

The Demand for Corporate Liquidity: A Theory and Some Evidence*

Heitor Almeida

New York University
halmeida@stern.nyu.edu

Murillo Campello

University of Illinois
m-campe@uiuc.edu

Michael S. Weisbach

University of Illinois
weisbach@uiuc.edu

(This Draft: September 1, 2002)

Abstract

This paper proposes a theory of corporate liquidity management. Firms have access to valuable investment opportunities, but potentially cannot fund them with the use of external finance. Instead, they can retain internally-generated cash to finance those investments. Firms that are financially unconstrained can undertake all positive NPV projects regardless of their cash position, so their cash positions is irrelevant; however, firms facing financial constraints have an optimal cash position determined by the value of today's investments relative to the expected value of future investments. Taking into account hedging, dividend and borrowing policies, the model predicts that constrained firms will save in the form of liquid assets a positive fraction of incremental cash flows, while unconstrained firms will not. The impact of Jensen (1986) style overinvestment on the model's equilibrium is also considered. We test the model's implications on a sample of large, publicly-traded manufacturing firms over the 1981-2000 period. The empirical results are consistent with the main predictions of our theory of corporate cash policies.

Key words: Liquidity management, corporate governance, financial constraints, agency problems.

JEL classification: G31, G32, D23, D92.

*We thank Viral Acharya, Charlie Hadlock, and seminar participants at New York University, the New York Federal Reserve,... for helpful comments and suggestions. We also thank Steve Kaplan and Luigi Zingales for providing us with data. The usual disclaimer applies.

I Introduction

One of the most important decisions a financial manager makes is how liquid a firm's balance sheet should be. Given an inflow of cash to the firm, a manager can choose to reinvest the cash in physical assets, to distribute the cash to investors, or to keep the cash inside the firm. In fact, managers choose to hold a substantial portion of their assets in the form of cash and other liquid securities; in 1999, of the 25 nonfinancial companies in the Dow Jones index, the average ratio of cash and equivalent securities to annual capital expenditures was 227% and for 11 of the 25, the ratio was at least 97%. The financial press has been critical of these large cash holdings, and suggests that they are a manifestation of agency problems.¹ However, the difficulty with these sorts of criticisms is that they are made without a sense of what cash holdings would be in the absence of agency problems.

As Keynes (1936) originally discussed, the major advantage of a liquid balance sheet is that it allows firms to make value-increasing investments when they occur; however, Keynes also pointed out that this advantage is limited by the extent to which firms have access to capital markets (p. 196).² We present a model that formalizes this intuition. In it, a firm whose access to capital markets is limited by the nature of its assets may anticipate facing financing constraints when undertaking investments in the future. Cash holdings are valuable because they increase the likelihood that the firm will be able to fund those investments. However, increasing cash is also costly for a firm which faces limited access to capital markets, because it decreases the quantity of current investments that the firm can make. In other words, cash yields a lower return than that associated with the firm's physical investments precisely because the firm foregoes current positive NPV projects in order to hold cash. In contrast to a firm facing constrained access to capital markets, an unconstrained firm (i.e., a firm which invest in all of its positive NPV projects) has no use for cash, but also faces no cost of holding cash.

Our model contains a number of empirical predictions for corporate cash policies. The cleanest of those predictions concerns a firm's propensity to 'save' cash out of unexpected cash inflows; which we refer to as the cash flow sensitivity of cash. Our model implies that a firm's cash flow

¹See, for example, "What to do with all that cash?", *Business Week*, Nov/20/2000, and "Time pressure on six continents", *Financial Times*, Jan/22/2002.

²Kalay (1982) is one of the first papers to document that many firms maintain a "reservoir" of cash.

sensitivity of cash depends on the extent to which the firm faces financing constraints: firms that are financially unconstrained should not have a systematic propensity to save cash, while firms that are constrained should have a positive cash flow sensitivity of cash. We also study whether these optimal cash policy implications remain when the firm can hedge against future cash flows. In a framework similar to that of Froot et al. (1993), we analyze both hedging and cash policies. Differently from those authors, however, we do not assume that firms are unconstrained in their ability to hedge. On the contrary, we allow for the same frictions that make firms financially constrained to constrain their hedging.³ Although the analysis of cash policies becomes more involved with hedging, the main implications of our basic model continue to hold.

We also evaluate implications of agency arguments such as Jensen (1986) in the context of our model. We do so because of the common view that large cash positions are a manifestation of agency problems, and also because evidence from Blanchard et al. (1994) and Harford (1999) suggests that incremental cash is likely to be used on value-reducing investments (consistent with the free cash flow story in which managers' utilities are increasing with the quantity of the firm's assets). Accordingly, we model a situation in which overinvestment-prone managers may distort their firms' cash policies. Because managers derive utility from value-reducing investments in addition to value-increasing ones, they will save a portion of cash inflows to the firm that may exceed the amount of savings needed to fund the first-best level of investment. Such policies ensure managers' ability to undertake all the investments they desire in the future, without having to access the capital markets. Perhaps the most interesting implication of the agency model of liquidity is that the effect of overinvestment tendencies on firm's cash policies will be most pronounced for firms that are relatively *unconstrained* in the capital market, but which do not have sufficient idle resources to fund the managers' desired investment ("free cash flow"). Intuitively, the agency problem turns a overinvestment-prone firm that would be unconstrained if it invested at the first best levels into a firm that is effectively constrained because of the extra investment it wants to undertake.

One important feature of our analysis speaks directly to future work on the corporate demand for liquidity. Specifically, our results imply that there is not a theoretically optimal *level* of cash for

³Froot et al. consider a one-shot investment decision which characterizes the optimal hedging policy. Their model can be seen as a special case of our model when there is no first period.

all firms. For example, Keynes' insight implies that cash holdings for a firm such as Microsoft, that surely is unconstrained in its access to external capital, are likely to have neither costs nor benefits. Our analysis suggests that theory has much clearer predictions on the cash flow sensitivity of cash than on its level. Therefore, we focus our empirical work on this sensitivity rather on the level of cash holdings.

We evaluate the implications of our theory on a sample of manufacturing firms between 1981 and 2000. Because the main predictions of our model concern differences between constrained and unconstrained firms, we classify firms by the nature of their financial constraints using five alternative approaches suggested by the literature. For each classification scheme, we estimate the cash flow sensitivity of cash for both the constrained and unconstrained subsamples. In each case, we find that the cash flow sensitivity of cash is close and not statistically different from zero for the unconstrained firms, but positive and significantly different from zero for the constrained firms. This finding is consistent with the implications of our basic (no agency) model.

We also assess the extent to which agency considerations affect the decision to retain cash flows. To do so, we follow much of the literature in assuming that managerial ownership of stock and options is negatively associated with underlying agency problems in firms. Given this assumption, our model implies that the cash flow sensitivity of cash should be related to managerial ownership, but only for firms which have easy access to capital markets but do not have large stockpiles of cash (low free cash flow firms). We find that the extent to which this pattern occurs in the data depends on the measure of financial constraints we use. When we use dividend policy and size to measure financial constraints, the coefficient on cash flow interacted with ownership of stock and options is negative and statically significant for financially unconstrained firms with low free cash flow, and not significant for all other firms. These results are consistent with our theory, and suggest that financially unconstrained firms whose managers are likely to have little or no incentives to adopt value-maximizing policies (e.g., have low ownership and low pay-for-performance sensitivity) seem to manage firm liquidity as if they were financially constrained. On the other hand, the results are less strong for our alternative measures of financial constraints (such as bond and commercial paper ratings). We interpret these findings as providing at least weak evidence that agency problems at the margin can induce managers to hold excessive cash, supporting our agency view of liquidity.⁴

⁴This contrasts with Opler et al. (1999) who conclude that such view is not relevant based on the absence of

The remainder of the paper proceeds as follows: Section 2 briefly summarizes the existing related literature. Section 3 presents the theory and Section 4 discusses the empirical tests. Section 5 is a brief conclusion.

II Relationship with Previous Literature

A Theoretical Literature

We are by no means the first ones to consider the issue of corporate liquidity. Keynes (1936) identifies three reasons why agents should hold liquid securities: the transactions, precautionary, and speculative motives. The transactions motive arises because there are transaction costs involved in raising funds, such as flotation costs. This idea is the motivation for papers which focus on inventory-type models of cash holdings, such as Meltzer (1963), Miller and Orr (1966, 1968), Baumol (1970), and Frankel and Jovanovic (1980). The precautionary motive, as discussed by Keynes, is associated with the need to save cash in order to meet future unexpected contingencies, while the speculative motive, which is closely related to the precautionary motive, says that firms should hold cash because they may have difficulties to raise funds in the future, and may have to pass on good investments because of insufficient liquidity.⁵

The idea that firms may underinvest because of insufficient liquidity and imperfect capital markets has been emphasized in several classic papers in the corporate finance literature, such as Jensen and Meckling (1976), Myers (1977), and Myers and Majluf (1984). More recently, Kim et al. (1998) present a model of optimal cash holdings for firms which face costly external financing.⁶ In their model, firms trade off an (exogenously assumed) lower return of holding liquid assets, and the benefit of relaxing financial constraints in the future. They use their model to derive implications for the optimal level of cash holdings, arguing that firms which a) face higher costs of external funds, b) have more profitable future investment opportunities, and c) have higher variance in future cash flows should hold more cash.

correlation between proxies for agency and corporate cash levels.

⁵The difference between these two motives seems to be that in one case (precautionary motive) cash is used to guard against unexpected contingencies, while in the other case (speculative motive) the future contingencies which induce cash hoarding are expected. In both cases, not having cash is costly because the firm may be forced to take inefficient actions (e.g., underinvesting) in the future.

⁶Two other papers about cash holdings which use similar ideas are John (1993), who studies the link between liquidity and financial distress costs, and Baskin (1987), who examines the strategic value of cash in games of product-market competition.

Our model is related to Kim et al. (1998) in several aspects. Both models start from financial constraints as the underlying motivation for optimal cash policies, giving a less prominent role for the transactions motive and the potential tax implications of cash holdings. Our analysis, nonetheless, improves upon Kim et al. in a number of ways. First, our model endogenizes the cost of holding cash. This contrasts with Kim et al., who impose that liquid assets have a lower rate of return than the opportunity cost of funds for the corporation. The endogeneity of costs generates implications that are different from Kim et al.⁷ In particular, our theory emphasizes the importance of financial constraints in the cash holding decision, not only in terms of the benefits, but also of the costs of holding cash. In addition, our analysis improves on Kim et al. by allowing for corporate hedging and agency problems, which are likely to be important factors in the decision to retain cash.

Our model builds on arguments by Froot et al. (1993, 1994) about the corporate demand for hedging. These authors argue that given the costs of raising external capital, a reason for firms to hedge their cash flows is to ensure that they will have sufficient cash flows to finance future valuable investment opportunities. Our model can be seen as an extension of the Froot et al. analysis to incorporate a demand for cash.

B Empirical Literature

A number of recent papers examine the cross-section of cash holdings, and the factors that appear to be associated with higher levels of cash.⁸ These papers find that the levels of cash tend to be positively associated with future investment opportunities, business risk, and negatively associated with proxies for the cost of external finance, and with the level of protection of outside investors (in an international context).⁹ While these studies generally focus on differences in the *level* of cash, our paper examines the *sensitivity* of cash holdings to incremental changes in cash flow, and the extent to which they are affected by the firm's financial status.

The strategy of analyzing corporate policies by looking at cross-sectional differences in cash flow sensitivities has been previously explored by the vast empirical literature on corporate investment

⁷Acharya et al. (2002) also have a model where the costs of holding cash are endogenous. Their main focus is the effect of optimal cash policies on yield (credit) spreads.

⁸An incomplete list of papers includes Kim et. al. (1998), Opler et al. (1999), Pinkowitz and Williamson (2001), Faulkender (2002), Ozkan and Ozkan (2002), and Dittmar et al. (2002).

⁹Opler et al. (1999) also examine the persistence of cash holdings, and characterize what firms do with "excess" cash. They find that the cash policy is persistent, and that the propensity to spend excess cash on mergers is small.

initiated by Fazzari et al. (1988).¹⁰ While this literature has focused on corporate policies such as working capital (Fazzari and Petersen (1993) and Calomiris et al. (1995)), and inventory demand (Carpenter et al. (1994) and Kashyap et al. (1994)), it has remained silent on the issue of liquidity demand.

Finally, our findings on the agency aspects of cash policies adds to the literature providing evidence that firms with large cash holding tend to undertake sub-optimal, value-reducing investments. Blanchard et al. (1994) study 11 firms receiving large cash windfalls from legal settlements. Although most of these firms have poor investment opportunities, they generally do not pay the extra cash to their shareholders or reduce their debt. Instead, their managers hoard the cash and later spend it on value-reducing acquisitions. Harford (1999) shows that cash-rich firms are more likely than other firms to make acquisitions, and that those acquisitions ex post perform poorly. Finally, Lie (2000) finds that stock prices react positively to the announcement of large cash disbursements, and concludes that those disbursements mitigate the problems associated with the hoarding of “excess funds”. On the other hand, Opler et al. (1999) do not find evidence that agency issues have explanatory power for cash policies (in levels).

III A Simple Theory of Liquidity Demand

A The Basic Model: Cash as a Storage Technology

The first step of our analysis is to model corporate demand for liquid assets as a means of ensuring the ability to invest in the future. In an imperfect capital market, saving for future expenditures might be valuable if the firm anticipates rising financing costs or if the firm anticipates that the future investment opportunities will be particularly profitable. Our basic model is a simple representation of a dynamic problem where the firm has both present and future investment opportunities. Although the firm knows about the quality of those opportunities, it does not know whether it will have enough internally generated funds to finance those opportunities. Specifically, the firm does not know if cash flows from current assets will be sufficient to fund all positive NPV projects (if any). Hoarding cash may therefore facilitate future investments. Another way the firm can plan for the funding of future investments is by hedging against future earnings. Alternatively, the firm may also adjust its dividend policies or its borrowing. In all, our framework considers four

¹⁰See Hubbard (1998) and Stein (2001) for surveys of this literature.

components of financial policy: liquidity management, hedging, dividend payments, and borrowing.

A.1 Structure

The model has three dates, 0, 1, and 2. At time 0, the firm is an ongoing concern whose cash flow from current operations is c_0 . At that date, the firm has the option to invest in a long term investment opportunity that requires I_0 today and pays off $F(I_0)$ at time 2. Additionally, the firm expects to have access to another investment opportunity at time 1. If the firm invests I_1 at time 1, the technology produces $G(I_1)$ at time 2. The production functions $F(\cdot)$ and $G(\cdot)$ have standard properties, i.e., are increasing, concave, and continuously differentiable. The firm also has existing assets which will produce a cash flow equal to c_1 in period 1. The time 1 cash flow is high, equal to c_1^H , with probability p . With probability $(1 - p)$ that cash flow is low, equal to $c_1^L < c_1^H$. We assume that the discount rate is 1, everyone is risk neutral, and the cost of investment goods equals 1. Finally, the investments I_0 and I_1 can be liquidated at the final date, generating a payoff equal to $q(I_0 + I_1)$, where we assume that $q < 1$. Define the total cash flows from investments as $f(I_0) \equiv F(I_0) + qI_0$, and $g(I_1) \equiv G(I_1) + qI_1$.

We suppose that the cash flows $F(I_0)$ and $G(I_1)$ from the new investments are not verifiable. Thus, the firm cannot pledge these cash flows to outside investors. However, the firm can raise external finance by pledging the underlying productive assets as collateral (Hart and Moore (1994)). The idea is that the liquidation value of the assets is verifiable. If the firm thus reneges on its debt, creditors liquidate the physical assets. Assume that the liquidation value of those assets that can be captured by creditors is given by $(1 - \tau)qI$. $\tau \in (0, 1)$ is a function of factors such as asset tangibility, and the legal environment that dictates the relations between debtors and creditors.¹¹ This parameter is an important element of our theory in that we want to separate the behavior of firms which are financially constrained — and thus need to rely more on cash as a storage technology — from financially unconstrained firms. Clearly, for a high enough τ , the firm may pass up positive NPV projects for lack of external financing, and is therefore financially constrained.¹²

¹¹Myers and Rajan (1998) parametrize the liquidity of a firm's assets in a similar way.

¹²In the Hart and Moore framework the optimal financial contract is most easily interpreted as collateralized debt. Our conclusions, however, do not depend strongly on any particular element of the Hart and Moore framework. So long as constrained firms have a limited capacity to issue equity (or if equity issues entail deadweight costs), there would be no substantial changes in our conclusions. An alternative framework that allows for equity finance is the moral hazard model of Holmstrom and Tirole (1997). In their model, it is not optimal for firms to issue equity beyond a certain threshold, because of private benefits of control. See Almeida and Campello (2002) for additional discussion of the Holmstrom and Tirole (1997) model.

In this set up, the firm is only concerned about whether to store cash from time 0 until time 1 since there is no new investment opportunity at time 2. We denote by C the amount of cash the firm chooses to carry from date 0 to date 1. In principle, C can be negative as the firm may not only carry no cash from time 0 to time 1, but also borrow against future earnings c_1 . However, for practical purposes we can think of the optimal cash policy C as being always positive.¹³ We also assume that $I_0, I_1 > 0$.

As a benchmark case, we solve for the optimal cash policy when the firm can fully hedge future earnings. However, consistent with our assumptions about income contractibility, we also analyze the more interesting situation in which only a fraction $(1 - \mu)$ of future earnings can be costlessly pledged to external investors. In this case, the firm cannot credibly sign a contract in which it pays more than $(1 - \mu)c_1^H$ in the high state. Under this richer environment, the underlying source of incomplete contractibility (reflected in both τ and μ) caps the firm's ability to transfer resources both across time and across states.¹⁴

To see how the hedging technology works, consider the case where $c_1^L = 0$. Suppose the firm has the same investment opportunities in both states (L and H) at time 1. Because borrowing capacity is limited, the firm might wish to transfer cash flows to state L . This can be accomplished, for example, by selling futures contracts on the asset that produces the time 1 cash flow. In a frictionless world, the firm would be able to fully hedge by selling that asset's entire stream of cash flows in the futures market at time 0 and the firm would have locked in a payoff of pc_1^H in both states.¹⁵ However, since the amount μc_1^H of cash flows is not contractible, the firm always has the option of walking away with μc_1^H in state H . Thus, a perfectly hedged position through the use of futures contracts can only happen if $\mu c_1^H \leq pc_1^H$. If on the other hand $\mu > p$, then the hedging policy of the firm will be constrained.

¹³We will later show that our main predictions about cash flow sensitivities of cash do not depend on C being necessarily positive.

¹⁴One could think of τ (the *borrowing constraint*) and μ (the *hedging constraint*) as highly correlated. In fact, our analysis would yield similar results if we assumed they are equal. We, however, denote those parameters differently so that the effects of hedging on cash policies are made clear in our analysis.

¹⁵Notice that because of risk-neutrality the fair futures price is the expected future spot price, so the payoff from the futures position must be the expected cash flow, pc_1^H .

A.2 Analysis

When the interests of managers and shareholders converge, the objective is to maximize the expected lifetime sum of all dividends subject to several budget and financial constraints. The firm's problem can be written as

$$\max_{C, h, I} \left(d_0 + pd_1^H + (1-p)d_1^L + pd_2^H + (1-p)d_2^L \right) \text{ s.t.} \quad (1)$$

$$d_0 = c_0 + B_0 - I_0 - C \geq 0$$

$$d_1^S = c_1^S + h^S + B_1^S - I_1^S + C \geq 0, \text{ for } S = H, L$$

$$d_2^S = f(I_0) + g(I_1^S) - B_0 - B_1^S, \text{ for } S = H, L$$

$$B_0 \leq (1 - \tau)qI_0$$

$$B_1^S \leq (1 - \tau)qI_1^S, \text{ for } S = H, L$$

$$ph^H + (1-p)h^L = 0$$

$$-h^H \leq (1 - \mu)c_1^H$$

The first two constraints restrict dividends (d) to be non-negative in periods 0 and 1. B_0 and B_1 are the amounts of collateralized borrowing. Debt obligations are repaid at the time when the assets they help finance generate cash flows, and their face values are constrained by the liquidation value of those assets.¹⁶ h^H and h^L are the hedging payments. The hedging strategies we focus on typically give $h^H < 0$ and $h^L > 0$. If the firm uses futures contracts, for example, we should think of $c_1^S + h^S$ as the futures payoff in state S . The firm sells futures at a price equal to the expected future spot value, and thus increases cash flows in state L at the expense of reducing cash flows in state H . If the hedge ratio is equal to 1, then the firm is fully hedged and $c_1^H + h^H = c_1^L + h^L = E_0[c_1]$. When the firm faces capital market imperfections not all future cash flows can be used for hedging purposes, and the hedge ratio will be lower than 1. Finally, note that the fair hedging constraint $ph^H + (1-p)h^L = 0$ defines h^H as a function of h^L :

$$h^H = \frac{(p-1)}{p}h^L.$$

¹⁶This formulation implies that our financial constraint is a quantity constraint. Alternatively, we could study a model in which firms face an increasing (deadweight) cost of external finance. As we will argue later, in our analysis all constrained firms have a similar propensity to save cash (irrespective of how tight the constraint is), and our results do not hinge on the formulation based on quantities.

We refer to h^H as the firm’s “hedging policy”. This policy is constrained by the fact that the firm cannot commit to pay out more than $(1 - \mu)c_1^H$ in state H .

A.2.1 First best solution The firm is financially unconstrained if it is able to invest at the first best levels. The first best investment levels at times 0 and 1 (I_0^{FB} and I_1^{FB}) are defined by:

$$\begin{aligned} f'(I_0^{FB}) &= 1 \\ g'(I_1^{FB,S}) &= 1, \text{ for } S = H, L. \end{aligned}$$

If the firm is unconstrained, its investment policy satisfies all the dividend, hedging, and borrowing constraints above for some financial policy (B_0, B_1^S, C, h^H) . Except when the constraints are exactly binding at the first best solution, the financial policy of an unconstrained firm will not matter.¹⁷ What we mean is that if a firm j is financially unconstrained, then its financial policy $(B_{0j}, B_{1j}, C_j, h_j^H)$ can be replaced by an entirely different financial policy $(\hat{B}_{0j}, \hat{B}_{1j}, \hat{C}_j, \hat{h}_j^H)$ with no consequence for firm value. It follows that there is no optimal cash hoarding policy for a financially unconstrained firm (*cash policy irrelevance*). To see the intuition, suppose the firm increases its cash holdings by a small amount ΔC . Would that policy entail any *costs*? The answer is no. The firm can compensate for ΔC by paying a smaller dividend today. Are there *benefits* to the increase in cash holdings? The answer is also no. The firm is already investing at the first best level at time 1, and an increase in cash is a zero NPV project since the firm foregoes paying a dividend today for a dividend tomorrow which is discounted at the market rate of return.

A.2.2 Constrained solution A financially constrained firm is a firm whose investment policy is distorted by capital markets frictions. Specifically, a firm is financially constrained if its optimal investment policy is such that $(I_0^*, I_1^*) < (I_0^{FB}, I_1^{FB})$. Because the firm is financially constrained, an increase in cash holdings decreases the amount of investment the firm can make today. If financial constraints are binding, this is *costly* for the firm. However, precisely because financial constraints are binding there will also be a *benefit* to saving cash for the next period, as this will allow the firm to increase next period’s investment. So the same underlying reason (capital market imperfections)

¹⁷The case where the firm invests at the first best and all the constraints are exactly binding is, technically speaking, a zero-measure case.

generates both the costs and benefits of holding cash in our model.¹⁸

As a result of these countervailing effects, financial constraints will give rise to an optimal cash policy C^* . This is in stark contrast with the “irrelevance of cash” result which holds for financially unconstrained firms. The optimal cash policy of financially constrained firms will be a function $C(\cdot)$ of the structural parameters of the model — c_0 , c_1^H , c_1^L , p , τ , and μ — and the parameters of the production functions of the firm.

In order to characterize the optimal cash holding of a constrained firm we have to determine the optimal investment and financial policies of that firm. If the firm is financially constrained, it will not be optimal to pay any dividends at times 0 and 1. Furthermore, borrowing capacity will be exhausted in both periods and in both states at time 1. This must be the case, since foregoing a dividend payment or borrowing an additional unit is a zero NPV project, and, recall, the constrained firm is foregoing positive NPV projects. Using these facts, we can write the firm’s optimization problem as follows:

$$\max_{C, I, h^L} f(I_0) - B_0 + p \left(g(I_1^H) - B_1^H \right) + (1-p) \left(g(I_1^L) - B_1^L \right) \quad s.t. \quad (2)$$

$$\begin{aligned} I_0 &= c_0 + B_0 - C \\ I_1^S &= c_1^S + h^S + B_1^S + C, \text{ for } S = H, L \\ B_0 &= (1 - \tau)qI_0 \\ B_1^S &= (1 - \tau)qI_1^S, \text{ for } S = H, L \\ \frac{1-p}{p}h^L &\leq (1 - \mu)c_1^H \end{aligned}$$

Notice that we have collapsed the fair hedging condition and the hedging constraint into one equation. Moreover, note that the hedging constraint $h^L \leq (1 - \mu)\frac{p}{1-p}c_1^H$ will not necessarily bind. This happens, for example, when the firm can transfer enough cash flows to state L such that there is no constrained hedging demand.

The firm’s problem can be further simplified by replacing the binding constraints in the objective function and dropping the terms that are constant:

$$\max_{C, h^L} f \left(\frac{c_0 - C}{1 - q + \tau q} \right) + pg \left(\frac{c_1^H - \frac{1-p}{p}h^L + C}{1 - q + \tau q} \right) + (1-p)g \left(\frac{c_1^L + h^L + C}{1 - q + \tau q} \right) \quad s.t. \quad (3)$$

¹⁸The endogeneity of costs contrasts with Kim et al. (1998), who assume that the cost of holding cash is exogenously given.

$$h^L \leq (1 - \mu) \frac{p}{1 - p} c_1^H$$

Now the firm's problem reduces to an optimization in C and h^L , constrained by the maximum hedging available. As suggested above, we consider solving this problem both with and without hedging constraints. In order to economize on notation, define $\lambda \equiv 1 - q + \tau q$.

Unconstrained hedging: Suppose the hedging constraint does not bind. Because hedging is fairly priced the firm can eliminate its cash flow risk. This implies that the optimal amount of hedging is given by $h^L = p(c_1^H - c_1^L)$, which gives similar cash flows in both states (equal to $E_0 [c_1]$).¹⁹ It is easy to see that the hedging constraint will not bind so long as $(1 - p)(c_1^H - c_1^L) \leq (1 - \mu)c_1^H$.

If the optimal hedge is feasible, the optimal cash policy will then be determined by:

$$\max_C f\left(\frac{c_0 - C}{\lambda}\right) + g\left(\frac{E_0 [c_1] + C}{\lambda}\right) \quad (4)$$

or

$$f'\left(\frac{c_0 - C}{\lambda}\right) = g'\left(\frac{E_0 [c_1] + C}{\lambda}\right) \quad (5)$$

The left-hand side of Eq. (5) is the marginal *cost* of increasing cash holdings. If the firm hoards cash it sacrifices valuable (positive NPV) current investment opportunities.²⁰ The right-hand side of Eq. (5) is the marginal *benefit* of hoarding cash under financial constraints. By holding more cash the firm is able to relax the constraints on its ability to invest in the future.

How much of its current cash flow will a constrained firm save? This can be calculated from the derivative $\frac{\partial C}{\partial c_0}$, which we define as the *cash flow sensitivity of cash*. As we illustrate below, the cash flow sensitivity of cash is a very useful concept in that it reveals a dimension of corporate liquidity policy that is suitable for empirical analysis. The interpretation resembles that of the *cash flow sensitivity of investment* used in the financial constraint literature (Fazzari et al. (1988)).

The cash flow sensitivity of cash holdings is given by:

$$\frac{\partial C}{\partial c_0} = \frac{f''(I_0)}{f''(I_0) + g''(I_1)} > 0$$

¹⁹This is just a traditional "full-insurance" result. In order to check it, one can take the derivative of the objective function with respect to h^L and set it equal to zero.

²⁰These opportunities are valuable precisely because financial constraints force the marginal productivity of investment to be higher than the opportunity cost of capital.

This sensitivity is positive, indicating that if a financially constrained firm gets a positive cash flow innovation this period, it will optimally allocate the extra cash across time, saving some resources for future investments.

Importantly, note that the optimal cash holdings bear no obvious relationship with borrowing capacity (the parameter τ). This can be seen by examining the derivative:

$$\frac{\partial C}{\partial \tau} = \frac{-q(c_0 - C)f''(I_0) + q(E_0[c_1] + C)g''(I_1)}{\tau(f''(I_0) + g''(I_1))},$$

which cannot be generally signed. The intuition is that an increase in debt capacity relaxes financial constraints both today and in the future, and thus it is not obvious whether the firm should save more or less. Cash hoarding is relatively independent of τ , because a change in borrowing capacity has a similar effect on the marginal value of cash across time.

AN EXAMPLE: A simple example gives the intuition for how our model provides for an empirically consistent way of examining the influence of financial constraints on corporate cash policies.

Consider parametrizing the production functions $f(\cdot)$ and $g(\cdot)$ as follows:

$$f(x) = A \ln(x) \quad \text{and} \quad g(y) = B \ln(y)$$

This parametrization assumes that while the concavity of the production function is the same in periods 0 and 1, the marginal productivity of investment may change over time.²¹ With these restrictions, it is a straightforward task to derive an explicit formula for C :

$$C^* = \frac{\delta c_0 - E_0[c_1]}{1 + \delta}, \tag{6}$$

where $\delta \equiv \frac{B}{A} > 0$. The parameter δ can be interpreted as a measure of the importance of future growth opportunities vis-a-vis current opportunities. Eq. (6) shows that C is increasing in δ (i.e., $\frac{\partial C}{\partial \delta} > 0$), which agrees with the intuition that a constrained firm will hoard more cash today if future investment opportunities are more profitable. More importantly, Eq. (6) illustrates one of the main points of our analysis: the usefulness of cash flow sensitivity of cash as a descriptive measure of liquidity management. To see this, note that cash flow sensitivity of cash, given by

²¹Similar results will hold for a more general Cobb-Douglas specification for the production function, namely $f(x) = Ax^\alpha$ and $g(x) = Bx^\alpha$. The important assumption is that the degree of concavity of the functions f and g is the same. Given this, the particular value of α is immaterial. We use the $\ln(\cdot)$ specification because it simplifies the algebra and economizes on notation.

$\frac{\delta}{1+\delta}$, is independent of the parameter τ .²² Since the optimal cash policy is determined by an intertemporal trade-off, a change in borrowing capacity does not matter if the firm is already financially constrained. This in turn establishes a precise and monotonic empirical relationship between financial constraints and the cash flow sensitivity of cash. Unconstrained firms should have a non-systematic propensity to save cash, and thus their cash flow sensitivities of cash should not be statistically different than zero. In contrast, constrained firms should have positive sensitivities. For the purpose of empirical testing, note that *degree* of the financial constraints need not matter for already *constrained* firms.²³ This means that the problem of non-monotonicity in the relationship between financial constraints and cash policies are not a primary concern for empirical analysis.²⁴ We explore these properties of our theory in Section IV.

Constrained hedging: If the hedging constraint binds, the amount of hedging is given by $h^L = (1 - \mu)\frac{p}{1-p}c_1^H$. In this case, the optimal cash policy is determined by:

$$\max_C f\left(\frac{c_0 - C}{\lambda}\right) + pg\left(\frac{\mu c_1^H + C}{\lambda}\right) + (1 - p)g\left(\frac{c_1^L + (1 - \mu)\frac{p}{1-p}c_1^H + C}{\lambda}\right) \quad (7)$$

or

$$f'\left(\frac{c_0 - C}{\lambda}\right) = E_0[g'(I_1)]. \quad (8)$$

The only difference from the previous Eq. (5) is that marginal productivity now varies across states because of the constraint on hedging. The comparative statics are more involved with constrained hedging, but our previous results remain. We illustrate this using the same parametrization used above for functions $f(\cdot)$ and $g(\cdot)$. Drawing on that example we can write the first order condition as:

$$(c_0 - C^*)^{-1} = \delta \left[p \left(\mu c_1^H + C^* \right)^{-1} + (1 - p) \left(c_1^L + (1 - \mu)\frac{p}{1-p}c_1^H + C^* \right)^{-1} \right]. \quad (9)$$

²²Notice the sensitivity does not depend on whether the cash balance C^* is positive or negative. This formula makes it clear that the sign of C^* depends on the the size of current versus expected future cash flows.

²³This shows that our results do not hinge on the fact that we formulated our financial constraints as quantity constraints. The cash flow sensitivity of cash is similar for all constrained firms, irrespective of how constrained they are. If the financial constraint manifests itself in terms of increasing costs of external finance, a change in the cost would relax constraints by a similar amount today and in the future, thus generating very similar implications.

²⁴This result is important because it essentially avoids the theoretical critique advanced by Kaplan and Zingales (1997, 2000) regarding the traditional interpretation of investment-cash flow sensitivities. Kaplan and Zingales argue that investment-cash flow sensitivities are not monotonically increasing in financial constraints because one cannot derive an unambiguous relationship between sensitivities and borrowing capacity for constrained firms. See also the discussion in Fazzari et al. (2000), Povel and Raith (2001), and Almeida and Campello (2002).

There is no closed form solution for C^* now, but we can still obtain comparative statics results.

Define the function $F \equiv F(C, c_0, c_1^H, c_1^L, \mu, p)$ as:

$$F(\cdot) = (c_0 - C^*)^{-1} - \delta p \left(\mu c_1^H + C^* \right)^{-1} - \delta(1-p) \left(c_1^L + (1-\mu) \frac{p}{1-p} c_1^H + C^* \right)^{-1}.$$

With some algebra, we can show that: $\frac{\partial F}{\partial C} > 0$, $\frac{\partial F}{\partial c_0} < 0$, $\frac{\partial F}{\partial \mu} < 0$, and $\frac{\partial F}{\partial \delta} < 0$. These derivatives yield the following results for hedge-constrained firms:

- If time 0 cash flow increases, then the firm hoards more cash:

$$\frac{\partial C}{\partial c_0} = -\frac{\frac{\partial F}{\partial c_0}}{\frac{\partial F}{\partial C}} > 0$$

In other words, the cash flow sensitivity of cash is positive.

- If future investment opportunities are more profitable than the current investment opportunities (δ is high), then the firm hoards more cash:

$$\frac{\partial C}{\partial \delta} = -\frac{\frac{\partial F}{\partial \delta}}{\frac{\partial F}{\partial C}} > 0$$

Also similarly to the case of perfect hedging, borrowing capacity will not affect cash policies for firms which are constrained. However, we now have an additional implication related to changes in the hedging constraint:

- Firms which can hedge less hoard more cash:

$$\frac{\partial C}{\partial \mu} = -\frac{\frac{\partial F}{\partial \mu}}{\frac{\partial F}{\partial C}} > 0$$

The intuition is as follows. The cost of limited hedging is the difference in the marginal value of funds across states in the future. The marginal value is higher in the state where the firm has lower cash flows. An increase in μ increases funds in state H , but decrease funds in state L . This increases the difference in the marginal value of funds across states, and causes the firm to increase cash hoarding so as to rebalance the future marginal value in the two states.

Thus, the main implications of the basic model are still true when hedging is constrained. While there is no optimal cash policy if the firm is financially unconstrained, the cash flow sensitivity of cash is positive for constrained firms. Moreover, conditional on the fact that a firm is financially

constrained, borrowing capacity has no additional effect on the optimal cash policy. Thus, cash flow sensitivities of cash should be monotonically increasing in financial constraints. We state this result in the form of a proposition.

Proposition 1 *The cash flow sensitivity of cash for financially unconstrained and financially constrained firms have the following properties:*

$$\begin{aligned} \frac{\partial C}{\partial c_0} &= 0 \text{ for financially unconstrained firms} \\ \frac{\partial C}{\partial c_0} &> 0 \text{ for financially constrained firms} \end{aligned} \tag{10}$$

This is the main implication of the basic model that we test in the empirical section.²⁵ Two additional implications of the basic model are that constrained firms should hoard more cash if they have more valuable future investment opportunities, and that cash and hedging are substitutes for firms that are hedge-constrained. While we can empirically examine the first of these two additional implications, data availability precludes us from studying the later implication in much detail.

B Agency Problems: Overinvestment Tendencies

Any model in which those in charge of running the day-to-day operations of the firm (managers) have objectives that are different from those who own the firm (shareholders) can be seen as an agency model. For practical purposes, the more interesting types of agency problems are those in which managers take actions that reduce shareholders' wealth. Within this class of problems, most of the research in corporate finance has investigated one type of agency problem: the overinvestment problem (see Stein (2001) for a review). In this subsection, we build on our basic model of liquidity demand and study how overinvestment-prone managers handle cash stocks.

There are alternative ways of modeling managers' tendency towards overinvestment. As in Hart and Moore (1995), we analyze a model in which managers enjoy private benefits from gross investment. The typical scenario is one in which managers derive power or reputational gains from investing more, even when investment opportunities are unprofitable. This happens when

²⁵Notice that when we say that $\frac{\partial C}{\partial c_0} = 0$ for financially unconstrained firms, we do not mean to say that the sensitivity must be always equal to zero in an economic sense. The cash policy of unconstrained firms is undetermined, and thus their cash flow sensitivity should not be statistically different than zero. Naturally, this distinction does not matter for empirical purposes.

no feasible incentive contract, corporate governance system, or other external threats can make managers internalize the value consequences of inefficient investment decisions (Jensen (1993)).

A very simple way to introduce this type agency problem in our model is to assume that managers try to maximize the following utility function (Stein (2001)):²⁶

$$U^M = (1 + \theta) \left[f(I_0) + pg(I_1^H) + (1 - p)g(I_1^L) \right], \text{ where } \theta \geq 0. \quad (11)$$

θ can be interpreted as a measure of the residual amount of agency problems which remains after all feasible corrective mechanisms have been applied. Notice that the maximization program of the previous subsection (Eq. (1)) is naturally nested in Eq. (11). In other words, our basic model is a special case of Eq. (11), which obtains when there is no overinvestment problem (i.e., when $\theta = 0$).

Managers make all the investment and financing decisions according to the function U^M . This is equivalent to assuming that managers apply the following transformation to the investment functions $f(\cdot)$ and $g(\cdot)$:

$$\begin{aligned} f^M(x) &= (1 + \theta)f(x) \\ g^M(x) &= (1 + \theta)g(x) \end{aligned}$$

It is straightforward to verify that the particular agency problem we consider — a tendency to overinvest — has no first-order effect on the cash policy of financially constrained firms. Intuitively, a positive θ uniformly raises the marginal productivity of all investment opportunities (current and future), and so the trade-off which determines optimal cash is the same irrespective of the value of θ .

The more interesting result concerning the influence of agency on cash management happens when the firm is financially unconstrained. For a large θ , an unconstrained firm will behave “as if” it were financially constrained. Intuitively, the reason is that, even when capital markets are perfect, investors will only be willing to give funds to the firm up to a limit determined by the true payoff from investment. Consequently, there exists an “optimal” financial policy of a firm controlled by an overinvestment-prone manager, similarly to what we predict for a financially constrained firm.

In order to see this result, notice that we can write the program solved by a firm facing perfect

²⁶We borrow the linear transformation from Stein for ease of exposition. A broader class of more complex transformations would also lead to our main conclusions about cash management in the presence of overinvestment tendencies.

capital markets that is subject to overinvestment problems as:

$$\max_{C, I, h^L} (1 + \theta)f(I_0) - B_0 + p[(1 + \theta)g(I_1^H) - B_1^H] + (1 - p)[(1 + \theta)g(I_1^L) - B_1^L] \text{ s.t.} \quad (12)$$

$$\begin{aligned} I_0 &= c_0 + B_0 - C \\ I_1^S &= c_1^S + h^S + B_1^S + C, \text{ for } S = H, L \\ B_0 &\leq f(I_0) \\ B_1^S &\leq g(I_1^S) \text{ for } S = H, L \\ \frac{1-p}{p}h^L &\leq (1 - \mu)c_1^H \end{aligned}$$

The firm can borrow up to the true value of the investments I_0 and I_1 . Recall, the functions $f(\cdot)$ and $g(\cdot)$ include the cash flows from liquidation qI_0 and qI_1 . And we are implicitly setting $\tau = 1$, consistent with the idea that the firm faces perfect capital markets.²⁷ Clearly, if $\theta = 0$, the firm would invest at the first best levels and would not have a systematic cash policy. Let us now solve for the optimal investment and cash policies when $\theta > 0$.

If managers are able to (over)invest as much as they wish, they would choose the levels of investment to satisfy:

$$f'(\hat{I}_0) = g'(\hat{I}_1) = \frac{1}{1 + \theta} < 1.$$

The question is whether managers can finance these levels of investment. Here we consider the case of unconstrained hedging. In this case, we can assume with no loss of generality that the firm will have the same cash flow in both states at date 1 (equal to $E_0[c_1]$). Now the condition guaranteeing that the firm is able to finance the investment levels \hat{I}_0 and \hat{I}_1 is that there exists a level of cash \hat{C} such that:

$$\begin{aligned} \hat{I}_0 &\leq c_0 + f(\hat{I}_0) - \hat{C} \\ \hat{I}_1 &\leq E_0[c_1] + f(\hat{I}_1) + \hat{C} \end{aligned}$$

Summing the two equations we obtain the condition:

$$\hat{I}_0 - f(\hat{I}_0) + \hat{I}_1 - f(\hat{I}_1) \leq c_0 + E_0[c_1] \quad (13)$$

²⁷Notice that profit maximization implies that if $I_0^{FB} > 0$:

$$f(I_0^{FB}) \geq I_0^{FB}$$

and thus the firm can finance the first best level of investment (similarly for I_1).

The left hand-side of (13) is the negative NPV generated by the projects, at the super-optimal scales of production.²⁸ The right hand-side can be interpreted as the firm's "free cash flow", or total free resources available for investment. Since there is a tendency for overinvestment, shareholder wealth is decreasing in the amount of firm's free cash flows (Jensen (1986)).²⁹ The expression simply says that overinvestment will be limited by the availability of cash from current operations (c_0 and $E_0[c_1]$). Free cash flow will enable managers to invest in negative NPV projects even when the market is not willing to finance those projects.

The implication is that the overinvestment-prone firm will have a uniquely defined cash policy only if $\widehat{I}_0 - f(\widehat{I}_0) + \widehat{I}_1 - f(\widehat{I}_1) > c_0 + E_0[c_1]$, that is, if total resources available for investment are not too large. If condition (13) is met, then there are multiple cash policies \widehat{C} which allow the firm to invest at the super-optimal levels (unless the condition is satisfied with an exact equality). Similarly to financially unconstrained firms which invest optimally, these firms do not have a well-defined cash policy. In other words, if these firms receive an additional cash inflow (that is, if c_0 goes up), it is a matter of indifference to such firms whether they save the additional cash, or pay dividends.

If condition (13) is not obeyed, then the firm behaves as if it were a financially constrained firm. The borrowing constraints will be binding, and the firm will choose optimal cash and investment policies according to:

$$\max_{C, I_0, I_1} (1 + \theta)f(I_0) - I_0 + (1 + \theta)g(I_1) - I_1 \text{ s.t.} \quad (14)$$

$$I_0 = c_0 + f(I_0) - C$$

$$I_1 = E_0[c_1] + g(I_1) + C$$

which is equivalent to:

$$\max_{C, I_0, I_1} \theta f(I_0) + \theta g(I_1) \text{ s.t.}$$

$$I_0 = c_0 + f(I_0) - C$$

$$I_1 = E_0[c_1] + g(I_1) + C$$

²⁸Notice it is possible that the investment projects are still positive NPV, even at the super-optimal scale. In this model, only the marginal investments above I^{FB} are necessarily negative NPV. The total NPV of the investment \widehat{I} may be positive or negative. If it is positive, then the firm can always overinvest in this model. However, if the difference between \widehat{I} and I^{FB} is high enough then the total NPV should also be negative.

²⁹Since the firm can finance the wealth-maximizing investment in the financial market, extra cash can only induce the firm to overinvest and therefore has no benefit to shareholders.

The only difference with respect to the constrained firm's optimization problem (recall Eq. (4)) is that since the borrowing constraints are not linear in investment, we cannot solve the constraints explicitly for I_0 and I_1 . The intuition, though, is the same. The optimal cash balance C^* is determined so as to equate the marginal productivity of investment at the two dates (notice that θ will not matter for this choice), and investment levels are determined directly from the constraints:

$$\begin{aligned} I_0^* &= c_0 + f(I_0^*) - C^* \\ I_1^* &= E_0[c_1] + g(I_1^*) + C^* \end{aligned}$$

Notice that $I_t^{FB} < I_t^* < \hat{I}_t$, with $t = 1, 2$. And we can formalize Jensen's (1986) argument about managerial overinvestment tendencies: firms with plenty of free resources in hand (high c_0 , $E_0[c_1]$) will invest at the level \hat{I}_t , while firms with less resources will only be able to invest at the lower level, I_t^* , that is desirable from the perspective of shareholders — i.e., it is closer to the first best investment level.

In terms of cash policies, the overinvestment-prone, resource-constrained (but financially unconstrained) firm will have a systematic cash policy. In particular, it is easy to show that the cash flow sensitivity of cash is positive for such firm. We can write the first order condition as:

$$f'[I_0(C, c_0)] = g'[I_1(C)]$$

where the functions $I_0(C, c_0)$ and $I_1(C)$ represent the investment levels which are determined directly from the constraints, for each level of cash C . Notice that $\frac{\partial I_0}{\partial c_0} > 0$, $\frac{\partial I_0}{\partial C} < 0$ and $\frac{\partial I_1}{\partial C} > 0$. Differentiating the first order condition, we can show that the cash flow sensitivity of cash is given by:

$$\frac{\partial C^*}{\partial c_0} = \frac{f''(I_0) \frac{\partial I_0}{\partial c_0}}{g''(I_1) \frac{\partial I_1}{\partial C} - f''(I_0) \frac{\partial I_0}{\partial C}} > 0$$

This analysis has several interesting implications for empirical tests of the effect of overinvestment on optimal cash policies. First of all, if a firm is underinvesting because of limited access to external capital markets (our broad definition of financial constraints), then overinvestment tendencies have no distinct effect on cash policies in general, and on the cash flow sensitivity of cash in particular. This is because overinvestment does not affect a constrained firm's trade-off between foregoing investment opportunities today and increasing investment tomorrow. Naturally, any empirical tests of the overinvestment hypothesis should focus on firms with access to external funds.

But notice that in order for overinvestment to have an effect on cash policies, it is also necessary that the firm does not have too much internal resources (free cash flow). If those resources are abundant, then the firm can invest at the super-optimal levels, even when the external market is only willing to finance positive NPV investments.

Therefore, in order to isolate the effect of overinvestment on cash policies, one has to focus on groups of firms that are financially unconstrained in the sense of having good access to capital markets, but that do not have too much idle (internal) resources. If one is able to empirically identify such firms, then the implication of our overinvestment model is that the cash flow sensitivity of cash should be zero when overinvestment tendencies are not too strong, but should be positive when the propensity to overinvest is greater. In other words, the cash flow sensitivity of cash should increase with empirical proxies for managerial tendencies to overinvest. We re-state this result in the form of a proposition.

Proposition 2 *Managerial overinvestment tendencies (captured by θ) have the following effects on the sensitivity of cash holdings to cash flow:*

$$\begin{aligned}
 \frac{\partial C}{\partial c_0 \partial \theta} &= 0 \text{ for financially constrained firms} & (15) \\
 \frac{\partial C}{\partial c_0 \partial \theta} &> 0 \text{ for financially unconstrained firms with limited free cash flow} \\
 \frac{\partial C}{\partial c_0 \partial \theta} &= 0 \text{ for financially unconstrained firms with abundant free cash flow}^{30}
 \end{aligned}$$

Empirically implementing the implications of this model is not a simple task. It requires us to focus on a particular group of firms, and, moreover, requires us to be able to separate financial constraints (limited access to capital markets) from resource constraints (free cash flow). Thus, even when overinvestment tendencies are present, it might not be possible to empirically identify their effect on cash policies. These results might explain why previous papers like Opler et al. (1999) have failed to find strong evidence for the effect of the Jensen's overinvestment problem on firm's optimal cash policies. In the next section, we empirically test our overinvestment model.

IV Empirical Tests

A Sample

We now test the model's main predictions about the cash flow sensitivity of cash, and its relation to financial constraints and the nature of agency problems inside the firm. To do so, we consider the sample of all manufacturing firms (SICs 2000-3999) from the period 1981-2000 with data available on COMPUSTAT on total assets, sales, and holdings of cash and marketable securities. Similar to Opler et al. (1999), we exclude firms with negative sales growth over the sample period and firms without market data available from CRSP. Finally, because we are interested in relating our findings on cash holdings to agency problems, we require that our sample firms appear in the Standard & Poor's ExecuComp dataset for at least one year. The resulting sample contains 1,026 firms yielding 11,135 firm-years.

B Measuring the Cash Flow Sensitivity of Cash and Financial Constraints

According to our basic theory, we should expect to find a positive relationship between cash flow and changes in cash holdings for financially constrained firms. Unconstrained firms, in contrast, should display no such sensitivity. In order to implement a test of this argument we need to specify an empirical model relating changes in cash holdings to cash flows, and also to distinguish between financially constrained and unconstrained firms.

B.1 An Empirical Model of Cash Flow Retention

Our model's main predictions concern the cash flow sensitivity of cash, which is the propensity to retain cash inside the firm from an incremental shock to a firm's cash flows. To measure the cash flow sensitivity of cash, we estimate a model explaining a firm's decision to change its holdings of liquid assets as a function of its sources and (competing) uses of funds. We borrow insights from the literature on investment-cash flow sensitivities (e.g., Fazzari et al. (1988), Carpenter and Fazzari (1993), Calomiris et al. (1995)) and on cash management (Opler et al. (1999) and Harford (2000)), modeling the annual change in a firm's cash to total assets as a function of cash flows, capital expenditures, acquisitions, changes in non-cash net working capital (*NWC*), investment

opportunities (proxied by Q) and size:

$$\begin{aligned} \frac{Cash_{i,t} - Cash_{i,t-1}}{Assets_{i,t-1}} = & \alpha_0 + \alpha_1 \frac{CashFlow_{i,t}}{Assets_{i,t-1}} + \alpha_2 \frac{Expenditures_{i,t}}{Assets_{i,t-1}} \\ & + \alpha_3 \frac{Acquisitions_{i,t}}{Assets_{i,t-1}} + \alpha_4 \frac{NWC_{i,t} - NWC_{i,t-1}}{Assets_{i,t-1}} \\ & + \alpha_5 Q_{i,t} + \alpha_6 Ln(Assets_{i,t}) + \mu_i + \varepsilon_{i,t}. \end{aligned} \quad (16)$$

Cash is Compustat’s data item#1. Following Opler et al. (1999), *Cash Flow* is defined as earnings before extraordinary items and depreciation, minus dividends: item #18 + item #14 – item #19 – item #21.³⁴ We use item #6 for *Assets*, item #128 for *Expenditures*, and item #129 for *Acquisitions*. *NWC* is receivables, plus inventories minus accounts payable (item#2 + item#3 – item#70). Finally, Q is computed as the market value of assets divided by book assets (item #6 + (item #24 × item #25) – item #60) / (item #6).

Theoretically, our model’s predictions concern the change in cash flows in response to a shock to cash flows, i.e., α_1 in Eq. (16). We control for investment expenditures and acquisitions because firms can draw down on cash reserves in a given year in order to pay for investments and acquisitions. We thus expect α_2 and α_3 to be negative. We control for the change in net working capital because working capital can be a substitute for cash (Opler et al. (1999)),³⁵ or it may compete for the available pool of funds (Fazzari and Petersen (1993)). Our model also suggests that a constrained firm’s cash policy should be influenced by the relative profitability of future investment opportunities vis-à-vis current opportunities. We use Q as an empirical proxy for the relative attractiveness of future investment opportunities. In principle, we would expect the coefficient for α_5 to be positive for constrained firms and indistinguishable from zero for unconstrained firms. We, however, recognize that Q may also capture other factors possibly related to liquidity demand and re-state our priors about α_5 : that coefficient should be *larger* for constrained firms.³⁶ Finally, we control for size because there could be economies of scale in cash management (Opler et al. (1999)),

³⁴Results are very similar when we measure cash flows before dividends (item #14 + item #18).

³⁵Lines of credit and loan commitments are another potential substitute for cash. Unfortunately, we do not have data on these cash alternatives, so we ignore them in the empirical analysis.

³⁶Of course, it would be a problem to our tests if the quality of Q as a proxy for future opportunities influencing liquidity demand varied precisely along the lines of the sample partitions we use below. This is not an easy case to make. However, similar concerns have become a major issue in the related investment-cash flow literature, as the “well-established” evidence of higher cash flow sensitivities of constrained firms has been attributed to measurement errors in Q that happen to be more relevant in samples of constrained firms (see, e.g., Erickson and Whited (2000)). Fortunately to our strategy, if that critique was correct then we should find α_5 to be smaller (rather than larger) in the constrained firm subsample.

consistent with a negative estimate for α_6 .

B.2 Financial Constraints Criteria

Testing the implications of our model requires separating firms according to the financial constraints they face, so that we can examine whether there are differences in the estimates of α_1 across the constrained and unconstrained subsamples. Unfortunately, the literature is not clear on the best way to identify these constraints. There are a number of plausible approaches to sorting firms into ‘constrained’ and ‘unconstrained’ subsamples. Since we do not have strong priors about which approach is best, we use five alternative schemes to partition our sample:

- Scheme #1: We rank firms based on their average annual dividend payout ratio over the 1981-2000 period and assign to the financial constrained (unconstrained) group those firms in the bottom (top) three deciles of the payout distribution. The intuition that financially constrained firms have significantly lower payout ratios follows from Fazzari et al. (1988), among other studies. As in Fazzari et al., firms stay in categories for the entire sample period.
- Scheme #2: We rank firms based on their average real asset size over the 1981-2000 period and assign to the financially constrained (unconstrained) group those firms in the bottom (top) three deciles of the size distribution. This approach resembles Gilchrist and Himmelberg (1995), who also distinguish between groups of financially constrained and unconstrained firms on the basis of firm size.
- Scheme #3: We retrieve data on firms’ bond ratings and assign to the financially constrained group those firms which never had their public debt rated during our sample period.³⁷ Financially unconstrained firms are those whose bonds have been rated during the sample period. A similar approach for characterizing financial constraints is used by Whited (1992), Kashyap et al. (1994), and Himmelberg and Gilchrist (1995). Under this classification scheme an individual firm is in either category of financial constraints throughout the estimation period.
- Scheme #4: We retrieve data on firms’ commercial paper ratings and assign to the financially constrained group those firms which never had their issues (if any) rated during our sample period. Firms that issued commercial papers receiving ratings at some point during the

³⁷We note that comprehensive coverage on bond ratings by COMPUSTAT only starts in the mid-1980s.

sample period are considered to be unconstrained. This approach follows from the work of Calomiris et al. (1995) on the characteristics of commercial paper issuers.

- Scheme #5: We construct an index of firm financial constraints based on Kaplan and Zingales (1997) and separate firms according to this index as follows. First, using the original data from Kaplan and Zingales, we run an ordered probit regression which models the probability each one of the five categories of financial constraints in their paper as a function of a firm’s cash flows, Q , leverage, and dividend payout.³⁸ Next, the coefficient estimates from this regression are used in our data (employing those author’s variable definitions) to construct a linear index of firm financial constraints, which we call “KZ Index”:

$$\begin{aligned}
 KZ\ Index &= -1.126961 \times CashFlow + 0.2643228 \times Q \\
 &\quad + 3.480773 \times Leverage - 35.78327 \times Dividends.
 \end{aligned}
 \tag{17}$$

Firms in the bottom (top) three deciles of the KZ Index ranking are considered financially unconstrained (constrained). In the spirit of Kaplan and Zingales, we allow firms to change their status throughout the sample period by ranking firms on an annual basis. See Lamont et al. (2001) for a similar approach.

Table 1 reports the number of firm-years under each of the ten financial constraints categories used in our analysis. According to the dividend payout scheme, for example, there are 2,507 financially constrained firm-quarters and 4,075 financially unconstrained firm-quarters. The difference in the number of observations stems from the fact that unconstrained firms have a greater number of firm-quarters in COMPUSTAT. Perhaps more interestingly, the table also displays the cross-correlation among the various classification criteria. Of the 2,507 firm-quarters considered constrained according to dividends, 1,147 are also constrained according to size, while 452 are unconstrained based on size. Nearly half of the dividend-constrained firm-quarters are also constrained according to the bond rating criterion, while the other half is actually unconstrained. Finally, note the remarkable discrepancy in financial constraint categorization provided by the Kaplan and Zingales Index and all other measures, including dividends. Only 18% (or 453) of the dividend-constrained firms are also constrained according to the KZ Index, while about 23% of those firms are unconstrained according to the KZ Index.

³⁸We thank Steve Kaplan and Luigi Zingales for kindly providing access to their data.

B.3 Results

Table 2 presents summary statistics on the level of cash holdings of firms in our sample after separating them into constrained and unconstrained categories based on each of the five criteria we consider. According to the dividend payout, size, and the ratings criteria, unconstrained firms, which comprise the vast majority of observations, hold on average roughly 10% of their total assets in the form of cash and marketable securities. This figure resembles those of Kim et al. (1998), who report mean (median) holdings of 8.1% (4.7%). Constrained firms, on the other hand, hold far more cash in their balance sheets; on average, approximately 30%. Mean and median tests reject equality in the level of cash holdings across groups in all cases.

The one measure that appears substantially different from the others is the KZ Index, which tends to classify firms that hold a lot cash as unconstrained. A likely reason for this difference is Kaplan and Zingales' presumption that an unconstrained firm is one that has sufficient internal resources for its investments. Our implementation of the KZ Index reflects their premises even though we have expunged cash holdings from their original empirical model.

Table 3 presents the results obtained from the estimation of our baseline regression model (Eq.(16)) within each of the above sample partitions. The model is estimated via OLS with firm fixed-effects, and the error structure (estimated via Hubber-White) allows for residual correlation within industry-years. In all cases the set of constrained firms display a statistically significant (at better than 1% test level) positive sensitivity of cash to cash flow, while unconstrained firms show insignificant cash sensitivities. The sensitivity estimates for constrained firms vary between 0.188 and 0.351. The median estimate, which is based on firm size ($=0.311$), suggests that for each dollar of additional cash flow (normalized by assets), a constrained firm will save around 1/3 of a dollar, while an unconstrained firm does nothing. Note that the difference in cash flow coefficients between constrained and unconstrained firms is statistically different at the 5% significance level across these two subsamples (i.e., small and large firms). In fact, the coefficient pairs are different from each other at better than the 5% significance level with only one exception. These results are fully consistent with the prediction of our theory.

The coefficients on the control variables also have the expected signs in our regressions. Investments, acquisitions, and size are negatively correlated with the change in cash. The coefficient

on the change in net working capital is generally positive, but not always significant. The Q -sensitivity of liquidity is always positive and significant for constrained firms, as predicted by our model. This sensitivity is sometimes also positive and significant in the unconstrained sample, but the magnitude of the coefficient is always larger in the constrained sample and these differences are statistically significant at the 5% level in four of the five cases.

B.4 Dynamics of Liquidity Management: Responses to Macroeconomic Shocks

One potential source of concerns with the interpretation of the results above regards the endogeneity of financial decisions. To the extent that choice variables such as investment in net working capital and fixed assets enter the baseline cash equation, one could argue that the point estimates in Table 3 are biased in the *levels*. In the absence of an accepted structural model of corporate financing and investment we cannot dispute such type of criticism. We, however, emphasize that the support for the cross-sectional implications of our theory remain: the cash flow sensitivity of cash is *increasing* in financial constraints. In other words, our qualitative conclusions are not affected by those types of simultaneity issues.³⁹

More concerning to our conclusions is a scenario in which there exist biases in the levels of the estimated cash flow sensitivities of cash, *and* those biases are particularly more pronounced in some firms than in others precisely along the dimensions of our data partitioning. This is a difficult point to argue since our empirical results hold steady for partitions which are based on a number of (different) manifestations of financial constraints. Yet we should be able to provide evidence that the economic rationale of our results hold more generally regardless of concerns with such estimation biases. In other words, we should be able to provide evidence for our theory in a test that sidesteps those problems.

To do so, we look for exogenous, economy-wide events affecting both firms' ability to generate internal resources (i.e., cash flows) and the shadow cost of new investment. We find that examining the path of cash flow sensitivity of cash holdings over the business cycle is a useful test of the idea that financial constraints drive significant differences in corporate cash policies. To wit, if our conjecture about those policies are correct, then we should see financially constrained firms saving a greater proportion of their cash flows during recessions. This should happen because these

³⁹We feel it is beyond the scope of this study to provide a full structural empirical model of investment-financing decisions.

periods are characterized both by an increase in the marginal attractiveness of future investment when compared to current investments, and a decline in current income flows.⁴⁰ The cash policy of financially unconstrained firms, on the other hand, should not display such pronounced responses. Put differently, regardless of their *levels*, the *responses* of cash flow sensitivity of cash to changes in aggregate demand should be stronger for financially constrained firms.

To implement this test we use a two-step approach which is similar to that of Kashyap and Stein (2000) and Campello (2002). The idea is to relate the sensitivity of cash to cash flow and aggregate demand conditions by combining cross-sectional and times series regressions. The approach sacrifices estimation efficiency, but reduces the likelihood of Type I inference errors; that is, it reduces the odds of concluding that cash holdings respond to cash flow along the lines of out theory when they really don't.⁴¹

The first step of our procedure consists of estimating the baseline regression model (Eq. (16)) every year separately for groups of financially constrained and unconstrained firms. From each sequence of cross-sectional regressions, we collect the coefficients returned for cash flow (i.e., α_1) and 'stack' them into the vector Ψ_t , which is then used as the dependent variable in the following (second-stage) time series regression:

$$\Psi_t = \eta + \sum_{k=1}^2 \phi_k \text{Log}(GDP)_{t-k} + \rho \text{Trend} + u_t. \quad (18)$$

We are interested in the impact of aggregate demand, proxied by the real log of GDP, on the sensitivity of cash to cash flow. The economic and the statistical significance of aggregate demand can be gauged from the sum of the coefficients for the lags of GDP, $\sum \phi_k$, and from the t -statistics of this sum. We allow for two lags of GDP to account for the fact that macroeconomic movements spread out at different speeds throughout different sectors of the economy.⁴² A time trend (*Trend*) is included to capture secular changes in cash policies. Finally, because movements in aggregate demand and other key macroeconomic variables often overlap, in 'multivariate' versions of Eq. (18)

⁴⁰In terms of the theoretical model, a recession could for example decrease the attractiveness of current investments with respect to future ones (that is, increase the parameter δ). This should have a positive effect on cash-flow sensitivities for constrained firms, but no effect for unconstrained firms.

⁴¹An alternative one-step specification — with Eq. (18) below nested in Eq. (16) — would impose a more constrained parametrization and have more power to reject the null hypothesis of cash policy irrelevance.

⁴²Not allowing for lagged responses could bias our results if the distribution of financially constrained firms happen to be more concentrated in sectors of the economy that respond more rapidly to changes in demand. Our results are largely insensitive to variations in the lag structure for Eq. (18).

we also include current inflation (log CPI) and interest rates (Fed funds rate).⁴³ This will help ensure that our findings are not driven by contemporaneous macroeconomic innovations affecting the cost of money.

The results of interest from the two-stage estimator are displayed in Table 4. The table reports the sum of the coefficients for the two lags of GDP from Eq. (18), along with the t -statistics for the sum. Heteroscedasticity- and autocorrelation-consistent errors are computed with Newey-West lag window of size two in all regressions. The table summarizes the results from 20 two-step estimations (two different constraint categories \times five classification criteria \times two second-stage models). Panel A collects the results for financially constrained firms and Panel B reports results for unconstrained firms. Additional tests for differences between coefficients across groups are reported in the bottom of the table (Panel C). Standard errors for the “difference” coefficients are estimated via a SUR system that combines the two constraint categories (p -values reported).

All of the GDP-response coefficients displayed in Panel A are negative and statistically significant at the 5% level or better, suggesting that constrained firms’ cash policies respond to shocks affecting cash flows and the intertemporal attractiveness of investment along the lines of our theory. The response coefficients of Panel B display no clear patterns, but with only one exception (the KZ Index), are uniformly *lower* than those of Panel A. The differences between those sets of coefficients are summarized in Panel C. These results show that the cash flow sensitivity of cash of financially constrained and unconstrained firms follow markedly different paths over the business cycle, and that those sensitivities evolve according to our theory on financial constraints and liquidity management by firms.

In order to interpret the economic significance of the estimates in Table 4, consider a scenario in which the GDP falls by 1% over two years. Take two hypothetical firms, one constrained and the other unconstrained according to size.⁴⁴ Our estimates suggest that while there is no effect on the propensity of the unconstrained firm to hoard cash, the cash-flow sensitivity of the constrained firm increases by around 0.15 over the two years. Given that the overall propensity to save cash-flows estimated in Table 3 is around 0.3, the effect of a recession on the propensity to save appears to be substantial.

⁴³These series are obtained from the Bureau of Labor Statistics and from the Federal Reserve (*Statistical Release H.15*).

⁴⁴We use the size criterion here so as to be consistent with the discussion of the results of the previous table.

C Agency Problems and Cash Holdings

Our model predicts that unconstrained firms will display a propensity to store greater portions of cash flows in the form of liquid assets when management has overinvestment tendencies, provided that the firm does not already have plenty of internal funds. If the unconstrained firm has enough internal funds (free cash flow), on the other hand, it can thus dispense with the need to access credit markets to (over-)invest, and its cash policies will be observationally equivalent to those of financially unconstrained firms whose managers do not overinvest. In what follows, we focus on the main testable implication of our agency model (Proposition 2): the cash flow sensitivity of cash of financially unconstrained firms is increasing in proxies for misalignment of CEO incentives when those firms have limited internal resources (i.e., low free cash flow).

In implementing a test of our agency model of liquidity, our first task is finding suitable proxies for: a) agency problems potentially associated with overinvestment tendencies, and b) Jensen’s (1986) notion of “free cash flow”. We again resort to the literature for proxies.

We base our measurement of agency on CEO ownership. This strategy follows from the idea that managerial ownership works as a tentative solution to agency problems — particularly overinvestment problems (cf. Jensen and Meckling (1976)) — between managers and owners. Previous studies have argued that, to the extent that ownership is not perfectly set, managers with lower ownership could be more prone to value-destroying overinvestment (see, e.g., Morck et al. (1988), McConell and Servaes (1990), and Jensen (1993)). Accordingly, increases in ownership might lead to less suboptimal managerial behavior, which in our case will translate into a decreased propensity to save cash flows. To integrate this idea in our testing strategy, we estimate an augmented version of our baseline regression where we allow for the interaction between CEO ownership and cash flow:

$$\begin{aligned}
 \frac{Cash_{i,t} - Cash_{i,t-1}}{Assets_{i,t-1}} &= \alpha_0 + \alpha_1 \frac{CashFlow_{i,t}}{Assets_{i,t-1}} + \alpha_2 \frac{Expenditures_{i,t}}{Assets_{i,t-1}} \\
 &+ \alpha_3 \frac{Acquisitions_{i,t}}{Assets_{i,t-1}} + \alpha_4 \frac{NWC_{i,t} - NWC_{i,t-1}}{Assets_{i,t-1}} \\
 &+ \alpha_5 Q_{i,t} + \alpha_6 \ln(Assets_{i,t}) + \alpha_7 CEO\ Ownership_{i,t} \\
 &+ \alpha_8 \left(CEO\ Ownership_{i,t} \times \frac{CashFlow_{i,t}}{Assets_{i,t-1}} \right) + \mu_i + \varepsilon_{i,t}.
 \end{aligned} \tag{19}$$

Our proxy for CEO ownership includes both stock and option holdings, with the data collected

from ExecuComp for the 1993-2000 period.⁴⁵ As shown by Hall and Liebman (1998), the use of options as a compensation device has increased substantially during the sample period we study. Ideally, one would like to compute the sensitivity of CEO wealth to firm performance coming from option holdings. However, as discussed by Aggarwal and Samwick (1999), there are problems in using ExecuComp data to calculate this sensitivity. Here we follow the simple procedure suggested by Yermack (1995), which uses existing options as a fraction of total shares outstanding as a proxy for incentives coming from option holdings.⁴⁶ We note that our results hold equally if we use only stock holdings to measure CEO ownership.

Our theory suggests that the coefficient α_8 should be negative for financially unconstrained firms with limited stocks of internal funds, but insignificant for either financially constrained firms or unconstrained firms with abundant internally-generated resources (or free cash flow).

Nearly all of the free cash flow measures used in previous work are based on the difference between a firm’s cash flow and its current investments. Examples from the empirical literature are Fenn and Liang (2001), Christophe (2002), Opler and Titman (1993), and Lang et al. (1991). The first two papers focus primarily on cash flow–capital expenditures differences while the last two also incorporate some economic measure of investment opportunities (namely, Tobin’s Q).⁴⁷ Below, we implement proxies for free cash flow based on both of these approaches.

The first measure of free cash flow we use is based on the difference between a firm’s cash flow and capital expenditures (both scaled by assets) and that of the median firm in the same 2-digit SIC industry in the same year. We denote by “high” (“low”) free cash flow firms, those firms in the top (bottom) quintiles of the industry-year distributions of that “excess” operating cash flow. The second measure closely resembles that of Opler and Titman (1993) (see also Fenn and Liang (2001)). We denote a firm as a “high” free cash flow firm when its excess operating cash flow is above the distribution median and its Q is below the median Q . A “low” free cash flow firm has below median excess cash flow and above median Q . The only difference from the previous papers is that instead of using the median of the entire distribution of excess cash flow and Q , we use

⁴⁵We use the adjustment factor provided by ExecuComp (AJEX) to adjust CEO ownership to stock splits.

⁴⁶As Aggarwal and Samwick (1999), we measure option holdings using in-the-money vested options (item IN-MONEX in ExecuComp).

⁴⁷Arguably, the last approach is more in the spirit of Jensen (1986) in that it also takes into account the “quality” of the investment being funded.

industry-year medians as benchmarks to compute our measures of free cash-flow.^{48,49}

Rather than directly including our free cash flow measures in the empirical specification, we partition the sample firms according to their relative ranking on those constructed proxies and estimate Eq. (19) separately over those subsamples. This approach more closely relates to the statement of Proposition 2 and facilitates the interpretation of the results — avoiding multiple interaction terms in reported outputs — with little cost to estimation.⁵⁰

Table 5 reports the results from the estimation of Eq. (19) over subsamples of financially constrained and unconstrained firms, with the latter group further subdivided into “high” and “low” free cash flow firms. Financial constraints are defined according to firm dividend policies through the 1981-2000 period (refer to scheme #1 above). Panel A in the table reports the results obtained when the first measure of free cash flow (or excess operating cash flow) is considered and Panel B does similarly for the second measure (which also includes Q).

The first column in each of the panels shows that our main conclusions about the cash policies of financially constrained firms remain for the 1993-2000 subsample and are insensitive to managerial incentive issues. The second and third columns are of more importance to our agency story. Summarizing the results in those columns, they show that managerial incentives do not seem to influence cash management of financially unconstrained firms when they have a wealth of internal resources, but incentives do alter those policies when internal resources are scarce. Consistent with our theory, the results in the third column show that the tendency to hold cash is decreasing in the amount of value maximizing incentives (ownership) CEOs have. The fourth column in both panels of Table 5 shows that differences in the influence of ownership on cash policies are significant across groups of high and low free cash flow firms. The differences in the coefficient of the ownership–cash flow interaction term (α_8) are significant at better than 1% level in both panels. In terms of economic significance, our estimates imply that an increase of 1% on CEO ownership reduces the cash flow sensitivity of cash of unconstrained-low free cash flow firms by a factor between 0.025 and

⁴⁸While adjusting for industry and year effects does not alter the nature of our findings, we believe this to more appropriate given that ignoring industry and year idiosyncratic differences might lead to biased sampling. Consider, for instance, what happens with firms in durable goods industries. Given a fixed investment schedule, these firms will (jointly) observe a steeper decline in cash flows during recession years relative to all other firms, and thus be systematically labeled as “low” free cash flow in those periods, with the opposite occurring in booms.

⁴⁹We keep only industry-years with more than ten observations, so that the measure of centrality makes sense.

⁵⁰The approach is inefficient in a statistical sense if the error structure can be assumed homogenous across subsamples.

0.075, depending on the measure of free cash flow used. This effect appears substantial given the point estimates we obtained for the cash flow sensitivity of cash throughout the paper of around 0.3 for constrained firms.

While we interpret the results of Table 5 as consistent with the implications of our agency model, we find that they hold only weakly when we replicate the same experiments using the other four alternative measures of financial constraints. In particular, although the results hold well when we partition on size and also — albeit more weakly — when we use bonds ratings for financial constraint categorization, the same does not occur when we use either commercial paper ratings or the Kaplan-Zingales criteria to classify firms into financial constraint categories.⁵¹ Overall, we take the empirical findings of this section as suggestive, but not conclusive evidence in support of the agency view of corporate cash management. We believe this to be a fruitful avenue for future research on corporate liquidity.

V Concluding Remarks

One of Keynes' (1936) many important contributions is his notion that the liquidity of a firm's assets is not predetermined, but rather an important decision firms have to make. He suggested that observed choices regarding liquidity will depend on firms' access to capital markets and the importance of future investments to the firms. This idea was echoed in a recent talk given by Richard Passov, the Treasurer of Pfizer, who claimed that Pfizer keeps cash balances that are larger than its long-term debt precisely because its assets are not easily collateralizable, and that its future investments have a huge value to the company.⁵²

This paper models this idea formally, and tests it using recent data on large, publicly-traded manufacturing firms. In the model, firms have access to investment opportunities, but potentially cannot fund them. As in Froot et al. (1993, 1994), financial decisions are important because they enable firms to undertake valuable investment opportunities. In the model's equilibrium, cash holdings for an unconstrained value-maximizing firm are irrelevant because such a firm can undertake all positive NPV projects regardless of its cash position. However, value-maximizing firms that face financial constraints have an optimal level of cash holdings, which are determined

⁵¹The results from those estimations are available upon request.

⁵²Richard Passov, address to the National Forum on Corporate Finance, delivered on May 3, 2002 in Austin, Texas.

by a first-order condition equating the value of the foregone marginal projects (the marginal cost of cash holdings) to the expected value of additional projects the firm will be able to fund in the future (the marginal benefit of cash holdings). This model contains the testable prediction that an unconstrained firm will have a *non-systematic* propensity to save out of incremental cash flows, while a constrained firm will save a positive portion of incremental cash flows.

We also analyze the case where, as hypothesized by Jensen (1986), managers have incentives to overinvest, especially from internally-generated cash flows. In this version of the model, the equilibrium of a constrained firm is unaffected, because the overinvestment effect alters preferences equally in each period, so it does not affect the intertemporal choice between investments. However, a firm that is unconstrained, meaning that it can undertake all positive its NPV investments, can effectively become constrained given agency considerations if cash flows in each period are not sufficient to allow the firm to undertake all the investments managers would like to undertake. In this case, an otherwise unconstrained firm will act like a constrained firm regarding cash, in that there will be an optimal level of cash holdings, and it will have a propensity to save a positive portion of incremental cash flows. Such behavior, though, will only be observed by the econometrician when the constrained firm does not have abundant internal resources (or free cash flow) to fund super-optimal levels of investment.

We examine the empirical implications of this model on a sample of 1,026 publicly-traded manufacturing firms between 1981 and 2000. We use five alternative measures of financial constraints that have been suggested in the literature, and test the hypothesis that the propensity to save incremental cash flows is larger for the constrained firms than for the unconstrained ones using each of the five measure of financial constraints. Consistent with the value-maximizing model, we find that constrained firms save a larger portion of incremental cash flows than unconstrained firms. Moreover, we find that the propensity of constrained firms to save incremental cash flows is larger in recessions than in good economic times, consistent with the Keynes' notion that when firms are more likely to be financially constrained in the future, they are more likely to save cash today.

Finally, we also test whether financially unconstrained firms whose managers are likely to have little or no incentives to adopt value-maximizing policies (e.g., have low ownership) manage firm liquidity as if they were financially constrained. The results for this test depend on the particular measure of financial constraints used. Generally, we find weak evidence in support of the agency

view of corporate liquidity management.

References

- Acharya, V., J. Huang, M. Subrahmanyam and R. Sundaram, 2002, "When Does Strategic Debt Service Matter?", *mimeo*.
- Aggarwal, R. and A. Samwick, 1999, "The Other Side of the Trade-Off: The Impact of Risk on Executive Compensation," *Journal of Political Economy* 107, 65-105.
- Almeida, H. and M. Campello, 2002, "Financial Constraints and Investment-Cash Flow Sensitivities: New Research Directions," *mimeo*.
- Baskin, J., 1987, "Corporate Liquidity in Games of Monopoly Power," *Review of Economics and Statistics*, 69, 312-319.
- Baumol, W., 1970, "Earnings Retention, New Capital and the Growth of the Firm," *Review of Economics and Statistics*, 52, pp. 345-55.
- Beltz, J. and M. Frank, 1996, "Risk and Corporate Holdings of Highly Liquid Assets," *mimeo*, University of British Columbia.
- Blanchard, O., F. Lopez-de-Silanes and A. Shleifer, 1994, "What Do Firms Do with Cash Windfalls?" *Journal of Financial Economics*, 36, pp. 337-60.
- Calomiris, C., C. Himmelberg and P. Wachtel, 1995, "Commercial Paper and Corporate Finance: A Microeconomic Perspective," *Carnegie Rochester Conference Series on Public Policy*, 45, pp. 203-50.
- Campello, M., 2002, "Capital Structure and Product Markets Interactions: Evidence from Business Cycles," *Journal of Financial Economics* (forthcoming).
- Carpenter, R., S. Fazzari and B. Petersen, 1994, "Inventory Investment, Internal-Finance Fluctuations, and the Business Cycle," *Brookings Papers on Economic Activity*, 5?, pp. 75-122.
- Cristophe, S., 2000, "The Value of U.S. MNC Earnings Changes from Foreign and Domestic Operations," *Journal of Business*, 75, pp. 67-94.
- Dittmar, A., J. Mahrt-Smith and H. Servaes, 2002, "Corporate Liquidity," *mimeo*, Indiana University and London Business School.
- Erickson, T. and T. Whited, 2000, "Measurement Error and the Relationship between Investment and Q," *Journal of Political Economy*, 108, pp. 1027-57.
- Faulkender, M., 2002, "Cash Holdings Among Small Business," *mimeo*, Northwestern University.
- Fazzari S., R. G. Hubbard and B. Petersen, 1988, "Financing Constraints and Corporate Investment," *Brooking Papers on Economic Activity*, 1, pp. 141-95.
- Fazzari S., R. G. Hubbard and B. Petersen, 2000, "Investment-Cash Flow Sensitivities Are Useful: A Comment on Kaplan and Zingales," *Quarterly Journal of Economics*, 115, pp. 695-706.
- Fazzari, S. and B. Petersen, 1993, "Working Capital and Fixed Investment: New Evidence on Financing Constrains," *RAND Journal of Economics*, 24, 328-42.
- Fenn, G. and N. Liang, 2001, "Corporate Payout Policy and Managerial Stock Incentives," *Journal of Financial Economics*, 60, pp. 45-72.

- Frankel, A. and B. Jovanovic, 1980, "On Transactions and Precautionary Demand for Money," *Quarterly Journal of Economics*, 95, pp. 25-42.
- Froot, K., D. Scharfstein and J. Stein, 1993, "Risk Management: Coordinating Corporate Investment and Financing Policies," *Journal of Finance*, 48, pp. 1629-58.
- Froot, K., D. Scharfstein and J. Stein, 1994, "A Framework for Risk Management," *Harvard Business Review*, November-December 1994, pp. 91-102.
- Gilchrist, S. and C. Himmelberg, 1996, "Evidence on the Role of Cash Flow for Investment," *Journal of Monetary Economics*, 36, pp. 541-72.
- Hall, B. and J. Liebman, 1998, "Are CEOs Really Paid Like Bureaucrats?" *Quarterly Journal of Economics*, 113, pp. 654-691.
- Harford, J., 1999, "Corporate Cash Reserves and Acquisitions," *Journal of Finance*, 54, pp. 1969-97.
- Hart, O. and J. Moore, 1994, "A Theory of Debt Based on the Inalienability of Human Capital," *Quarterly Journal of Economics*, 109, 841-79.
- Hart, O. and J. Moore, 1995, "Debt and Seniority: An Analysis of the Role of Hard Claims in Constraining Management," *American Economic Review*, 85, pp. 567-85.
- Holmstrom, B. and J. Tirole, 1998, "Private and Public Supply of Liquidity," *Journal of Political Economy*, 106, pp. 1-40.
- Hubbard, R. G., 1998, "Capital Market Imperfections and Investment," *Journal of Economic Literature*, 36, pp. 193-227.
- Jensen, M., 1986, "Agency Costs of Free Cash Flow, Corporate Finance and Takeovers," *American Economic Review*, 76, pp. 323-29.
- Jensen, M., 1993, "The Modern Industrial Revolution, Exit, and the Failure of Internal Control Systems," *Journal of Finance*, 48, pp. 831-80.
- Jensen, M. and W. Meckling, 1976, "Theory of the Firm Managerial Behavior, Agency Costs and Capital Structure," *Journal of Financial Economics*, 3, pp. 305-60.
- John, K., 1993, "Accounting Measures of Corporate Liquidity, Leverage, and Costs of Financial Distress," *Financial Management*, 22, pp. 91-100.
- Kalay, A., 1982, "Stockholder-Bondholder Conflict and Dividend Constraints", *Journal of Financial Economics*, 10, pp. 211-233.
- Kaplan, S. and L. Zingales, 1997, "Do Financing Constraints Explain why Investment is Correlated with Cash Flow?" *Quarterly Journal of Economics*, 112, pp. 169-215.
- Kaplan, S. and L. Zingales, 2000, "Investment-Cash Flow Sensitivities are not Useful Measures of Financial Constraints," *Quarterly Journal of Economics*, 115, pp. 707-12.
- Kashyap, A., O. Lamont and J. Stein, 1994, "Credit Conditions and the Cyclical Behavior of Inventories," *Quarterly Journal of Economics*, 109, pp. 565-92.
- Kashyap, A. and J. Stein, 2000, "What Do a Million Observations on Banks Say about the Transmission of Monetary Policy?" *American Economic Review*, 90, pp. 407-28.
- Keynes, J. M., 1936, *The General Theory of Employment, Interest and Money*, London: McMillan.

- Kim, C., D. Mauer and A. Sherman, 1998, "The Determinants of Corporate Liquidity: Theory and Evidence," *Journal of Financial and Quantitative Analysis*, 33, pp. 335-59.
- Kiyotaki, N. and J. Moore, 1997, "Credit Cycles," *Journal of Political Economy*, 105, pp. 211-48.
- Lamont, O., C. Polk and J. Saá-Requejo, 2001, Financial constraints and stock returns, *Review of Financial Studies*, 14, pp. 529-54.
- Lang, L., R. Stulz and R. Walkling, 1991, "A Test of the Free Cash Flow Hypothesis: The Case of Bidder Returns," *Journal of Financial Economics*, 29, pp. 315-35.
- Lie, E., 2000, "Excess Funds and Agency Problems: An Empirical Study of Incremental Cash Disbursements," *Review of Financial Studies*, 13, pp. 219-47.
- McConnell, J. and H. Servaes, 1990, "Additional Evidence on Equity Ownership and Corporate Value," *Journal of Financial Economics*, 27, pp. 595-612.
- Meltzer, A., 1963, "The Demand for Money: A Cross-Section Study of Business Firms," *Quarterly Journal of Economics*, 77, pp. 405-22.
- Miller, M. and D. Orr, 1966, "A Model of the Demand for Money by Firms," *Quarterly Journal of Economics*, 80, pp. 413-35.
- Mørck, R., A. Shleifer and R. Vishny, 1988, "Management Ownership and Market Valuation: An Empirical Analysis," *Journal of Financial Economics*, 20, pp. 293-315.
- Mulligan, C., 1997, "Scale Economies, the Value of Time and the Demand for Money: Longitudinal Evidence for Firms," *Journal of Political Economy*, 105, 1061-79.
- Myers, S., 1977, The Determinants of Corporate Borrowing, *Journal of Financial Economics*, 5, pp. 146-75.
- Myers, S. and Majluf, 1984, Corporate Financing and Investment Decisions When Firms Have Information that Investors do not Have, *Journal of Financial Economics*, 13, pp. 187-222.
- Myers, S. and R. Rajan, 1998, "The Paradox of Liquidity," *Quarterly Journal of Economics*, 113, 733-71.
- Opler, T., L. Pinkowitz, R. Stulz and R. Williamson, 1999, "The Determinants and Implications of Corporate Cash Holdings," *Journal of Financial Economics*, 52, pp. 3-46.
- Opler, T. and S. Titman, 1993, "The Determinants of Leveraged Buyout Activity: Free Cash Flow vs. Financial Distress Costs," *Journal of Finance*, 48, pp. 1985-99.
- Ozkan A. and N. Ozkan, 2002, "Corporate Cash Holdings: An Empirical Investigation of UK Companies," Working Paper, University of York.
- Pinkowitz, L. and R. Williamson, 2001, "Bank Power and Cash Holdings: Evidence from Japan," *Review of Financial Studies*, 14, pp. 1059-82.
- Povel, P. and M. Raith, 2001, "Optimal Investment Under Financial Constraints: the Roles of Internal Funds and Asymmetric Information," Working Paper, University of Chicago.
- Stein, J., 2001, "Agency, Information and Corporate Investment," *mimeo*, Harvard University.
- Tirole, J., 2001, "Corporate Governance," *Econometrica*, 69, pp. 1-35.
- Yermack, D., 1995, "Do Corporations Award Stock Options Effectively?" *Journal of Financial Economics*, 39, pp. 237-69.
- Whited, T., 1992, "Debt, Liquidity Constraints and Corporate Investment: Evidence from Panel Data," *Journal of Finance*, 47, pp. 425-60.

Table 1: Cross-Classification of Financial Constraint Types

This table displays firm-quarter cross-classification for the various criteria use to categorize firm-quarters as either financially constrained or unconstrained firms (see text for definitions). The sampled firms include only manufacturers (SICs 2000-3999) in the COMPUSTAT annual industrial tapes. The sample period is 1981 through 2000.

Financial Constraints Criteria	Div. Payout		Firm Size		Bond Ratings		CP Ratings		KZ Index	
	(A)	(B)	(A)	(B)	(A)	(B)	(A)	(B)	(A)	(B)
1. Dividend Payout										
Constrained Firms (A)	2,507									
Unconstrained Firms (B)		4,075								
2. Firm Size										
Constrained Firms (A)	1,147	472	2,865							
Unconstrained Firms (B)	452	2,111		3,793						
3. Bond Ratings										
Constrained Firms (A)	1,252	1,029	2,351	194	4,480					
Unconstrained Firms (B)	1,255	3,046	514	3,599		6,655				
4. Commercial Paper Ratings										
Constrained Firms (A)	2,257	1,946	2,865	1,020	4,339	3,342	7,681			
Unconstrained Firms (B)	250	2,129	0	2,773	141	3,313		3,454		
5. Kaplan-Zingales Index										
Constrained Firms (A)	453	1,218	136	1,796	378	2,321	1,245	1,454	2,699	
Unconstrained Firms (B)	873	551	1,535	123	1,869	686	2,387	168		2,555

Table 2: Summary Statistics of Cash Holdings

This table displays summary statistics for cash holdings across groups of financially constrained and unconstrained firms (see text for definitions). All other data are from the annual COMPUSTAT industrial tapes. The sampled firms include only manufacturers (SICs 2000-3999) and the sample period is 1981 through 2000.

3	$\frac{\text{Cash}_{i,t}}{\text{Assets}_{i,t-1}}$	Mean	Median	Std. Dev.	N. Obs
Financial Constraints Criteria					
1. Dividend Payout					
	Constrained Firms (A)	0.372	0.176	0.539	2,507
	Unconstrained Firms (B)	0.112	0.049	0.208	4,075
	p-value (A-B \neq 0)	0.00	0.00		
2. Firm Size					
	Constrained Firms (A)	0.372	0.219	0.502	2,865
	Unconstrained Firms (B)	0.096	0.043	0.168	3,793
	p-value (A-B \neq 0)	0.00	0.00		
3. Bond Ratings					
	Constrained Firms (A)	0.296	0.140	0.452	4,480
	Unconstrained Firms (B)	0.135	0.051	0.259	6,655
	p-value (A-B \neq 0)	0.00	0.00		
4. Commercial Paper Ratings					
	Constrained Firms (A)	0.253	0.105	0.412	7,681
	Unconstrained Firms (B)	0.081	0.041	0.130	3,454
	p-value (A-B \neq 0)	0.00	0.00		
5. Kaplan-Zingales Index					
	Constrained Firms (A)	0.068	0.029	0.100	2,699
	Unconstrained Firms (B)	0.469	0.303	0.566	2,555
	p-value (A-B \neq 0)	0.00	0.00		

Table 3: Baseline Regressions: The Cash Flow Sensitivity of Cash

This table displays results for OLS with firm fixed-effects estimations of the baseline model. All other data are from the annual COMPUSTAT industrial tapes. The sampled firms include only manufacturers (SICs 2000-3999) and the sample period is 1981 through 2000. The estimations correct the error structure both for heteroskedasticity and for within-period error correlation using the White-Huber estimator. t-stats (in parentheses).

Dependent Variable	Independent Variables						R^2
$\frac{\text{Cash}_{i,t} - \text{Cash}_{i,t-1}}{\text{Assets}_{i,t-1}}$	CashFlow	Expenditures	Acquisitions	Δ NW Capital	Q	Ln(Assets)	
Financial Constraints Criteria							
1. Dividend Payout							
Constrained Firms (A)	0.3645 (2.73)*	-0.8850 (-5.88)*	-0.3280 (-2.47)*	0.1110 (1.49)	0.0210 (4.71)*	-0.0454 (-2.19)**	0.283
Unconstrained Firms (B)	0.0471 (0.86)	-0.3949 (-5.35)*	-0.1913 (-3.68)*	0.0190 (0.16)	0.0037 (0.72)	-0.0075 (-0.65)	0.122
p-value (A-B \neq 0)	0.01	0.03	0.27	0.55	0.04	0.67	
2. Firm Size							
Constrained Firms (A)	0.3118 (3.03)*	-0.7674 (-4.09)*	-0.6160 (-4.72)*	0.1666 (1.50)	0.0264 (7.38)*	-0.0396 (-2.30)**	0.264
Unconstrained Firms (B)	0.0324 (0.49)	-0.4504 (-4.26)*	-0.1408 (-3.97)*	0.0457 (0.87)	0.0026 (0.40)	-0.0454 (-3.75)*	0.234
p-value (A-B \neq 0)	0.05	0.19	0.00	0.30	0.00	0.72	
3. Bond Ratings							
Constrained Firms (A)	0.3157 (3.20)*	-0.8208 (-5.06)*	-0.5777 (-4.97)*	0.2087 (1.57)	0.0224 (5.54)*	-0.0571 (-3.28)*	0.317
Unconstrained Firms (B)	0.1351 (1.35)	-0.4985 (-4.19)*	-0.1678 (-7.08)*	0.0538 (1.94)	0.0117 (2.32)**	-0.0340 (-2.37)**	0.274
p-value (A-B \neq 0)	0.19	0.19	0.00	0.23	0.01	0.13	

Table 3 - Continued

	Independent Variables						R ²
	CashFlow	Expenditures	Acquisitions	ΔNWCapital	Q	Ln(Assets)	
4. Commercial Paper Ratings							
Constrained Firms (A)	0.2573 (3.24)*	-0.7080 (-7.88)*	-0.3556 (-4.88)*	0.1735 (2.06)**	0.0217 (4.59)*	-0.0489 (-3.35)*	0.307
Unconstrained Firms (B)	0.0008 (0.01)	-0.4004 (-2.91)*	-0.0971 (-4.38)*	-0.0738 (-2.37)**	0.0013 (0.23)	-0.0259 (-1.94)	0.170
p-value (A-B≠0)	0.02	0.12	0.01	0.01	0.01	0.07	
5. Kaplan-Zingales Index							
Constrained Firms (A)	0.2758 (5.60)*	-0.4686 (-6.19)*	-0.1293 (-3.45)*	-0.0685 (-1.49)	0.0182 (2.07)**	-0.0015 (-0.37)	0.463
Unconstrained Firms (B)	0.1225 (0.74)	-1.2513 (-4.32)*	-0.6669 (-3.38)*	0.2009 (1.66)	0.0120 (2.42)**	-0.0673 (-2.26)**	0.379
p-value (A-B≠0)	0.01	0.54	0.00	0.01	0.84	0.00	

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

Table 4: Macroeconomic Dynamics: Two-Stage Estimator of the Impact of Aggregate Activity on the Cash Flow Sensitivity of Cash.

The dependent variable is the estimated sensitivity of cash holdings to cash flow for firms classified as financially constrained vs. unconstrained. In each estimation, the dependent variable is regressed on two lags of the log of real GDP and a time trend. In the multivariate regressions, current inflation (log CPI) and interest rates (Fed funds rate) are also added. The sampled firms include only manufacturers (SICs 2000-3999) and the sample period is 1981 through 2000. The sum of the coefficients for the two lags of the economic activity measure is shown along with the t-statistic of this sum (in paranthesis). Heteroskedasticity- and autocorrelation-consistent errors are computed with a Newey-West (1987) lag window of size two. The standard errors for the difference of the sum of the two lags of GDP are computed with a SUR system that estimates constraint categories regressions jointly.

	Financial Constraints Criteria				
	Div. Payout	Firm Size	Bond Ratings	CP Ratings	KZ Index
A. Constrained Firms					
Univariate					
Sum of Lag Coefficients	-16.566	-14.101	-10.791	-7.125	-2.428
Summation Test (t-stat)	(-3.92)*	(-3.08)*	(-4.83)*	(-2.13)**	(-2.42)**
Multivariate					
Sum of Lag Coefficients	-18.834	-16.188	-11.139	-8.770	-2.409
Summation Test (t-stat)	(-5.21)*	(-5.62)*	(-5.31)*	(-3.53)*	(-2.32)**
B. Unconstrained Firms					
Univariate					
Sum of Lag Coefficients	11.332	-1.475	-4.003	7.749	-14.984
Summation Test (t-stat)	(2.02)**	(-0.53)	(-0.82)	(1.30)	(-3.56)*
Multivariate					
Sum of Lag Coefficients	11.502	-0.960	-5.130	7.365	-16.024
Summation Test (t-stat)	(2.54)**	(-0.47)	(-1.51)	(1.39)	(-6.45)*
C. Diff. Constrained–Unconstrained					
Univariate					
Diff. Coefficient	-27.898	-12.626	-6.788	-14.874	12.556
Diff. p-value	0.01	0.09	0.47	0.12	0.06
Multivariate					
Diff. Coefficient	-30.336	-15.228	-6.009	-16.135	13.616
Diff. p-value	0.00	0.04	0.51	0.09	0.05

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

Table 5: The Cash Flow Sensitivity of Cash the Agency Problem

This table displays results for fixed-effects OLS estimations of the cash flow sensitivity of cash with proxies for agency problems. The baseline regression model is augmented with the inclusion of CEO Ownership (based on stocks + options) as a proxy for CEO incentives, and its interaction with cash flow. Financial constraints are defined based on firm dividend policies throughout the 1981-2000 period. In Panel A, High (Low) free cash flow firms are those in the top (bottom) quintile of the industry-year-normalized distribution of the “excess operating cash flow” measure. This measure is based on the difference between a firm’s cash flow and capital expenditures (both scaled by assets) and that of the median firm in the same 2-digit SIC industry in the same year. In Panel B, High (Low) free cash flow firms are those with above (below) industry-year median “excess operating cash flow” and below (above) industry-year median Q. The estimation period is 1993-2000. The estimations correct the error structure both for heteroskedasticity and for within-period error correlation using the White-Huber estimator. t-stats (in parentheses).

Panel A: Free Cash Flow Proxyed by (Relative to Industry-Year) “Excess Operating Cash Flow” Rankings

Indep. Variables	Financially Constrained	Financially Unconstrained		p-value (A-B≠0)
		High Free Cash Flow (A)	Low Free Cash Flow (B)	
CashFlow	0.2676 (2.67)*	0.1041 (0.38)	0.1329 (0.52)	0.85
Expenditures	-1.1997 (-3.04)*	-0.2301 (-0.34)	-0.9996 (-1.65)	0.58
Acquisitions	-0.5053 (-5.00)*	0.3661 (0.41)	-0.2284 (-1.70)	0.19
ΔNWCapital	0.0827 (0.48)	0.1764 (1.56)	0.1079 (0.84)	0.78
Q	0.0179 (2.45)*	0.0186 (3.06)*	0.0155 (1.19)	0.82
Ln(Assets)	0.0428 (0.87)	-0.0026 (-0.09)	-0.0201 (-1.31)	0.42
CEO Ownership	0.1116 (0.33)	-0.5051 (-0.93)	0.9870 (2.27)**	0.04
CEO Ownership × CashFlow	-0.3900 (-0.20)	4.2166 (1.27)	-7.0219 (-2.58)*	0.00
Observations	965	206	187	
R ²	0.194	0.521	0.580	

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

Table 5 - Continued

Panel B: Free Cash Flow Proxy by the Joint Distribution of "Excess Operating Cash Flow" and Tobin's Q

Indep. Variables	Financially Constrained	Financially Unconstrained		p-value (A-B≠0)
		High Free Cash Flow (A)	Low Free Cash Flow (B)	
CashFlow	0.2676 (2.67)*	0.3287 (0.82)	-0.1689 (-0.57)	0.18
Expenditures	-1.1997 (-3.04)*	-0.7024 (-0.83)	-0.0338 (-0.17)	0.41
Acquisitions	-0.5053 (-5.00)*	-0.0368 (-0.41)	-0.2326 (-3.38)*	0.03
ΔNWCapital	0.0827 (0.48)	-0.1706 (-0.97)	0.1589 (0.97)	0.44
Q	0.0179 (2.45)*	-0.0219 (-0.97)	0.0240 (3.25)*	0.01
Ln(Assets)	0.0428 (0.87)	0.0245 (1.79)	0.0122 (0.33)	0.54
CEO Ownership	0.1116 (0.33)	-1.3643 (-1.04)	-0.3906 (-1.14)	0.27
CEO Ownership × CashFlow	-0.3900 (-0.20)	5.0026 (0.69)	-2.5261 (-1.87)**	0.01
Observations	965	202	191	
R ²	0.194	0.553	0.242	

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