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ABSTRACT

Much of corporate finance is concerned with the impact of financing constraints on firms. However, the literature on financing constraints largely ignores the intertemporal implications of those constraints; in particular, how future financing constraints affect current investment decisions. We present a model in which future financing constraints lead firms to have a current preference for investments with shorter payback periods, investments with less risk, and investments that utilize more liquid/pledgeable assets. The model has a host of implications in different areas of corporate finance, including firms' capital budgeting rules, risk-taking behavior, capital structure choices, hedging strategies, and cash management policies. We show how a number of patterns reported in the empirical literature can be reconciled and interpreted in light of the intertemporal optimization problem firms solve when they face costly external financing. For example, contrary to Jensen and Meckling (1976), we show that firms may reduce rather than increase risk when leverage increases exogenously. Furthermore, firms in economies with less developed financial markets will not only take different quantities of investment, but will also take different kinds of investment (safer, short-term projects that are potentially less profitable). We also point out to several predictions that have not been empirically examined. For example, our model predicts that investment safety and liquidity are complementary: constrained firms are specially likely to distort the risk profile of their most liquid investments.

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1 Introduction

Keynes (1936) originally pointed out that the ability of capital markets to provide financing for projects can affect firms' financial policies (p. 196). Keynes argued that if a firm can always costlessly access external capital markets, then it has no reason to save cash internally. Alternatively, if a firm faces incremental costs each time it raises capital, then it can increase its value by maintaining a more liquid balance sheet. Keynes focused his discussion on corporate cash policies, but the argument is much more general: *any* decision that affects a firm's ability to finance its projects will be affected by the distribution of financing demand and costs across time.

In this paper, we extend Keynes's ideas to the question of how real investments are affected by intertemporal financing frictions. In particular, we show that when future projects are valuable and capital markets are imperfect, factors related to a firm's ability to smooth financing over time become relevant to investment decisions today (see also Smith and Stulz (1985) and Froot, Scharfstein, and Stein (1993)). Our argument is quite general and has relevance to any situation in which a firm potentially faces costly financing decisions in the future. Indeed, we show that a number of existing empirical findings can be explained through this idea, in which firms take actions today to minimize the impact of future financial constraints.[1]

We formalize our arguments through a stylized model. Suppose that a firm can choose among a menu of projects that differ across a number of dimensions, including not only the value of the cash flows produced, but also their timing, risk, and the liquidity of the assets the firm must acquire. The net present value (NPV) rule implies that the appropriate calculation for determining the value of an investment is to compare the investment's initial cost to the discounted expected cash flows from the project using the discount rate that reflects the project's risk. However, investment decision-making becomes more complex when firms face capital markets imperfections. In the absence of competitively-priced external funding, observed firm investment can depart significantly from what would result from standard capital budgeting approaches.

Our model characterizes the nature of these departures. In particular, when credit constraints are likely to bind in the future, we show that firms' capital budgeting rules are distorted towards projects that generate earlier cash flows, and against those that generate back-loaded flows. This distortion occurs because cash flows from current investments can provide financing for future valuable projects that otherwise would go unfunded. We also model firms' choices between projects that differ with

[1] We use the term "financial constraints" more broadly than is common in the literature. If a firm's current and/or future investments differ from the "unconstrained" (first-best) solution due to costly financing arising from capital markets imperfections, we consider that firm to be financially constrained. For example, we see deadweight costs arising from financial distress as a particular manifestation of financial constraints. We also consider firms that face credit constraints arising from poor development of financial markets and institutions as financially constrained firms.

respect to their risk profile. When financing constraints are likely to bind in the future, firms will prefer projects with safe cash flows over projects with the same (or even lower) NPV but risky cash flows, since safe cash flows are more likely to be useful in mitigating future financing constraints. In addition, our model also shows how firms will distort their investment policy towards projects that generate more tangible, verifiable cash flows when they face financing constraints, even when those projects have lower expected profits. We also show that constrained firms will tend to distort the risk profile of the more liquid projects, rather than that of illiquid ones. Because illiquid projects have a lower impact on future financing capacity, their riskiness matters less for a constrained firm. As a result, project liquidity and safety become complementary attributes in the investment policy.

Our analysis yields fairly general points that can be applied to various areas of corporate finance. Our basic model is intentionally vague regarding the underlying source of the constraints. We use this general approach because financial constraints can come from many sources in the real world. Regardless of the underlying reason for financial constraints, our model suggests that their existence will lead firms to adjust their policies in predictable directions. To better match the ideas of our theory and the particular applications that we discuss, we provide a series of extensions of our basic model in Section 3. Among other things, we formalize alternative notions of financial constraints sources.

Our analysis provides insights into the following much-debated research questions: 1) Why do firms use payback in addition to the NPV rule in capital budgeting? 2) Why firms do not appear to "risk-shift" when standard theory says they should? 3) Why are firms typically "underleveraged"? 4) How do firms decide on the liquidity of their asset portfolio, in particular, how much cash to hold? 5) Why do managers appear to hedge operationally in addition to financially, even if operational hedges come at a real cost to the firm? 6) Why do firms in countries with underdeveloped capital markets make different types of investments than firms in countries with developed capital markets? and 7) Why does financial development add so much to corporate growth by changing the mix of investments, in addition to their quantity?

Let us briefly discuss some of these questions here. Under the NPV rule, the value of a project equals the sum of the expected payoffs from the project, discounted at a rate that reflects the project's particular risk profile. This valuation rule, however, fails when credit markets are imperfect. While traditional discounting accounts for cash flow timing and riskiness, it is difficult to incorporate the role of cash flows in funding future investments into standard NPV calculations. When markets are imperfect, the true value of an investment opportunity today incorporates the value of all future projects that can be financed with its payoffs. In turn, the value of these future projects is a function of other projects that can be financed with their cash flows. Taken to the limit, this argument implies that in order to make a decision about an investment today, a manager must be able to forecast the cash flows of all investment opportunities that might arise in the future. Given that the ability to do such a forecast is likely to be bounded in practice, it might make sense for managers to use 'payback' (in combination with NPV) as an "heuristically reasonable" way to bias capital budgeting decisions towards projects that produce earlier cash flows (see Section 3.1).[2]

One of the most widely-discussed arguments in corporate finance is the Jensen and Meckling (1976) "risk-shifting" story, by which firms have incentives to increase project risk when they become highly leveraged and near financial distress. While this argument has been taken to be an important consideration in capital structure decisions, there has been very little direct evidence of risk-shifting in practice. One of the extensions of our basic model (Section 3.3) describes how financing constraints can lead to an effect that offsets a firm's incentives to risk-shift. In particular, when leverage leads firms to expect higher costs of external finance in the future, they distort investments toward *safer* projects. This effect is one reason why there is virtually no evidence that firms actually increase risk in the manner suggested by Jensen and Meckling. In addition, to the extent that leverage is endogenously determined, our analysis suggests an additional reason why firms limit their leverage. Higher leverage creates incentives for firms to distort real investments towards safer and liquid but potentially less profitable projects. Firms can mitigate this potential cost by limiting their leverage.

We also generalize Almeida, Campello, and Weisbach's (2004) arguments about cash holdings. As in that paper, we argue that a firm's cash balances and incremental savings out of new cash flows should be a function of the firm's position in the financial market. We extend this analysis in Section 3.4 by considering additional ways in which a constrained firm can transfer resources through time. In particular, we show that the sign of "cash–cash flow sensitivities" need not be positive when the firm has access to liquid investment technologies other than cash. An increase in current cash flows, for example, can reduce future costs of external financing through its effect on liquid capital investments, and can also reduce the demand for cash. Consequently, whether cash–cash flow sensitivities are positive or negative becomes an empirical question. We review the available evidence in Section 4.

Our arguments also have implications for the burgeoning literature on international comparisons of corporate financial policy. Much of this literature documents that there is substantial variation across countries in the ability of firms to raise external finance (see, e.g., La Porta, Lopez de Silanes, Shleifer, and Vishny (1997, 1998)). Our model suggests that a high cost of external finance should affect not only the quantity of investments made in different countries, but also the types of investments that we observe. In particular, where costs of raising additional external finance are high, we expect to observe a preference for investments that use more tangible assets and generate more

[2] Graham and Harvey (2001) find that the majority of firms in their survey still consider the payback method for project valuation. They report that the use of the payback rule is particularly prevalent among small, private firms.

collateral.[3] The empirical literature largely supports these predictions (see, e.g., Demirgüç-Kunt and Maksimovic (1999). A consequence of our theory is that financial development should make firms in emerging markets more prone to make longer term, potentially riskier investments over time. Noteworthy, the effect of financial development on investment distortions inside firms can also help explain the strong link between financial development and investment efficiency (see Beck, Levine, and Loyaza (2000) and Wurgler (2000)).

Our paper extends the existing literature on financing constraints (see Hubbard (1998) and Stein (2003) for reviews) by considering intertemporal links between financing constraints and investment. These links generate implications that are absent from a purely static framework. For example, financial constraints do not always generate underinvestment in all kinds of assets. While this result is generally true for illiquid, long-term projects (those that do not generate cash flows that can be used to finance future investments), it need not hold for investments that help mitigate future financing problems. Our model shows that whether the constrained firm underinvests or overinvests in liquid assets, relative to the first-best solution occurring with frictionless capital markets, depends on the relative strength of current versus future constraints, and on the profitability of current versus future investment opportunities. We show that in order to derive robust empirical implications about the effects of constraints on investment, it is helpful to look at the *ratios* between different kinds of investment. For example, irrespective of whether constraints cause under or overinvestment in liquid assets, our analysis implies that the ratio of liquid to illiquid investments (and of safe to risky investments) is always increasing in the degree of financing constraints.

We are not the first paper to consider intertemporal implications of financing constraints. Smith and Stulz (1985) and Froot, Scharfstein, and Stein (1993), for example, argue that one reason for corporate hedging is to minimize future financing costs and future costs of financial distress. Essentially, their argument is that constrained firms have incentives to use financial instruments such as forwards, futures, and options to hedge negative cash flow shocks that have real effects on investment or distress costs. In contrast, our paper focuses on operational hedges that might involve distortions in real investments. Operational hedges are likely to be more costly than financial hedges. In practice, however, several sources of cash flow risk are nonmarketable and thus cannot be hedged using financial derivatives (see Section 4). As we discuss below, distortions arising from operational hedges are likely to be very important in practice, especially in situations in which derivative markets are poorly developed.

Other papers have also looked at intertemporal links between financing constraints and investment. Boyle and Guthrie (2003) analyze firms' choice of investment in a real-options framework,

[3] We formally motivate this application by extending our model in order to incorporate weak investor protection as a source of future financing constraints (see Section 3.2).

showing that constrained investment can be accelerated with respect to the first-best schedule due to future financing frictions. The nature of the interactions between real investment and financial constraints considered by Boyle and Guthrie is markedly different from ours, nonetheless. In their model, the threat of future financing constraints ("cash shortfalls") is exogenously specified and only affects the timing of investment. Importantly, their model does not allow for cash flows from current investments to affect future financing constraints. Froot and Stein (1998) consider a model in which financial institutions cannot frictionlessly hedge the risks associated with their portfolios in the capital markets, and thus also use capital structure and capital budgeting as hedging devices. Hennessy, Levy, and Whited (2005) show that firms anticipating collateral constraints experience a side benefit from current investment because installed capital relaxes future constraints. An important innovation of our paper relative to Froot and Stein and Hennessy et al. is that we model the constrained firm's choice over a menu of investments that differ along several dimensions including risk and liquidity. In contrast, Froot and Stein focus mostly on risk distortions, while Hennessy et al. only consider one type of capital asset. Our focus on a menu of investments generates new empirical implications, including the effects of financial constraints and cash flows on the ratios between different kinds of investment, the complementarity between safety and liquidity of projects, and implications about cash flow sensitivities of cash holdings in the presence of alternative liquid investments.

The remainder of the paper proceeds as follows. Section 2 introduces our basic theory, and describes its main implications. Section 3 builds on the general framework of Section 2 to characterize some applications of our main results to specific areas of corporate finance, including capital budgeting and capital structure choices. Section 4 presents a discussion of empirical findings in light of the implications of the model. We show how findings in disparate areas such as capital structure, hedging and cash policies, product market competition, and international corporate finance can be understood as implications of the same types of investment distortions. We also discuss hitherto untested implications. Section 5 concludes.

2 A Model of Intertemporal Investment Decisions with Deadweight Costs of External Financing

2.1 Structure

Our model is a simple representation of a dynamic problem in which the firm has both present and future investment opportunities, and in which external finance may entail deadweight costs. There are three dates: 0, 1, and 2. The future investment, I_1, made at date 1, produces cash flows in period 2 equal to $g(I_1)$. We parametrize the costs of external finance as in Froot, Scharfstein, and Stein (1993) by assuming that the firm pays a deadweight cost $C(E, k)$ if it raises an amount E in external funds. For example, if the firm has zero internal funds at date 1, it will pay deadweight costs $C(I_1, k)$ for any amount of investment $I_1 > 0$. We assume that $C_E(E, k) > 0$ if $E > 0$, $C_E(E, k) = 0$ if $E = 0$, $C_k(E, k) > 0$, $C_{Ek}(E, k) > 0$, and $C_{EE}(E, k) > 0$. The parameter k summarizes the variables that affect the marginal cost of external funds for the firm. Firms that have high costs of external funds have high k.

Froot, Scharfstein, and Stein (1993) discuss a number of economic rationales — based on agency and information problems — to motivate a link between capital market imperfections ("financing constraints") and corporate policies. Formally, those authors show how the above external financing cost function, $C(E, k)$, naturally arises from the Gale and Hellwig (1985) variant of Townsend's (1979) costly-state verification model. Stein (1998) arrives at a similar functional form for financing costs within a banking framework in which non-deposit liabilities are subject to adverse selection problems. In Section 3.2, we further demonstrate that the external financing cost function $C(E, k)$ also arises from a variant of the Shleifer and Wolfenzon (2002) model in which capital markets are imperfect because of poor investor protection.[4] Since deadweight costs of external finance can arise from many different sources, in this section we abstract from modeling any particular source of constraints when developing our baseline framework. Indeed, the underlying reason for the financing cost does not affect our analysis, as long as it results in a cost function similar to $C(E, k)$. What is important is that the ideas that come from our basic model are very general, and they can be applied whenever there is a potential incremental cost of external finance in the future.

At date 0, the firm has access to a menu of investment opportunities that differ along the following dimensions:

• *Liquidity/Pledgeability*: Some date-0 investments produce cash flows that have high pledgeability (i.e., are highly liquid) to creditors, while others produce cash flows that cannot be pledged at date 1. For example, some investments might have front-loaded cash flows (short-term projects), which can be used for (re-)investment at date 1. Other investments might only produce long-term cash flows (at date 2). The firm can borrow against these date-2 cash flows at date 1. However, the extent to which date-2 cash flows can serve as collateral at date 1 varies across different investments.[5]

We capture these differences in asset liquidity/pledgeability in the following way. One of the date-0 investments that the firm can make, I_0, produces cash flows at date 2, equal to $(1 + \theta)g(I_0)$, with $\theta > 0$. We assume that these investments generate zero collateral at date 1. There is also another set of date-0 investments, I_0^λ, that generate total cash flows equal to $g(I_0^\lambda)$ at date 2. A fraction λ of

[4] We also show in Section 3.3 that financial distress costs can be thought of as an alternative motive for the $C(E, k)$ formulation.

[5] One can also think of the resale value/redeployability of the assets that are acquired with investment funds at date 0. Some assets may provide high level of collateral (liquidating values) in the future, while other assets may not provide collateral (either because their liquidating cash flows are unverifiable or because liquidation costs are too high).

these cash flows can be used as collateral at date 1. There are two possible interpretations for $\lambda g(I_0^\lambda)$. One is that the firm can borrow against the date-2 cash flow $\lambda g(I_0^\lambda)$ without paying deadweight costs of external finance. The other interpretation is simply that $\lambda g(I_0^\lambda)$ is a date-1 cash flow (investment with front-loaded cash flows). In either case, $(1-\lambda)g(I_0^\lambda)$ is a date-2 cash flow that is totally illiquid as of date 1, in the same way that the cash flow $(1+\theta)g(I_0)$ is illiquid. The assumption that $\theta > 0$ means that the perfectly illiquid investment has higher productivity.

• *Risk*: Some date-0 investments produce risky cash flows in the future, while others produce certain (safe) cash flows.

As it will become clear, the riskiness of the illiquid investment I_0 is irrelevant for the constrained firm. Thus, we can assume that the payoff $(1+\theta)g(I_0)$ is nonstochastic. In contrast, we consider two types of liquid investment: I_{0S}^λ produces a safe cash flow equal to $g(I_{0S}^\lambda)$, while I_{0R}^λ produces a risky cash flow. In particular, with probability p, the firm is in the high state (H) in which the cash flow is equal to $c_H g(I_{0R}^\lambda)$; and with probability $(1-p)$ the firm is in the low state (L), in which the cash flow is equal to $c_L g(I_{0R}^\lambda)$. We let $\bar{c} = pc_H + (1-p)c_L$, where $\bar{c} > 1 > c_L$. These assumptions imply that the risky investment is more productive than the safe one, but the safe investment produces higher cash flows than the risky one in state L. The uncertainty about the state gets resolved at date 1.

In addition to these investment opportunities, the firm has assets in place that produce exogenous cash flows equal to w_0 at date 0, and w_1 at date 1. We assume that the cash flow w_1 is risky, and is equal to w_{1H} in state H, and 0 in state L. Cash flows from assets in place will help determine the marginal cost of external funds.

2.2 Analysis

At date 0, the firm must allocate funds across three types of the investments: I_0, I_{0S}^λ, and I_{0R}^λ. At date 1, a new investment opportunity arises, and conditional on the observed state (H or L), the firm invests either I_{1H} or I_{1L}. To economize on notation, we drop the superscript λ and let $\{I_{0S}^\lambda, I_{0R}^\lambda\} \equiv \{I_{0S}, I_{0R}\}$. If, at date 0, the firm's total investment is larger than w_0, then the firm must pay the deadweight cost of external finance, $C(I_{0R}+I_{0S}+I_0-w_0, k)$. At date 1, we assume that the cash flow w_{1H} is large enough that the firm can invest at first-best levels in state H without paying any deadweight costs. In contrast, the firm pays the deadweight cost $C(I_{1L} - \lambda c_L g(I_{0R}) - \lambda g(I_{0S}), k)$ in state L. Thus, the liquid investments I_{0R} and I_{0S} allow the firm to reduce deadweight costs of external finance at date 1 in state L, because a fraction λ of these cash flows can be used to finance the new investment opportunities that are available at that date.

The firm's program is to maximize the sum of the value of its investments, net of the deadweight costs of external funds:

$$\max_{I_{0S},I_{0R},I_0,I_{1H},I_{1L}} p\left[c_H g(I_{0R}) + g(I_{1H}) - I_{1H}\right] + (1-p)\left[c_L g(I_{0R}) + g(I_{1L}) - I_{1L}\right] \tag{1}$$
$$-I_{0R} + g(I_{0S}) - I_{0S} + (1+\theta)g(I_0) - I_0$$
$$-C(I_{0R} + I_{0S} + I_0 - w_0, k) - (1-p)C(I_1 - \lambda c_L g(I_{0R}) - \lambda g(I_{0S}), k),$$

where we incorporate the assumption that $C(.,k) = 0$ in state H. In state H, the firm will invest at the first-best level defined by:

$$g^{'}(I_{1H}^{FB}) = 1. \tag{2}$$

Notice that a sufficient condition to ensure that $C(.,k) = 0$ in state H is that $w_{1H} > I_{1H}^{FB}$.

In state L, investment is determined by:

$$g^{'}(I_{1L}^{*}) = 1 + C_E(E_L, k), \tag{3}$$

where $E_L = I_{1L} - \lambda c_L g(I_{0R}) - \lambda g(I_{0S})$. If $E_L > 0$, then $C_E(E_L, k) > 0$, and $I_{1L}^{*} < I_{1L}^{FB}$. This setup captures the idea that the firm is more likely to be constrained in the future if future cash flows turn out to be low.[6]

We can divide the solution in two cases:

Case 1: The firm is unconstrained in state L, that is, $I_{1L}^{*} = I_{1L}^{FB}$.

If we define $(\widehat{I}_0, \widehat{I}_{0S}, \widehat{I}_{0R})$ as:

$$(1+\theta)g^{'}(\widehat{I}_0) = \bar{c}g^{'}(\widehat{I}_{0R}) = g^{'}(\widehat{I}_{0S}) = 1 + C_E(\widehat{I}_0 + \widehat{I}_{0S} + \widehat{I}_{0R} - w_0, k), \tag{4}$$

then this case obtains as long as $I_{1L}^{FB} < \lambda c_L g(\widehat{I}_{0R}) + \lambda g(\widehat{I}_{0S})$.

The investment levels $(\widehat{I}_0, \widehat{I}_{0S}, \widehat{I}_{0R})$ represent the optimal investment policy if the firm ignores the interplay between *current* investment polices and *future* financing constraints. In this case, the firm simply equates the marginal productivity of the three types of investment.

Whether or not the firm is constrained at date 0 does not affect the marginal conditions established in Eq. (4). To see this, notice that if $C_E(I_0^{FB} + I_{0S}^{FB} + I_{0R}^{FB} - w_0, k) = 0$, then investment policy is set at first-best levels: $(\widehat{I}_0, \widehat{I}_{0S}, \widehat{I}_{0R}) = (I_0^{FB}, I_{0S}^{FB}, I_{0R}^{FB})$. In contrast, if $C_E(I_0^{FB} + I_{0S}^{FB} + I_{0R}^{FB} - w_0, k) > 0$, then $(\widehat{I}_0, \widehat{I}_{0S}, \widehat{I}_{0R}) < (I_0^{FB}, I_{0S}^{FB}, I_{0R}^{FB})$. Yet, the ratios of the marginal productivities of the different

[6]For simplicity, we assume that investment opportunities are uncorrelated with future cash flows. If the firm has higher investment opportunities in state H, then it could become more financially constrained in that state. We are also abstracting away from financial hedging policies that might allow the firm to transfer cash flows across states (where they are most needed for investment). These issues are analyzed in Acharya, Almeida, and Campello (2005).

types of investment are the *same* under either investment regime:

$$\begin{aligned} \frac{g'(\widehat{I}_0)}{g'(\widehat{I}_{0R})} &= \frac{\bar{c}}{(1+\theta)} = \frac{g'(I_0^{FB})}{g'(I_{0R}^{FB})} \\ \frac{g'(\widehat{I}_0)}{g'(\widehat{I}_{0S})} &= \frac{1}{(1+\theta)} = \frac{g'(I_0^{FB})}{g'(I_{0S}^{FB})} \\ \frac{g'(\widehat{I}_{0R})}{g'(\widehat{I}_{0S})} &= \frac{1}{\bar{c}} = \frac{g'(I_{0R}^{FB})}{g'(I_{0S}^{FB})}. \end{aligned} \tag{5}$$

Case 2: The firm is constrained in state L. This case obtains if $I_{1L}^{FB} > \lambda c_L g(\widehat{I}_{0R}) + \lambda g(\widehat{I}_{0S})$.

If the firm invests myopically at date 0, then it will become constrained in future low cash flow states. The condition for optimality is modified in a straightforward way:

$$\begin{aligned} (1+\theta)g'(I_0^*) = [\bar{c} + (1-p)c_L\lambda C_E(E_{1L}^*, k)]\, g'(I_{0R}^*) = \\ [1 + (1-p)\lambda C_E(E_{1L}^*, k)]\, g'(I_{0S}^*) &= 1 + C_E(E_0^*, k), \end{aligned} \tag{6}$$

where $E_0^* = I_0^* + I_{0S}^* + I_{0R}^* - w_0$, and $E_{1L}^* = I_{1L}^* - \lambda c_L g(I_{0R}^*) - \lambda g(I_{0S}^*)$. The cash flows from the liquid investments I_{0R}^* and I_{0S}^* reduce the marginal cost of external finance in state L (the term $C_E(E_{1L}^*, k)$) by an amount that is proportional to the liquidity of investments (the parameter λ). This equation implies that:

$$\begin{aligned} \frac{g'(I_0^*)}{g'(I_{0R}^*)} &= \frac{\bar{c} + (1-p)c_L\lambda C_E(E_{1L}^*, k)}{(1+\theta)} > \frac{g'(\widehat{I})}{g'(\widehat{I}_{0R})} \\ \frac{g'(I_0^*)}{g'(I_{0S}^*)} &= \frac{1 + (1-p)\lambda C_E(E_{1L}^*, k)}{(1+\theta)} > \frac{g'(\widehat{I})}{g'(\widehat{I}_{0S})} \end{aligned} \tag{7}$$

In words, the firm's investment policy is *distorted* towards more liquid investments because of future financing constraints. In equilibrium, the ratios $\frac{g'(I_0^*)}{g'(I_{0R}^*)}$ and $\frac{g'(I_0^*)}{g'(I_{0S}^*)}$ are higher than in the myopic case.

In addition, we have:

$$\frac{g'(I_{0R}^*)}{g'(I_{0S}^*)} = \frac{1 + (1-p)\lambda C_E(E_{1L}^*, k)}{\bar{c} + (1-p)c_L\lambda C_E(E_{1L}^*, k)} > \frac{g'(\widehat{I}_{0R})}{g'(\widehat{I}_{0S})}. \tag{8}$$

Because the safe investment produces greater cash flows in state L ($1 > c_L$), the investment policy is also distorted towards safe investments. Thus, among the liquid investments, the constrained firm is particularly prone to increasing the allocation of funds towards the safest investments.

Eq. (8) implies that if $\lambda = 0$, then future constraints create no distortions in the riskiness of the firm's investment policy. In other words, if all investments are illiquid, then the firm does not care about the riskiness of its investments, and simply allocates funds according to marginal productivities. Consequently, there is a complementarity effect between risk and liquidity induced by financing constraints. The firm is particularly prone to fine-tuning the riskiness of its liquid investment, as opposed to that of the illiquid ones. This positive interaction is a novel implication of the financing constraints framework we develop here.

2.3 Results

To demonstrate that our framework yields precise empirical implications about investment distortions under financing constraints, we make a mild parametric assumption regarding the function $g(.)$.

Assumption 1: $\frac{g'(x)}{g'(y)}$ is monotonically decreasing in the ratio $\frac{x}{y}$; i.e., the ratio between marginal productivities is monotonic in the ratio of investment levels.

This assumption is satisfied, for example, by a simple log production function $g(x) = \ln x$. The same applies to $g(x) = Ax^{\alpha}$, for $\alpha < 1$, which is a standard Cobb-Douglas functional form. We stress that our results should also hold under other parametric choices for $g(.)$. Depending on the complexity chosen, these other choices can produce countervailing effects; however, the first-order intuition we obtain is similar to what we discuss under Assumption 1.

We can now state a number of testable predictions:

Result 1: If future financing constraints are binding, the ratio between liquid and illiquid investments increases relative to a benchmark case in which future constraints are not binding:

$$\frac{I_{0R}^*}{I_0^*} > \frac{\widehat{I}_{0R}}{\widehat{I}_0} \text{ and } \frac{I_{0S}^*}{I_0^*} > \frac{\widehat{I}_{0S}}{\widehat{I}_0}. \tag{9}$$

Result 2: If future financing constraints are binding, the ratio between safe and risky investments increases relative to a benchmark case in which future constraints are not binding:

$$\frac{I_{0S}^*}{I_{0R}^*} > \frac{\widehat{I}_{0S}}{\widehat{I}_{0R}}. \tag{10}$$

Proof: Both results follow directly from Eqs. (7) and (8), and from Assumption 1.

Results 1 and 2 are implications about investment *ratios*. In this framework, it is possible to derive more interesting results about investment ratios than about investment levels. To see why, notice that it is possible that the constrained firm chooses to overinvest in both risky and safe investments ($I_{0R}^* > \widehat{I}_{0R}$ and $I_{0S}^* > \widehat{I}_{0S}$), because both increase the firm's date-1 liquidity. Alternatively, for other parameter values, the constrained firm can underinvest in safe and risky assets. However, Result 2 unambiguously shows that the ratio between safe and risky assets will be biased upwards relative to the first-best solution.

As we suggested, there is a complementarity effect between investment liquidity and risk for constrained firms. If $\lambda = 0$, implying that investments are completely illiquid, then the firm does not benefit from distorting the risk of its investment policy. For example, even though we assumed that the illiquid investment (I_0^*) is risk-free, the optimal choice of I_0^* would be independent of its riskiness. We can show a more complete characterization of this result:

Result 3: There is a threshold level of λ, $\overline{\lambda}$, such that for all $\lambda < \overline{\lambda}$ the optimal ratio between safe and risky investments increases with investment liquidity; that is, $\frac{\partial \frac{I_{0S}^*}{I_{0R}^*}}{\partial \lambda} > 0$.

Proof: Eq. (8) and Assumption 1 imply that $\frac{I_{0S}^*}{I_{0R}^*}$ is monotonically increasing in the following expression:

$$h(\lambda) = \frac{1 + (1-p)\lambda C_E(E_{1L}^*, k)}{\overline{c} + (1-p)c_L \lambda C_E(E_{1L}^*, k)}. \tag{11}$$

Differentiating $h(\lambda)$ with respect to λ we obtain:

$$sgn\left[h^{'}(\lambda)\right] = sgn\left[(\overline{c} - c_L)(C_E(E_{1L}^*, k) + \lambda \frac{dC_E(E_{1L}^*, k)}{d\lambda})\right]. \tag{12}$$

While the first term inside the brackets is positive, the second term can be negative since $\frac{dC_E(E_{1L}^*, k)}{d\lambda}$ can be lower than zero (an increase in liquidity decreases marginal costs of external funds). However, because the effect of the second term is proportional to the level of λ, it follows that for sufficiently low values of λ, one can guarantee that $h^{'}(\lambda) > 0$, which gives $\frac{\partial \frac{I_{0S}^*}{I_{0R}^*}}{\partial \lambda} > 0$.

Notice that the parameter λ captures the liquidity of the liquid investments with respect to the illiquid ones. In particular, we assume in this derivation that the change in λ is uncorrelated with the parameter k, which captures variables that change the firm's overall costs of external funds. In an international context, for example, the effect of laws that improve the protection of external investors would be captured by k. Of course, one issue with Result 3 is that λ and k might be correlated. For instance, better laws might help the firm collateralize future cash flows more easily (higher λ) as well as reduce the costs of external finance (lower k). In order to test Result 3, it is important to look for sources of variation in λ that are uncorrelated with k. For example, some firms might invest in more pledgeable assets because of the properties of their technology (e.g., they may invest more in buildings and machines as opposed to R&D and human capital). Result 3 would then say that such firms would be particularly likely to distort their investment choices towards safe investments.

Result 3 also helps one understand the risk choices of financial versus fixed investments. Financial investments such as cash, bonds, and stocks of other firms can be liquidated at any point, so in the context of our model can be thought to have a $\lambda = 1$. Result 3 would then suggest that if a constrained firm decides to invest in financial assets, it should also choose safe investments such as cash, as opposed to risky investments such as stocks. In contrast, the firm would care relatively less about the risk profile of its fixed capital investments (which are presumably less liquid).

Maintaining the assumption that k and λ are uncorrelated, we can also derive predictions regarding variation in k.

Result 4: The ratio between liquid and illiquid investments is increasing in k; that is, $\frac{I_{0R}^*}{I_0^*}$ and $\frac{I_{0S}^*}{I_0^*}$ increase with k.

Proof: Eq. (7) and Assumption 1 imply that $\frac{I_{0R}^*}{I_0^*}$ is monotonically increasing in the following expression:

$$\nu(k) = \frac{\overline{c} + (1-p)c_L \lambda C_E(E_{1L}^*, k)}{(1+\theta)}. \tag{13}$$

This expression increases with k if marginal costs of external finance increase with k; that is, $\frac{dC_E(E_{1L}^*,k)}{dk} > 0$. Notice that the first-order condition for I_{1L}^* implies that:

$$g^{''}(I_{1L}^*)\frac{\partial I_{1L}^*}{dk} = \frac{dC_E(E_{1L}^*, k)}{dk}. \tag{14}$$

Since $g^{''} < 0$, as long as optimal future investment decreases with external financing costs ($\frac{\partial I_{1L}^*}{dk} < 0$), we must have $\frac{dC_E(E_{1L}^*,k)}{dk} > 0$. The proof is similar for $\frac{I_{0S}^*}{I_0^*}$.

Result 4 is also straightforward. However, it is again important to focus on investment ratios to derive this implication. In particular, it is not necessarily the case that both I_{0R}^* and I_{0S}^* are increasing in k. An increase in k raises both current and future external financing costs. Thus, while higher future costs push towards higher liquid investments, higher current costs tend to reduce investment. Result 4 obtains because it pertains to the *ratio* between liquid and illiquid investments. Even when I_{0R}^* and I_{0S}^* decrease with k, Result 4 shows that they will decrease less than the illiquid investment, I_0^*.

We can show a similar result for the firm's risk choices.

Result 5: The ratio between safe and risky investments is increasing in k; that is, $\frac{I_{0S}^*}{I_{0R}^*}$ increases with k.

Proof: Eq. (8) and Assumption 1 imply that $\frac{I_{0S}^*}{I_{0R}^*}$ is monotonically increasing in the following expression:

$$h(k) = \frac{1 + (1-p)\lambda C_E(E_{1L}^*, k)}{\overline{c} + (1-p)c_L \lambda C_E(E_{1L}^*, k)}. \tag{15}$$

Differentiating $h(k)$ with respect to k we obtain:

$$sgn\left[h^{'}(k)\right] = sgn\left[(\overline{c} - c_L)\frac{dC_E(E_{1L}^*, k)}{dk})\right] > 0. \tag{16}$$

Once again, one potential caveat regarding Results 4 and 5 is that it may be hard to isolate sources of variation in k that do not affect λ. If the cost of external funds is higher, it should also be harder for firms to collateralize future cash flows, and thus λ should decrease. This effect could push towards the opposite direction to that emphasized in Results 4 and 5. For example, in the region in which $\lambda < \overline{\lambda}$, Result 3 suggests that a decrease in λ will push towards a decrease in $\frac{I_{0S}^*}{I_{0R}^*}$.

One way to separate variations in external finance costs, k, from liquidity, λ, is to focus on variations in the availability of internal funds, the parameter w_0. In the model, this parameter represents current cash flows from assets in place. As we show next, this cash flow affects the marginal costs of external finance through its effect on E_0^* and E_{1L}^*.

Result 6: An increase in w_0 decreases the ratio of liquid to illiquid investments, and also the ratio of safe to risky investments.

Proof: The first order condition for I_{1L}^* implies that:

$$g^{''}(I_{1L}^*)\frac{\partial I_{1L}^*}{dw_0} = \frac{dC_E(E_{1L}^*, k)}{dw_0} = C_{EE}\frac{dE_{1L}^*}{dw_0}. \tag{17}$$

As long as $\frac{\partial I_{1L}^*}{dw_0} > 0$ we have that $\frac{dC_E(E_{1L}^*,k)}{dw_0} < 0$. Suppose, instead, that we had $\frac{\partial I_{1L}^*}{dw_0} < 0$, such that $\frac{dC_E(E_{1L}^*,k)}{dw_0} > 0$. This would require $\frac{dE_{1L}^*}{dw_0} > 0$. The definition of E_{1L}^* would then imply that:

$$\frac{dE_{1L}^*}{dw_0} = \frac{\partial I_{1L}^*}{dw_0} - \lambda c_L g^{'}(I_{0R}^*)\frac{\partial I_{0R}^*}{dw_0} - \lambda g^{'}(I_{0S}^*)\frac{\partial I_{0S}^*}{dw_0} > 0 \tag{18}$$

However, since $\frac{\partial I_{1L}^*}{dw_0} < 0$, this would require current investment–cash flow sensitivities to be negative as well; that is, $\frac{\partial I_{0R}^*}{dw_0} < 0$ and/or $\frac{\partial I_{0S}^*}{dw_0} < 0$. This implies that any reasonable solution of the problem should have $\frac{dC_E(E_{1L}^*,k)}{dw_0} < 0$. It is then trivial to use this result to replicate the proofs of Results 4 and 5 for variations in w_0.[7]

The intuition for this result is as follows: An increase in w_0 relaxes current and future financing constraints, thereby mitigating the distortions towards safer and more liquid investments. In particular, higher w_0 increases current liquid investments, which in turn reduces future costs of external financing.

Testing this implication empirically is subject to the standard problem that observed cash flow might capture variations in investment opportunities. In particular, investment can increase with cash flows even if financial constraints are never binding (see, e.g., Gomes (2001) and Alti (2003)). However, that our focus on investment ratios proves to be helpful in these circumstances. Presumably, higher investment opportunities should increase *all* types of investment. Unless cash flow

[7] A more formal proof is available from the authors.

contains significantly more information about the marginal productivity of some particular types of investments (through some involved story), the sensitivity of the *ratio* of investments to cash flow will capture the effect of future financing constraints on current firm policies.

3 Model Extensions

In Section 2 we kept the complexity of our benchmark model to a minimum level. This allowed us to derive implications about the impact of future financing constraints on current investment decisions in a natural, general way. As we have suggested, our analysis not only contains new implications for future empirical testing, but also implies that various existing findings can be interpreted in a different light. In this section, we explore various extensions of our analysis as a way to facilitate our discussion of the literature. In particular, we consider extensions that address: the effect of financial constraints on capital budgeting decisions, how poor investor protection can lead to constraints and their impact on investment, leverage and its effect on constraints and investment, and how financial constraints can affect a firm's optimal cash policy.

3.1 Capital Budgeting Rules under Financial Constraints

Our model implies that capital budgeting becomes substantially more complex in the presence of financing constraints. We elaborate on this issue in this section, and argue that one central difficulty for capital budgeting in the real world lies in incorporating the effect of future financing costs into current investment decisions under standard valuation approaches such as the NPV rule.

The standard NPV rule can be represented in our model by the optimality conditions in the absence of current and future financing constraints:

$$\begin{aligned} (1+\theta)g'(I_0^{FB}) &= 1 \\ \bar{c}g'(I_{0R}^{FB}) &= 1 \\ g'(I_{0S}^{FB}) &= 1. \end{aligned} \tag{19}$$

The firm needs to decide on how much to invest in three different types of projects. In the absence of financing constraints, it invests in each project as long as the marginal productivity of each type of investment is higher than one (in our model the discount rate for unconstrained firms is equal to zero, given the assumptions of risk-neutrality and no time discounting).[8] Notice that in the absence of financing constraints the optimal amount of each investment can be determined independently of the decisions regarding the other investments. In other words, the hurdle rate is only a function of project characteristics, and is unaffected by firm-specific variables. In addition, this hurdle rate

[8] It is straightforward to relax Eq. (19) to take project systematic risk and time discounting into account.

can be correctly estimated by CAPM-based methods. These are the exact same capital budgeting considerations discussed in corporate finance textbooks (e.g., Brealey and Myers (2004)).

Introducing *current* financing constraints affects optimal capital budgeting by increasing the hurdle rate for marginal investments. As shown in Eq. (6), the firm must now compare the marginal productivities of investment with $1 + C_E(I_0 + I_{0S} + I_{0R} - w_0, k)$. The latter term reflects the fact that increasing investment beyond available internal funds entails deadweight costs. In particular, the hurdle rate is now a function of the amount of investment in each project and available internal funds, and thus contains a firm-specific component in addition to a project-specific one.

Even under these conditions it is still relatively straightforward to modify the NPV rule so as to take current constraints into account. To a first approximation, all that is required is a higher discount rate that reflects firm characteristics (i.e., how constrained the firm is, as measured by w_0 and k) and the amount of desired investment. While it might be difficult to estimate the exact size of the constraint adjustment, the entire exercise is not much more difficult than estimating the expected future cash flows of a risky project. For instance, the impact of some sources of deadweight external financing costs is quantifiable (e.g., flotation costs). The impact of other sources might be more difficult to measure. One example is the impact of pure capital rationing (Stiglitz and Weiss (1981)), which by its very nature is not reflected in market prices.[9] However, even in these situations the optimal capital budgeting rule can be approximated by an arbitrary rule of thumb containing an upward adjustment to the cost of capital estimated via standard CAPM methods.

The introduction of *future* financing constraints complicates the problem considerably. In order to see the issue, rewrite Eq. (6) as:

$$\begin{aligned}(1+\theta)g^{'}(I_0^*) &= 1 + C_E(E_0^*, k) \\ cg^{'}(I_{0R}^*) &= 1 + C_E(E_0^*, k) - (1-p)c_L\lambda C_E(E_{1L}^*, k)g^{'}(I_{0R}^*) \\ g^{'}(I_{0S}^*) &= 1 + C_E(E_0^*, k) - [1 + (1-p)\lambda C_E(E_{1L}^*, k)]\, g^{'}(I_{0S}^*).\end{aligned} \tag{20}$$

The optimal capital budgeting rule for the illiquid investment is still to use a higher discount rate that takes constraints into account. However, the hurdle rate for the liquid investments (both safe and risky) must take into account the impact of their future cash flows into future financing costs. For example, for the safe investment the hurdle rate is reduced by the term $[1 + (1-p)\lambda C_E(E_{1L}^*, k)]\, g^{'}(I_{0S}^*)$. This term, in turn, depends on future investment opportunities since $C_E(E_{1L}^*, k) = g^{'}(I_{1L}^*) - 1$. In a fully dynamic model, the value of future investments would also depend on how their cash flows correlate with other investment opportunities that lie even farther into the future. If we take this argument

[9] A rationed firm does not benefit from offering to pay a higher interest rate because that conveys negative information about the firm's type. Hence, asymmetric information cannot be compensated by a higher interest rate. See also Tirole (2005) for a similar argument in a moral hazard-based model.

to the limit, it follows that in order to make a decision about an investment today a firm must also forecast the value of *all* of its future investment opportunities. In other words, the correct discount rate for a firm that expects to face future financing costs is a function of the entire set of future investment opportunities that the firm expects to face. Unfortunately, it becomes quite hard to formulate a practical valuation rule capturing the effect of financing frictions on optimal investment decisions. In particular, the effective discount rate can be either higher or lower than the frictionless one.

How should a manager incorporate the effect of future financing costs into real world capital budgeting decisions? One interesting possibility is that the difficulties that we discussed above might help explain the widespread use of the payback method as a capital budgeting rule. It is important to explain what we mean by this statement. Of course, the correct way to solve our model is to maximize the NPV of all current and future investments subject to current and future financing costs (Eq. (1)). If managers had unbounded rationality and unlimited resources, they should be able to directly solve the program in (1). However, given the complexity of that problem in the face of financing constraints, it might make sense for managers to use a capital budgeting rule that captures in a heuristic way the fact that short-term, liquid projects should be valued more highly than long-term, illiquid ones.

3.2 Poor Investor Protection as a Source of Financial Constraints

The prior analysis has adopted a "reduced form" specification of financing costs, simply assuming that financing costs increase with the amount of capital raised an exogenous parameter that indexes the overall level of financing costs. This specification is sufficiently general so that it can apply in a number of different circumstances. Yet, one concern is that the underlying reasons for the financial constraints could somehow affect the distortions in investment we focus on.

To address this concern, we extend our basic model by explicitly modeling an underlying structure that creates a cost of external finance with the properties of the $C(E, k)$ function we use in Section 2. We do so in the context of one of the most commonly discussed reasons for costly external financing: weak legal protection. In particular, we show how poor investor protection can generate the external financing cost function $C(E, k)$ by solving a modified version of the Shleifer and Wolfenzon (2002) model that is similar to Almeida and Wolfenzon (2006).

Suppose that the date-1 investment in our model (I_1) is chosen by a controlling shareholder who owns the entire firm at that date. The controlling shareholder also has wealth equal to W, and has to raise cash from outside investors to help finance the date-1 investment. As in Shleifer and Wolfenzon, we assume that external finance takes the form of equity. Accordingly, the controlling shareholder ends up owning a fraction $(1 - \alpha)$ of the cash flows $g(I_1)$ that will be produced at date 2, while the remaining cash flows $\alpha g(I_1)$ are owned by minority shareholders.[10] After the investment level is chosen, the controlling shareholder can divert a fraction d of the cash flows. Hence, the firm produces $dg(I_1)$ in private benefits for the controlling shareholder, and $(1-d)g(I_1)$ in security benefits. We do not need to think of $dg(I_1)$ as stealing. More generally, the private benefits represent the fraction of the value that accrues only to the controlling shareholder.[11]

Also, as in Shleifer and Wolfenzon, we assume that the consumption of private benefits creates deadweight costs that are represented by $h(d,P)g(I_1)$. The function $h(d,P)$ is assumed to be increasing and convex in d, and the variable P represents the level of investor protection.[12] Shleifer and Wolfenzon model investor protection by assuming that higher investor protection increases the cost of diversion by the controlling shareholder ($h_P > 0$). To simplify the analysis, we adopt a parametric form for $h(d,P)$:

$$h(d,P) = P\frac{d^2}{2}. \tag{21}$$

Given the investment level and the ownership stake α, the controlling shareholder decides on the optimal amount of private benefits that he will consume by solving the following problem:

$$\max_{d\in[0,1]} \left((1-\alpha)(1-d) + d - P\frac{d^2}{2}\right) g(I_1). \tag{22}$$

This program produces the optimal diversion $d^*(\alpha,P) = \frac{\alpha}{P}$.[13]

Given the optimal diversion function $d^*(\alpha,P)$ that is expected to occur ex-post, the controlling shareholder chooses 1) how much to invest in the project, and 2) how much external funds to raise to maximize his ex-ante payoff. His maximization problem is constrained by the condition that minority shareholders must break even:

$$\begin{aligned} &\max_{\alpha,I_1} \left[(1-\alpha)(1-\frac{\alpha}{P}) + \frac{\alpha}{P} - \frac{\alpha^2}{2P}\right] g(I_1) \text{ s.t.} \qquad (23)\\ I_1 - W \;\; &\leq \;\; \alpha(1-\frac{\alpha}{P})g(I_1). \end{aligned}$$

If the constraint is binding, we can also write this program as:

$$\begin{aligned} &\max_{\alpha,I_1} g(I_1) - I_1 - \frac{\alpha^2}{2P}g(I_1) \text{ s.t.} \qquad (24)\\ I_1 - W \;\; &= \;\; \alpha(1-\frac{\alpha}{P})g(I_1). \end{aligned}$$

[10] We note, however, that the model can also accommodate debt finance that is constrained by protection of outside creditors. In that case, $\alpha g(I_1)$ should be interpreted as the total cash flows belonging to outside investors.

[11] For example, the controlling shareholder may derive private benefits from employing members of his family in the firm.

[12] For instance, employing the controlling shareholder's family might reduce total productivity. Notice that this formulation also assumes that the costs of private benefits are increasing in the size of the firm. It is assumed that the costs $h(d)g(I_1)$ are borne by the controlling shareholder, but this assumption is not crucial for the results.

[13] This assumes that $d^* < 1$. If $P < \alpha$, then $d^* = 1$.

The controlling shareholder maximizes the NPV of the investment net of diversion costs. Because diversion is priced at the time the controlling shareholder issues shares, the controlling shareholder would like to commit to zero diversion, if possible. To increase investment the manager might need to issue shares and raise external funds. As α increases, ex-post diversion will increase ($d_\alpha > 0$), generating external financing costs per unit of output of $\frac{\alpha^2}{2P}$.

The budget constraint creates a relation between the investment level I_1 and the minority ownership stake α, which we denote as $\alpha(I_1, P)$. The optimal investment level satisfies:

$$\max_{I_1} g(I_1) - I_1 - \frac{\alpha(I_1, P)^2}{2P} g(I_1). \tag{25}$$

This expression maps directly into the framework discussed in Section 2, with an external financing cost function equal to $C(I_1, P) = \frac{\alpha(I_1,P)^2}{2P} g(I_1)$. The properties of $C(I_1, P)$ depend on the function $\alpha(I_1, P)$. When the firm raises zero external finance ($I_1 - W < 0$), the controlling shareholder keeps $\alpha(I_1, P) = 0$. This implies that external financing costs are zero, and so $C(I_1, P) = 0$ for $I_1 < W$.

For $I_1 > W$, external financing costs are a function of I_1 and P. We can calculate $\alpha_{I_1}(I_1, P)$ as:

$$\alpha_{I_1}(I_1, P) = \frac{1 - \alpha(1 - \frac{\alpha}{P})g'(I_1)}{g(I_1)(1 - \frac{2\alpha}{P})}. \tag{26}$$

At the optimal solution I_0^* the numerator of (26) must be positive, or else the financial constraint could not be binding (it would be possible to relax the constraint by increasing investment). Similarly, Shleifer and Wolfenzon argue that at the optimum investment level, $\alpha_{I_1}(I_1, P) > 0$. Otherwise, the controlling shareholder could increase his payoff by increasing investment, which would raise his ownership stake and decrease diversion. This logic implies that the denominator of $\alpha_{I_1}(I_1, P)$ must also be positive. We can additionally calculate $\alpha_P(I_1, P)$ as:

$$\alpha_P(I_1, P) = -\frac{\alpha^2}{P^2 g(I_1)(1 - \frac{2\alpha}{P})}. \tag{27}$$

Since $g(I_1)(1 - \frac{2\alpha}{P}) > 0$, it follows that $\alpha_P(I_1, P)$ is negative.

We can now use the properties of $\alpha(I_1, P)$ to show that the cost function $C(I_1, P)$ satisfies the assumptions of Section 2 for $I_1 > W$:

$$C_{I_1} = \frac{\alpha^2 g'(I_1) + 2\alpha\alpha_{I_1} g(I_1)}{2P} > 0, \tag{28}$$

$$C_P = \frac{[2\alpha\alpha_P - \alpha^2] g(I_1)}{2P^2} < 0. \tag{29}$$

These expressions indicate that the costs of external financing increase with the level of investment that is subject to expropriation, and decline with the level of investment protection. It is also true that an increase in P (keeping I_1 constant) lowers marginal costs of external finance ($C_{I_1 P} < 0$).[14] Thus, the function $C(I_1, P)$ satisfies the assumptions made about $C(E, k)$ in Section 2.

[14] This holds generally, except for the (unlikely) case in which the cross-derivative $\alpha_{I_1 P}$ is substantially greater than 0.

3.3 Firm Leverage, Financial Distress, and Financial Constraints

Poor investor protection thus can lead to deadweight financing costs as described by the reduced form specification discussed in Section 2. Yet, poor investor protection is only one of a number of potential underlying sources of financial costs. Another possible source of financing constraints occurs when a levered firm enters financial distress. To put it in simple terms, a firm that faces a true cost of financial distress — a loss in firm value due to the inability to honor financial obligations; most prominently, to service/repay debt — is also financially constrained. We show next how distress costs can map into the reduced form specification of financing costs discussed above.

To introduce financial distress into our framework, suppose there are no new investments at date 1, but that the firm will enter financial distress if its total date-1 cash flow (including the payoffs from date-0 investments) is lower than a certain threshold $\overline{W}$. Even though we do not model leverage explicitly, the underlying intuition is that if internal resources fall below some minimum level $\overline{W}$ the firm will not be able to service its debt. While $\overline{W}$ is undoubtedly a function of past financing decisions, we assume for now that $\overline{W}$ is exogenously given. If financial distress occurs, the firm loses an amount equal to $\phi(\overline{W}-W)$, which we presume captures the deadweight costs of financial distress, including both direct and indirect costs. We assume that financial distress costs are increasing in the cash shortfall and contain a fixed component, so that $\phi^{'}(.) > 0$ and $\phi(0) > 0$. We also assume that the cash flow from assets in state H is higher than $\overline{W}$, implying that the firm is never in distress in state H. In this setting, avoiding financial distress can be thought of as a positive NPV investment that arrives in state L. Financial distress costs are then very similar to financial constraints, in that the firm foregoes a positive NPV project because of financing frictions.

We define $W_{1L}^{FB} = \lambda c_L g(I_{0R}^{FB}) + \lambda g(I_{0S}^{FB})$ as the state-L cash flow that the firm realizes if it follows its first-best investment policy. As long as $W_{1L}^{FB} > \overline{W}$, the firm does not distort its investment policy to reduce financial distress costs at date 1. However, if $W_{1L}^{FB} < \overline{W}$ the optimal investment will be determined by:

$$(1+\theta)g^{'}(I_0^*) = \left[\overline{c} + (1-p)c_L\lambda\phi^{'}(\overline{W} - W_{1L})\right] g^{'}(I_{0R}^*) = \left[1 + (1-p)\lambda\phi^{'}(\overline{W} - W_{1L})\right] g^{'}(I_{0S}^*), \quad (30)$$

where $W_{1L} = \lambda c_L g(I_{0R}) + \lambda g(I_{0S})$.[15] Eq. (30) implies that for a distressed firm, the optimal ratios of safe to risky, and of liquid to illiquid investments are higher than in a situation with zero distress costs. In addition, an increase in $\overline{W}$ (higher leverage) increases the ratios of safe to risky, and liquid to illiquid investments.[16] In fact, one can verify that this equation is very similar to Eq. (6) in the bench-

[15]Because of the fixed costs of financial distress ($\phi(0) > 0$), it is also possible that the optimal is at a corner solution where the firm distorts its investment policy to completely eliminate financial distress costs. The properties of this solution are similar to those of an interior solution and imply distortions towards safe and liquid investments.

[16]Strictly speaking, these comparative static results require the function $\phi(.)$ to be convex, so that marginal distress costs are increasing in the cash shortfall.

mark model, with external financing costs $C(.)$ replaced by $\phi(\overline{W} - W)$. Accordingly, one can view financial distress costs as a source of the external financing costs modeled in Section 2. In addition, the expected financing costs induced by higher leverage, as well as the associated costs from suboptimal investment occurring because of these financing costs, are indirect costs of financial distress.

Naturally, the firm can also adjust its leverage policy to reduce distress costs; that is, $\overline{W}$ should be endogenous. Because the additional investment distortions created by high leverage are costly for the firm, our model extension implies that the firm will have incentives to reduce leverage in order to avoid the frictions just described. In other words, while distress costs associated with leverage are not a necessary condition for our results on investment distortions, high leverage may aggravate those distortions. Accordingly, our model suggests that firms may well take into account those considerations when choosing their capital structure. Since prior research on capital structure has all but ignored the issue of capital markets imperfections (Lemmon and Zender (2004) and Faulkender and Petersen (2005) are exceptions in the empirical literature), our model may provide an explanation for why firms' leverage ratios seem too low to be explained by standard tradeoff theories that emphasize the costs of financial distress.

Importantly, a firm can be financially constrained without necessarily facing financial distress costs. To see this, consider a version of the model in Section 3.2 in which outside investor protection is so low that the firm cannot raise any external finance. In this case, there are no costs of financial distress, because leverage is zero. However, the firm faces the constraint that it cannot invest more than its internal funds. The firm's optimization problem reduces to:

$$\max_{I_{0S}, I_{0R}, I_0, I_{1L}} \bar{c}g(I_{0R}) - I_{0R} + g(I_{0S}) - I_{0S} + (1+\theta)g(I_0) - I_0 + (1-p)[g(I_{1L}) - I_{1L}] \text{ s.t.} \tag{31}$$

$$W_0 = I_{0R} + I_{0S} + I_0$$

$$I_{1L} = \lambda c_L g(I_{0R}) + \lambda g(I_{0S})$$

The solution to this problem will have the same properties as the basic solution in Section 2:

$$(1+\theta)g'(I_0^*) = \left[\bar{c} + (1-p)c_L\lambda\left(g'(I_{1L}^*) - 1\right)\right] g'(I_{0R}^*) = \left[1 + (1-p)\lambda\left(g'(I_{1L}^*) - 1\right)\right] g'(I_{0S}^*). \tag{32}$$

Liquid and safe investments help the firm increase I_{1L}^*, and this is valuable if $g'(I_{1L}^*) - 1 > 0$; that is, if the firm is constrained in state L in the future.

In the real world, both financial distress costs and "pure" financing constraints can be important. However, these phenomena need not be jointly observed. For example, notice that a large, highly-leveraged US firm might not be constrained in the sense of the Shleifer and Wolfenzon model. In particular, this firm may not be financially constrained in that it may very well find plenty of external funding for any profitable opportunity it faces in "normal times" (i.e., times at which it is not distressed).[17] This firm, however, may care about financial distress costs if those costs are potentially large. Consider, in contrast, a small firm in a low investor protection country. That firm cannot be truly distressed given its inability to raise substantial leverage. However, that constrained firm will certainly worry about the management of its internal funds, as future investments will have to rely on those funds.

3.4 Cash as a Safe Investment and the Cash Flow Sensitivity of Cash

Recent papers have studied the role played by cash in the optimal financial policy of financially constrained firms (see Almeida, Campello, and Weisbach (2004) and Acharya, Almeida, and Campello (2005)). These papers, however, do not consider the possibility that the firm can also use its real investments to manage liquidity intertemporally. In this section, we extend our model to show how cash savings behavior interacts with other liquid investments in the intertemporal optimization that we consider.

The firm's demand for cash is just a particular case of the safe investment I_{0S} that we considered in our general model. Cash has the particular property that its future payoff is linear in the amount held, where the return on cash reflects the market interest rate on safe investments and perhaps also costs of holding cash such as taxes and a liquidity premium.[18] We denote the firm's cash balance as S, and assume that its future payoff is equal to $(1-\tau)S$, where the parameter $\tau > 0$ captures the cost of carrying cash. If we replace I_{0S} with S in the model of Section 2, we obtain the first order condition for an interior solution for the optimal level of cash balances S^*:

$$(1-p)(1-\tau)C_E(E^*_{1L}, k) = C_E(E^*_0, k) + \tau. \tag{33}$$

The left-hand side of Eq. (33) is the marginal benefit of carrying cash for firms that are constrained in future periods occurring because cash reduces future marginal costs of external finance. The right-hand side of (33) represents the marginal cost of carrying cash, which reflects both current marginal costs of external financing and the carrying cost τ. Eq. (33) implies that the optimal cash balance, $S^* = 0$ for firms that do not expect to be constrained in future periods. In contrast, the constrained solution will generally imply a positive level of cash balances. Accordingly, Results 1 and 2 hold for investment in cash (i.e., savings): financially constrained firms should invest more in cash relative to other investments than unconstrained firms. The result also holds for the absolute levels of cash; that is, constrained firms should hold more cash in their balance sheets than unconstrained firms.

Importantly, the constrained firm has an alternative way of transferring resources across time in our model, which is to make real liquid investments (I_{0R}). However, cash has the advantage of being

[17] If the firm does not face profitable investment opportunities then it is, by definition, financially unconstrained.

[18] The results in Faulkender and Wang (2006) suggest that a dollar of cash is worth less than a dollar for firms that are financially unconstrained, consistent with a cost of carrying cash.

fully liquid and safe. In addition, increasing I_{0R} decreases its marginal productivity, so that beyond a certain level of investment the marginal productivity of I_{0R} will become even lower than that of cash, $(1-\tau)$. In equilibrium, the constrained firm balances all these considerations by setting:

$$\frac{g'(I_{0R}^*)}{(1-\tau)} = \frac{1+(1-p)C_E(E_{1L}^*, k)}{\bar{c}+(1-p)c_L\lambda C_E(E_{1L}^*, k)}. \tag{34}$$

One can think of $(1-\tau)$ as the marginal productivity of cash not including its future effect on financing costs, and of $1+(1-p)C_E(E_{1L}^*, k)$ as the marginal impact of a unit of cash (net of carrying costs) on future financing costs. Eq. (34) reflects the safety and liquidity of cash relative to I_R^* through the term $c_L\lambda < 1$. Similarly, I_0^* is given by:

$$\frac{g'(I_0^*)}{(1-\tau)} = \frac{1+(1-p)C_E(E_{1L}^*, k)}{(1+\theta)}. \tag{35}$$

One can verify from Eqs. (34) and (35) that as future marginal financing costs increase (higher C_E), the firm will decrease both I_{0R}^* and I_0^*. If $\frac{dC_E(E_{1L}^*, k)}{dk} > 0$ (as in Results 4 and 5), we obtain:

$$\frac{\partial I_{0R}^*}{\partial k} < 0 \text{ and } \frac{\partial I_0^*}{\partial k} < 0. \tag{36}$$

These results contrast with those of Section 2 in that in the general model we could only show that the *ratio* I_{0R}^*/I_{0S}^* was decreasing with k. These more precise results come from the linearity of cash's payoff. Notice that S^* does not appear on the left-hand side of Eq. (34). Hence, if the right-hand side increases with k, I_{0R}^* must fall.

Whether cash balances increase or decrease with k can be derived from Eq. (33). Higher k increases both current and future external financing costs (both sides of Eq. (33)). Accordingly, it is not obvious what should happen to the propensity to hold cash when k changes. However, the results in Eq. (36) make it more likely that cash balances will increase with external financing costs. To see why, note that Eq. (33) implies:

$$(1-p)(1-\tau)\left[C_{EE}(E_{1L}^*, k)\frac{dE_{1L}^*}{dk} + C_{Ek}(E_{1L}^*, k)\right] = C_{EE}(E_0^*, k)\frac{dE_0^*}{dk} + C_{Ek}(E_0^*, k). \tag{37}$$

The results in (36) imply that, for fixed S^*, $\frac{dE_{1L}^*}{dk}$ is positive, and $\frac{dE_0^*}{dk}$ is negative. A decline in I_{0R}^* increases future demand for external financing, because future cash flows from liquid (non-cash) investments are lower, while declines in both I_{0R}^* and I_0^* reduce current demand for external funds. Thus, future marginal costs of external finance increase with k (the left-hand side of (37)). Also, current marginal costs tend to decrease with k because $\frac{dE_0^*}{dk} < 0$ (the right-hand side of (37)). Unless the term $C_{Ek}(E_0^*, k)$ is very large, it should be the case that the demand for cash increases with k, such that $\frac{\partial S^*}{\partial k} > 0$. As we discuss in the next section, the empirical literature generally shows that cash holdings increase with proxies for financing constraints. Since S^* increases with k, and I_{0R}^* and I_0^* decrease with k, Results 4 and 5 also hold in this extension of the benchmark model.[19]

We also analyze the relation between current internal funds and the various types of investment we have considered in the general model. One can verify from Eqs. (34) and (35) that if an increase in internal funds w_0 relaxes future financing constraints, i.e., $\frac{dC_E(E_{1L}^*,k)}{dw_0} < 0$ (as in Result 6), we obtain:

$$\frac{\partial I_{0R}^*}{\partial w_0} > 0 \text{ and } \frac{\partial I_0^*}{\partial w_0} > 0. \tag{38}$$

The logic behind these results also comes from (36). Specifically, an increase in w_0 relaxes current and future financing constraints, allowing the firm to invest more aggressively in illiquid and risky assets. Eq. (33) also implies:

$$(1-p)(1-\tau)C_{EE}(E_{1L}^*,k)\frac{dE_{1L}^*}{dw_0} = C_{EE}(E_0^*,k)\frac{dE_0^*}{dw_0}. \tag{39}$$

An increase in w_0 reduces future demand for external financing by increasing I_{0R}^* ($\frac{dE_{1L}}{dw_0} < 0$). And an increase in I_{0R}^* and I_0^* also increases current demand for external funds. These effects push towards lower cash balances for the firm in equilibrium; that is, $\frac{dS^*}{dw_0} < 0$. However, w_0 also has the direct effect of relaxing current financial constraints (since E_0^* decreases with w_0). If this latter effect is strong enough, we can also obtain a positive effect of cash flows on cash demand; that is, $\frac{dS^*}{dw_0} > 0$.

This last result, $\frac{dS^*}{dw_0} > 0$, is similar to that emphasized in Almeida, Campello, and Weisbach (2004). The central difference between that model and the current one is that in Almeida et al., cash is assumed to be the only way the constrained firm can transfer funds across time ($I_{0R} = 0$). This assumption increases future demand for financing (cash is the only liquid investment available), and reduces current demand (since the firm does not need to allocate funds to I_{0R}). Accordingly, Almeida et al. always obtain $\frac{dS^*}{dw_0} > 0$.

The analysis here shows that in the presence of an alternative liquid investment that is less liquid and riskier than cash, Almeida et al.'s theoretical result can be reversed: the cash flow sensitivity of cash might be negative. Importantly, we note that there might still be other effects that push towards more positive or negative cash flow sensitivities of cash. For example, the variation in w_0 may contain information about future cash flows and investment opportunities. In fact, as discussed in Riddick and Whited (2006), a positive serial correlation between cash flows could reduce the constrained firm's propensity to save, since a positive cash flow shock would also increase future cash flows, relaxing future financing constraints. Clearly, however, if cash flows also contain information about future investment opportunities, then the demand for future external financing might increase with current cash flows, increasing the firm's propensity to save cash today. In a related study,

[19] Notice that the marginal choice between I_{0R}^* and I_0^* is unchanged in this model, so it is still the case that k increases I_{0R}^* relative to I_0^*, that is, I_{0R}^* will decrease less than I_0^* with an increase in k.

Acharya, Almeida, and Campello (2005) show that the cash flow sensitivity of cash may depend on the constrained firm's future hedging needs. If hedging needs are low, saving cash might be dominated by saving debt capacity, which reduces the cash flow sensitivity of cash. Ultimately, whether cash–cash flow sensitivities are positive or negative is an empirical matter. Section 4 provides a discussion of the available evidence.

4 Implications

We have presented a simple framework that shows how future expected financing costs can influence investment today. The model in Section 2 (and the extensions in Section 3) leads to a host of empirical predictions through propositions regarding investment choices and how they relate to financial constraints. In this section, we discuss various applications of our theory and the relevant empirical evidence. In addition, we point out to additional implications that can be tested in future empirical work. For ease of reference, our discussion is summarized in Table 1.

- **Capital Budgeting Rules**

Finance professors have always taught students to use the net present value rule for capital budgeting decisions. They often seem puzzled and surprised when discussing the reasons why so many firms still use the payback method. As discussed in Section 3.1, however, the use of payback can be rationalized as a way for managers to simplify a complex intertemporal capital budgeting problem, which would otherwise require managers to forecast the value of all future investment opportunities in order to make a decision about a single project today.[20]

A clear empirical prediction that comes from this analysis is that we expect financially constrained firms to be more likely to use payback for their capital budgeting decisions than financially unconstrained firms. The survey evidence of Graham and Harvey (2001) suggests that this pattern appears to hold in the data. These authors find that CFOs are more likely to use payback rather than NPV when their firms are smaller, do not pay dividends, have more growth opportunities, and are private. All of these characteristics are likely to be associated with a relatively high demand for and cost of external financing.

Nevertheless, we stress that even in the context of our model using payback is not strictly correct — in a purely theoretical sense, at least. Going forward, it would be interesting to verify, for example, whether a combination of the payback and the NPV rules can approximate the optimal

[20] An alternative explanation for the use of payback in capital budgeting has been developed by Harris and Raviv (1996, 1998). Their explanation differs from ours as it is based on information and incentive problems *inside* the firm, while ours depends on the firm's cost of external financing.

capital budgeting decisions predicted by an intertemporal model with financing constraints.[21] More generally, we believe that developing a better understanding of optimal capital budgeting rules under financing constraints and providing guidance for practitioners to implement them would be an excellent topic for future research.

- **Leverage and Risk-Shifting**

The extension in Section 3.3 suggests that high leverage can force firms to distort their investments in the directions suggested by our model. In particular, to the extent that leverage is (at least partly) exogenous, we expect highly leveraged firms to have a preference for safer investments, investments that produce cash flows sooner, and for investments that utilize assets that can be collateralized to help finance other investments.[22] We emphasize that the first prediction, the preference for safe investments by highly leveraged firms, is exactly the *opposite* of what comes from the classic Jensen and Meckling (1976) risk-shifting analysis. Hence, our model provides a plausible explanation for the lack of evidence for Jensen and Meckling's proposition.[23]

The preference for safe assets is consistent with the findings of a number of studies. Andrade and Kaplan (1998) examine a sample of firms undergoing financial distress following leveraged recapitalizations. Despite the fact that these firms are likely candidates for risk-shifting, Andrade and Kaplan find no evidence, even in their firm-by-firm analysis, that any of their sample firms take any actions that increase risk. Instead, consistent with our model, the distressed firms' investments tend to be safer ones, designed to increase the probability of firm survival.[24] Rauh (2006) considers how firms manage the assets in their pension fund and how pension fund management relates to firm-wide risk. He finds that as firms get into financial difficulties, their pension fund management becomes more conservative, the opposite of what the Jensen and Meckling arguments would imply, but consistent with the arguments in our model. His result is also consistent with the implication of our model that the preference for safer assets by constrained firms would be primarily in liquid assets.

[21] In a related fashion, McDonald (2000) examines whether rules of thumb such as the profitability index can approximate optimal capital budgeting decisions that stem from a real options framework.

[22] There is substantial evidence that leverage has a negative impact on investment *levels* (see, e.g., Lang, Ofek, and Stulz (1996) and Zingales (1998)). We emphasize, however, that these predictions pertain to distortions in the *types* of investments rather that their levels.

[23] One can also look at the existence (and enforcement) of covenants as a reason why there is little asset substitution in practice (see Nini, Smith, and Sufi (2006)). Covenants are often tied to cash flows (Sufi (2006)) and violating a covenant today may lead to having higher costs of external financing in the future. These intertemporal considerations about future financing costs and current investment decisions lead to the same dynamics we describe in our model: higher expected costs of external financing leads firms to choose safer, more liquid investment today.

[24] See also Maksimovic and Phillips (1998) for evidence on the efficiency of plant sales (disinvestment) by distressed firms. Khanna and Poulsen (1995) contrast the decisions of bankrupt firms with those of a matched sample of non-bankrupt firms. Based on stock market reactions to managerial actions (e.g., asset sales, personnel reductions, acquisitions), the authors conclude that managers of bankrupt firms make investment decisions that are very similar to those of non-bankrupt firms with respect to risk and efficiency.

Peyer and Shivdasani (2001) consider a sample of firms that have undergone leveraged recapitalizations. Consistent with our second prediction, these authors find that their sample firms tend to undertake investments that yield cash flows sooner, even though these investments do not appear to be as profitable as the ones they took prior to the recapitalization. Ahn, Denis, and Denis (2006) show that higher leverage causes conglomerates to curtail investment in non-core/high-Q segments, to the benefit of core/low-Q segments, indicating that higher financing frictions lead conglomerates to refocus on corporate survival at the expense of inefficient investment decisions.

Evidence from "involuntary changes" in leverage also provides results that are consistent with our theory. In the product markets literature, Chevalier and Scharfstein (1996), Campello (2003), and Campello and Fluck (2005) examine the pricing policies of leveraged firms during recessions. These studies find that the more leveraged firms increase markups (i.e., underinvest in market share building) by more than their unleveraged industry rivals during the onset of recessions. In addition, they do so in a way consistent with an attempt to boost cash flows in the short term at the expense of long-term profits.

We do not know of any studies that examine the liquidity of the assets used in investments by firms undergoing large changes in leverage; studying such changes would be a useful topic for future research. Whenever firms can substitute into investments with varying degrees of liquidity, our model suggests that we should observe "liquidity-shifting" into more tangible assets when firms begin to face financial constraints. In addition, one prediction of our model is that financing constraints should have a higher effect on the risk profile of the firm's liquid investments than on its illiquid ones. Thus, to the extent that risk-shifting does occur, we expect to observe it more with a firm's real (illiquid) assets than with its financial (liquid) ones.

- **Capital Structure Choices**

One of the most commonly discussed and taught theories of capital structure is that a firm adjusts its capital structure over time to maintain (or to be near) a prespecified "target," determined by the tradeoff between taxes and bankruptcy costs. But a puzzle for this theory is that firms in the real world appear to be setting their targets too low. Graham (2000), for example, argues that most firms could add substantial leverage and reap the corresponding tax benefits of debt without noticeably increasing distress costs.

Our model extension in Section 3.3 identifies an additional cost of financial leverage: the potential impact of high leverage on future financing costs might cause today's real investments to be distorted away from their first-best levels. As we explain in Section 3.3, this investment policy distortion can be viewed as an indirect cost of distress, albeit one that has been less emphasized by the academic literature. While it is hard to quantify the magnitude of this effect, the expected value losses from distorted investment could be one factor leading firms to set their target debt ratio lower than one might otherwise expect.[25]

Our arguments also suggest that in addition to tax shields and pure bankruptcy costs, managers will be concerned with the ability to secure additional financing when deciding on capital structures. Anecdotal evidence is certainly consistent with this argument. For example, in the Graham and Harvey (2001) survey, "financial flexibility," presumably referring the ability to fund future investment at a fair cost, was cited by 59% of CFOs as an important determinant of leverage levels — the single most commonly cited determinant of leverage in the survey (see also Bancel and Mittoo (2002)). Richard Passov, the treasurer of Pfizer, argues in Passov (2003) that, because of the high value they place on future R&D expenditures, technology and life science companies carry very little (or even "negative") debt in their balance sheets. Supporting this argument, Bates, Khale, and Stulz (2006) document that the increase in R&D expenditures in recent years is associated with a massive decline in 'net leverage' (debt minus cash) ratios among industrial firms: from 1980 to 2004, the average net leverage ratio of industrial firms plummeted from 16% to –1%.

- **Cash Management**

Another important financial decision for managers is how liquid a balance sheet their firms should have. This was the context in which Keynes (1936) proposed his original argument, and this idea has been further extended by Almeida, Campello, and Weisbach (2004). The decision to hold cash is, at its core, an investment decision. A firm could otherwise invest the money in physical or alternative financial investments, or pay it out to shareholders.

The analysis in Section 3.4 shows how a constrained firm should distort its cash and investment policies to mitigate future financing constraints. In particular, when firms are anticipating tighter financing constraints in the future, they should hold more cash today. This prediction is consistent with available evidence (see, e.g., Almeida, Campello, and Weisbach (2004), Han and Qiu (2006), Faulkender and Wang (2006), and Riddick and Whited (2006)).

Following Almeida, Campello, and Weisbach (2004), recent literature has also focused on the "cash flow sensitivity of cash," namely the propensity to save cash out of a marginal dollar of cash flow. In contrast to Almeida et al., the analysis in Section 3.4 shows that in general the cash flow sensitivity of cash can be positive or negative. The difference in results is explained by Almeida et al.'s assumption that holding cash is the only way to transfer resources across time; put differently, that all fixed investments are illiquid. Under the more general set up that we consider in this study,

[25] We note that there are other explanations for debt conservatism (see, e.g., Hennessy and Whited (2005)).

it follows that whether constrained firms disproportionately save or spend their marginal cash flows becomes an empirical question.

Almeida et al. consider a number of measures of credit constraints, and estimate the sensitivity of cash holdings to incremental cash flow. They find that the cash flow sensitivity of cash is noticeably higher for the firms classified as financially constrained than for those classified as unconstrained.[26] Sufi (2006) uses data that allow him to further refine the financial constraint proxies used in Almeida et al. Looking at information on whether a firm has access to an unused line of credit, Sufi finds that constrained firms that do not have access to a line of credit are more likely to save cash out of cash flows. Acharya, Almeida, and Campello (2005) find that the cash flow sensitivity of cash depends on constrained firms' hedging needs. If hedging needs are high (that is, if future cash flows and investment opportunities are not highly correlated), then constrained firms tend to save cash out of cash flows. However, if hedging needs are low, cash–cash flow sensitivities become insignificant. In contrast, Riddick and Whited (2006) use a different empirical methodology to estimate cash flow sensitivities of cash and find that such sensitivities are often negative.

Besides the direct evidence on the level of cash holdings and on cash flow sensitivities of cash, there is also other evidence suggesting that the concern about future financing ability is an important determinant of firms' cash policies. Using Almeida et al.'s measures, Faulkender and Wang (2006) show that the value of the cash increases with the degree of financing constraints a firm faces (see also Sibilkov (2005)). Han and Qiu (2006) use those same measures of financing constraints to show that constrained firms' cash savings increase with the volatility of their cash flows. Thus, constrained firms appear to use cash holdings to counteract the riskiness of their cash flows.[27]

• **Hedging Policy**

When a firm hedges its cash flows, it is essentially taking a series of investments that alter its cash flow distribution. Froot, Scharfstein, and Stein (1993) argue that one reason why firms hedge is to better align their cash flows with their investment opportunities, and to minimize the deadweight costs associated with future financing needs.[28] To a degree, our model is a generalization of Froot et al.[29] In particular, one can think of the constrained firm's preference for safer investments as a hedging-like strategy.

[26] A number of recent papers have reported similar results using international data. See Ferreira and Vilela (2004) for Continental Europe; Nguyen (2005) for Japan; Chang, Tan, and Wong (2005) for Australia; Costa and Paz (2005) for Brazil; Marchica (2006) for the UK; and Saddour (2006) for France.

[27] Opler, Pinkowitz, Stulz, and Williamson (1999) also report a positive relationship between volatility and cash holdings. However, they do not examine the mediating role of financing constraints.

[28] Mello and Parsons (2000) propose an alternative model of the relation between financial constraints and optimal hedging strategies, while Smith and Stulz (1985) argue that financial distress creates incentives for hedging.

[29] Indeed, our work was motivated in part by thinking about the Froot et al. original analysis.

One important difference between our paper and Froot et al. is that they focus their discussion on the use of financial derivatives and options. In fact, there seems to be a strong theoretical justification for this choice. Barring transaction costs, a financial derivative such as futures contracts can be thought of as a zero NPV investment that transfers funds across future states of the world. In contrast, the investment distortions that we discuss in this paper can have real costs for a firm that pursues them. Following the Froot et al. argument, the empirical hedging literature has attempted to characterize the use of similar kinds of financial instruments (futures, forwards, etc.).[30] However, the bulk of the evidence suggests that, contrary to the intuition of Froot et al., the use of financial derivatives is concentrated in large (likely unconstrained) companies. As a result, the link between future financial constraints and hedging remains somewhat controversial.

We believe that a potential advantage of our argument is precisely that we *do not* focus on financial derivatives. In practice, the effectiveness of derivatives might be hampered by the difficulty of securitizing cash flows that are not contingent on easily verifiable variables, such as commodity prices and currency exchange rates.[31] These limits to securitization should be particularly stringent on firms that face deadweight costs of issuing more standard securities such as debt (i.e., potentially constrained firms). This argument might explain why, in practice, firms use alternative means of hedging that involve both financial and operating strategies (see Petersen and Thiagarajan (2000)). It might also explain why the literature has struggled to find evidence for a link between hedging and financial constraints. In particular, while the investment distortions that we discuss in this paper entail true NPV costs, they might be more easily implementable, hence they may be a more relevant hedging tool than futures and forwards for constrained firms.

This discussion also suggests that the investment distortions that we describe would be less likely to obtain for firms that can more easily use financial derivatives to hedge future cash flows. An implication of our argument is that increases in the use of derivatives contracts written on the firm's operating cash flows should be associated with a decline in investments that are safer and liquid relative to riskier and potentially more profitable ones. While the use of financial derivatives is a choice variable for the firm, financial innovation processes could be used as a source of exogenous variation in the supply of derivatives that are associated with corporate cash flows. We are not aware

[30] Papers with evidence that speak to the link between financial constraints and hedging include Nance, Smith, and Smithson (1993), Mian (1996), Géczy, Minton, and Schrand (1997), Gay and Nam (1998), and Guay (1999).

[31] Froot and Stein (1998) make a similar point, in the context of a model in which financial institutions cannot frictionlessly hedge all risks of its positions in the capital markets. They analyze capital structure and capital budgeting choices of financial institutions that face costly external finance and limited hedging. Besides the specific focus on financial institutions, one important difference between our paper and Froot and Stein is that they analyze only one dimension of capital budgeting distortions, namely, distortions in the risk of real investments. Additional examples of hedging papers that did not focus only on financial derivatives are Vickery (2004), who analyzes the maturity structure of corporate debt, and Acharya, Almeida, and Campello (2005), who analyze the choice between cash and debt capacity. Both papers report evidence that is consistent with a link between hedging and financial constraints. See also Faulkender (2005).

of any empirical evidence that speaks directly to interplay between real and financial hedging in the presence of financing constraints.[32]

• **Cross-Country Comparisons**

There is substantial evidence that in many countries the financial system does an imperfect job of allocating capital across the economy's investment opportunities (see Levine (2005) and Demirgüç-Kunt and Levine (2001) for recent surveys). These capital allocation frictions arise partly from costly external financing. For example, in environments with poor investor protection (La Porta, Lopez de Silanes, Shleifer, and Vishny (1998)), firms may not be able to fully undertake their investment opportunities due to the high costs associated with external funding by minority investors (see Shleifer and Wolfenzon (2002)).

In Section 3.2, we built on Shleifer and Wolfenzon (2002) to show how the level of investor protection can be a source of external financing costs. Given the well-documented cross-country differences in institutional environments related to investor protection and international differences in the costs of external finance, our model predicts that we should observe different types of investments across different countries. In countries where costs of raising external finance are high, we should observe a stronger preference for shorter-term, safer investments that use more liquid assets (such as cash), relative to countries with low costs of external finance. The findings of Dittmar, Mahrt-Smith, and Servaes (2003) are consistent with these predictions. These authors show that firms in countries with poor shareholder protection — thus high cost of external finance — hold substantially more cash than otherwise similar firms in high shareholder protection countries. In addition, Khurana, Pereira, and Martin (2006) show that the cash flow sensitivity of cash decreases with the degree of financial development, indicating that firms are more concerned with cash management if the level of financial development is low.[33]

There is also substantial evidence that firms try to increase the pledgeability of their assets as a response to financial market underdevelopment. Demirgüç-Kunt and Maksimovic (1999) find that firms in developing countries have higher proportions of fixed assets to total assets and use less intangible assets than firms in developed countries. Carlin and Mayer (2003) show that the structure of countries' financial systems has a stronger effect on R&D expenditures than in fixed capital. As

[32] Opler, Pinkowitz, Stulz, and Williamson (1999) report results suggesting that cash holdings decrease with observed derivatives usage. However, they do not attempt to measure exogenous shifts in the supply of derivatives nor look at implications for real corporate investment.

[33] At the same time, Kalcheva and Lins (2005) and Pinkowitz, Stulz, and Williamson (2006) argue that because poor investor protection is associated with more severe agency costs of managerial entrenchment, higher cash balances may also intensify overinvestment by entrenched managers. Specifically, they report evidence suggesting that a dollar of liquid assets is valued at less than a dollar in countries with poor investor protection, and that this discount is even greater in firms that show large separation between cash flow and control rights. Thus, further research is required to establish the optimality of cash balances for firms in poor investor protection countries.

emphasized by Rajan and Zingales (2001), this finding is consistent with the idea that fixed assets create pledgeable collateral, which is more valuable when financial markets are underdeveloped. Claessens and Laeven (2003) find that sectors that use intangible assets grow faster in countries with more secure property rights, again consistent with the idea that tangible (pledgeable) assets are relatively more valuable than intangible assets when external financing costs are higher. Finally, Braun (2003) shows that in countries with poorly developed financial systems, industrial composition is skewed towards industries with tangible assets. In addition, the impact of underdevelopment on industry growth is greater if the industry is more dependent on external finance. The evidence in all of these papers supports the notion that high financing costs distort the types of investments firms make toward more pledgeable assets, that can be used to secure financing for future investments.

The literature has paid less attention to the effect of poor investor protection on corporate risk-taking. Yet, the available evidence is also consistent with the implications of our model. Specifically, John, Litov, and Yeung (2005) report cross-country evidence that suggest that risk-taking is positively associated with the degree of investor protection. More research is required to confirm the link between financial market underdevelopment and corporate risk-taking.

- **Real Effects of Financial Development**

Our theory posits that when financing costs are high, firms might be willing to sacrifice profits at the margin in exchange for more pledgeable assets and less risky, shorter-term cash flow distributions that can be used to finance subsequent investments. Taken to the context of financial development, our theory implies that as a country develops financially, its companies will be less likely to sacrifice profits to facilitate future financing, and we should observe changes in the nature of their investments, as well as an increase in their ultimate profitability.

This prediction is consistent with much of the recent literature in international finance indicating that financial development lowers the cost of external funding and leads to higher investment and growth (see, e.g., King and Levine (1993), Levine and Servos (1998), Rajan and Zingales (1998), and Demirgüç-Kunt and Maksimovic (1998)). Our argument suggests that financial development will affect not only the level of investment, but also its quality. Consistent with this argument, Beck, Levine, and Loyaza (2000) find that financial intermediary development affects growth mostly through its effect on productivity growth and technological change. In addition, Wurgler (2000) suggests a strong link between financial development and investment efficiency across countries.

Clearly, there are other explanations for why financial development has specially large effects on the productivity of investment. For example, developed financial systems might do a better job at generating information about investment projects, improving the flow of capital across firms. Future research should attempt to understand the relative importance of these alternative channels, and thereby quantify the magnitude of investment distortions inside firms for economic growth and welfare.

5 Conclusion

The vast majority of managers in the U.S. and Europe list "financial flexibility" as the most important goal of their firms' financial policies (see, e.g., Graham and Harvey (2001) and Bancel and Mittoo (2002)). More generally, managers' stated policies are consistent with the idea of ensuring funding for present and future investment undertakings in a world where contracting and information frictions often force firms to pass up profitable opportunities. A consequence of these frictions is that they affect the marginal costs and benefits of various projects depending on *both* the firm's financial position and on the project's ability to help the firm finance future investments. We develop this idea in a formal model and discuss numerous implications. The key insight of the model is that future financing constraints lead firms to prefer investments with shorter payback periods, investments with less risk, and investments that utilize more liquid/pledgeable assets. These characteristics of investment are valuable because they help relax future financing constraints.

Our model has implications for a number of areas of corporate finance. It suggests that, in contrast to the commonly-discussed risk-shifting arguments, firms should take *safer* rather than riskier projects as they becomes more leveraged. This implication is in line with the empirical literature that finds that firms tend to focus on projects that generate quicker, more certain cash flows when leverage increases. Contrary to the usual arguments about capital budgeting, our analysis shows that the value of a project depends not only on the project's cash flows, but also on how these cash flows interact with the firm's financial position. It provides an explanation for the popularity of capital budgeting methods such as payback, which places a large weight on the timing of cash flows. In addition, our model suggests that high costs of external financing in a particular country will affect not only the quantity of investment, but also the kind of investments that firms make. In countries with high costs of external financing, we expect firms to focus on shorter-term, safer investments and ignore longer-term, potentially more profitable ones. In addition, when a country develops its financial system, we should observe an increase in not only the quantity of investment, but a change to more long-term, risky investments, that ultimately are likely to prove more profitable.

Much of what we know about corporate finance has been developed under the assumption that firms can access capital markets costlessly. As we show in this paper, when this assumption is relaxed, firms will distort their investments in predictable ways. This leads to a host of implications that may help explain and reconcile empirical findings in different areas of corporate finance.

As Modigliani and Miller (1958) show in their celebrated paper, corporate finance is interesting only to the extent that financing frictions of one form or another are present. Managers not only react to financing frictions when they occur, but they also anticipate future frictions and adjust their firms' policies so that the impact of these frictions is minimized. We have discussed a number of margins on which managers can make these adjustments. Undoubtedly, our stylized model understates the extent to which this type of behavior occurs. Further research into the nature of these adjustments will likely lead to a more thorough understanding of corporate financial decisions.

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Table 1: Summary of Model's Implications and Relevant Empirical Evidence

Topic	***Empirical Implications***	***Relevant Empirical Studies***
Capital Budgeting (General)	Investment distortion towards liquid assets is highest if liquid assets are safer (complementarity between safety and liquidity)	Untested
Capital Budgeting (Valuation Rules)	Constrained firms are more likely to use heuristic rules that place higher weight on earlier cash flows (e.g., payback)	Graham/Harvey (2001)
Leverage and Risk	Highly levered firms should take safer, and *not* riskier investments	Andrade/Kaplan (1998), Rauh (2006)
	Asset substitution more likely to be observed in illiquid assets	Untested
Leverage and Investment Liquidity	Highly levered firms should invest in more liquid/tangible assets, and in assets that produce shorter-term cash flows	Peyer/Shivdasani (2001), Ahn/Denis/Denis (2006), Chevalier/Scharfstein (1996), Campello/Fluck (2005)
Leverage Levels	Lower leverage than traditional tradeoff model predicts	Graham (2000)
Cash Management	Constrained firms hold more cash	Almeida/Campello/Weisbach (2004), Han/Qiu (2006), Riddick/Whited (2006)
	Difference between constrained and unconstrained firms in cash flow sensitivity of cash	Almeida/Campello/Weisbach (2004), Acharya/Almeida/Campello (2005), Riddick/Whited (2006), numerous int'l studies
	Cash management more valuable for constrained firms	Faulkender/Wang (2006), Sibilkov (2005)
Hedging	Constrained firms should use real investments to hedge, particularly when derivatives are not available	Untested
Cross-Country Comparisons	More liquid investments in countries with high costs of external financing	Dittmar/Mahrt-Smith/Servaes (2003), Khurana/Pereira/Martin (2006)
	More tangible investments in countries with high costs of external financing	Demirguc-Kunt/Maksimovic (1999), Carlin/Mayer (2003), Claessens/Laeven (2003)
	Safer investments in countries with high costs of external financing	John/Litov/Yeung (2005)
Real Effects of Financial Development	Strong link between financial development and investment efficiency	Beck/Levine/Loyaza (2000), Wurgler (2000)