Is Cash Negative Debt?*

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This Draft: September 7, 2004

Abstract

We model a firm's decision to allocate excess cash flows to cash holdings versus debt reductions in the presence of financing constraints. Our model shows that holding cash allows firms to hedge against the effect of future cash flow shortfalls on constrained investment, but that reducing current leverage is a more effective way to increase investment in future states of nature in which cash flows are high. This trade-off in the cash–debt decision generates the prediction that constrained firms will prefer to allocate current cash flows into cash holdings if their hedging needs are high (that is, if the correlation between cash flows and the availability of new investment opportunities is low), but that the same constrained firms will use cash flows to reduce debt if their hedging needs are low. The empirical examination of (joint) debt and cash policies of a large sample of firms over the 1971-2001 reveals evidence that is consistent with our theory. In particular, we find that financially constrained firms with high hedging needs show a strong propensity to save cash out of excess cash flows, leaving their debt positions largely unchanged. Constrained firms with low hedging needs, in contrast, behave much alike financially unconstrained firms in that they strongly favor the use of excess cash flows towards debt redemption (they save debt capacity) and only at the margin allocate cash flow surpluses into their cash accounts. In general, our results show that cash is *not* always equal to negative debt: cash savings and debt repayments play a distinct role in the optimization of investment under financial constraints.

Key words: Cash holdings, debt policies, financing constraints, hedging, cash flow sensitivities.

JEL classification: G31.

1 Introduction

Standard valuation models used by practitioners and academics commonly treat cash as negative debt: the amount of cash held by the firm is simply subtracted from the value of debt outstanding in order to compute shareholders' stake in the firm. This practice reflects the belief that because cash can be used at any point in time to redeem debt, only net leverage should matter for shareholders. The standard valuation approach can also be justified by an "indifference" argument: shareholders should be indifferent between one extra dollar of cash and one less dollar of debt in the firm's balance sheet. Hence, a financial position with high debt and some cash is in principle equivalent to another one in which the entire stock of cash is used to repay debt. In one way or another, the view of cash as negative debt does not assign a significant economic role for cash holdings.

In contrast to this view, a number of studies in the recent literature argue that cash holdings are an important component of the firm's optimal financial structure. Among other results, these studies show that cash policies are correlated with firm value, growth opportunities, risk, and performance,[1] and that those policies are influenced by issues ranging from firm access to capital markets to the quality of laws protecting minority investors.[2] One interpretation of the results in this literature is that they broadly suggest that cash should not be seen as negative debt for a large fraction (possibly most) firms — cash may fulfil an economic role. As Opler, Pinkowitz, Stulz, and Williamson (1999) point out, however, most of the variables that are empirically associated with high cash levels are also known to be associated with low leverage. The findings that cash holdings are systematically related to variables such as growth opportunities and risk — although relevant in their own right — may therefore provide only an incomplete view of firms' policies towards cash and debt. Indeed, those findings cannot rule out the argument that firms simply regard cash as the negative of debt. In the words of Opler et al., (p. 44), "...it is important to figure out, both theoretically and empirically, to what extent cash holdings and debt are two sides of the same coin."

Our goal in this paper is to propose a testable theory of cash–debt substitutability in optimal financial policy. The starting point of our analysis is the observation that while traditional valuation models commonly assume that financing is frictionless, most real-world managers will argue that assessing investment funds in the capital markets is not always easy (Graham and Harvey (2001)). Indeed, contracting and information frictions often entail additional costs to external financing, which substantially affect the way in which firms conduct their optimal financial and investment

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[1]Some relevant papers are Harford (1999), Harford, Mikkelson, and Partch (2003), Mikkelson and Partch (2003), Pinkowitz, Stulz, and Williamson (2003), Faulkender and Wang (2004), and Pinkowitz and Williamson (2004).

[2]See Kim, Mauer, and Sherman (1998), Opler, Pinkowitz, Stulz, and Williamson (1999), Pinkowitz and Williamson (2001), Billett and Garfinkel (2002), Faulkender (2003a), Dittmar, Mahrt-Smith, and Servaes (2003), Kalcheva and Lins (2003), Almeida, Campello, and Weisbach (2004), and Harford, Mansi, and Maxwell (2004).

policies.[3] Building on this argument, we consider a framework in which cash–debt policies are integrated with real investment decisions; an approach that is largely missing from the literature. Under the financial constraints framework, we are then able to identify conditions under which cash is *not* the same as negative debt. By way of contrasting these conditions with a benchmark case in which financial constraints are absent, we are able to empirically assess how constrained firms optimally choose between cash and debt.

In a nutshell, our theoretical analysis considers a firm with some amount of existing leverage supported by assets in place, and a future investment opportunity that might not be fully undertaken because of financing constraints. We assume that there is uncertainty regarding both future cash flows and future investment opportunities, and we model the firm's decision to allocate a dollar of (excess) cash flows into cash balances and/or debt holdings. The benchmark case is that of a financially unconstrained firm. Unconstrained firms' future investment levels are generally independent of their funds policy; such a firm does not need to save internally to fund future profitable investment opportunities since all such opportunities will find funding in the capital markets. Because of this independence, and in the absence of other costs/benefits of carrying cash and reducing debt, our model predicts that for unconstrained firms it is a matter of indifference as to whether they use excess cash flows to increase cash or to lower debt. In contrast, a constrained firm's financial decision can be value-enhancing, since this firm's feasible investment depends crucially on future financing capacity. Crucially, *both* higher cash levels and low leverage may increase the constrained firm's financing capacity and thus its ability to invest in future. While high cash increases this ability directly, lower leverage increases future debt capacity and allows the firm to borrow more in case a profitable investment opportunity arises.

Our analysis shows that there is a simple trade-off guiding the constrained firm's choice between higher cash and lower debt. Because there is uncertainty in the cash flow process, financially constrained firms' investment may be severely compromised in those states of the world in which cash flows are *lower* than expected. Internal savings will be useful for investment optimization for those firms experiencing both low cash flows and limited access to external funds: cash will sustain (constrained) investment in those states. In particular, the effect of cash in future investment is *higher* than the corresponding effect of lower debt. This differential effect of cash and debt is driven by the fact that when cash flows are low debt is likely to be risky, and thus the constrained firm's additional debt capacity is very small. Hence, reducing current debt by one dollar increases future debt capacity in bad states by *less* than one dollar. In contrast, in states in which future cash

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flows are *higher* than expected, higher cash balances have a *lower* effect on financing capacity and investment than a corresponding reduction in outstanding debt. Again, this differential effect is driven by the riskiness of the debt. If debt is risky, its current value is supported mostly by future states of the world in which cash flows are high. Thus, reducing current debt by one dollar increases future debt capacity in those states by *more* than one dollar.

In sum, while cash holdings have a particularly strong effect on future financing capacity and investment in bad states of nature (poor cash flow realizations), debt reductions are a particularly effective way to boost investment in future states of nature in which cash flows are high. We show that because of this trade-off a constrained firm will prefer to save cash (as opposed to reducing debt) whenever the correlation between cash flows from existing assets and future investment opportunities is low enough. In these cases, the firm has valuable investment opportunities even in bad states of the world. Thus, the value of cash increases since cash increases investment precisely in those states. In contrast, if the correlation between cash flows and investment opportunities is high, the firm benefits more from debt reductions. In these cases, it is desirable to increase investment in good states of the world, since future investment opportunities are substantially more profitable in such states. The model thus predicts that if the correlation between cash flows and investment opportunities is low a constrained firm will prefer to use current cash flows to increase cash, but that the firm prefers to lower debt when this correlation is high.

The intuition for the theory's main result can also be understood in the hedging framework introduced by Froot, Scharfstein, and Stein (1993). Holding cash has hedging value for a constrained firm, because it allows it to invest more in states in which debt capacity is low. If the correlation between cash flows and investment opportunities is low, hedging needs are high, and thus the constrained firm has a preference towards holding cash. However, if profitable investment opportunities tend to arise in states in which cash flows are high, the benefit of hedging strategies is lower because the constrained firm has a "natural hedge."[4] The natural hedge decreases the value of cash holdings, and makes it more likely that the firm will prefer to concentrate investment in good states by reducing its current leverage.

In terms of our starting motivation, we propose that cash is *not* always equal to negative debt. However, this assertion begs some qualification. In particular, financially constrained firms with high hedging needs will strictly prefer positive cash to negative debt. For this type of firm, cash holdings have a significant economic role because cash allows the firm to bring future investment

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[4]Gay and Nam (1998) and Petersen and Thiagarajan (2000) also use the idea that firms whose investment opportunities are highly correlated with the source of cash flow risk are less likely to demand hedging. Their papers, however, focus on derivatives usage to measure hedging demand.

closer to efficient levels. In contrast, constrained firms with low hedging needs prefer having spare debt capacity, and thus prefer negative debt to positive cash. For these firms cash is not negative debt in the sense that they are also *not indifferent* between high cash and low debt. On the other hand, the model predicts that these firms do have a tendency to use cash flows to reduce debt. Furthermore, holding cash does not necessarily fulfill a substantial economic role for such firms. In this particular sense, cash *is* negative debt for them.

Regarding unconstrained firms, our model's prediction that they should be *indifferent* among a range of different cash and debt policies suggests that cash could indeed be treated as negative debt. However, this strict indeterminacy of financial policies only holds in the absence of other costs and benefits of cash and debt that are unrelated to financial constraints, such as the possibility that cash has a low yield because of a liquidity premium. We extend our model to allow for these additional factors in a stylized way, and we show that indeed an additional cost of cash (or a cost of retaining debt) translates naturally into a preference for using cash flows to reduce debt.[5] Importantly, the possibility that unconstrained firms display systematic preferences towards cash or debt does not hinder identification of the constrained model that we laid out above. The reason is that even if, for example, unconstrained firms prefer to use cash flows to reduce debt this preference should be *independent* of considerations about future financing capacity. Thus, unconstrained firms' cash and debt policies — whatever they are in practice — should *not* depend on their hedging needs (i.e., the correlation between cash flows and investment opportunities). Given our theory's key prediction about the effect of hedging needs on constrained firms' cash and debt policies, the lack of relationship between unconstrained policies and hedging needs provides us with an additional identification restriction. To wit, while constrained firms' propensity to direct cash flows into cash or debt should depend closely on the correlation between their cash flows and investment opportunities, such a relationship should *not* exist for financially unconstrained firms.

We evaluate the extent to which our theory's main predictions are born by the data using a large sample of manufacturing firms between 1971 and 2001. We estimate the simultaneous (within-firm) responses of cash and debt policies to cash flow innovations for various firm subsamples, partitioned both on the basis of the likelihood that firms have constrained/unconstrained access to external capital and on measures of the correlation between firms' cash flows and investment opportunities. In doing so, we consider four alternative firm characteristics in empirically identifying constrained and unconstrained subsamples: payout policy, asset size, bond ratings, and commercial paper ratings. To measure cash flow–investment opportunity correlations, we use a *firm*'s cash flow from

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[5]Of course, the reverse direction also holds. An additional net benefit of debt would induce unconstrained firms to prefer cash retention over debt reduction.

current operations and either its *industry-level* median R&D expenditures, median future (three-year ahead) sales growth, or changes in median Q. The reason for using industry measures of firms' investment opportunities is that such measures are exogenous to firms' internal cash flow processes, while firm-level measures could be contaminated by firms' ability to undertake their investment opportunities and thus by the degree of firm-level financing constraints.

We find robust, coherent results across all of our empirical tests. First, unconstrained firms do not display a significant propensity to save cash. Instead, they use cash flows to reduce the amount of debt that they carry into future periods. Noteworthy, as we suppose, this pattern holds *irrespective* of whether unconstrained firms have high or low hedging needs. When we look at constrained firms, we find that they display a markedly different pattern in the way they conduct their financial policies. In general, constrained firms do not use cash flows to reduce debt, but instead prefer using excess cash flows to increase cash holdings. Finally, and more importantly, we show that constrained firms' propensities to reduce debt and to increase cash are *strongly influenced* by the correlation between cash flows and investment opportunities. In other words, hedging needs drive the optimal balance between cash and debt policies for these firms. When this correlation is high (i.e., when hedging needs are low), constrained firms behave somewhat similarly to unconstrained ones: they show a propensity to use excess cash flows to reduce the amount of debt they carry into future periods, and a relatively weaker cash flow sensitivity of cash holdings. When constrained firms have high hedging needs, however, they display a strong preference for saving cash (their cash–cash flow sensitivities are highly significant and far exceed those of any other group) and show no propensity to pay down their debt (their debt–cash flow sensitivities are uniformly higher than that of any other group). These results are entirely consistent with the predictions of our model.

Our paper is related to several strands of literature and it is important that we establish the marginal contribution of our study. We have already discussed above the literature on cash policies. The main contribution of our paper to that literature is that we model both cash and debt policy in an integrated framework; this allows us to differentiate cash and negative debt in the presence of financial frictions. In particular, we isolate theoretically and empirically one element that affects the cash and debt policies of financially constrained firms in a different way, namely the correlation between future cash flows and investment opportunities through its effects on firms' hedging needs. Our analysis uses this wedge to identify the cash–debt policy interplay in a novel fashion.

Our paper is naturally related to the literature on corporate hedging. As we argued above, the intuition for the results of our model is very similar to that in Froot, Scharfstein, and Stein (1993).[6] Our contribution to this literature is two-fold. First of all, we develop and test a frame-

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[6]Previous literature has characterized alternative motivations for hedging (other than financial constraints), includ-

work that shows how firms can use their cash and debt policies as a hedging tool. As discussed by Petersen and Thiagarajan (2000), while most of the hedging literature focuses on the direct usage of derivatives, in practice firms can hedge using other financial and operational means (such as locating plants in countries where they have currency exposure). Our results suggest that the choice between cash and debt is an important way in which firms can hedge. Second, we provide empirical results which are consistent with the view that financial constraints create incentives for hedging. Previous empirical literature on derivatives usage has attempted to test the implications of Froot et al., but has found mixed results.[7] Our paper suggests that firms' cash and debt policies might be an alternative place to look for the type of hedging behavior suggested by Froot et al.

Our paper's empirical methodology follows recent capital structure literature in that we focus on companies' marginal financing decisions — changes in cash and debt — in order to learn about financial policy-making. Some papers that use this methodology are Shyam-Sunder and Myers (1999), Frank and Goyal (2003), and Lemmon and Zender (2004). These papers are primarily concerned with firms' marginal choice between debt and outside equity in the face of a "financing deficit" that is calculated under the assumption that cash holdings are exogenous. In contrast, in our paper we endogenize cash and focus our analysis on the cash versus debt margin.[8]

Finally, our paper is related to the large literature on the impact of financing constraints on firm policies. While earlier literature focuses largely on firms' physical investments and other *real* expenditures such as inventories,[9] recent papers also analyze the impact of constraints on firm *financial* policies (Almeida, Campello, and Weisbach (2004) and Faulkender and Petersen (2004) are some examples). We contribute to this recent literature by suggesting an additional financial decision that is directly affected by financial constraints — firms' preferences for higher cash or lower debt.

The remainder of the paper is organized as follows. In the next section we lay out a model of cash–debt substitutability in the presence of financing constraints and derive its empirical predictions. Section 3 describes our empirical methods and presents our main findings. Section 4 examines the question of whether cash is negative debt in light of our results. Section 5 concludes the paper.

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ing tax convexity (Smith and Stulz (1985)), debt capacity and associated tax shields (Leland (1998) and Stulz (1996)), managerial risk-aversion (Stulz (1984) and Smith and Stulz (1985)), costs of financial distress (Smith and Stulz (1985)) and information issues (DeMarzo and Duffie (1991)). Empirical work testing these hypotheses includes Tufano (1996), Haushalter (2000), and Graham and Rogers (2002). See Petersen and Thiagarajan (2000) for a survey of the literature.

[7] Papers with evidence that speak to the link between financial constraints and hedging include Nance, Smith, and Smithson (1993), Mian (1996), Géczy, Minton, and Schrand (1997), Gay and Nam, (1998), and Guay (1999). As discussed by Vickery (2004), the bulk of the evidence suggests that, contrary to expectations, the use of financial derivatives is concentrated in large companies. In addition, even for large public companies the magnitude of derivatives hedging seems to be very small (see Guay and Kothari (2003)).

[8] Hennessy and Whited (2004) also endogenize cash in their dynamic capital structure model. However, their main objective is to show that variation in tax parameters alone can explain some of the empirical puzzles that have recently been raised in the literature, such as market timing (Baker and Wurgler (2002)).

[9] See Hubbard (1998) for a review of this literature.

2 The Model

We model the optimal financial policy of a firm that has profitable growth options in the future, and which might face limited access to external capital to fund those growth options. The firm's main financial decision in the model is whether to hold cash or to reduce current debt in order to increase its ability to undertake future investments.

2.1 Structure

2.1.1 Assets and Technologies

The model has three dates. The firm starts the model at date 0 with assets in place that will produce cash flows at date 2. This cash flow c_2 is random from the perspective of date 0. At date 1, the firm learns whether this cash flow is high (c_H), which happens with probability p, or low (c_L), which happens with probability $(1 - p)$. The firm also has an existing amount of internal funds at date 0, equal to $c_0 > 0$.

At date 1, the firm can make an additional investment I, which produces output equal to $g(I)$ at date 2. Whether the firm does have a profitable growth opportunity at date 1 depends on the distribution of cash flows from assets in the following way. If cash flows are high (state H), there is a probability equal to ϕ that the firm will have an investment opportunity, but with probability $(1 - \phi)$ the productivity of the investment is zero. If cash flows are low (state L), the probability that the firm has an investment opportunity is equal to $(1 - \phi)$, while with probability ϕ there is no additional investment.

The parameter ϕ captures in our model the correlation between cash flows from existing assets and future investment opportunities, in the spirit of Froot, Scharfstein, and Stein (1993). Notice that when $\phi = \frac{1}{2}$ the firm has the same probability of having profitable investment in either state (that is, the correlation between cash flows and investment opportunities is zero), while when $\phi > \frac{1}{2}$ this correlation is positive because the firm is more likely to have profitable investments when cash flows are high.

2.1.2 Financing and Limited Pledgeability

We consider a firm run by a manager (entrepreneur) with some debt in its capital structure. The manager and the creditors are assumed to be risk-neutral. The firm starts the model at date 0 with an exogenous amount of debt of face value equal to d_2. We assume that existing creditors cannot access the cash flows produced by the new investment opportunity, $g(I)$. This assumption eliminates the possibility of debt overhang (Myers (1977)) in our model. Existing debt is then

backed entirely by the cash flow from assets c_2. We allow the firm at date 0 both to redeem some of this debt and to issue additional debt backed by cash flows from assets if it wishes to do so. The amount of debt redemption is captured by the parameter Δ, which can be greater or lower than zero. After debt redemption/issue, the face value of debt goes to d_2^N. We will determine below the relationship between d_2^N, Δ and d_2.

Besides debt redemption, the firm chooses at date 0 how much cash to retain for date 1. Given our assumptions the level of cash retained is equal to $c_1 = c_0 - \Delta$.

The firm can also raise new financing at date 1 backed by existing assets or the new investment opportunity. If d_2^N is such that there is additional debt capacity from existing assets, they will support more external finance. Also, the firm can raise more finance by pledging the cash flows $g(I)$. We let this amount of new finance at date 1 to be equal to B_1. Notice that since there is no longer any uncertainty at date 1, B_1 will be fully repaid at date 2. The risk-free rate is normalized to zero and all new financing is assumed to be fairly priced as rationally expected future cash flows.

We assume that the firm can only pledge a fraction τ of the cash flows that both existing assets and the new investment opportunity produce. The limited pledgeability assumption can be justified by several contracting frameworks. For example, it is a consequence of the inalienability of human capital (Hart and Moore 1994). Entrepreneurs cannot contractually commit never to leave the firm. This leaves open the possibility that an entrepreneur could use the threat of withdrawing his human capital to renegotiate the agreed upon payments. If the entrepreneur's human capital is essential to the project, he will get a fraction of cash flows. Limited pledgeability is also an implication of the Holmstrom and Tirole (1997) model of moral hazard in project choice. When project choice cannot be specified contractually, investors must leave a high enough fraction of the payoff to entrepreneurs to induce them to choose the project with low private benefits but high potential profitability.

Limited pledgeability implies that the new finance that can be raised at date 1 is capped:

$$B_1 \leq \tau g(I) + \left[\tau c_2 - d_2^N\right]^+, \tag{1}$$

where c_2 is either equal to c_L or c_H. Because of this constraint, the firm might not be able to undertake its investment opportunities to their full extent, as we describe below.

2.2 Solution

We solve the model starting at date 1. At this date, the firm chooses optimal investment and new financing levels for given amounts of cash retained and existing debt that must be repaid. Then, given expected future investment choices the firm chooses the optimal cash and debt redemption policies at date 0.

2.2.1 Date 1 - Optimal Investment Choice

The first thing to notice is that if there is no investment opportunity, the firm does not have any relevant choice to make. Thus, optimal date 1 behavior amounts to determining the value-maximizing investment levels, subject to the relevant budget and financing constraints. Specifically, the firm solves the following program at each relevant state of nature given Δ, d_2^N, and the realization of c_2:

$$\max_I g(I) - I \tag{2}$$

s.t.

$$I \leq c_0 - \Delta + B_1$$
$$B_1 \leq \tau g(I) + \left[\tau c_2 - d_2^N\right]^+$$

which can be collapsed as the firm's financing constraint:

$$I \leq c_0 - \Delta + \tau g(I) + \left[\tau c_2 - d_2^N\right]^+. \tag{3}$$

The financing available to the firm consists of (i) $c_0 - \Delta$, the cash holdings of the firm, (ii) $\tau g(I)$, the financing that can be raised against the pledgeable cash flows from the new investment opportunity, and (iii) $\left[\tau c_2 - d_2^N\right]^+$, spare debt-capacity (if any) from cash flows of the existing project.

We define I^{FB} (the first best investment level) as:

$$g'(I^{FB}) = 1. \tag{4}$$

If the financial constraint (3) is satisfied at I^{FB}, the firm invests I^{FB}. Otherwise, it invests exactly the value that satisfies the constraint (3). In this case, the equilibrium investment level satisfies:

$$I = c_0 - \Delta + \tau f(I) + \left[\tau c_2 - d_2^N\right]^+ \tag{5}$$

and $g'(I) > 1$.[10]

We shall denote this constrained investment level as $I_L(\Delta)$ for state L and as $I_H(\Delta)$ for state H, where we have stressed the dependence on Δ, the amount of debt redemption.

Notice that optimal investment is determined for each state of nature. We say that a firm is *financially constrained* if future investment is below the first best in at least one state of nature. Otherwise the firm is *financially unconstrained*. Notice that for the firm to be unconstrained it is necessary that investment is at the first best level in *both* states of nature.

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[10]Notice that a necessary condition for the problem to make sense is that a decrease in investment relaxes the constraint, that is, $\tau g'(I) < 1$ for any I that is a constrained solution to the firm's problem. Otherwise the firm could never be constrained because it would be possible to self-finance the new investment opportunity: the financial constraint can be relaxed by simply increasing investment.

2.2.2 Date 0 - Optimal Cash and Debt Policies

Now we determine whether the firm is better off retaining cash or repaying debt at date 0. The date-0 financial policy can be subsumed in the optimal choice of Δ, which determines both the face value of debt d_2^N and the level of cash retained for the future, $c_1 = c_0 - \Delta$.

Notice that Eq. (5) determines constrained investment levels for each state, as an implicit function of Δ and other exogenous parameters. Anticipating future investment levels, the firm chooses the optimal date-0 financial policy.

Market Values of Debt   The first step is to figure out how debt repayment Δ will affect the face value of debt d_2^N. Without loss of generality, we can assume that the existing level of debt before repayment (d_2), is lower than the maximum income that can be extracted by existing creditors in state H:

$$d_2 \leq \tau c_H. \tag{6}$$

Anything bigger than this is not compatible with limited pledgeability, and thus can be ignored. In addition, we also assume that the initial debt of the firm is risky:

$$d_2 \geq \tau c_L. \tag{7}$$

That is, the low cash flow state is to be interpreted as a state in which firm's cash flow is lower than the promised payment on the existing debt. Given these assumptions the market value of existing debt is equal to:

$$D_0 = pd_2 + (1 - p) \min[\tau c_L, d_2] \geq \tau c_L. \tag{8}$$

For each Δ, if existing creditors are indifferent between tendering debt or not, the new market value of debt must satisfy:

$$D_0^N = D_0 - \Delta. \tag{9}$$

The new face value of debt, d_2^N, must satisfy:

$$D_0^N = pd_2^N + (1 - p) \min[\tau c_L, d_2^N]. \tag{10}$$

Thus we must have:

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\begin{aligned}
d_2^N &= d_2 - \frac{\Delta}{p}, \text{ if } \tau c_L < D_0 - \Delta \\
&= D_0 - \Delta, \text{ if } \tau c_L \geq D_0 - \Delta
\end{aligned}
\tag{11}
$$

or alternatively:

$$d_2^N = d_2 - \frac{\Delta}{p}, \text{ if } \tau c_L < d_2^N \tag{12}$$
$$= D_0 - \Delta, \text{ if } \tau c_L \geq d_2^N.$$

Intuitively, when the debt repayment is not so large as to make the new debt completely riskless, one unit of debt repayment reduces the new face value by more than one unit. But when the debt becomes riskless this effect disappears and one unit of repayment reduces face value by one unit.

Notice also that Eqs. (11) and (12) also determine the new face value if $\Delta < 0$, that is, if instead of redeeming debt, the firm issues additional debt. Because of limited pledgeability, $\Delta < 0$ is only possible if τc_H is strictly greater than the existing face value d_2. The minimum possible value of Δ is such that $\tau c_H = d_2^N$. Using the equations above this minimum level can be written as:

$$\Delta_{\min} = -[p\tau c_H + (1-p)\tau c_L - D_0]. \tag{13}$$

Finally, Δ cannot be higher than either the market value of existing debt D_0, or the firm's total internal funds, c_0:

$$\Delta_{\max} = \min(c_0, D_0). \tag{14}$$

The feasible range for Δ is therefore $[\Delta_{\min}, \Delta_{\max}]$.

Optimal Policies The optimal choice of Δ is determined by the following program:

$$\max_{\Delta \in [\Delta_{\min}, \Delta_{\max}]} p\phi \left[g(I_H^*(\Delta)) - I_H^*(\Delta) \right] + (1-p)(1-\phi) \left[g(I_L^*(\Delta)) - I_L^*(\Delta) \right], \tag{15}$$

where $I_H^*(\Delta)$ and $I_L^*(\Delta)$ are the investment levels that obtain for each choice of Δ. Specifically, if Δ is such that the first-best investment level is feasible for a given state s, then $I_s^*(\Delta) = I^{FB}$. Otherwise, $I_s^*(\Delta)$ is equal to $I_s(\Delta)$ as determined in Section 2.2.1 (by the financial constraint, Eq. (3)).

Before we characterize the optimal solution, it is useful to understand intuitively what is accomplished by the choice of financial policy. The key intuition is established by the following Lemma.

Lemma 1 - Let $\widetilde{\Delta}$ be defined by $\widetilde{\Delta} = [D_0 - \tau c_L]$. For $\Delta < \widetilde{\Delta}$, $I_H(\Delta)$ *is strictly increasing in* Δ *and* $I_L(\Delta)$ *is strictly decreasing in* Δ. *For* $\Delta \geq \widetilde{\Delta}$, $I_H(\Delta)$ *and* $I_L(\Delta)$ *are independent of* Δ. *Thus,* $I_H^*(\Delta)$ *is weakly increasing in* Δ *and* $I_L^*(\Delta)$ *is weakly decreasing in* Δ *for all* $\Delta \in [\Delta_{\min}, \Delta_{\max}]$.

In other words, debt repayment at date 0 is associated with a trade-off in the future choice of investment. If a firm chooses to repay more debt, it can increase investment in the state of nature in which cash flows are high (state H). However, this decreases feasible investment in state L.

Thus, state L investment increases with the level of cash balances $(c_0 - \Delta)$ that the firm carries to the future.

We prove this result in the appendix. The intuition is as follows. If the face value of existing debt is higher than the pledgeable cash flows in state L, the value of debt at date 0 is supported mostly by state H cash flows. Thus, if the firm decides to use one dollar of date 0 cash to reduce outstanding debt, it reduces the promised payment for state H by *more than one unit*. As a consequence, state H financing capacity goes up even though the firm carries one less dollar of cash until date 1. If the firm is financially constrained in state H, this effect increases state H investment. By the same token, debt capacity in state L goes up by less than one unit, and thus feasible state L investment goes down because the firm has less cash. The cutoff level $\widetilde{\Delta}$ represents precisely the maximum amount of debt that can be repaid before debt becomes riskless. Once debt is riskless, the debt repayment has no effect on financing capacity. Note however that debt *issues*, which are feasible when $\Delta_{\min} < 0$, increase financing capacity in state L at the expense of state H even when current debt is riskless.

This result suggests that the optimal financial policy will be determined by the firm's need to increase investments in particular states of nature. If it is particularly profitable to increase investment in state L, the firm will carry more cash into the future. If it becomes more desirable to increase investment in state H, the firm will tend to use its current internal funds to reduce outstanding debt.

We start the characterization of the optimal financial policy with the following lemma.

Lemma 2 - *The firm is financially unconstrained if and only if it is unconstrained in state L when $\Delta = \Delta_{\min}$. Otherwise, it is financially constrained in the sense that there does not exist a Δ that allows the firm to invest at first best levels in both states.*

This lemma is a straightforward consequence of the fact that the only (ex-post) difference between state L and state H in our model is that cash flows from existing assets are higher in state H. Thus, the financing capacity in state H is always higher than in state L, for all possible Δ, which means that if the firm is financially unconstrained in state L, it must also be financially unconstrained in state H. Because state L financing capacity is decreasing in Δ (lemma 1), a necessary and sufficient condition for the firm to be unconstrained is thus that the firm is unconstrained when financing capacity in state L is at its maximum.

With these two lemmas, we can state and prove the central result of our theory.

Proposition 1 - *The optimal financial policy depends on the degree of financial constraints and on the correlation between cash flows and investment opportunities in the following way:*

- *If the firm is financially unconstrained, it is indifferent among all possible Δ in a range equal*

to $[\Delta_{\min}, \widehat{\Delta}]$, where $\widehat{\Delta}$ is either equal to $\Delta_{\max}$, or to the value of Δ that renders the firm financially constrained in state L. Any value of $\Delta > \widehat{\Delta}$, if feasible, yields a lower value for the firm;

- If the firm is financially constrained, then the optimal financial policy depends on the parameter ϕ:

  - If $\phi \leq \frac{1}{2}$, the optimal policy is to choose $\Delta^* = \Delta_{\min}$;
  - There exists a threshold level $\overline{\phi}$, satisfying $\frac{1}{2} < \overline{\phi} < 1$, such that
    * For $\phi \leq \overline{\phi}$, the optimal policy is to choose $\Delta^* \leq 0$.
    * For $\phi > \overline{\phi}$, the optimal policy is to choose $\Delta^* > 0$.
  - There exists a second threshold level $\overline{\overline{\phi}}$, satisfying $\overline{\phi} < \overline{\overline{\phi}} < 1$, such that for $\phi > \overline{\overline{\phi}}$ the optimal policy is to choose $\Delta^* = \min(\widetilde{\Delta}, \Delta_{\max})$.

In words, Proposition 1 suggests that unconstrained firms should be indifferent between using current internal funds to increase cash holdings or to reduce debt. In contrast, financially constrained firms should display a clear preference for holding cash or reducing debt, depending on the correlation between cash flows from assets and new investment opportunities. If this correlation is zero or negative ($\phi \leq \frac{1}{2}$), the optimal policy is to increase investment in state L as much as possible. This is accomplished by making Δ equal to the lowest possible value, $\Delta_{\min}$, which might involve additional debt issues when $\Delta_{\min} < 0$. In any case, the firm has a preference towards carrying cash to the future in this situation. Furthermore, as long as the correlation is low enough ($\phi \leq \overline{\phi}$), the firm continues to prefer carrying cash to date 1 ($\Delta^* \leq 0$). However, when the correlation is high ($\phi > \overline{\phi}$), the optimal policy might involve using at least some of the firm's current internal funds c_0 to repay debt.[11] Finally, for very high correlation values ($\phi > \overline{\overline{\phi}}$), the constrained firm should use its current internal funds such that it either exhausts its internal funds ($\Delta^* = \Delta_{\max}$), or it completely eliminates the risk of debt ($\Delta^* = \widetilde{\Delta}$).

In order to understand the intuition for this result, consider first the case in which the correlation between cash flows and investment opportunities is zero, and the firm is constrained. In this case, the (ex-ante) productivity of the firm's investment is the same in both states. Because the production function is concave, the optimal investment policy involves equalizing investment levels across states. But since financing capacity is always higher in state H, the constrained firm benefits from

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[11] As explained above, debt repayment has no effect on financing capacity when current debt is riskless ($\widetilde{\Delta} = 0$), and so a necessary condition for it to be optimal for the firm to repay debt is that $\widetilde{\Delta} > 0$, our maintained assumption.

increasing capacity in state L as much as possible. This is accomplished by making cash holdings as high as possible ($\Delta = \Delta_{\min}$). If $\phi < \frac{1}{2}$ it is even more desirable to increase investment in state L, so the result continues to hold. However, as the correlation ϕ increases, it becomes more likely that the firm will need funds in state H because expected productivity in that state goes up. At high levels of ϕ, equalization of the marginal productivity of investment across states requires debt repayment.[12] In contrast, if the firm is financially unconstrained it can achieve first best investment levels irrespective of financial policy, and thus small changes in Δ have no effect on investment and value.[13]

This intuition is very similar to that in the hedging framework of Froot, Scharfstein, and Stein (1993). As they show, financially constrained firms benefit from transferring resources across states if the marginal productivity of investment is decreasing. Their general result, like ours, is that constrained firms' optimal financial policies should be structured such that the equilibrium marginal productivity of investment is the same in all states. If investment opportunities are the same across states, this implies a constant investment level in all states. In terms of financial policies, this corresponds to a fully hedged position, and to the case of optimally low Δ in our model. However, if investment opportunities tend to arise in states in which cash flows are large the firm has a "natural hedge". In this case the benefit of cash holdings and hedging strategies decreases and it might be worthwhile for the firm to concentrate financing capacity in state H by repaying debt.

Next, we derive comparative statics results which will be useful in the empirical analysis.

Proposition 2 - *Suppose the firm is financially constrained. We obtain the following effects on the firm's cash and debt policies from a variation in the availability of internal funds, c_0.*

- *If the correlation between cash flows and investment opportunities is low ($\phi \leq \frac{1}{2}$), then a change in c_0 should result in a corresponding change in the firm's cash balances ($\frac{\partial c_1}{\partial c_0} > 0$), but no change in the amount of debt outstanding ($\frac{\partial \Delta}{\partial c_0} = 0$).*

- *If the correlation between cash flows and investment opportunities is high ($\phi > \overline{\overline{\phi}}$), then a change in c_0 should change the amount of debt outstanding ($\frac{\partial \Delta}{\partial c_0} > 0$), but not the firm's cash balances ($\frac{\partial c_1}{\partial c_0} = 0$).*

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[12]Notice that the optimal policy is independent of p, the probability of state H. The intuition for this is that while high p makes it more likely that funds will be needed in state H, it makes existing debt less risky and so it results in a lower increase in state H financing capacity for a given amount of debt repayment. As we show in the proof of the proposition, these two effects cancel each other out and p drops out of the conditions that characterize optimality.

[13]The only policy that is sub-optimal for an unconstrained firm is to reduce cash holdings so much that the firm becomes constrained in state L, as explained in the proposition.

These comparative statics results are a straightforward consequence of the optimal policies characterized in Proposition 1. If the correlation ϕ is low, the firm does not benefit from debt repayment. Thus, increases/decreases in internal funds result in increases/decreases in the amount of cash balances held by the firm. For very high correlation levels, the firm's optimal policy is such that it benefits more from debt repayments than from holding cash. In this range, changes in internal funds result mostly in changes in debt levels.

For intermediate correlation levels ($\phi \in (\frac{1}{2}, \bar{\bar{\phi}})$), the firm is in an equilibrium in which internal funds are split between debt repayments/issues and cash balances (see Proposition 1). In other words, both cash and debt respond to variations in cash flows in this parameter range. Recall, the objective of the firm is to equalize the marginal productivity of investment across states. Because cash increases investment in bad states and lower debt increases investment in higher states, intuition would suggest that an increase in cash flows would lead *both* to an increase in cash ($\frac{\partial c_1}{\partial c_0} > 0$), *and* to a smaller increase (or a higher reduction) in debt ($\frac{\partial \Delta}{\partial c_0} > 0$), so that marginal productivities remain equalized after the change in cash flows. Nevertheless, the precise change in financial policies depends also on the rate of change of the marginal productivities, following a change in cash flows. In other words, the exact effect depends also on the properties of the second derivative of the production function, $g''(I)$. It turns out that in the case in which $g''(I)$ is a constant for all I, intuition prevails. For a sufficiently high ϕ, the cash flow sensitivity of debt is negative and the cash flow sensitivity of cash is positive at the same time.

Example 1 - *If $g''(I)$ is a constant for all I, then there exists a ϕ^* satisfying $\phi^* > \frac{1}{2}$, such that $\frac{\partial \Delta}{\partial c_0} > 0$ and $\frac{\partial c_1}{\partial c_0} > 0$ for all $\phi \in [\phi^*, \bar{\bar{\phi}})$.*

Before we turn to this empirical analysis, we summarize the key testable empirical implications of our theory.

2.3 Empirical Implications

Our theory's key empirical implications concern the effect of the correlation between financially constrained firms' cash flows and investment opportunities on their cash and debt policies. In particular, the theory has implications for how constrained firms should allocate cash flows into cash balances and debt, depending on whether they have high or low hedging needs (i.e., low or high correlation between cash flows and investment opportunities). We can summarize these implications as follows:

Implication 1 If the correlation between cash flows and investments opportunities is low (high hedging needs), constrained firms allocate excess cash flows primarily to cash balances. Their

propensity to use cash flows to reduce debt is much lower. Thus, firms' cash flow sensitivities of cash should be positive, and their cash flow sensitivities of debt should not be significantly negative (possibly zero).

Implication 2 If the correlation between cash flows and investment opportunities is high (low hedging needs), constrained firms should display a much weaker propensity to hold cash, and a much stronger propensity to use current cash flows to reduce debt. Thus, their cash flow sensitivities of debt should be negative, and their cash flow sensitivities of cash should be less positive than those for firms with high hedging needs (possibly zero).

Notice that the theory has less clear implications for the *average level* of the cash flow sensitivities of cash and debt for constrained firms. Because constrained firms have an incentive to save financing capacity for the future, intuition suggests that the cash flow sensitivity of cash (debt) should generally be positive (negative). However, our results suggest that one might observe different average sensitivity patterns, depending on the hedging needs of the average firm in the sample.

Regarding unconstrained firms, our benchmark model predicts that because these firms do not need to worry about financing capacity, their cash and debt policies should not be necessarily related to cash flows, or to the correlation between cash flows and investment opportunities.

However, this strict indeterminacy of financial policies only holds in the absence of other costs and benefits of cash and debt. Not surprisingly, we show in the Appendix that in the presence of an additional cost of carrying cash, unconstrained firms generally prefer to use excess cash flows to reduce debt instead of adding more cash to their balance sheets. Similarly, in the presence of an additional benefit of holding cash (or a benefit of not reducing debt, which are the same in our model), unconstrained firms will prefer to increase cash instead of reducing debt.

More importantly, because these additional costs and benefits are orthogonal to the financing constraints rationale that we use to derive Propositions 1 and 2, we can also show that they do not change the qualitative nature of the results derived above for constrained firms (see the Appendix). For example, if there is an additional cost of carrying cash constrained firms' hedging needs have to be higher in order to induce them to save cash. This effect changes only the particular value of the correlation cutoff below which constrained firms prefer to hold cash.

Furthermore, because unconstrained firms do not need to worry about future financing capacity, their cash and debt policies (whatever they are in practice) should not depend on their hedging needs. Thus, irrespective of the *levels* of the unconstrained sensitivities that we observe in practice, these sensitivities should *not depend* on the correlation between cash flows and investment opportunities. This insight provides us with a way to identify our model irrespective of the actual

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(average) levels of cash flow sensitivities that we observe for constrained and unconstrained firms. We summarize these considerations in an additional implication.

Implication 3 The levels of unconstrained firms' cash flow sensitivities of cash and debt could be different than zero if there are additional costs and benefits of cash and debt. However, these sensitivities patterns (whatever they are) should be independent of the correlation between cash flows and investment opportunities.

3   Empirical Tests

3.1   Sample

To test our model's predictions we use a sample of manufacturing firms (SICs 200–399) taken from COMPUSTAT's P/S/T, Full Coverage, and Research annual tapes over the 1971–2001 period.[14] We require firms to provide valid information on their total assets, sales, debt, market capitalization, cash holdings, operating income, depreciation, tax payments, interest payments, and dividend payments. We deflate all series to 1971 dollars.

Our data selection criteria and variable construction approach follows that of Almeida, Campello, and Weisbach (2004), who study the impact of financing constraints on the management of internal funds, and that of Frank and Goyal (2003), who look at external financing decisions. Similarly to Frank and Goyal we look at changes in debt and cash positions using data from firms' "flow of funds statements" — this allows us to verify whether changes in cash and debt figures are associated with actual cash flows (as opposed to, for example, simple accounting restatements). As in Almeida, Campello, and Weisbach, we discard from the raw data those firm-years for which the market capitalization is less than $10 million as well as firm-years displaying asset or sales growth exceeding 100%.[15] We further require that firm annual sales exceed $1 million in order to minimize the sampling of distressed firms, that firms have at least $0.5 million in cash in their balance sheets, and that they have positive debt in at least one year of the sample period.

We eliminate firm-years for which debt exceeds total assets (near-bankruptcy firms), those firms whose net debt issuance or retirement exceed the value of their total assets for the year (see Lemmon and Zender (2004)), and those whose market-to-book asset ratio (or Q) is either negative or greater than 10 (see Gilchrist and Himmelberg (1995) and Almeida and Campello (2004)). Also

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[14]We start collecting our sample from 1971 because the flow of funds data we use is not available prior to that year.

[15]The first screen eliminates from the sample those firms with severely limited access to the public markets; the internal–external funding interplay of our theory implies that the firm does have active (albeit potentially constrained) access to funds from the financial markets. The second eliminates those firm-years registering large jumps in their business fundamentals; these are typically indicative of major corporate events.

following Gilchrist and Himmelberg and Almeida and Campello, we try to minimize the impact of sample attrition on the stability of the data process by requiring that firms provide more than five years of valid information on their debt and cash policies. In fact, requiring firms to appear for a minimum of periods in the sample serves an important objective: it allows us to more robustly compute an empirical counterpart of the notion of firms' "hedging needs" (more on this shortly). Our final sample consists of 20,146 firm-year observations. Descriptive statistics for some the empirical variables we construct using this sample are provided below.

3.2 Methodology

According to our theory, we should expect to find that constrained firms' propensities to use cash flows to reduce debt and to increase cash depend closely on their hedging needs, as measured by the correlation between cash flows and investment opportunities. Specifically, constrained firms' cash flow sensitivity of cash should be large and positive when hedging needs are high (correlation is low), and they should decrease substantially when hedging needs decrease. In contrast, cash flow sensitivities of debt should be most negative for firms with low hedging needs, and should become substantially less negative when hedging needs increase. Finally, this close association between cash/debt policies and hedging needs should not be observed if firms are financially unconstrained, because in this case cash and debt policies are not driven by future investment needs.

In order to implement a test of this argument we need to specify an empirical model that allows us to see how cash flow innovations are absorbed by cash savings and debt issuance policies. We also need to empirically identify financially constrained and unconstrained firms. Third, we need to measure the correlation between cash flows and investment opportunities. We tackle these issues in turn.

3.2.1 Empirical Specification

We examine the simultaneous (within-firm) responses of cash and debt policies to cash flow innovations across sets of constrained and unconstrained firms through a system of equations. The equations in the system are parsimoniously specified and, in addition to firm size, they only include proxies for the variables that we believe are related to the primitives of our theory: free cash flows and investment opportunities. Define $\Delta Debt$ as the ratio of the net debt issuances (COMPUSTAT's item #111 – item #114) to total book value of assets (item #6). $\Delta CashHold$ is defined as changes in the holdings of cash and other liquid securities (item #234) to total debt. $CashFlow$ is an empirical measure that is designed to proxy for "free cash flow" in our theory. Recall, we want to describe a firm's use of "uncommitted" cash inflows in its cash–debt polices. In empirically measuring those uncommitted funds, we start from the firm's gross operating income (COMPUSTAT's item #13)

and from it subtract amounts committed to capital reinvestment (proxied by asset depreciation, or item #14), to the payment of taxes (item #16), to the payment of debtholders (interest expense, item #15), and to payments to equity holders (dividends, items #19 and #21).[16] Our basic proxy for investment opportunities, Q, is computed as the market value of assets divided by the book value of assets, or (item #6 + (item #24 × item #25) − item #60 − item #74) / (item #6). Through the analysis we gather estimates from the following 3SLS system:[17]

$$
\begin{aligned}
\Delta Debt_{i,t} &= \alpha_0 + \alpha_1 CashFlow_{i,t} + \alpha_2 Q_{i,t} + \alpha_3 Size_{i,t} \\
&\quad + \alpha_4 \Delta CashHold_{i,t} + \alpha_5 Debt_{i,t-1} + \sum_i firm_i + \sum_t year_t + \varepsilon_{i,t}^d,
\end{aligned}
\tag{16}
$$

$$
\begin{aligned}
\Delta CashHold_{i,t} &= \beta_0 + \beta_1 CashFlow_{i,t} + \beta_2 Q_{i,t} + \beta_3 Size_{i,t} \\
&\quad + \beta_4 \Delta Debt + \beta_5 CashHold_{i,t-1} + \sum_i firm_i + \sum_t year_t + \varepsilon_{i,t}^c,
\end{aligned}
\tag{17}
$$

where $Size$ is the natural log of sales (item #12), and $firm$ and $year$ absorb firm- and time-specific effects, respectively.

Our theory's predictions concern the debt issuance and cash savings policy responses to cash flows, captured by α_1 and β_1 in Eqs. (16) and (17), respectively. Lagged *levels* of the dependent (*change*) variables in those equations are entered in order to identify the system.[18] Accordingly $Debt$ in Eq. (16) is defined as COMPUSTAT's item #9 over item #6, and $CashHold$ in (17) is item #2 over item #6. Note that although we aim at shedding light at the joint determination of debt and cash policies (this is the focus of our theory), we are *not* interested in estimating accounting

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[16]To wit, *CashFlow* is computed as (item #13 − item #14 − item #16 − item #15 − item #19 − item #21) / (item #6). Implicitly, we see depreciation (item #14) as a minimum amount of investment needed to avoid asset depletion, in this vein we see it as a proxy for "nondiscretionary"investment (observed investment spending is, of course, a more discretionary measure of investment). Dividends can be seen as discretionary; however, real-world firms don't seem to fine tune their dividend policy according to their cash flow process (dividends are relatively sticky, whereas cash flows are not). We also experimented computing *CashFlow* without the inclusion of dividends and our findings are qualitatively similar. The same happens when, following a number of studies in the financial structure literature, we compute *CashFlow* as net income before extraordinary items (COMPUSTAT's item #18).

[17]Admittedly, a more intuitive approach to the question of how cash and debt balances respond to cash flow innovations across constrained and unconstrained firms would entail running the following set of (stacked) OLS regressions across the two constraint firm-types:

$$
\Delta Debt_{i,t} = \alpha_0 + \alpha_1 CashFlow_{i,t} + \alpha_2 Q_{i,t} + \alpha_3 Size_{i,t} + \sum_i firm_i + \sum_t year_t + \varepsilon_{i,t}^d,
$$

$$
\Delta CashHold_{i,t} = \beta_0 + \beta_1 CashFlow_{i,t} + \beta_2 Q_{i,t} + \beta_3 Size_{i,t} + \sum_i firm_i + \sum_t year_t + \varepsilon_{i,t}^c.
$$

When we experiment with this SUR-like OLS system we also get results that agree with our theory. However, using an estimator that, for each sampled firm, simultaneously endogenizes the impact of debt issuance activity on cash policies and vice-versa — in the way the 3SLS does — provides for a better empirical testing of our ideas.

[18]Our results also hold when we use twiced lagged levels of debt and cash and when we use the projections of those firm proxies onto indicators for industry-years.

identity-style regressions, where firms' external financing are regressed on "financing deficits" (à la Shyam-Sunder and Myers (1999) and others).[19] We explicitly control for possible biases stemming from unobserved individual heterogeneity and time idiosyncrasies by expunging firm- and time-fixed effects from our slope coefficient estimates. In fitting the data, we allow residuals to be correlated across our debt and cash models.

3.2.2 Financial Constraints Criteria

Testing the implications of our model requires separating firms according to *a priori* measures of the financing frictions that they face. There are a number of plausible approaches to sorting firms into financially constrained and unconstrained categories. We do not have strong priors about which approach is best and, following Almeida, Campello, and Weisbach (2004), we use a variety alternative schemes to partition our sample:

- Scheme #1: In every year over the 1971 to 2001 period, we rank firms based on their payout ratio and assign to the financially constrained (unconstrained) group those firms in the bottom (top) three deciles of the annual payout distribution. We compute the payout ratio as the ratio of total distributions (dividends and repurchases) to operating income. The intuition that financially constrained firms have significantly lower payout ratios follows from Fazzari, Hubbard, and Petersen (1988), among many others, in the financial constraints literature.[20] In the capital structure literature, Fama and French (2002) use payout ratios as a measure of difficulties firms may face in assessing the financial markets.

- Scheme #2: We rank firms based on their asset size over the 1971 to 2001 period, and assign to the financially constrained (unconstrained) group those firms in the bottom (top) three deciles of the size distribution. The rankings are again performed on an annual basis. This approach resembles that of Gilchrist and Himmelberg (1995) and Erickson and Whited (2000), who also distinguish between groups of financially constrained and unconstrained firms on the basis of size. Fama and French (2002) and Frank and Goyal (2003) also associate firm size with the degree of external financing frictions. The argument for size as a good observable measure of financial constraints is that small firms are typically young, less well known, and thus more vulnerable to capital market imperfections.

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[19]As discussed in the introduction, these regressions assume that changes in cash are an *exogenous* component of the financing deficit. Such an approach is clearly inappropriate in the context of our paper.

[20]The deciles are set according to the distribution of the payout ratios reported by the firms themselves (rather than according to the distribution of the reporting firms), which yields an unequal number of observations being assigned to each of our constraint groups.

- Scheme #3: We retrieve data on firms' bond ratings and categorize those firms that never had their public debt rated during our sample period as financially constrained. Given that unconstrained firms may choose not to use debt financing and hence not obtain a debt rating, we only assign to the constrained subsample those firm-years that *both* lack a rating and report positive debt (see Faulkender and Petersen (2004)).[21] Financially unconstrained firms are those whose bonds have been rated during the sample period. Related approaches for characterizing financial constraints are used by Whited (1992), Gilchrist and Himmelberg (1995), and Lemmon and Zender (2004). The advantage of this measure over the former two is that it gauges the *market*'s assessment of a firm's credit quality. The same rationale applies to the next measure.

- Scheme #4: We retrieve data on firms' commercial paper ratings and categorize as financially constrained those firms that never display any ratings during our sample period. Observations from those firms are only assigned to the constrained subsample in the years a positive debt is reported. Firms that issued commercial papers receiving ratings at some point during the sample period are considered unconstrained. This approach follows from the work of Calomiris, Himmelberg, and Wachtel (1995) on the characteristics of commercial paper issuers.

Table 1 reports the number of firm-years under each of the eight financial constraint categories used in our analysis. According to the payout scheme, for example, there are 6,153 financially constrained firm-years and 6,231 financially unconstrained firm-years. The table also shows the extent to which those classification schemes are correlated. For example, out of the 6,153 firm-years considered constrained according to payout, 2,680 are also constrained according to size, while a lower number, or 1,078 firm-years, are considered unconstrained. The remaining firm-years represent payout-constrained firms that are neither constrained nor unconstrained according to size. In general, there is a positive correlation among the four measures of financial constraints. For example, most small (large) firms lack (have) bond ratings. Also, most small (large) firms have low (high) payout policies. However, the table also makes it clear that these cross-group correlations are far from perfect.

$$- \text{ insert Table 1 here } -$$

Table 2 provides a glimpse at the cash and debt positions of firms in our sample. The table reports summary statistics for cash holdings, leverage ratios, and cash flows separately for constrained and unconstrained firms across each one of our four classification criteria. As our sampling

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[21]Firms with no bond rating and no debt are considered unconstrained, but our results are not affected if we treat these firms as neither constrained nor unconstrained. We use the same criterion for firms with no commercial paper rating and no debt in scheme #4. In the robustness checks below, we restrict the sample to the period where firms' bond ratings are observed every year (from 1986 to 2001), allowing firms to migrate across constraint categories.

approach and variable construction criteria follow the literature, it is not surprising that the numbers we report in Table 1 generally resemble those found in related studies (see, e.g., Frank and Goyal (2003) and Almeida, Campello, and Weisbach (2004)). One will notice, nonetheless, that there are marked differences between cash and debt positions of constrained and unconstrained firms. Across most classification criteria, the median constrained firm *both* has less debt and holds more cash than the median unconstrained firm. At the same time that constrained and unconstrained firms have markedly different financial policies, those firms' cash flow process do not seem to display any cross-constraint differential patterns.

− insert Table 2 here −

3.2.3 Measuring Hedging Needs

We say that firms have high hedging needs when their investment opportunities (i.e., demand for investment funds) and cash flow process (i.e., internal supply of funds) are not related. In trying to empirically identify firms in need of hedging, we examine the relationship between firms' free operating cash flows and a proxy for investment opportunities that is both exogenous to their internal cash flow process and extraneous to our baseline empirical model (Eqs. (16) and (17)).[22] We consider three alternative measures fitting those requirements, all of which are industry-level proxies.

First, following a strand of papers in the literature that links expenditures in product research and development with investment opportunities (see, e.g., Graham (2000) and Fama and French (2002)), we look at the correlation between a *firm*'s cash flow from current operations (*CashFlow*) and its *industry-level* median level of R&D expenditures to assess whether firms' demand for and availability of (internal) funds are highly related in the data.[23] We compute this correlation, firm by firm, and subsequently partition our sample across firms displaying a high level of correlation between investment demand and supply of internal funds (i.e., investment opportunities and cash flows) from those firms whose investment demand and supply of internal funds are negatively related. To be precise, recall that our theory has particularly clear implications for cash and debt policies in the face of financing constraints at the high and low end of the cash flow–investment opportunity correlation range. Accordingly, we assign to a group of "low hedging needs" firms,

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[22]Of course, we cannot look directly at the correlation between a firm's cash flows and investment spending, since the latter is endogenous to the former when firms are financially constrained. The same is true for the firm-level Q if financial markets participants' anticipation of a firm's ability to pursue profitable investment opportunities is capitalized in its stock price.

[23]R&D expenditures is measured as COMPUSTAT item #46 divided by item #6. Recall, all of the firms in our sample come from the manufacturing sector. Industries in this sector of the economy are relatively homogeneous in a number of dimensions. We think of temporal, cross-industry differences in R&D expenditures as a phenomenon that is correlated with the emergence of differential growth/profitable opportunities across these industries (cause by, for example, changes in consumers' preferences and process innovation). We identify industries using firms' three-digit SICs.

those for which the empirical correlation between cash flow and industry R&D are above 0.2, and to the "high hedging needs" firm group those firms whose firm cash flow–industry R&D correlation is below –0.2. We note that although these cut-offs could seem arbitrary, they *both* partition the sample in groups of about the same size (about 25% of the sample fall into each category) and ensure that firms in either group have correlation coefficient estimates that are statistically reliable.[24]

The second measure of investment opportunities we consider is related to observed product market demand. To gauge a firm's present demand for investment funds we look at the sales growth of the typical producer in the firm's industry in the three-year period following a firm's cash and debt data. To be precise, for each firm-year in the sample we compute the three-year-ahead sales growth rate of the median producer in the firm's three-digit SIC and later compute the correlation between the firm's cash flow and that measure of industry sales growth. The premise of this approach is that firms' perceived investment opportunities (and demand for investment funds) will be related to their estimates of future sales growth in their industries and that those estimates, on average, coincide with the data.

The third measure we use as a proxy for industry growth opportunities is somewhat closer to that contained in our baseline 3SLS specification; we look at Q. Importantly, rather than relying on a firm's industry *level* of Q, which could be highly related to the firm's Q itself (and recall, this is included in the specification), we look at *changes* in the firm's industry-level median Q. By looking at changes in industry Q we remove the fixed, level component of Q and yet retain a reasonably good proxy for innovations in investment opportunities different firms face.

3.3 Debt and Cash Policies across Constrained and Unconstrained Firms: Preliminary Results

Our testing approach requires us to relate cash flow sensitivities of cash and debt both to our proxies for financial constraints *and* to our correlation measures. We do that next section by estimating our regression system (Eqs. (16) and (17)) for four different groups of firms, sorted both on the measures of constraints and on their hedging needs. Before we do that, however, we present some preliminary regressions in which we consider only the differences between constrained and unconstrained firms, without sorting on hedging needs. The purpose of this is two-fold. First, as we explained above, it is interesting to know what is the average pattern of cash flow sensitivities for unconstrained firms, as this average pattern provides some evidence on the net costs of cash/debt in the absence of constraints and thus provides a benchmark against which to evaluate the results

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[24]This last point is important in that our sample, although large in the cross-section dimension, is limited in the time series dimensional (this is the dimension used to computed firm cash flow–investment opportunity correlations).

obtained for constrained firms. Second, these regressions allow for easy comparison with previous papers that have run similar regressions on the marginal financing literature, such as Almeida, Campello, and Weisbach (2004) and Shyam-Sunder and Myers (1999).[25]

Table 3 presents the results obtained from the estimation of our baseline regression system (Eqs. (16) and (17)) within each of the sample partition schemes described in Section 3.2.2. A total of 16 estimated results are reported in the table (2 equations × 4 constraint criteria × 2 constraint firm-types). The results of the cash regressions (Panel B) resemble those in Almeida, Campello, and Weisbach (2004). Under every one of the constraint criteria considered, we find that the set of financially constrained firms display a significantly positive relationship between cash flows and changes in cash holdings — their cash–cash flow sensitivities are all significant at better than a 1% test level. In contrast, unconstrained firms do not display a systematic propensity to save cash out of excess cash flows. Regarding the debt regressions (Panel A), we find that constrained firms show no systematic tendency to change its debt position (Panel A). This is in sharp contrast to the policies of financially unconstrained firms. Facing the same cash flow innovation, an unconstrained firm will reduce the amount of debt it issues by approximately 25 to 33 cents — debt–cash flow sensitivities are all significant at better than a 1% test level. This negative relationship between cash flows and debt issues should also be expected, given the findings in Shyam-Sunder and Myers (1999) that debt issues are positively related to firm financing deficits for the types of firms that we classify as financially unconstrained.[26]

$$- \text{ insert Table 3 here } -$$

As we discussed above, our theory makes clearer predictions about the relationship between sensitivities and correlations than about the levels of the sensitivities themselves. This is partly because the theory does not pin down the levels of the unconstrained sensitivities, and partly because the particular levels of the constrained sensitivities depend on firms' hedging needs. Nonetheless, one can reconcile the "average" results from Table 3 as follows. Unconstrained firms seem to display a preference towards using cash flows to reduce debt, instead of holding cash in their balance sheets. This finding indicates that holding cash is relatively costly for these firms, perhaps because of cash's low yields. Hence, unconstrained firms channel cash flows surpluses towards reducing

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[25]The latter paper does not consider contrasts between constrained and unconstrained firms. However, its sample selection scheme ensures that only large firms with rated debt enter the sample, and thus can be compared with our unconstrained debt regressions. Shyam-Sunder and Myers do not endogenize cash, and assume it is part of the financing deficit.

[26]As discussed above, the financing-deficit literature usually deduct current changes in cash from firm financing deficits, effectively assuming thy are exogenous to firm financial policies. Our results show that this assumption might be appropriate if firms are unconstrained, as in Shyam-Sunder and Myers (1999), since unconstrained firms do not display a systematic propensity to save cash. However, the assumption is clearly less tenable when firms are constrained.

external financing, including debt. In contrast, constrained firms choose to retain cash *despite* of the fact that cash may be relatively costly. This finding alone suggests that cash has a substantial economic role to play when firms are financially constrained. Finally, the additional finding that debt is not systematically related to cash flows for constrained firms suggests that these firms prefer (on average) positive cash over negative debt.

Of course, in order to provide concrete evidence that the cash–debt policies of constrained firms are driven by our theory's predictions, we have to show some evidence that these policies are significantly affected by constrained firms' hedging needs. We tackle this issue in turn.

3.4 Debt and Cash Policies: Hedging Needs

In this section we propose a set of empirical experiments aimed at testing our theory's predictions more directly. In particular, we examine if and how previous results change when we allow for variations in firms' hedging needs.

The tests of this section consist of performing estimations of our 3SLS debt–cash system across (double) partitions of constrained/unconstrained firms *vs.* firms with low/high hedging needs. Table 4 reports the results from the above system separately for constrained (Panel A) and unconstrained firm samples (Panel B). That table features our first proxy for investment opportunities, industry R&D expenditures, in the computation of the cash flow–investment opportunity correlation. Table 5 is similarly compiled, but the results there come from our second measure of growth opportunities, industry sales growth. Finally, Table 6 presents the same sorts of regression outputs, but it employs changes in industry Q as the proxy for investment demand. For ease of exposition, we only present the results for the estimates associated with the cash flow innovations in the system (α_1 and β_1).

$$\overline{\quad - \text{ insert Table 4 here } - \quad}$$

$$\overline{\quad - \text{ insert Table 5 here } - \quad}$$

$$\overline{\quad - \text{ insert Table 6 here } - \quad}$$

Results in Tables 4 through 6 are all very similar. As in previous estimations, unconstrained firms display a strong, negative cash flow sensitivity of debt — they use their free cash flow to pay down debt regardless of their hedging needs — and their cash policies are completely insensitive to cash flow innovations. More importantly, these patterns are *insensitive* to the correlation measures. Cash flow sensitivities of cash are mostly insignificant for these firms, even if their hedging needs are high. Cash flow sensitivities of debt are sometimes more negative for firms with low hedging needs, but the reverse pattern occurs with almost the same frequency. Overall, it is hard to say that there is any relationship at all between correlations and sensitivities for unconstrained firms.

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The results are markedly different for constrained firms, however. The results show that constrained firms with high hedging needs are the ones paying down debt the least — in fact their net borrowing positions increase — and are also the ones doing the most cash savings.[27] Constrained firms with low hedging needs, in contrast, display a tendency to pay down their outstanding debt when they have cash flow surpluses, a pattern that is similar (but weaker in magnitude) than that observed for unconstrained firms. Constrained firms with low hedging needs do seem to have a propensity to save cash, however, this propensity is clearly lower in magnitude than that of constrained firms with high hedging needs. Cash flow sensitivities of cash are generally, but not always statistically significant for this group of firms. Notice that these patterns do not depend on the measure of correlation that we choose to look at – the results are robust to variations in the correlation measure.

Taken as a whole, the results from Tables 4 through 6 are consistent with the predictions of our model. Constrained firms do seem to have a much stronger propensity to save cash, and a much weaker propensity to reduce debt when their hedging needs are high. This pattern suggests that future investment needs, jointly with expectations about the availability of internal funds, are key determinants of these firms' financial policies. The fact that unconstrained firms display no such patterns gives additional evidence that they are indeed caused by the joint, dynamic optimization of financing and investment that characterizes financially constrained firms.

4 Is Cash Negative Debt? What We Learn From Our Results

As we discussed in the introduction, there are two possible characterizations of the "cash is negative debt" view of the world. One view is that firms might be strictly indifferent between having positive cash and negative debt in their balance sheets. Another possible characterization is that "cash is negative debt" when firms use cash to reduce debt. The common aspect of both views is that they assign no (or little) economic role to firms' cash holdings.

Our theory suggests that if one uses the first characterization, cash can only be negative debt if firms are financially unconstrained and if there are no other frictions that cause firms to prefer negative debt over positive cash or vice-versa. In other words, cash is negative debt in a Modigliani-Miller world, but generally not outside of it. The existence of financial constraints, in particular, eliminates the indifference between cash and negative debt because these two components of a firm's financial structure have different implications for firms' feasible future investments. Under the second characterization, the theory provides a more detailed answer to the question of whether cash

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[27]The finding that cash flow sensitivities of debt are *positive* for constrained firms with high hedging needs, however, is the result that is least robust to small variations in the correlation cut-offs. Nevertheless, these sensitivities are never significantly *negative*, irrespective of the cutoff. Thus, the contrast with constrained firms with low hedging needs, which display negative and large cash flow sensitivities of debt, is robust.

is negative debt. Specifically, cash can be negative debt even for constrained firms, if their hedging needs are small. In this case, firms should display a preference towards using cash to reduce debt. In contrast, cash is not negative debt for constrained firms with hedging needs, even under this alternative characterization. These firms assign the highest economic value to cash holdings. In particular, their value inside the firm is higher than when they are used to reduce debt. Thus, irrespective of the definition, cash holdings cannot be seen as negative debt if firms are financially constrained.

Our empirical results support the prediction that constrained firms with high hedging needs have a strong preference towards holding cash. For these firms, cash is clearly not negative debt. The results also suggest that constrained firms with low hedging needs and unconstrained firms do use cash to repay debt. Clearly, these firms do not appear to be indifferent among the different options to allocate their cash flows. However, cash appears to have a less important (or non-significant) economic role for them. In this sense, cash may be seen as negative debt for these firms.

5   Concluding Remarks

We propose and test a theory of cash–debt substitutability in the presence of financing constraints. Our results show that cash cannot be treated as negative debt for constrained firms, particularly for those that have high hedging needs. Our theory predicts that these firms will prefer to direct excess cash flows to cash holdings, instead of using these income surpluses to reduce outstanding debt. Because cash fulfills the important economic role of hedging future investment against cash flow shortfalls, these firms prefer positive cash to negative debt. In contrast, constrained firms with low hedging needs are more likely to use their cash flows to reduce debt, since a decrease in current debt is the most effective way to increase investment in future states of the world in which cash flow is high. Since these firms use cash to reduce debt, cash is closer to negative debt for them. Our empirical results confirm these predictions of the theory. In addition, we show that financially unconstrained firms also seem to use current cash flows to reduce outstanding debt. Thus, under the view that "cash is negative debt" when firms use cash to reduce debt, our conclusion is that cash is negative debt for unconstrained firms and for constrained firms with low hedging needs, but not for constrained firms with high hedging needs. However, this conclusion does not imply that unconstrained firms and firms with low hedging needs are *indifferent* between having positive cash and negative debt. In fact, our results suggest that these firms (particularly the unconstrained ones) appear to prefer negative debt to positive cash.

Our theory focuses exclusively on the effect of financial constraints on the substitution between cash and debt. We do that because previous literature has suggested that financial constraints

do have a substantial effect on both cash and debt policies (Almeida, Campello, and Weisbach (2004) and Faulkender and Petersen (2004)), and also because we want to isolate the implications of financing constraints for the "is cash negative debt?" question. However, the fact that financially unconstrained firms appear to display a systematic preference to reduce debt suggests that other frictions might be at play in our empirical results. Future research could try to better identify the effects of variables such as tax parameters, agency problems, and liquidity premiums on the substitutability between cash and debt, and thereby provide further insights on whether and when cash should be treated as negative debt.

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Appendix

A Other Costs and Benefits of Cash *vs.* Debt

We introduce a parameter k to capture in a simplified way other (net) costs and benefits of cash and debt. We assume that holding a unit of cash for a period yields a return of $(1-k)$ next period. For example, given the level of cash retained in period 0, $c_1 = c_0 - \Delta$, the cash available for the firm in period 1 is $(1-k)c_1$. If, for example, cash has a low yield as a consequence of its liquidity, the parameter k would be positive. Variables that favor debt issues and cash retention, such as tax benefits of debt, could be captured by a negative k.

A.1 Solution when $k > 0$

A.1.1 Unconstrained Firms

A cost of holding cash means that unconstrained firms will no longer be indifferent between holding cash and repaying debt. In fact, it becomes optimal for such firms to carry as little cash as possible, given that cash does not increase investment for such firms.

In order to show this, we start by characterizing optimal decisions at date 1, for a given Δ. For a given Δ, the firm has an amount of cash equal to $(1-k)(c_0 - \Delta)$ available at that date. In the states in which there is no investment opportunity, the optimal strategy is to pay out this cash so that the firm does not carry it again into period 2. In the states in which there is an investment opportunity, it is optimal for unconstrained firms to issue as little debt as possible, so that less cash is carried to period 2. Given that the unconstrained firm invests I^{FB} if there is an investment opportunity, and given the firm's budget constraint at date 1, we have that the optimal debt issue B_1^* in states in which there is an investment opportunity satisfies:

$$I^{FB} = (1-k)(c_0 - \Delta) + B_1^*.$$

If $B_1 = B_1^*$, the firm carries no cash from date 1 to date 2 in states in which an investment opportunity arises. Given these date 1 decisions, the firm's expected equity value at date 0 can be written as:

$$p\phi[c^H + g(I^{FB}) - B_1^* - d_2^N] + p(1-\phi)[c^H + (1-k)(c_0 - \Delta) - d_2^N] +$$
$$(1-p)\phi[c^L + (1-k)(c_0 - \Delta) - \tau c^L] + (1-p)(1-\phi)[c^L + g(I^{FB}) - B_1^* - \tau c^L].$$

The firm's objective is to choose Δ to maximize this expression, an optimization problem which using the definition of B_1^* and the relationship between d_2^N and Δ can be written as:

$$\max_\Delta[\Delta + (1-k)(c_0 - \Delta)].$$

Clearly, as long as $k > 0$, and conditional on the firm being unconstrained the firm benefits from increasing Δ as much as possible. Thus, the optimal solution for Δ, Δ^*, is such that:

$$\Delta^* \geq \widehat{\Delta} = \min(\Delta_{\max}, \Delta'),$$

where Δ' is the value of Δ that renders the firm constrained in state L. Δ' satisfies:

$$\Delta' = c_0 - \frac{[I^{FB} - \tau g(I^{FB})]}{(1-k)}.$$

If $\Delta' < \Delta_{\max}$, we cannot guarantee that $\Delta^* = \Delta'$ exactly. The problem is that it might be worthwhile for the firm to become a little bit constrained in state L given the benefit of reducing debt and carrying less cash. The optimal value of Δ is somewhere between Δ' and $\Delta_{\max}$. In any case, we have the result that the cash flow sensitivity of debt should be negative in this case. Both Δ' and $\Delta_{\max}$ are increasing with c_0, and thus an increase in c_0 reduces the amount of debt that the firm carries into the future. (Here it helps again to assume that $c_0 < D_0$, so that $\Delta_{\max} = c_0$).

The intuition for the sensitivity result is simple. An increase in cash flow either allows the firm to repay more debt directly, or indirectly through a relaxation of the financial constraint in state L, in case this constraint becomes binding.

Notice also that even though we have a negative relationship between cash flow and debt for unconstrained firms in this case, this relationship should hold irrespective of the correlation between cash flows and investment opportunities (Δ^* is independent of ϕ).

A.1.2 Constrained Firms

The introduction of a cost of holding cash does not change the qualitative nature of the results obtained for the constrained firms. First, for constrained firms that choose to repay debt when $k = 0$, there is obviously no change in behavior. Second, because the cost of carrying cash increases, the only change in the result characterized in Proposition 1 is that the threshold $\overline{\phi}$ below which it is optimal for the constrained firm not to repay any debt should be lower, and decreasing with k.

A.2   Solution when $k < 0$

A.2.1   Unconstrained Firms

A negative cost of carrying cash translates into a benefit of allowing debt to be as high as possible, with the additional proceeds parked in the cash account. A similar reasoning to that described above shows that the unconstrained firm benefits from issuing debt at date 0, that is:

$$\Delta^* = \Delta_{\min}.$$

By definition, the firm can only be unconstrained if it is unconstrained in state L when $\Delta = \Delta_{\min}$, so now there is a uniquely optimal value for Δ.

Since $c_1 = c_0 - \Delta_{\min}$ for such firms, we get the implication that an increase in cash flow should result in higher cash savings for unconstrained firms. Notice that $\Delta_{\min}$ is independent of cash flow. Again, this implication is independent of the correlation between cash flows and investment opportunities.

A.2.2   Constrained Firms

As in the analysis for the other case, there is no qualitative change in the implications for constrained firms. The only change is that the threshold above which the firm finds it profitable to repay debt in Proposition 1 will increase.

B Proofs

<u>Proof of Lemma 1</u> Differentiating both sides of equation (5) with respect to I, we obtain

$$[1 - \tau g'(I)]I' = -1 + \frac{\partial}{\partial \Delta}\left[\tau c_2 - d_2^N\right]^+. \tag{18}$$

It is our maintained assumption that $[1 - \tau g'(I)]$ is greater than zero. From equation (11), if $\Delta > \widetilde{\Delta}$, then $\tau c_H > \tau c_L > d_2^N$ and $[\tau c_2 - d_2^N]^+ = \tau c_2 - D_0 + \Delta$. It follows that in this case, $I_H(\Delta)$ and $I_L(\Delta)$ are independent of Δ.

When $\Delta < \widetilde{\Delta}$, $\tau c_H \geq d_2^N > \tau c_L$. Hence, $[\tau c_H - d_2^N]^+ = \tau c_H - d_2 + \frac{\Delta}{p}$ and $[\tau c_L - d_2^N]^+ = 0$. It follows that in this case, $I_H(\Delta)$ is strictly increasing in Δ and $I_L(\Delta)$ is strictly decreasing in Δ.

Finally, note that for a given state s, $I_s^*(\Delta)$ is either equal to I^{FB}, which is independent of Δ, or equal to $I_s(\Delta)$. The lemma now follows from the properties of $I_s(\Delta)$ derived above. $\diamondsuit$

<u>Proof of Lemma 2</u> From equation (5), note that for a given Δ, if the firm is unconstrained in state L, then

$$I^{FB} > c_0 - \Delta + \tau g(I^{FB}) + \left[\tau c_L - d_2^N\right]^+. \tag{19}$$

Since $c_H > c_L$, this inequality must also hold with c_L replaced by c_H, and in turn, the firm must be unconstrained in state H as well. Furthermore, from Lemma 1, $I_L^*(\Delta)$ is weakly decreasing in Δ. Hence, if the firm is unconstrained in state L at $\Delta = \Delta_{\min}$, then the firm is always financially unconstrained. $\diamondsuit$

<u>Proof of Proposition 1</u> Consider first a firm that is unconstrained at $\Delta = 0$. From Lemma 2, when the firm is unconstrained, it must be unconstrained in state L: $I_L^*(0) = I^{FB}$. From Lemma 2, $I_L^*(\Delta)$ is weakly decreasing in Δ, so that $I_L^*(\Delta) = I^{FB}$ for $\Delta < 0$ and the firm continues to remain unconstrained. Thus, for $\Delta > 0$, $I_L^*(\Delta) \leq I_L^*(0)$ and the firm may be rendered constrained if it becomes constrained in state L. Denote $\widehat{\Delta}$ as the minimum of $\Delta_{\max}$ and the maximum value of Δ for which $I_L^*(\Delta) = I^{FB}$. It follows that for $\Delta \in [\Delta_{\min}, \widehat{\Delta}]$, the firm is unconstrained and hence indifferent in picking any policy Δ. For $\Delta > \widehat{\Delta}$, the firm is rendered constrained in state L (and possibly in state H) which can only reduce firm-value.

Consider now a firm that is constrained at $\Delta = 0$. The firm is thus necessarily constrained in state L and may or may not be constrained in state L. We divide the proof in two cases:

- Case 1: the firm is unconstrained in state H when $\Delta = 0$. Recall from Lemma 1 that $I_H^*(\Delta)$ is weakly increasing in Δ and $I_L^*(\Delta)$ is weakly decreasing in Δ. Lowering Δ alleviates the firm's financing constraint in state L. This increases firm value unless the firm is rendered constrained in state H also. Thus, if $I_H^*(\Delta_{\min}) = I^{FB}$, then it is optimal for the firm to choose $\Delta^* = \Delta_{\min}$. Else, let $\widehat{\widehat{\Delta}}$ be the minimum value of Δ such that $I_H^*(\Delta) = I^{FB}$.

- Case 2: the firm is constrained in state H when $\Delta = 0$. In this case, the firm solves the maximization problem in (15) and $I_s^*(\Delta) = I_s(\Delta)$, the constrained investment levels given by equation (5). Consider first the effect of "small" increases in Δ, such that $\tau c_L < d_2^N$ after the debt repayment. In this case, the first-order condition for an interior solution of Δ is:

$$(1-p)\left[\frac{\phi(g'_H - 1)}{(1 - \tau g'_H)} - \frac{(1-\phi)(g'_L - 1)}{(1 - \tau g'_L)}\right] = 0,$$

where we have substituted the derivatives

$$\frac{\partial I_H}{\partial \Delta_0} = \frac{(1-p)}{p(1 - \tau g'_H)},$$

$$\frac{\partial I_L}{\partial \Delta_0} = -\frac{1}{(1 - \tau g'_L)}.$$

For any given Δ, we clearly have that $I_H > I_L$, and in turn, $g'_H < g'_L$, implying that

$$\frac{(g'_H - 1)}{(1 - \tau g'_H)} < \frac{(g'_L - 1)}{(1 - \tau g'_L)}.$$

In particular, for $\phi \leq 0.5$, the left hand side of the first-order condition is always negative whereby $\Delta^* = \Delta_{\min}$, and at $\phi = 1$, it is always positive whereby $\Delta^* = \min(\widetilde{\Delta}, \Delta_{\max})$. This last step follows from the fact that once the debt repayment is "large" (equal to $\widetilde{\Delta}$), the debt becomes riskless and a further increase in debt repayment does not affect the objective function. To see this, note that equations (5) and (11) for $\tau c_L > d_2^N$ imply that

$$I_H = c_0 + \tau g(I_H) + \tau c_H - D_0 \tag{20}$$

$$I_L = c_0 + \tau g(I_L) + \tau c_L - D_0. \tag{21}$$

Next, we show that whenever Δ^* is interior, it is increasing in ϕ. Then, the existence of unique $\bar{\phi}$ and $\bar{\bar{\phi}}$ follows by the intermediate-value theorem.

Denoting the objective function in (15) by $f(\Delta)$, we obtain that at the optimal Δ^*,

$$\frac{\partial f}{\partial \Delta} = 0, \frac{\partial^2 f}{\partial \Delta^2} < 0.$$

By the implicit-function theorem, that is, taking derivative of the first order condition w.r.t. ϕ, we obtain

$$\text{sign}\left(\frac{d\Delta}{d\phi}\right) = \text{sign}\left(\frac{\partial^2 f}{\partial \phi \partial \Delta}\right).$$

Now,

$$\frac{\partial f}{\partial \Delta} = (1-p)\left[\frac{\phi(g'_H - 1)}{(1 - \tau g'_H)} - \frac{(1-\phi)(g'_L - 1)}{(1 - \tau g'_L)}\right].$$

Thus,

$$\frac{\partial^2 f}{\partial \phi \partial \Delta} = (1-p)\left[\frac{(g'_H - 1)}{(1 - \tau g'_H)} + \frac{(g'_L - 1)}{(1 - \tau g'_L)}\right] > 0.$$

This completes the proof. $\diamondsuit$

<u>Proof of Proposition 2</u> For $\phi \leq \frac{1}{2}$, $\Delta^* = \Delta_{\min}$ which is independent of c_0. Since $c_1 = c_0 - \Delta$, it follows that for $\phi \leq \frac{1}{2}$, $\frac{\partial c_1}{\partial c_0} > 0$ and $\frac{\partial \Delta}{\partial c_0} = 0$.

For $\phi \geq \bar{\bar{\phi}}$, $\Delta^* = \min(\widetilde{\Delta}, \Delta_{\max})$. Since $\widetilde{\Delta}$ is independent of c_0 and $\Delta_{\max} = \min(c_0, D_0)$ is weakly increasing in c_0, we obtain that for $\frac{\partial \Delta}{\partial c_0} > 0$. When the relevant parameter range is $\Delta^* = c_0$, then we also obtain that $\frac{\partial c_1}{\partial c_0} = 0$. $\diamondsuit$

<u>Proof of Example 1</u> When the choice of Δ is interior, $\frac{d\Delta}{dc_0}$ can be characterized as follows.

Let $f(c_0, \Delta)$ denote the objective function of the constrained firm, that is, with $I_H(c_0, \Delta)$ and $I_L(c_0, \Delta)$ being constrained and substituted in the objective function. Then, the optimal interior Δ satisfies the first-order and the second-order conditions:

$$\frac{\partial f}{\partial \Delta} = 0, \frac{\partial^2 f}{\partial \Delta^2} < 0.$$

By the implicit-function theorem, that is, taking derivative w.r.t. c_0, we obtain

$$\text{sign}\left(\frac{d\Delta}{dc_0}\right) = \text{sign}\left(\frac{\partial^2 f}{\partial c_0 \partial \Delta}\right).$$

Now,

$$\frac{\partial f}{\partial \Delta} = (1-p)\left[\frac{\phi(g'_H - 1)}{(1 - \tau g'_H)} - \frac{(1-\phi)(g'_L - 1)}{(1 - \tau g'_L)}\right].$$

It follows that

$$\frac{\partial^2 f}{\partial c_0 \partial \Delta} = \frac{\partial^2 f}{\partial I_H \partial \Delta} \cdot \frac{\partial I_H}{\partial c_0} + \frac{\partial^2 f}{\partial I_L \partial \Delta} \cdot \frac{\partial I_L}{\partial c_0},$$

where

$$\frac{\partial^2 f}{\partial I_H \partial \Delta} = \frac{(1-p)(1-\tau)\phi g''_H}{(1 - \tau g'_H)^2},$$

$$\frac{\partial^2 f}{\partial I_L \partial \Delta} = \frac{-(1-p)(1-\tau)(1-\phi)g''_L}{(1 - \tau g'_L)^2},$$

$$\frac{\partial I_H}{\partial c_0} = \frac{1}{(1 - \tau g'_H)},$$

$$\frac{\partial I_L}{\partial c_0} = \frac{1}{(1 - \tau g'_L)}.$$

Putting these pieces together, we obtain that

$$\frac{\partial^2 f}{\partial c_0 \partial \Delta} = (1-p)(1-\tau)\left[\frac{\phi g''_H}{(1 - \tau g'_H)^3} - \frac{(1-\phi)g''_L}{(1 - \tau g'_L)^3}\right].$$

To understand the behavior of this expression as a function of ϕ, we substitute the first-order condition that must be satisfied for an interior choice of Δ. In particular, this condition is

$$\phi \frac{(g'_H - 1)}{(1 - \tau g'_H)} = (1-\phi)\frac{(g'_L - 1)}{(1 - \tau g'_L)}.$$

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Substituting this condition in the expression for $\frac{\partial^2 f}{\partial c_0 \partial \Delta}$, we obtain

$$\frac{\partial^2 f}{\partial c_0 \partial \Delta} = \frac{(1-p)(1-\tau)\phi}{(1-\tau g_H')^3}\left[g_H'' - \frac{\phi^2 g_L''}{(1-\phi)^2}\left(\frac{g_H'-1}{g_L'-1}\right)^3\right].$$

In general, the behavior of this expression depends upon how g'' varies with investment levels, i.e., it depends upon g'''. However, a characterization can be obtained if we assume that $g''' = 0$.

Suppose that $g''(I) = -G$, $\forall I$ and $G > 0$. Then, we can write

$$\frac{\partial^2 f}{\partial c_0 \partial \Delta} = \frac{(1-p)(1-\tau)\phi G(g_H'-1)^3}{(1-\tau g_H')^3 (g_L'-1)^3}\left[\frac{\phi^2}{(1-\phi)^2} - \left(\frac{g_L'-1}{g_H'-1}\right)^3\right].$$

Now, note that $g_L' < g'(0) < \frac{1}{\tau}$. The last inequality follows from the assumption that $(1-\tau g'(I)) < 0$, $\forall I$. In turn, $g_L' - 1 < \frac{1-\tau}{\tau}$.

Furthermore, since there is an interior solution for Δ for all $\phi \in (\overline{\phi}, \overline{\overline{\phi}})$, we obtain that $g_H' > g'(I_H(\overline{\overline{\phi}})) \equiv \overline{g}_H'$. In turn, $g_H' - 1 > \overline{g}_H' - 1$.

Then, we obtain that $\frac{\partial^2 f}{\partial c_0 \partial \Delta}$ is positive whenever

$$\frac{\phi}{1-\phi} > \left(\frac{g_L'-1}{g_H'-1}\right)^{\frac{3}{2}} > K^*,$$

where

$$K^* = \left(\frac{1-\tau}{\tau(\overline{g}_H'-1)}\right)^{\frac{3}{2}}.$$

Putting together these steps, we conclude that if g'' is a constant, then $\frac{d\Delta}{dc_0} > 0$ in the range $[\phi^*, \overline{\overline{\phi}})$, where $\phi^* = \frac{K^*}{1+K^*}$. $\diamond$

Table 1: Constraint Type Cross-Correlations

This table displays constraint type cross-classifications for the four criteria used to categorize firm-years as either financially constrained or unconstrained (see text for definitions). To ease visualization, we assign the letter (C) for constrained firms and (U) for unconstrained firms in each row/column. All data are from the annual COMPUSTAT industrial tapes and the sample period is 1971 through 2001.

FINANCIAL CONSTRAINTS CRITERIA		PAYOUT POLICY		FIRM SIZE		BOND RATINGS		CP RATINGS	
		(C)	(U)	(C)	(U)	(C)	(U)	(C)	(U)
1. PAYOUT POLICY									
Constrained Firms	(C)	6,153							
Unconstrained Firms	(U)		6,231						
2. FIRM SIZE									
Constrained Firms	(C)	2,680	1,221	6,060					
Unconstrained Firms	(U)	1,078	2,645		6,231				
3. BOND RATINGS									
Constrained Firms	(C)	2,605	2,190	4,217	922	7,953			
Unconstrained Firms	(U)	3,548	4,041	1,843	5,309		12,193		
4. COMMERCIAL PAPER RATINGS									
Constrained Firms	(C)	4,920	3,229	5,763	1,781	7,689	5,254	12,943	
Unconstrained Firms	(U)	1,233	3,002	297	4,450	264	6,939		7,203

Table 2: Summary Statistics

This table displays summary statistics for long-term debt, holdings of cash and liquid securities, and cash flows (all normalized by total assets) across groups of financially constrained and unconstrained firms. All data are from the annual COMPUSTAT industrial tapes and the sample period is 1971 through 2001.

	Debt			*CashHold*			*CashFlow*		
	Mean	Median	StdDev	Mean	Median	StdDev	Mean	Median	StdDev
FINANCIAL CONSTRAINTS CRITERIA									
1. PAYOUT POLICY									
Constrained Firms	0.1742	0.1615	0.1107	0.1338	0.0864	0.1367	0.0235	0.0336	0.0834
Unconstrained Firms	0.1800	0.1669	0.1570	0.0867	0.0567	0.0872	0.0197	0.0192	0.0525
2. FIRM SIZE									
Constrained Firms	0.1540	0.1282	0.1326	0.1674	0.1242	0.1395	0.0366	0.0436	0.0751
Unconstrained Firms	0.1887	0.1787	0.1086	0.0771	0.0533	0.0753	0.0227	0.0245	0.0469
3. BOND RATINGS									
Constrained Firms	0.1508	0.1354	0.1186	0.1317	0.0934	0.1215	0.0334	0.0351	0.0613
Unconstrained Firms	0.2019	0.1869	0.1289	0.0904	0.0596	0.0950	0.0283	0.0312	0.0584
4. COMMERCIAL PAPER RATINGS									
Constrained Firms	0.1871	0.1698	0.1380	0.1229	0.0827	0.1202	0.0285	0.0317	0.0646
Unconstrained Firms	0.1747	0.1655	0.1079	0.0788	0.0549	0.0761	0.0334	0.0342	0.0495

Table 3: The Cash Flow Sensitivity of Debt and Cash Holdings

This table displays 3SLS-FE (firm and year effects) results of empirical models for debt issuance and cash holdings (see Eq. (XX) in the text). Panel A displays the results for long-term debt issuance (net of retirements), while Panel B displays the results for changes in the holdings of cash and liquid securities. All data are from the annual COMPUSTAT industrial tapes and the sample period is 1971 through 2001. The debt and cash models are jointly estimated (within constraint types) and the empirical error structure allows for unstructured correlation across models. t-statistics (in parentheses).

PANEL A: CASH FLOW SENSITIVITY OF DEBT (NET DEBT ISSUANCE)

Dependent Variable $\Delta Debt_{i,t}$	$CashFlow_{i,t}$	$Q_{i,t}$	$Size_{i,t}$	$\Delta CashHold_{i,t}$	$Debt_{i,t-1}$	R^2	N
FINANCIAL CONSTRAINTS CRITERIA							
1. PAYOUT POLICY							
Constrained Firms	0.0148	-0.0077**	0.0306**	0.0980	−0.2393**	0.11	3,338
	(0.57)	(−3.26)	(9.40)	(1.63)	(−16.49)		
Unconstrained Firms	−0.3531**	0.0004	0.0384**	0.1464**	−0.3301**	0.16	3,835
	(−21.03)	(0.20)	(12.32)	(2.77)	(−21.05)		
2. FIRM SIZE							
Constrained Firms	−0.0037	−0.0072**	0.0365**	-0.0011	−0.2720**	0.11	3,043
	(−0.13)	(−3.16)	(9.40)	(-0.02)	(−17.11)		
Unconstrained Firms	−0.2408**	−0.0031*	0.0240**	0.2829**	−0.2493**	0.10	4,023
	(-11.29)	(−1.93)	(10.41)	(3.24)	(−19.02)		
3. BOND RATINGS							
Constrained Firms	0.0642**	−0.0114**	0.0330**	0.0060	−0.2629**	0.11	3,844
	(2.74)	(−6.50)	(9.40)	(0.14)	(−17.70)		
Unconstrained Firms	−0.2330**	-0.0007	0.0240**	0.1214**	−0.2708**	0.13	7,836
	(−13.50)	(-0.49)	(10.41)	(2.54)	(−28.89)		
4. COMMERCIAL PAPER RATINGS							
Constrained Firms	−0.0633**	-0.0044	0.0344**	0.0359	−0.2636**	0.11	7,039
	(−3.43)	(-2.78)	(15.42)	(0.92)	(−25.94)		
Unconstrained Firms	−0.3183**	−0.0026	0.0262**	0.2113**	−0.2811**	0.14	4,641
	(−14.79)	(—1.61)	(10.93)	(2.91)	(−22.31)		

Notes: *,** indicate statistical significance at the 5- and 1-percent (two-tail) test levels, respectively.

Table 3: — Continued

Dependent Variable	Independent Variables					R^2	N
$\Delta CashHold_{i,t}$	$CashFlow_{i,t}$	$Q_{i,t}$	$Size_{i,t}$	$\Delta Debt_{i,t}$	$CashHold_{i,t-1}$		
FINANCIAL CONSTRAINTS CRITERIA							
1. PAYOUT POLICY							
Constrained Firms	0.1666**	0.0100**	-0.0085**	0.1826**	−0.3221**	0.12	3,338
	(8.37)	(5.09)	(−2.82)	(3.72)	(−20.05)		
Unconstrained Firms	-0.0088	0.0016	−0.0039	-0.0344	−0.3908**	0.20	3,835
	(-0.54)	(1.35)	(−1.84)	(-1.16)	(−30.78)		
2. FIRM SIZE							
Constrained Firms	0.2201**	0.0064**	−0.0154**	0.1593**	−0.3323**	0.14	3,043
	(9.26)	(2.85)	(−3.69)	(2.84)	(−19.89)		
Unconstrained Firms	0.0026	0.0033**	−0.0042**	0.0326	−0.2385**	0.09	4,023
	(0.19)	(3.53)	(−2.90)	(1.05)	(−19.52)		
3. BOND RATINGS							
Constrained Firms	0.1873**	0.0059**	−0.0072*	0.0770	−0.3439**	0.15	3,844
	(8.56)	(3.20)	(−2.09)	(1.39)	(−23.26)		
Unconstrained Firms	0.0369*	0.0049**	−0.0084**	0.1002**	−0.2951**	0.11	7,836
	(2.21)	(4.89)	(−5.82)	(4.34)	(−31.12)		
4. COMMERCIAL PAPER RATINGS							
Constrained Firms	0.1422**	0.0073**	−0.0091**	0.1422**	−0.3290**	0.13	7,039
	(4.50)	(5.59)	(−4.42)	(4.50)	(−31.27)		
Unconstrained Firms	-0.0061	0.0032*	−0.0069**	-0.0061	−0.2702**	0.10	4,641
	(-0.22)	(3.13)	(−4.25)	(-0.22)	(−22.23)		

Notes: *,** indicate statistical significance at the 5- and 1-percent (two-tail) test levels, respectively.

Table 4: Hedging Needs (R&D Measure) and the Propensity to Save Cash
vs Pay Down Debt

This table reports 3SLS-FE (firm and year effects) results of empirical models for debt issuance and cash holdings (see Eq. (XX) in the text). Each cell displays estimates of the coefficient returned for *CashFlow* (and the associated test statistics) separately for sets of firms with high hedging needs and for sets of firms with low hedging needs. Panel A displays the results returned for financially constrained firms, while Panel B displays the results for financially unconstrained firms. All data are from the annual COMPUSTAT industrial tapes and the sample period is 1971 through 2001. The debt and cash models are jointly estimated (within constraint types) and the empirical error structure allows for unstructured correlation across models. *t*-statistics (in parentheses).

PANEL A: CONSTRAINED FIRMS

	FINANCIAL CONSTRAINTS CRITERIA			
	PAYOUT POLICY	FIRM SIZE	BOND RATINGS	CP RATINGS
ENDOGENOUS POLICY VARIABLE:				
1. DEBT ISSUANCE (NET OF RETIREMENTS)				
Firms w/ High Hedging Needs	0.0994**	0.0968**	0.1518**	0.0642*
	(2.65)	(2.40)	(3.88)	(2.16)
Firms w/ Low Hedging Needs	–0.1026*	–0.1705**	–0.0994**	–0.2692**
	(–2.00)	(–2.74)	(–2.54)	(–9.20)
2. INCREASES IN CASH HOLDINGS				
Firms w/ High Hedging Needs	0.2011**	0.2571**	0.2532**	0.1852**
	(7.44)	(8.51)	(7.18)	(8.70)
Firms w/ Low Hedging Needs	0.0737	0.0747	0.1035**	0.1096**
	(1.57)	(1.19)	(2.14)	(3.33)

Notes: *,** indicate statistical significance at the 5- and 1-percent (two-tail) test levels, respectively.

Table 4: — Continued

	Financial Constraints Criteria			
	Payout Policy	Firm Size	Bond Ratings	CP Ratings
Endogenous Policy Variable:				
1. Debt Issuance (Net of Retirements)				
Firms w/ High Hedging Needs	-0.4277**	-0.1822**	-0.2712**	-0.4286**
	(-9.27)	(-3.50)	(-5.86)	(-10.75)
Firms w/ Low Hedging Needs	−0.3629**	−0.3935**	−0.3903**	-0.3867**
	(−15.63)	(-9.74)	(−9.59)	(−8.93)
2. Increases in Cash Holdings				
Firms w/ High Hedging Needs	0.0356	0.0526	0.1087**	-0.0157
	(1.12)	(1.63)	(5.75)	(-0.47)
Firms w/ Low Hedging Needs	0.0267	-0.0081	0.0407**	-0.0627
	(0.53)	(-0.23)	(2.43)	(-1.35)

Notes: *,** indicate statistical significance at the 5- and 1-percent (two-tail) test levels, respectively.

Table 5: Hedging Needs (Sales Growth Measure) and the Propensity to Save
Cash *vs* Pay Down Debt

This table reports 3SLS-FE (firm and year effects) results of empirical models for debt issuance and cash holdings (see Eq. (XX) in the text). Each cell displays estimates of the coefficient returned for *CashFlow* (and the associated test statistics) separately for sets of firms with high hedging needs and for sets of firms with low hedging needs. Panel A displays the results returned for financially constrained firms, while Panel B displays the results for financially unconstrained firms. All data are from the annual COMPUSTAT industrial tapes and the sample period is 1971 through 2001. The debt and cash models are jointly estimated (within constraint types) and the empirical error structure allows for unstructured correlation across models. *t*-statistics (in parentheses).

PANEL A: CONSTRAINED FIRMS

| | FINANCIAL CONSTRAINTS CRITERIA | | | |
	PAYOUT POLICY	FIRM SIZE	BOND RATINGS	CP RATINGS
ENDOGENOUS POLICY VARIABLE:				
1. DEBT ISSUANCE (NET OF RETIREMENTS)				
Firms w/ High Hedging Needs	0.1017**	0.0777*	0.1528**	0.0820**
	(2.77)	(2.09)	(4.68)	(3.13)
Firms w/ Low Hedging Needs	−0.1973**	−0.1831**	−0.1037*	−0.3285**
	(−3.72)	(−3.39)	(−2.11)	(−8.90)
2. INCREASES IN CASH HOLDINGS				
Firms w/ High Hedging Needs	0.1673**	0.2453**	0.1953**	0.1435**
	(4.82)	(6.68)	(6.12)	(6.39)
Firms w/ Low Hedging Needs	0.0878*	0.1420**	0.1154**	0.1168**
	(2.20)	(2.54)	(2.50)	(3.06)

Notes: *,** indicate statistical significance at the 5- and 1-percent (two-tail) test levels, respectively.

Table 5: — Continued

PANEL B: UNCONSTRAINED FIRMS

| | FINANCIAL CONSTRAINTS CRITERIA | | | |
	PAYOUT POLICY	FIRM SIZE	BOND RATINGS	CP RATINGS
ENDOGENOUS POLICY VARIABLE:				
1. DEBT ISSUANCE (NET OF RETIREMENTS)				
Firms w/ High Hedging Needs	-0.2615**	-0.3087**	-0.2311**	-0.3046**
	(-8.16)	(-6.98)	(-5.07)	(-9.32)
Firms w/ Low Hedging Needs	−0.4107**	−0.4448**	−0.4604**	−0.4155**
	(−13.23)	(-11.89)	(−12.42)	(−7.38)
2. INCREASES IN CASH HOLDINGS				
Firms w/ High Hedging Needs	-0.0230	-0.0006	0.0236*	-0.0096
	(-0.93)	(-0.03)	(2.57)	(-0.48)
Firms w/ Low Hedging Needs	0.0377	-0.0022	0.0366*	-0.0526
	(-0.7480)	(-0.04)	(2.11)	(-1.04)

Notes: *,** indicate statistical significance at the 5- and 1-percent (two-tail) test levels, respectively.

Table 6: Hedging Needs (Industry Q Measure) and the Propensity to Save
Cash *vs* Pay Down Debt

This table reports 3SLS-FE (firm and year effects) results of empirical models for debt issuance and cash holdings (see Eq. (XX) in the text). Each cell displays estimates of the coefficient returned for *CashFlow* (and the associated test statistics) separately for sets of firms with high hedging needs and for sets of firms with low hedging needs. Panel A displays the results returned for financially constrained firms, while Panel B displays the results for financially unconstrained firms. All data are from the annual COMPUSTAT industrial tapes and the sample period is 1971 through 2001. The debt and cash models are jointly estimated (within constraint types) and the empirical error structure allows for unstructured correlation across models. *t*-statistics (in parentheses).

PANEL A: CONSTRAINED FIRMS

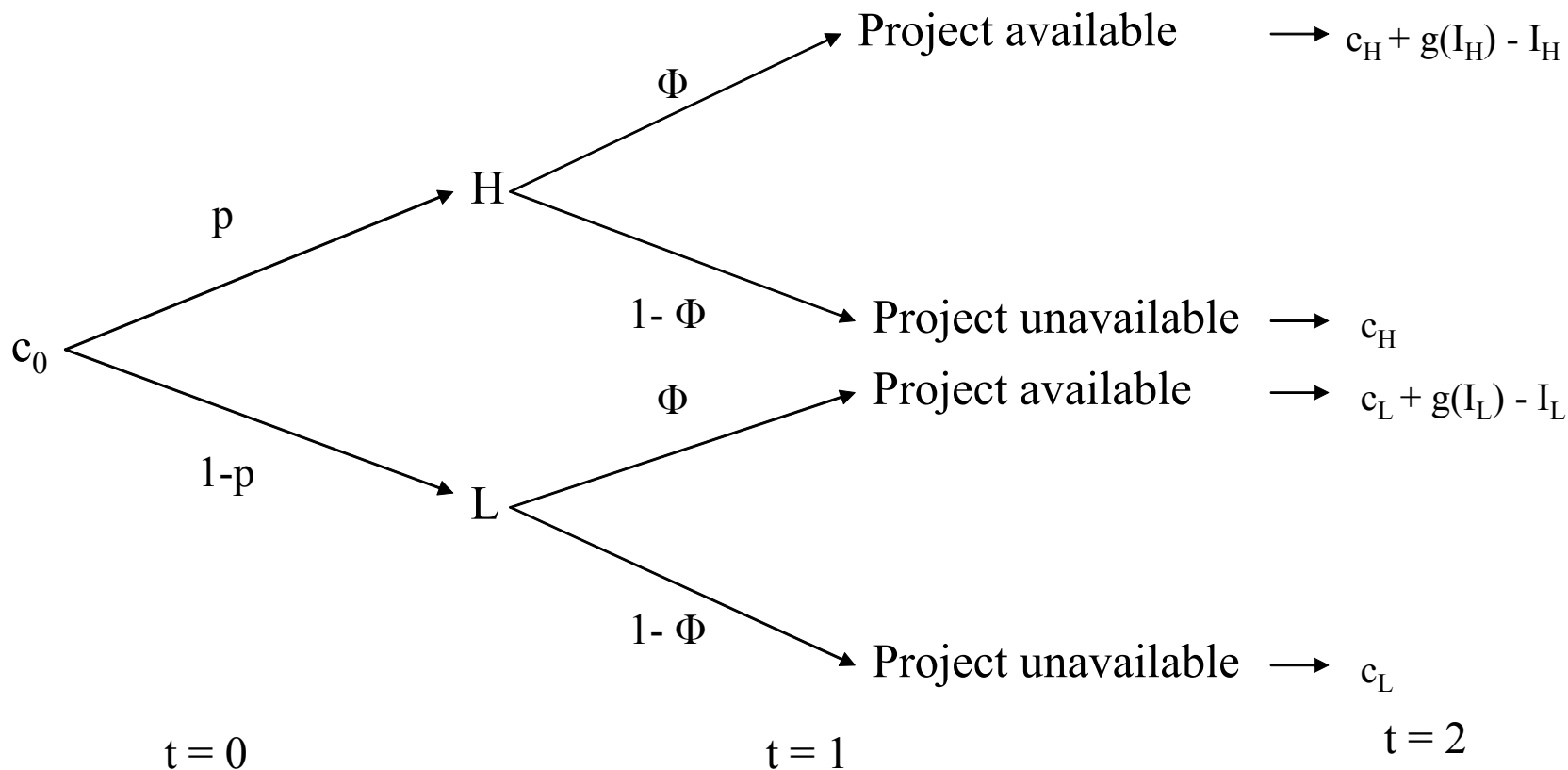| | FINANCIAL CONSTRAINTS CRITERIA | | | |
	PAYOUT POLICY	FIRM SIZE	BOND RATINGS	CP RATINGS
ENDOGENOUS POLICY VARIABLE:				
1. DEBT ISSUANCE (NET OF RETIREMENTS)				
Firms w/ High Hedging Needs	0.1417**	0.1448**	0.3324**	0.0775*
	(3.43)	(3.05)	(7.76)	(2.41)
Firms w/ Low Hedging Needs	−0.1042*	−0.1299**	−0.1350**	−0.0616*
	(-2.16)	(−2.92)	(−3.74)	(−1.79)
2. INCREASES IN CASH HOLDINGS				
Firms w/ High Hedging Needs	0.1420**	0.1674**	0.1483**	0.1320**
	(4.50)	(4.04)	(4.50)	(5.46)
Firms w/ Low Hedging Needs	0.1123**	0.0738	0.0934*	0.0866*
	(2.68)	(1.43)	(2.41)	(2.35)

Notes: *,** indicate statistical significance at the 5- and 1-percent (two-tail) test levels, respectively.

Table 6: — Continued

| | Financial Constraints Criteria | | | |
	Payout Policy	Firm Size	Bond Ratings	CP Ratings
Endogenous Policy Variable:				
1. Debt Issuance (Net of Retirements)				
Firms w/ High Hedging Needs	-0.4178**	-0.2740**	-0.3735**	-0.4223**
	(-12.75)	(-8.57)	(-10.52)	(-14.39)
Firms w/ Low Hedging Needs	−0.2145**	−0.3393**	−0.2552**	−0.3235**
	(−4.39)	(-6.50)	(−3.93)	(−6.55)
2. Increases in Cash Holdings				
Firms w/ High Hedging Needs	-0.0437	0.0044	0.0585**	-0.0182
	(-1.33)	(0.18)	(3.19)	(-0.68)
Firms w/ Low Hedging Needs	-0.1154*	-0.1079*	0.0253	-0.0806*
	(-2.18)	(-2.30)	(0.53)	(-1.63)

Notes: *,** indicate statistical significance at the 5- and 1-percent (two-tail) test levels, respectively.

Figure 1: Time-Line for the Model

c_0

p

1-p

H

L

Φ

Project available $\longrightarrow$ $c_H + g(I_H) - I_H$

1- Φ

Project unavailable $\longrightarrow$ c_H

Φ

Project available $\longrightarrow$ $c_L + g(I_L) - I_L$

1- Φ

Project unavailable $\longrightarrow$ c_L

t = 0

•Redeem Δ units of existing debt.

•Carry $(c_0 - \Delta)$ as cash reserves to next period.

t = 1

•Interim cash-flow is observed.

•Project opportunity, if any, is observed.

•New financing is raised, if required.

t = 2

•All cash-flows are realized.

•Only a fraction τ is pledeable to creditors.

•Creditors are paid, residual kept by firm.

Figure 2: Proposition 1, Optimal financial policy of a constrained firm