction or Drift?, *Journal of Finance*, 50, 2, 573-606.

Modigliani F., and M.H. Miller, 1958, The Cost of Capital, Corporation Finance, and the Theory of Investment, *American Economic Review*, 48, 3, 261-297.

Myers, S.C., 1977, The Determinants of Corporate Borrowing, *Journal of Financial Economics*, 5, 147-175.

Opler, T., Pinkowitz, L., Stulz, R., and R. Williamson, 2001, Corporate Cash Holdings, *Journal of Applied Corporate Finance* 14, 8-19.

Petersen, M., 2008, Estimating Standard Errors in Finance Panel Data Sets: Comparing Approaches, *Review of Financial Studies*, 21.

Rampini, A.A. and S. Viswanathan, 2009, Collateral and Capital Structure, *working paper*

Whited, T., 1992, Debt, Liquidity Constraints, and Corporate Investment: Evidence from Panel Data, *Journal of Finance*, 47, 1425-1460.

Whited, T., and G. Wu, 2006, Financial Constraints Risk, *Review of Financial Studies*, 19, 531-559.

Appendix A

In this appendix, I detail the construction of the variables used in the paper. Numbers in parentheses indicate the corresponding COMPUSTAT annual industrial data items in their legacy database. All variables are obtained from the S&P COMPUSTAT database with the exception of ILLIQ and ANEST, which come from Center for Research in Security Price (CRSP) and Thompsons I/B/E/S respectively.

Output, Y	$= \frac{\text{Net Sales (12)}}{\text{Total Assets (6)}}$
Cost of goods sold, C	$= \frac{\text{Cost of Goods Sold (41)}}{\text{Total Assets (6)}}$
Capital stock (beginning of period), K	$= lag\left(\frac{\text{Property, Plant, and Equipment - Gross (7)}}{\text{Total Assets (6)}}\right)$
Capital expenditure, I	$= \frac{\text{Capital Expenditure (128)}}{\text{Total Assets (6)}}$
Debt (beginning of period), B	$= lag\left(\frac{\text{Long-term Debt - Total (9)}}{\text{Total Book Assets}}\right)$
Risk-free Rate, r	= Annualized 1-month Treasury bill
Dividend paying firms, DDIV	$= \begin{cases} 1 & \text{if Common Dividends (21)} > 0 \\ 0 & \text{if Common Dividends (21)} = 0 \end{cases}$
Collateral, COL	$= \frac{\text{Total Inventories (3) + Net Plants, Property, and Equipment (8)}}{\text{Total Assets (6)}}$
Long-term debt, LEV	$= \frac{\text{Long-term Debt - Total (9)}}{\text{Total Assets (6)}}$
Industry debt (3 digit SIC), INDLEV	$= \frac{\sum_{i \in \text{SIC3 Industry}}^{N} \text{Long-term Debt - Total (9)}}{\sum_{i \in \text{SIC3 Industry}}^{N} \text{Total Book Assets}}$
Cash flow, CF	$= \frac{\text{Operating Income Before Depreciation (13)}}{\text{Total Assets (6)}}$
Cash flow volatility (3 year), CFVOL	$= \frac{\text{Standard Deviation}\{CF_{i,t}, CF_{i,t-1}, CF_{i,t_2}\}}{\text{Mean}\{CF_{i,t}, CF_{i,t-1}, CF_{i,t-2}\}}$
Cash stock, CASH	$= \frac{\text{Cash and Short Term Investments (1)}}{\text{Total Assets (6)}}$
Liquidation ratio, LIQV	$= \frac{\text{Common Equity - Liquidation Value (235) + Preferred Stock - Liquidation Value (10)}}{\text{Total Assets (6)}}$
Illiquidity, ILLIQ	$= \frac{\text{ASK - BID}}{\text{PRC}}$
Number of analyst estimates, ANEST	= Number of all analyst estimates made for firm i for time t.
Book equity to market equity, BTM	$= \frac{\text{Total Common Equity (60)}}{\text{Fiscal Year Close Price (199) * Common Shares Outstanding (54)}}$

S&P credit rating, SPCR	= S&P Current Long-Term Debt Rating (280) organized into ten groups: 1=AAA, 2=AA, 3=A, 4=BBB, 5=BB, 6=B, 7=CCC, 8=CC, 9=C, 10=D
S&P equity ranking, SPSR	= S&P Common Stock Ranking (282) organized into nine groups: 1=A+, 2=A, 3=A-, 4=B+, 5=B, 6=B-, 7=C, 8=D, 9=LIQ
Altman's ZSCORE	$= \frac{\text{3.3*Pretax Income (170) + 1.0*Net Sales (12) + 1.4*Retained Earnings (36) + 1.2*Working Capital (179)}}{\text{Total Assets (6)}}$

Table 1: Summary statistics of variables used in Euler equations (9) and (10). Y is the output of the firm expressed as sales over total book assets, C is cost of goods sold over total book assets, K is the beginning of the period capital stock over book assets, I is capital expenditures over total book assets, and B is the beginning of the period long term debt over book assets. r is the annualized one month Treasury bill, δ is the firm specific depreciation rate defined as two times the total depreciation expense over K, and θ is the ratio of the liquidation value over total asset value. LTA is the log of total assets, DDIV is a indicator for dividend paying firms, COL is plants, properties, and equipment plus inventories over total book assets, LEV is the firm's long term debt over total book assets, INDLEV is the industry's total long term debt over total book assets, CF is the firm's cash flow over total book assets, CFVOL is the five year trailing standard deviation of cash flows divided by the five year trailing mean of cash flows, CASH is cash holdings over total book assets, LIQV is the liquidation value of the firm over total book assets, ILLIQ is the bid-ask spread on the firm's equity over the stock price, ANEST is the number of analyst estimates, and BTM is the ratio of book equity to market equity. Appendix A provides detailed definitions on each variable.

	No. Obs.	Mean	Std. Dev.	Min	Med	Max
r	25204	0.050	0.019	0.010	0.052	0.084
δ	25204	0.159	0.077	0.054	0.142	0.435
θ	25204	0.516	0.187	0.125	0.504	0.913
Y/K	25204	3.565	4.016	0.287	2.470	21.232
C/K	25204	2.419	3.109	0.096	1.556	16.292
I/K	25204	0.136	0.128	0.010	0.103	0.623
$(I/K)^2$	25204	0.035	0.128	0.000	0.011	0.388
$(I/K)^3$	25204	0.018	0.196	0.000	0.001	0.242
B/K	25204	0.316	0.398	0.000	0.216	2.066
$(B/K)^2$	25204	0.258	0.940	0.000	0.047	4.267
$(B/K)^3$	25204	0.404	3.011	0.000	0.010	8.815
Log of Total Assets (LTA)	25203	5.783	2.149	1.502	5.658	10.778
Dividend Dummy (DDIV)	25203	0.606	0.489	0	1	1
Collateral (COL)	25203	0.526	0.199	0.066	0.539	0.922
Long-term Debt Ratio (LEV)	25183	0.157	0.136	0.000	0.138	0.535
Industry LTD Ratio (INDLEV)	25072	0.197	0.079	0.050	0.183	0.424
Cash Flow (CF)	25081	0.138	0.085	-0.095	0.137	0.351
Cash Flow Volatility (CFVOL)	24885	0.409	0.687	0.018	0.207	3.867
Cash Holding (CASH)	25201	0.116	0.140	0.000	0.061	0.636
Liquidation Value (LIQV)	25204	0.516	0.187	0.125	0.504	0.913
Bid-Ask Spread (ILLIQ)	21859	0.102	0.324	-1.976	0.112	0.691
Number of Analyst Estimates (ANEST)	25204	22.131	34.184	0	6	150
Book-to-Market (BTM)	23610	0.734	0.549	0.091	0.589	2.875

Table 2: Initial GMM estimation of Euler equations (7) and (8). The financing constraints are parameterized as follows: $\Lambda_{i,t+1} = l_0$ and $\Gamma_{i,t} = g_0$. μ is the cost markup factor, a's are the parameters on the adjustment cost of capital, and b's are the parameters on the firm specific interest rate. l_0 is the parameter on $\Lambda_{i,t+1} \equiv \frac{\lambda_{i,t+1}-\lambda_{i,t}}{1+\lambda_{i,t}}$, the financing constraint on equity tomorrow relative to equity today, where $\lambda_{i,t}$ is the shadow value on the equity financing constraint in equation (5). g_0 is the parameter on $\Gamma_{i,t} \equiv \frac{\gamma_{i,t}}{1+\lambda_{i,t}}$, the financing constraint on debt today relative to equity today, where $\gamma_{i,t}$ is the shadow value on the debt financing constraint in equation (6). The moment conditions are defined as in equation (11). Instruments include lagged versions of all variables in the model. Column (i) estimates the model under the assumption that there are no financing constraints ($\Lambda_{i,t+1} \equiv 0$ and $\Gamma_{i,t} \equiv 0$). Column (ii) estimates the model under the assumption that equity financing is constrained, but debt financing is not ($\Gamma_{i,t} \equiv 0$). Column (iii) estimates the model under the assumption that debt financing is constrained, but equity financing is not ($\Lambda_{i,t+1} \equiv 0$). Column (iv) estimates the model assuming that both equity and debt financing are constrained. GMM standard errors are given in the parentheses. Significance at the 10% level is indicated by *, 5% level by **, and 1% level by ***.

	(i)			(ii)			(iii)			(iv)		
μ	1.435	(0.043)	***	1.453	(0.049)	***	1.397	(0.033)	***	1.416	(0.043)	***
a_1	0.951	(0.208)	***	0.979	(0.155)	***	0.736	(0.200)	***	0.434	(0.127)	***
a_2	-0.355	(0.094)	***	-0.396	(0.070)	***	-0.264	(0.089)	***	-0.172	(0.054)	***
b_1	0.081	(0.006)	***	0.047	(0.005)	***	0.054	(0.005)	***	0.033	(0.006)	***
b_2	-0.020	(0.003)	***	-0.020	(0.003)	***	-0.020	(0.003)	***	-0.020	(0.004)	***
l_0				-0.027	(0.005)	***				-0.082	(0.012)	***
g_0							0.009	(0.001)	***	0.111	(0.011)	***

Table 3: Full GMM estimation of Euler equations (7) and (8). The financing constraints are parameterized as in equation (12) for $\Lambda_{i,t+1}$ and as in equation (13) for $\Gamma_{i,t}$. μ is the cost markup factor, a's are the parameters on the adjustment cost of capital, and b's are the parameters on the firm specific interest rate. l's are the parameters on $\Lambda_{i,t+1} \equiv \frac{\lambda_{i,t+1}-\lambda_{i,t}}{1+\lambda_{i,t}}$, the financing constraint on equity tomorrow relative to equity today, where $\lambda_{i,t}$ is the shadow value on the equity financing constraint in equation (5). g's are the parameter on $\Gamma_{i,t} \equiv \frac{\gamma_{i,t}}{1+\lambda_{i,t}}$, the financing constraint on debt today relative to equity today, where $\gamma_{i,t}$ is the shadow value on the debt financing constraint in equation (6). The moment conditions are defined as in equation (11). Instruments include lagged versions of all variables in the model. GMM standard errors are given in the parentheses. Significance at the 10% level is indicated by *, 5% level by **, and 1% level by ***.

	GMM Estimation		
μ	1.472	(0.024)	***
a_1	-0.155	(0.065)	***
a_2	0.066	(0.031)	**
b_1	0.039	(0.005)	***
b_2	-0.012	(0.002)	***
l_1: Log of Total Assets (LTA)	-0.246	(0.047)	***
l_2: Dividend Dummy (DDIV)	0.035	(0.019)	*
l_3: Collateral (COL)	0.010	(0.019)	
l_4: Long-term Debt Ratio (LEV)	-0.004	(0.008)	
l_5: Industry LTD Ratio (INDLEV)	0.035	(0.008)	***
l_6: Cash Flow (CF)	0.001	(0.009)	
l_7: Cash Flow Volatility (CFVOL)	-0.002	(0.003)	
l_8: Cash Holding (CASH)	0.021	(0.010)	**
l_9: Liquidation Value (LIQV)	-0.024	(0.013)	*
l_{10}: Bid-Ask Spread (ILLIQ)	0.064	(0.009)	***
l_{11}: Number of Analyst Estimates (ANEST)	-0.054	(0.008)	***
l_{12}: Book-to-Market (BTM)	0.050	(0.009)	***
g_1: Log of Total Assets (LTA)	-0.091	(0.024)	***
g_2: Dividend Dummy (DDIV)	0.047	(0.020)	***
g_3: Collateral (COL)	-0.033	(0.014)	***
g_4: Long-term Debt Ratio (LEV)	-0.003	(0.009)	
g_5: Industry LTD Ratio (INDLEV)	-0.032	(0.010)	***
g_6: Cash Flow (CF)	0.014	(0.008)	*
g_7: Cash Flow Volatility (CFVOL)	-0.006	(0.004)	
g_8: Cash Holding (CASH)	-0.023	(0.009)	***
g_9: Liquidation Value (LIQV)	0.033	(0.013)	***
g_{10}: Bid-Ask Spread (ILLIQ)	-0.083	(0.010)	***
g_{11}: Number of Analyst Estimates (ANEST)	0.029	(0.007)	***
g_{12}: Book-to-Market (BTM)	-0.014	(0.008)	*

Table 4: Summary statistics of the financing constraint indices provided by equations (14), (15), and (17). $\Lambda_{i,t+1} \equiv \frac{\lambda_{i,t+1}-\lambda_{i,t}}{1+\lambda_{i,t}}$ is the financing constraint on equity tomorrow relative to equity today, where $\lambda_{i,t}$ is the shadow value on the equity financing constraint in equation (5). $\Gamma_{i,t} \equiv \frac{\gamma_{i,t}}{1+\lambda_{i,t}}$ is the financing constraint on debt today relative to equity today, where $\gamma_{i,t}$ is the shadow value on the debt financing constraint in equation (6). $FC_{i,t} \equiv \Lambda_{i,t+1} + \Gamma_{i,t}$ is a measure that captures the overall degree of being financially constrained. Panel A provides the summary statistics. Panel B provides the frequency tabulation from sorting $\Lambda_{i,t+1}$ and $\Gamma_{i,t}$ into three bins individually and separately.

Panel A

	No. Obs.	Mean	Std. Dev.	Min	Med	Max
$\Lambda_{i,t+1} = \frac{\lambda_{i,t+1}-\lambda_{i,t}}{1+\lambda_{i,t}}$	109017	0.013	0.283	-0.718	0.044	0.569
$\Gamma_{i,t} = \frac{\gamma_{i,t}}{1+\lambda_{i,t}}$	105363	0.029	0.124	-0.238	0.025	0.354
$\text{FC}_{i,t} = \Gamma_{I,t} + \Lambda$	105352	0.014	0.361	-0.838	0.040	0.752

Panel B

	$\text{corr}_{\Lambda,\Gamma} = 0.6238$	$\Lambda_{i,t+1}$ LOW	$\Lambda_{i,t+1}$ MED	$\Lambda_{i,t+1}$ HIGH
$\Gamma_{i,t}$	LOW	21,381	11,291	2,435
	MED	9,563	14,174	11,382
	HIGH	4,182	9,654	21,290

Table 5: Probit analysis of debt and equity issuance and reduction on the lagged financing constraint of equity, $\Lambda_{i,t+1}$ and the lagged financing constraint of debt, $\Gamma_{i,t}$ as in equation (16). Debt issuance is an indicator for active issuance of long term debt. Similarly, equity issuance, debt reduction, and equity reduction are indicators for having issued equity, reduced long term debt, and repurchased shares, respectively. Standard errors clustered by firm are given in the parentheses. Significance at the 10% level is indicated by *, 5% level by **, and 1% level by ***.

	(i)	(ii)	(iii)	(iv)
	Panel A) Pure Equity Issuance (0 = 2,655 obs, 1 = 7,408 obs)			
Λ (Equity)	-1.665 ***		-1.770 ***	
	(0.305)		(0.378)	
Γ (Debt)		-1.625 ***	0.208	
		(0.438)	(0.549)	
FC (Overall)				-1.063 ***
				(0.192)
Constant	0.935 ***	0.887 ***	0.919 ***	0.969 ***
	(0.077)	(0.074)	(0.081)	(0.078)
	Panel B) Pure Debt Issuance (0 = 2,655 obs, 1 = 938 obs)			
Λ (Equity)	-1.831 ***		-1.210 ***	
	(0.321)		(0.396)	
Γ (Debt)		-3.107 ***	-1.634 ***	
		(0.571)	(0.693)	
FC (Overall)				-1.351 ***
				(0.213)
Constant	-0.640	-0.596 ***	-0.573 ***	-0.580 ***
	(0.094)	(0.092)	(0.092)	(0.093)
	Panel C) Pure Equity Reduction (0 = 2,655 obs, 1 = 1,166)			
Λ (Equity)	-0.599		-0.656	
	(0.322)		(0.393)	
Γ (Debt)		-0.534	0.161	
		(0.484)	(0.588)	
FC (Overall)				-0.380
				(0.220)
Constant	-0.178	-0.218 ***	-0.188 *	-0.170
	(0.095)	(0.095)	(0.099)	(0.101)
	Panel D) Pure Debt Reduction (0 = 2,655 obs, 1 = 5,333)			
Λ (Equity)	-0.634 ***		0.160	
	(0.252)		(0.318)	
Γ (Debt)		-1.652 ***	-1.814 ***	
		(0.355)	(0.470)	
FC (Overall)				-0.587 ***
				(0.164)
Constant	0.565 ***	0.627 ***	0.616 ***	0.618 ***
	(0.074)	(0.066)	(0.071)	(0.074)

Table 6: One-way sorts on the three financial constraint measures into three (LOW, MED, HIGH) bins. The first three columns sort on the overall financing constraint, $FC_{i,t}$. The middle three columns sort on the equity constraint tomorrow relative to the equity constraint today, $\Lambda_{i,t+1}$. The last three columns sort on the debt to equity constraint, $\Gamma_{i,t}$. SPCR is the S&P credit rating on long term debt grouped into ten categories where {1=AAA, 2=AA, 3=A, 4=BBB, 5=BB, 6=B, 7=CCC, 8=CC, 9=C, 10=D}, SPSR is the S&P equity ranking grouped into nine categories where {1=A+, 2=A, 3=A-, 4=B+, 5=B, 6=B-, 7=C, 8=D, 9=LIQ}. The means of the variables for each sorting bin are presented.

	Sort on $FC_{i,t}$			Sort on $\Lambda_{i,t+1}$			Sort on $\Gamma_{i,t}$		
	LOW	MED	HIGH	LOW	MED	HIGH	LOW	MED	HIGH
SPCR	3.794	5.194	6.031	3.713	5.100	5.892	4.027	3.937	4.157
SPSR	4.623	5.445	5.998	4.545	5.473	6.060	5.044	5.283	5.710
Has Credit Rating	0.606	0.104	0.003	0.567	0.135	0.011	0.529	0.168	0.016
Has Stock Ranking	0.848	0.849	0.798	0.854	0.846	0.795	0.825	0.858	0.812
Total Assets	7069.688	319.903	48.581	7020.773	360.087	57.258	6057.463	1195.942	183.688
Market Cap	9183.164	380.780	55.039	9225.049	346.016	47.958	6410.490	2623.976	582.240
Long-term Debt	1350.914	56.530	5.559	1325.136	78.149	9.950	1263.292	138.445	10.961
Dividend Paying Status	0.662	0.435	0.282	0.672	0.435	0.272	0.595	0.452	0.332
Total Deadweight Loss	0.013	0.020	0.025	0.012	0.020	0.026	0.018	0.018	0.022
Investments/Assets	0.077	0.070	0.053	0.075	0.069	0.056	0.080	0.068	0.052
R&D	170.761	8.036	1.874	172.020	6.992	1.660	103.466	64.603	12.528
R&D / Assets	0.033	0.048	0.063	0.030	0.033	0.045	0.015	0.038	0.054
R&D Growth	0.114	0.139	0.106	0.123	0.143	0.092	0.076	0.143	0.126
Cash Flow	1081.138	42.300	4.482	1078.938	44.535	4.445	880.636	212.129	34.938
Cash Flow / Assets	0.152	0.127	0.067	0.159	0.129	0.059	0.126	0.123	0.099
Cash Flow Growth	0.132	0.071	-0.098	0.142	0.083	-0.122	0.077	0.067	-0.038
Debt Issuance	423.253	29.956	4.689	415.227	35.921	6.740	385.475	64.893	7.491
Debt Reduction	359.228	29.589	5.024	352.850	34.044	6.940	324.933	60.544	8.328
Equity Issuance	55.577	6.307	1.284	55.743	6.184	1.242	40.007	18.438	4.705
Equity Reduction	190.127	6.905	0.646	190.636	6.466	0.577	135.544	50.038	12.035

Table 7: Two-way (conditional) sorts on $\Lambda_{i,t+1}$ and $\Gamma_{i,t}$ into three bins (LOW, MED, HIGH) each. Panel A sorts first on $\Lambda_{i,t+1}$ and second on $\Gamma_{i,t}$. Panel B sorts first on $\Gamma_{i,t}$ and then on $\Lambda_{i,t+1}$. $\Lambda_{i,t+1}$ is the adjusted inverse of the intertemporal equity financing constraint, i.e., the relative constraint between equity tomorrow and equity today. $\Gamma_{i,t}$ is the contemporaneous debt to equity constraint, e.g., the relative constraint between debt today and equity today. Across each panel, the first block of results presents the mean of the investment to assets ratio (I/A), the second block presents the mean of $\Lambda_{i,t+1}$, the third block presents the mean of $\Gamma_{i,t}$, and the last block presents the mean of the overall financing constraint, $FC_{i,t}$.

Panel A: Down: $\Gamma_{i,t}$, Across: $\Lambda_{i,t+1}$

	I/A				$\Lambda_{i,t+1}$				Γ				$FC_{i,t}$			
	LOW	MED	HIGH	MEAN	LOW	MED	HIGH	MEAN	LOW	MED	HIGH	MEAN	LOW	MED	HIGH	MEAN
LOW	0.082	0.081	0.070	0.078	-0.346	-0.003	0.211	-0.046	-0.147	-0.077	0.008	-0.072	-0.494	-0.081	0.219	-0.119
MED	0.076	0.070	0.053	0.066	-0.298	0.008	0.239	-0.017	-0.045	0.021	0.119	0.031	-0.343	0.029	0.358	0.014
HIGH	0.068	0.057	0.044	0.056	-0.273	0.033	0.300	0.020	0.043	0.104	0.230	0.126	-0.230	0.137	0.530	0.146
MEAN	0.075	0.069	0.056		-0.306	0.013	0.250		-0.050	0.016	0.119		-0.356	0.028	0.369	

Panel B: Down: $\Lambda_{i,t+1}$, Across: $\Gamma_{i,t}$

	I/A				$\Lambda_{i,t+1}$				Γ				$FC_{i,t}$			
	LOW	MED	HIGH	MEAN	LOW	MED	HIGH	MEAN	LOW	MED	HIGH	MEAN	LOW	MED	HIGH	MEAN
LOW	0.078	0.070	0.058	0.069	-0.440	-0.276	-0.022	-0.246	-0.112	0.020	0.115	0.007	-0.552	-0.256	0.093	-0.239
MED	0.081	0.069	0.050	0.067	-0.165	-0.011	0.191	0.005	-0.095	0.026	0.149	0.026	-0.260	0.015	0.340	0.031
HIGH	0.081	0.066	0.046	0.064	0.064	0.179	0.347	0.197	-0.079	0.033	0.200	0.051	-0.014	0.212	0.547	0.248
MEAN	0.080	0.068	0.052		-0.180	-0.036	0.172		-0.095	0.026	0.154		-0.276	-0.010	0.327	