

# Agency Costs, Information, and the Structure of Corporate Debt Covenants

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## Abstract

We analyze the determinants of covenant structure in private debt contracts. While previous studies have demonstrated a relationship between firm characteristics and the overall strictness of loan contracts, few studies have examined why covenants are written on a range of accounting variables and what determines their selective use. Using a simple model of firm investment where firms face uncertain cash flows and investment opportunities, we characterize the conditions under which it is optimal for a debt contract to specify a restriction on investment or to specify a minimum cash flow realization. Consistent with this model, we find that the application of covenants based on these variables is not necessarily monotonic in firm risk. While the financially riskiest firms tend to employ capital expenditure covenants, cash flow and net worth covenants are most common among moderately risky firms with greater profitability and firms with stronger banking relationships. The results also highlight the importance of debt covenants in both mitigating agency frictions and maximizing the value of future private information.

## 1 Introduction

Since the work of Smith and Warner (1979), researchers have recognized the critical influence of debt covenants in determining and shaping the cost of financial contracting. Debt covenants play a major role in mitigating the agency problems inherent in corporate finance by providing explicit restrictions on firm actions and by providing contractual rights to ex-post intervention on the part of the financier. The existence of these covenants is seen as evidence for the importance of agency conflicts, in particular those conflicts generated by risk-shifting incentives described in Jensen and Meckling (1976). The implied cost of these contracting provisions, as documented by recent studies such as Chava and Roberts (2008) and Roberts and Sufi (2009), is seen in turn as evidence of the costliness of external finance. A growing body of empirical research has begun to verify these

ideas by estimating the determinants of covenant assignment and by demonstrating the relationship between agency frictions and the overall strictness of debt contracts.

While a number of theoretical and empirical studies have examined the determinants of covenant strictness, few studies have examined the motivation behind the choice *between* various covenants. Firms appear to exhibit specific preferences in the selection of one covenant over another based on their characteristics and capital structure, and little research has been done to understand these differences. This study examines how basic agency problems create tradeoffs in the selection of three different types of covenants: dividend restrictions, investment restrictions, and cash flow maintenance covenants.

We develop a model of covenant choice that highlights the tradeoff between the choice of covenants. We argue that investment covenants, which cap ongoing investment expenditure, serve to restrain firms who are likely to have significant risk shifting incentives due to low intermediate cash flows. Investment restrictions are costly because firms lose the ability to make use of new information about the value of investment that arrives over the life of a loan. The use of a cash flow covenant instead of an investment covenant serves to mitigate this problem by transferring control to the lender only when risk-shifting is most likely to lead to inefficient investment. Conversely, a cash flow covenant allows the firm to fully control its investment decision via internally generated funds when risk shifting incentives are low.

We show how the value of investment covenants relative to cash flow covenants changes with variation in firm quality, information quality, and informational asymmetry. The model predicts that investment covenants will be most valuable for the lowest quality firms while the use of cash flow covenants is non-monotonic in firm quality. The model further predicts that cash flow covenants will become more valuable when lenders are more symmetrically informed about the value of the firm's investments. Empirically, we find evidence to support these predictions as investment restrictions are most common for the lowest quality firms. By contrast, the occurrence cash flow covenants decreases for both the highest and lowest quality firms and is more common among firms with higher growth opportunities. In addition, repeated banking relationships increase the likelihood

of a cash flow covenant, suggesting that better bank monitoring may make such covenants more valuable.

Our model starts with the basic premise that a firm investing in long-term projects faces uncertainty about both future cash flows and the value of future investment opportunities. Firms learn about the value of future reinvestment through the process of operating their business, but this information cannot be fully observed by the outside market. This information asymmetry, which develops after the initial project begins, makes it preferable to secure financing which does not have to be renegotiated or rolled over prior to the reinvestment decision. Such a contract allows the firm to make its reinvestment decision with internal cash flows by not requiring full repayment until the final payout from the project. This allows the firm to make full use of private information as it accrues.

Agency frictions, in the presence of new information about the value of reinvestment, make it difficult to efficiently contract on the optimal level of future reinvestment. As suggested by Myers (1977), dividend restrictions are often necessary to prevent the firm from paying out cash flows to shareholders when the value of reinvestment is revealed to be low and debt levels are high.<sup>1</sup> While dividend payout restrictions provide a well defined way to prevent shareholders from directly expropriating the firm's cash, the firm still has the ability to expropriate value from the debt holders through its ongoing investment policy. When the firm faces a high probability of bankruptcy and the outcome of follow-on investment is risky, it will have an incentive to over-invest its internal cash flows. What remains is a trade-off between the positive value of giving the firm discretion to use its private information about the value of new investment and the value destruction caused by the firm's incentive to over-invest. This trade-off gives rise to the selective use of two different classes of covenants: explicit restrictions on the level of future investment and maintenance covenants specifying minimum cash flow to debt ratios.

The accuracy new information and the severity of the firm's risk-shifting incentive determines whether it is optimal to restrict total investment ex-ante through investment covenants or to create

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<sup>1</sup>The importance and relative ease of implementation is supported by the fact that dividend restrictions are very common in debt agreements. In a sample of 3,500 private credit agreements, Nini et al. (2009) find that over 80% of the loan agreements contain a dividend restriction, by far the most common covenant present.

an ex-post trigger, conditional on low future cash flow realizations, which will allow the lender to dictate the investment decision. First, the contract may specify an investment restriction, which caps future investment. This is equivalent to including an intermediate interest payment since such a payment will reduce the cash available for future investment. However, since this provision must be specified in advance when both parties are uninformed, it also reduces the value of the firm's future private information by constraining the firm's choice set. For this reason, it is only optimal to impose such a restriction when the risk of eventual default is high and the value of information is low.

If the lender is able to verify the firm's private information through active monitoring, it may become optimal to give the lender discretion over the firm's investment policy ex-post rather than specifying an investment restriction (or intermediate repayment) ex-ante. The lender holds a concave claim on the firm's assets and would choose to under-invest when it makes the reinvestment decision, especially if the firm is relatively safe. Because this distortion is greatest when cash flows are high, it becomes optimal to give this discretion to the lender only when cash flows are low.

Crucial to our model is the interpretation of the role of covenant violation as a transfer of control. We interpret this control transfer as a function of the threat point implied by technical default from covenant violation. If the debt is a short term facility which has come due and the firm has insufficient funds to fully repay the promised payment, the lender can credibly threaten the firm with liquidation. The threat to declare the firm insolvent is credible because a bankruptcy court cannot force a lender to make a further investment. However, when such investment funds are already committed, such a threat is no longer credible if the firm's equity is still valuable under the existing contract. Thus, the threat point is one in which the lender demands full or partial repayment under the existing contract. In this case, the lender will demand repayment so as to leave the firm with enough funds to make the lender's preferred investment.

Under an optimal control transfer mechanism, when cash flows are high and the firm's risk-shifting incentives are low, the firm retains full access to its internal cash flows and can invest or repay according to its private information. When cash flows are low, the investment decision

transfers to the bank, whose incentive to under invest is consequently low. This provision is only valuable when the lender is sufficiently informed and the firm's expected future cash flows are not consistently high or low relative to the final debt repayment. If the cash flows are consistently high and the bankruptcy risk is always low, it is never optimal to give control to the bank. If bankruptcy risk is high regardless of interim cash flows, it is optimal to always give the bank control or simply to restrict allowable investment ex-ante to avoid hold-up.

Empirically, we document that the use of investment restrictions is monotonically increasing in financial risk. By contrast, maintenance covenants specifying minimum cash flows as a function of debt are less common among firms with the highest and lowest levels of financial risk. We also show that cash flow covenants are more likely to be included for firms which have borrowed from the same bank in the last five years while investment restrictions are less likely. This suggests that repeat borrowing and greater informational transparency makes these covenants more valuable. Rather than substituting for these direct contracting restrictions, increased monitoring and information acts as a complement by making these covenants more valuable.

Several studies have sought to explain empirically what drives the use of debt covenants, but most studies either examine a particular provision in isolation or tend to describe the overall strictness of contracts in a uniform way. Bradley and Roberts (2004) for instance finds documents greater covenant inclusion among firms with greater leverage, lower asset tangibility, and higher cash flow volatility, while Nini et al. (2009) document how poorly performing firms are more likely to take on investment covenants. Billett et al. (2007) finds that overall covenant protection is increasing in growth opportunities, and that the negative relationship between leverage and growth opportunities is attenuated by greater covenant protection. By contrast, this study seeks to highlight the large differences in how and why various types of accounting covenants are applied and to explain how firms weigh the costs and benefits of each.

In addition to examining claim holder agency conflicts, our paper builds upon literature on asymmetric information and maturity. Myers and Majluf (1984), Flannery (1986), and Goswami et al. (1995), for example, study the importance of asymmetric information in determining the type

and maturity of funding. We extend these ideas by examining the ex-post tradeoffs created from a desire to fund projects internally. Our paper also relates to the work on the value of internally generate cash flows and investment opportunities by Froot et al. (1993) and Acharya et al. (2007). Our paper seeks to highlight how the desire to retain internally generated cash flows interacts with the agency conflicts described by Jensen and Meckling (1976). In doing so, we illustrate how the structure of financial claims influences the ability of firms to manage this process.

Finally, in examining the role of covenants in shaping the value of information, our paper is related to recent work by Gârleanu and Zwiebel (2009). They present a model of covenant selection as a way of mitigating over-investment in the face ex-ante asymmetric information. However, our model differs significantly in its approach. Gârleanu and Zwiebel (2009) model covenants as an ex-ante screening device which allows lenders to incorporate ex-post information into the screening mechanism. In our model, there is no asymmetric information at the time the contract is initiated, and information acquisition occurs by both the borrower and lender ex-post. In doing so, we attempt to explain firm's stated preference for investment flexibility and the value of banking relationships in shaping that preference.

The paper proceeds as follows. Section 2 sets up the basic model and motivates the assumptions. Section 3 analyzes the model and introduces the information mechanism. This section then analyzes the efficiency of each covenant. Section 4 presents the empirical tests of the model. Section 5 concludes the paper.

## 2 Model

The model has three periods,  $t = 1, 2, 3$  and two players, a penniless entrepreneur and a bank. The entrepreneur has exclusive access to a two-stage investment project that requires an initial investment of  $k_0$  in period 1, generates an interim cash flow in period 2, and permits a follow-on investment in period 2 of  $k \in [0, 2]$ . The intermediate cash flow is  $c_H$  with probability  $\frac{1}{2}$  and  $c_L < c_H$  with probability  $\frac{1}{2}$ . The payoff to the follow-on investment, which accrues at the beginning of period

3, is given by:

$$g(k) = \begin{cases} 2k & b \geq k \\ 2b & k > b \end{cases}$$

where  $b \sim U[0, 2]$ . We evaluate two versions of the model. To illustrate the basic risk-shifting mechanism, we first consider a no information case where  $b$  is unknown in period 2 when the follow-on investment decision is made. Later, we will introduce informative signals about  $b$  for the entrepreneur and the bank, which will arrive in period 2.

In order to fund investment, the entrepreneur issues a debt security to the bank in exchange for  $k_0$ . The debt contract is a triple,  $\{F, \bar{k}, \chi\}$ , where  $F$  is the face value of debt,  $\bar{k}$  is the maximum follow-on investment permitted, and  $\chi : \{c_L, c_H\} \rightarrow \{\text{bank}, \text{entrepreneur}\}$  is a function allocating discretion over the follow-on investment to the bank or the entrepreneur, depending on the intermediate cash flow realization. If  $\chi(c_L) \neq \chi(c_H)$ , the debt contract is said to contain a cash flow covenant, while if  $\bar{k} < 2$  the contract is said to contain an investment covenant. The timeline and the realized payoffs are summarized below:

- t=1**
- The entrepreneur borrows  $k_0$  from a competitive bank to finance an initial investment.
  - The face value of debt,  $F$ , is set such that the expected repayment at  $t = 3$  is  $k_0$ .
- t=2**
- The entrepreneur realizes an interim cash flow  $c \in \{c_H, c_L\}$ , where  $c_H \geq c_L$  and  $Pr(c = c_H) = \frac{1}{2}$ .
  - A follow-on project becomes available which pays out  $g(k)$  at  $t=3$ . The distribution of the productivity parameter is  $b \sim U[0, 2]$  known at  $t = 1$ , but  $b$  is unknown until the final cash flow is realized at  $t = 3$ .
  - If  $\chi(c) = \text{entrepreneur}$ , the entrepreneur chooses to invest  $k \leq \bar{k}$ , saving  $c - k$  into the third period. If  $\chi(c) = \text{bank}$ , the bank chooses to invest  $k < 2$  of the cash flow of the firm into the project.
- t=3**
- Cash flows from the follow on investment are realized.
- The final, total payoff of the investment is  $c + b - |b - k|$ .

- The entrepreneur repays the debt  $F$ , if  $F < b - |b - k| + c$ ; otherwise, he defaults and repays all available cash to the bank.

To simplify the analysis, we confine attention to the following cases:

**Assumption 1.** *Low cash flow realizations and the face value of debt satisfy:*

1.  $c_L \geq 2$

2.  $-2 \leq c_L - F \leq 2$ .

The first assumption guarantees that the entrepreneur will not have to raise additional funds in the second period for any level of investment desired. The second assumption means that there is some risk that the initial debt will not be repaid in full for some level of investment  $k$ , but that there is some level of investment such that the debt will be repaid even in the low cash flow state.

In a sense, assumption 1.2 is a high level assumption because  $F$  is determined in equilibrium. Since  $F$  is monotonically increasing in  $k_0$ , this restriction is effectively a restriction on  $k_0$ . Analyzing the model for fixed  $F$  rather than solving explicitly for  $F$  given  $k_0$  is significantly simpler, so we take this approach in much of the analysis. For completeness, we show in Appendix A.1 that every region of  $F$  we analyze can be mapped to some region for  $k_0$  under the debt contract with no covenants. Thus, focusing on  $F$  is essentially without loss of generality.

We confine attention to long-term debt contracts, excluding the possibility that the firm will borrow for one period and then attempt to roll over the debt. Long-term debt is often observed in practice, and several models such as Flannery (1986), Diamond (1991), Berglöf and von Thadden (1994), Acharya et al. (2010), and Brunnermeier and Oehmke (2010) establish the optimality of long term debt in the presence of asymmetric information, contracting costs, nonassignable control rents, and market-wide rollover risk. In the context of our model, it is straightforward to extend the choice of the entrepreneur to include an opportunity to engage in activities that generate payoffs in the short-run at the expense of output from the follow-on project, as in von Thadden (1995). This



extension, which we omit in the interest of space, renders short-term debt inferior to long-term debt without changing the results on covenants. Short-term debt would also generate a holdup problem with the original lender, but modeling this problem requires introducing significant additional notation and analysis, so we omit this as well.

### 3 Long Term Debt without Information Arrival

We now consider the baseline model with long term debt where no information about  $b$  is revealed in the second period, either to the entrepreneur or to the bank. In this simple case, we show that cash flow covenants may or may not improve the ex ante value of the project compared to unrestricted debt, but that investment covenants always dominate cash flow covenants. The optimality of investment covenants is a consequence of the absence of information arrival in the second period. An investment covenant allows the firm to commit to refraining from overinvestment and, unsurprisingly, implements the first-best investment decision. This serves as a benchmark to highlight the importance of interim information in understanding the variation in types of covenants used.

We analyze the model by starting in period 2 and deriving the investment choice that the equity holder and the debt holder would make, conditional on a given face value of debt and realization of the intermediate cash flow. The first-best investment policy is  $k = 1$  regardless of intermediate cash flows, leading to an expected value of the follow on project of  $\frac{1}{2}$ . We show when the bank and the entrepreneur will make this first-best investment and when they will distort their investment decision due to frictions associated with the debt contract.

We first consider the case where  $\chi(c) = \text{entrepreneur}$ :

**Lemma 1.** *If the entrepreneur controls the investment decision at  $t = 2$ , he will choose investment level  $k$  subject to the realization of cash flows  $c$  such that*

$$k = \begin{cases} 1 & c > 1 + F \\ \frac{4}{3} - \frac{1}{3}(c - F) & c \leq 1 + F \end{cases} \quad (1)$$

*Proof.* At  $t = 2$ , the intermediate cash flow  $c$  is realized and the follow on investment is made. The expected value of equity and the payoff to the entrepreneur is the expected value of  $\max[c - k + g(k, \tilde{b}) - F, 0]$ . This is reduces to  $E[\max[\tilde{b} - |\tilde{b} - k| + c - F, 0]]$ . Integrating over the distribution of  $\tilde{b}$  yields the following value

$$E[V_E] = \begin{cases} \frac{1}{8}(8 + c - F - 3k)(c - F + k) & c - F < k < c - F + 4 \\ c - F + k - \frac{k^2}{2} & k < c - F \\ 0 & \text{otherwise} \end{cases} \quad (2)$$

The value of the equity is maximized by investment  $k = \frac{4}{3} - \frac{1}{3}(c - F)$  when  $F - c < k$  and by  $k = 1$  when  $F - c > k$ . The maximized equity value is greater for  $F - c < k$  when  $-2 < c - F < 1$  and greater for  $F - c > k$  when  $c - F \geq 1$ .

□

The entrepreneur will over-invest, relative to the first best, for any cash flow realizations less than  $F + 1$ . The level of over-investment is also decreasing in  $c$  for this region. The investment distortion becomes greater when cash flows are low relative to the outstanding debt. The total value of the follow-on investment when the entrepreneur makes the investment choice is

$$E[V] = \begin{cases} \frac{1}{2} & c > 1 + F \\ \frac{1}{18}(4 - (c - F))(2 + c - F) & c \leq 1 + F \end{cases} \quad (3)$$

For all cash flow realizations  $c < F + 1$ , the equity holders will over invest, and produce a firm value strictly less than the first best value of  $\frac{1}{2}$ .

We now derive the baseline case for the investment decision of the bank if it possessed control over the investment decision.

**Lemma 2.** *If the bank controls the investment decision at  $t = 2$ , it will choose investment level  $k$  subject to the realization of cash flows  $c$  such that*

$$k = \begin{cases} 1 & -1 \leq c - F \\ F - c & -1 < c - F \leq 0 \\ [0, c - F] & 0 < c - F \end{cases} \quad (4)$$

*Proof.* The expected payoff to the bank at  $t = 2$  is  $E[\min[\tilde{b} - |\tilde{b} - k| + c, F]]$ . Integrating over the distribution of  $\tilde{b}$  yields the following

$$E[V_B] = \begin{cases} F & k < c - F \\ c + k - \frac{k^2}{2} & k < F - c \text{ and } c - F < 0 \\ F - \frac{1}{8}(k - c + F)^2 & k > F - c \text{ and } c - F < 0 \end{cases} \quad (5)$$

When  $c - F \leq -1$  the investment value is greatest for  $k < F - c$  and the value is maximized at  $k = 1$ . When  $-1 < c - F < 0$ , the value of the bank's claim is increasing in  $k$  for both  $k > F - c$  and  $k < F - c$ . The optimal investment is therefore  $k = F - c$ . For any investment  $k < c - F$ , the debt is rendered completely safe and the expected value is always  $F$ . Since the value of the bank debt is bounded at  $F$  and  $k \geq 0$ , the bank is indifferent between any level of investment between 0 and  $c - F$  when  $F - c > 0$

□

The asymmetric payoff of the debt claim causes an opposite investment distortion when the bank is in control. Since the bank's upside is capped, the bank has an incentive to under-invest relative to the first best. Additionally, the incentive to under-invest is lower for low cash flow realizations. Consequently, the bank's investment policy is closer to the first best when cash flows are low.

The value of the follow on investment if the bank is in control is given by

$$E[V] = \begin{cases} \frac{1}{2} & \text{for } -1 \leq c - F \\ (F - c) - \frac{1}{2}(F - c)^2 & \text{for } -1 < c - F \leq 0 \\ [0, (c - F) - \frac{1}{2}(c - F)^2] & \text{for } 0 < c - F \leq 1 \\ [0, \frac{1}{2}] & \text{for } 1 \leq c - F \end{cases} \quad (6)$$

Note that when  $c > F$  it is possible to make the debt completely safe and still have positive investment. In this case, the bank is indifferent between a continuum of investment levels. When cash flows are high enough to fund the socially optimal investment  $k = 1$  and keep the debt safe, the value can return to the first best. Unlike the value under the entrepreneur control however, the value under bank control is not unique.

The primary friction in this model results from the convexity of the claim held by the entrepreneur and the concavity of the claim held by the bank. Because the equity holder does not always bear the full cost of over-investment, he has an incentive to over invest in the follow-on project. Conversely, since the bank does not always capture the full upside of investment, it will have an incentive to under invest in the follow-on project. This is similar to the intuition provided by Dewatripont and Tirole (1994) who use these conflicting incentives as a means of achieving credible ex-ante discipline to managers.

The value of the follow-on project as a function of  $c - F$  is shown in Figure 1. When cash flow falls below  $F + 1$ , the entrepreneur finds it optimal to over invest in the project, with the level of overinvestment depending on  $c - F$ . Conversely, the bank finds it optimal under invest in the follow on project to preserve the safety of its debt claim. When  $c - F$  falls below 0, the bank faces a tradeoff between investing up to a level which will fully repay the debt and preserving the existing capital base.

Note that the investment decision of the bank is decreasing in  $c - F$  from -1 to 0 but potentially increasing after  $c - F > 0$ . This occurs because once cash flow is sufficient to fully repay the face value of debt the bank becomes indifferent to *any* investment level which will keep its claim safe.

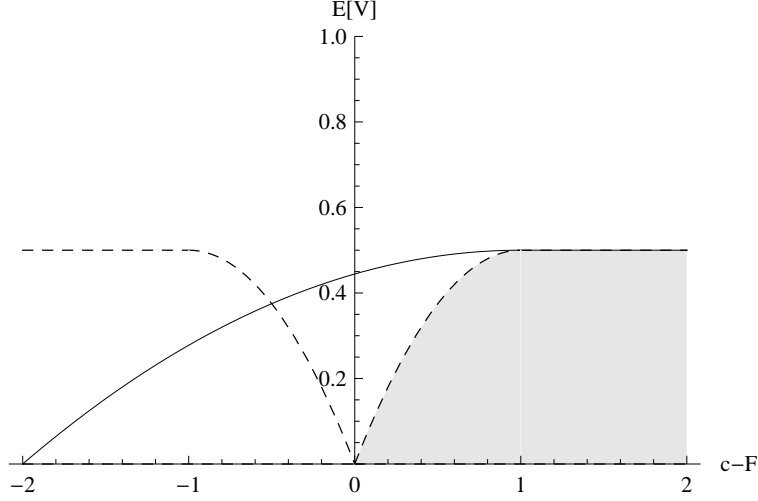


Figure 1: Value of follow on investment as a function of  $c - F$ . The solid line represents entrepreneur control and the dashed line represents bank control. The shaded area notes that for this region, bank control represents a set of possible values, bounded by the dashed line.

This is partially a function of our simplifying assumption of a bounded distribution of possible project outcomes. For most unbounded, monotone distributions, the investment level is always be monotonically decreasing in  $c - F$ . However, this is not critical to our analysis since the bank's investment choice is always weakly dominated by the equity holder's investment choice for high cash flow realizations.

It will be useful to define the difference between the realized cash flow at  $t = 2$  and the face value of debt as  $\delta \equiv c - F$ . Assume that the bank will choose the investment level preferred by the entrepreneur when it is indifferent between a range of investments. From equations (3) and (6), the expected value of the follow on investment satisfies the following inequalities:

E Control	B Control	$\delta$
$\frac{1}{2}$	$= \frac{1}{2}$	for $1 \leq \delta$
$\frac{1}{9}(4 + \delta - \frac{\delta^2}{2})$	$> \delta - \frac{1}{2}\delta^2$	for $0 < \delta \leq 1$
$\frac{1}{9}(4 + \delta - \frac{\delta^2}{2})$	$> -\delta - \frac{1}{2}(-\delta)^2$	for $-\frac{1}{2} < \delta \leq 0$
$\frac{1}{9}(4 + \delta - \frac{\delta^2}{2})$	$< -\delta - \frac{1}{2}(-\delta)^2$	for $-1 < \delta \leq -\frac{1}{2}$
$\frac{1}{9}(4 + \delta - \frac{\delta^2}{2})$	$< \frac{1}{2}$	for $-2 \leq \delta \leq -1$

For  $t = 2$  cash flow realizations such that  $\delta \geq -\frac{1}{2}$ , the expected value of the firm is weakly larger under entrepreneur control. For cash flow realizations such that  $\delta < -\frac{1}{2}$ , the expected value of the firm is larger under bank control. This naturally leads to a value for transfer of control over investment contingent on cash flow realizations, which we establish in the following result.

**Proposition 1.** *Contracts which let the bank make the investment decision upon the realization of  $c_L$  and entrepreneur control upon the realization of  $c_H$ :*

- *Increase the expected value of the entrepreneur's claim at  $t = 1$  for all  $c_L < \frac{1}{9}(10 + 9k_0) - \frac{68\sqrt{2}}{81}$*
- *Decrease the expected value of the entrepreneur's claim at  $t = 1$  for all  $c_L > k_0 - \frac{1}{2}$*

*As  $c_H - c_L$  increases, the threshold  $c_L^*$ , where  $c_L < c_L^*$  increases the expected value of the entrepreneur's claim, increases from  $\frac{1}{9}(10 + 9k_0) - \frac{68\sqrt{2}}{81}$  to  $k_0 - \frac{1}{2}$ .*

*Proof.* See Appendix

This proposition describes when contingent control is valuable and when it is value destroying. An investment covenant, however, will always dominate either unrestricted debt or debt with cash flow covenants; an optimally chosen investment covenant will implement first-best investment as long as there is no cash flow covenant. This dominance results simply because the entrepreneur never has an incentive to underinvest and consequently will always invest up to the bound  $\bar{k}$ , as long as this bound is at or below the first-best investment level.

While this result is not surprising, it plays an important role in developing one of the central empirical predictions of the model. For lower quality firms, which in the model are represented by firms where  $k_0$  is high relative to  $c_L$  and  $c_H$ , cash flow covenants are beneficial, but in this case the investment covenant is much preferred to unrestricted debt. Once the investment covenant is in place, the cash flow covenant is counterproductive, giving control to the bank when the bank makes value destroying investment decisions. In fact, for firms which are highly likely to default, it will in

some cases be impossible to raise debt when equity has control over the investment decision, even when there is control only in the high cash flow state. Thus, if investment covenants are applied to the lowest quality firms where they provide the greatest benefit over unrestricted debt, we should see a non-monotonic relationship between firm quality and cash flow covenants, while observing a monotonic relationship between firm quality and investment covenants.

Under this model, however, it is puzzling that investment covenants are not more universal since they bear no costs and always dominate cash flow covenants. In a sample of 3,720 private credit agreements Nini et al. (2009) found that less than a third contained some type of investment restriction and that these restrictions were primarily concentrated among low quality borrowers. Financial officers also appear to view these restrictions very negatively, arguing that they restrict flexibility in future investment decisions.

These facts suggest that some form of private information is influencing future investment and the terms of financing. In order for investment flexibility to have value, the optimal investment level must change according to new information received by the entrepreneur. To examine this idea, we will extend the model to capture the arrival of private information during the course of operations.

Once information about productivity is considered, a tradeoff develops between using investment covenants and using cash flow covenants. The important feature of cash flow covenants is that they permit discretionary responses to new information. Crucially, even when cash flows are low enough to result in risk shifting concerns, the entrepreneur will respond to certain signals in a way that preserves more of the firm value than would be preserved under an ex ante investment restriction. Thus, for sufficiently precise signals about productivity, cash flow covenants can dominate both unrestricted debt and investment covenants.

### **3.1 Information**

While the baseline case demonstrates that contingent control over investment may dominate entrepreneurial control, both cases are weakly dominated by an ex-ante restriction on investment.

We now examine the influence of private information on the investment decision and demonstrate the conditions under which contingent control may dominate investment restrictions.

We model the importance of information by allowing the entrepreneur to receive a signal about the productivity of the investment at  $t = 2$ , prior to making the follow-on investment. Specifically, the entrepreneur receives a signal  $\beta \in [0, 2]$  which is equal to the productivity parameter  $b$  with probability  $p_E$  and completely uninformative (and uniformly distributed over  $[0, 2]$ ) with probability  $1 - p_E$ . The equity holder does not know whether he has received the accurate signal or the noise signal. The informativeness of the signals is known by both parties at  $t = 1$ .

The bank may observe this signal with some additional noise. The bank observes  $\beta'$ , which equals  $\beta$  with probability  $p'$  and is completely uninformative, i.e. randomly distributed  $U[0, 2]$ , with probability  $1 - p'$ . Effectively, this gives the bank a similar but less precise signal whose informativeness can be expressed as  $p_B = p_E \times p'$ . This implies that  $p_E \geq p_B$ . Note that the bank is not generating any new information that the entrepreneur does not already know. The value of the bank's monitoring is embedded not in its own internal information generation, but in how well it is able to verify the entrepreneur's private information.

The purpose of this signal is to model the acquisition of private information that is generated by the entrepreneur during the operation of his business and the acquisition of information generated by the bank through monitoring. The entrepreneur's signal is privately observable to the entrepreneur and the bank's signal is privately observable to the bank at  $t = 2$ , but neither signal is verifiable and neither signal can be credibly conveyed to the outside market. This signal is also independent of the intermediate cash flow realization.

In the presence of a signal  $\beta$  with precision  $p$ , the payout of the follow on investment is

$$\begin{cases} \beta - |\beta - k| & \text{with probability } p \\ k - \frac{1}{2}k^2 & \text{with probability } 1 - p \end{cases}$$

and the expected value of the investment is given by



$$E[V] = p(\beta - |\beta - k|) + (1 - p)(k - \frac{1}{2}k^2) \quad (7)$$

We first find the socially optimal choice of  $k$  given  $\beta$ . The optimal investment  $k^*$  varies between  $\beta$  and a weighted average of  $\beta$  and the unconditional optimum  $k = 1$ , depending on the realization and informativeness of the signal. Since the value equation is discontinuous at  $k = \beta$ , we solve for the optimal  $k$  in a piecewise equation.

When the  $p$  is below some threshold value, the optimal investment will be a weighted average of the signal  $\beta$  and the unconditional optimum. When the value of  $p$  above this threshold, the optimal investment will be exactly  $\beta$ .

$$k^* = \begin{cases} 1 - \frac{p}{1-p} & 0 \leq \beta \leq 1 \text{ and } p \leq \frac{\beta-1}{\beta} \\ 1 + \frac{p}{1-p} & 1 < \beta \leq 2 \text{ and } p \leq \frac{\beta-1}{\beta-2} \\ \beta & \text{otherwise} \end{cases} \quad (8)$$

The ex-ante expected value of the investment is monotonically increasing in  $p$ , as the investment decision becomes more precise. For any signal precision  $\frac{1}{2} < p < 1$ , the investment which maximizes firm value is always  $\beta$ , and the ex-ante expected value of the follow on investment is  $\frac{1}{3}(1+2p)$ . When  $p = 1$ , the full information case, the project is twice as valuable as under the ignorant investment.

We now consider the investment choice of the entrepreneur, conditional on his signal. For general values of  $p_E$ , the entrepreneur's decision can be one of six possible expressions, but for simplicity we consider only  $\frac{1}{2} < p_E < 1$ , which reduces the number of cases to two:

**Lemma 3.** *For any signal precision  $\frac{1}{2} < p_E < 1$ , the entrepreneur will invest  $k = \frac{4}{3} - \frac{1}{3}\delta$  for all  $0 \leq \beta < \beta^*$ , where*

$$\beta^* = \frac{4}{3} \frac{1}{1-p} \sqrt{p} \sqrt{1 + (1-p)(1+\delta)} - \frac{1}{3}\delta, \quad (9)$$

and  $\beta$  otherwise.

*Proof.* See Appendix.

When information is introduced at  $t = 2$ , the standard risk-shifting problem takes on a new dimension. When cash flows are low, the equity holder ignores signals which imply a low value of future investment and acts identically to an ignorant entrepreneur with risk shifting incentives. This makes his information less valuable ex-ante, since he will only take advantage of the information when the signal is high. However, the information also serves to partially mitigate the original risk-shifting problem because the information makes the project less uncertain and therefore less risky.

We now establish the investment choice for the bank when the bank also has a signal about the productivity of the project. Here, the bank captures the full value of the investment when cash flows are low and investment is also low. Similar to the analysis of the entrepreneur's decision, we shall restrict the informativeness of the signal  $p_B$  such that  $\frac{1}{2} < p_B \leq 1$ .

**Lemma 4.** *For any signal precision  $\frac{1}{2} < p_B \leq 1$ , when  $\delta \equiv c - F \geq 0$ , the bank will be indifferent between any investment  $k \leq c - F$ . When  $\delta \equiv c - F < 0$ , the bank will wish to invest:*

- $k = F - c$  for any signal realization  $\beta \geq F - c$
- $k = \beta$  for any signal realization  $\beta < F - c$

For  $-2 < \delta \leq 0$ , the expected value of the follow on project under bank control is:

$$-\delta \left( \delta^2 \frac{1}{6}(1-p) + \delta \left( \frac{1}{2}p - \frac{3}{4} \right) - 1 \right) \quad (10)$$

*Proof.* See Appendix.

Under bank control, investment policy varies in an inverse fashion to investment under entrepreneur control. When  $\delta < 0$ , the bank will invest the socially optimal value  $\beta$  when  $\beta < |\delta|$  and  $|\delta|$  otherwise. When  $\delta > 0$ , the bank will be willing to invest any amount up to  $\delta$  which keep the

bank safe. Since the bank is indifferent, we will assume that the bank will invest  $\beta$  when  $\delta \geq \beta_B$  and  $\delta$  otherwise.

The investment policy is illustrated in Figures 2 and 3. When cash flow is high relative to the face value of debt, the banks investment policy ignores a greater fraction of signals than the entrepreneur since the bank internalize less of the upside. When cash flow is low the reverse is true, and the entrepreneur effectively ignores all but the highest values of  $\beta$ . As shown in Figure 3, the range of signals for which the entrepreneur over-invests shrinks for more informative signals.

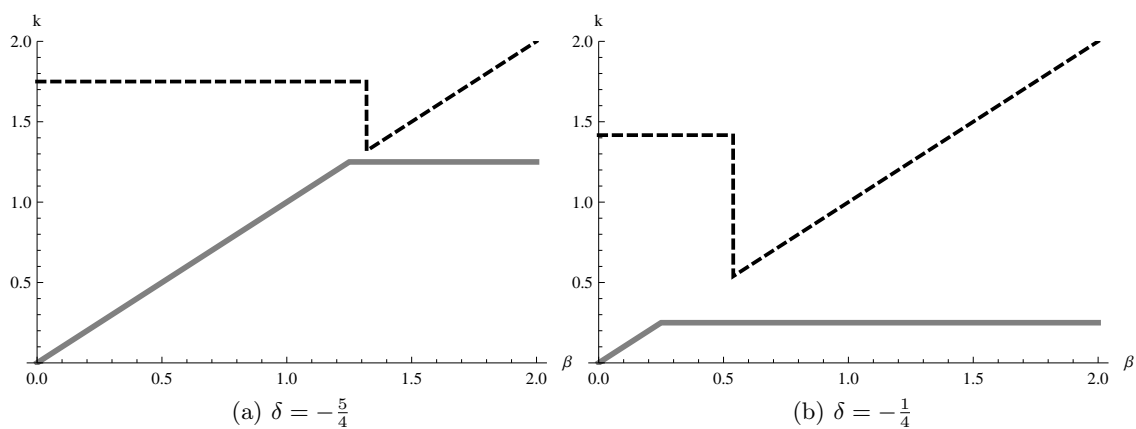


Figure 2: Investment policy as a function of the signal  $\beta$  when  $p_E = p_B = \frac{1}{2}$ . The dashed line represents the investment policy of the equity and the gray line represents the policy of the bank.

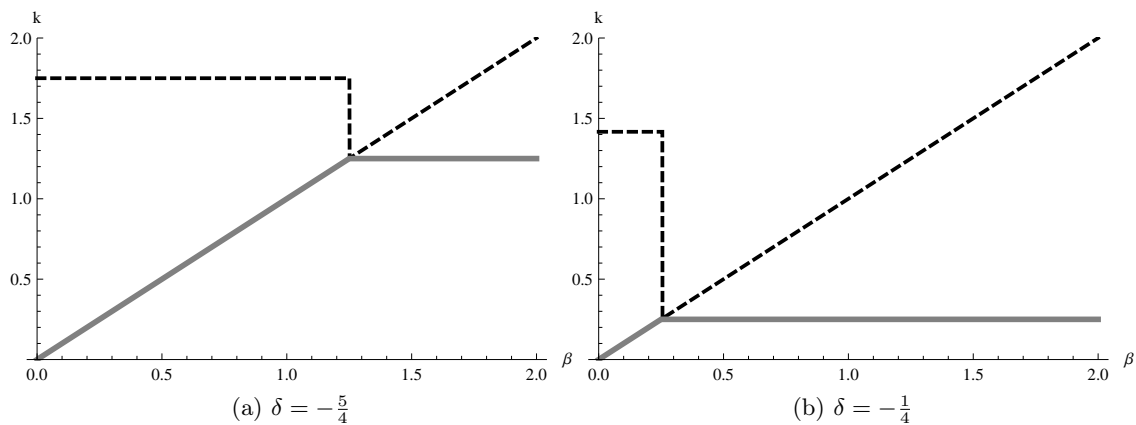


Figure 3: Investment policy as a function of  $\beta$  when  $p_E = p_B = .99$ . The dashed line represents the investment policy of the equity and the gray line represents the policy of the bank.

Under entrepreneur control, the expected value of the follow on project increases with  $p_E$ , and

the threshold cash flow over which the entrepreneur chooses to over-invest shrinks. As shown in Figure 4a, this also has the effect of reducing the threshold cash flow for which bank control dominates entrepreneur control. Figure 4b illustrates the project value when the bank has a similarly informative signal, increasing the threshold cash flow for which bank control is optimal, relative to the case with the uninformed bank.

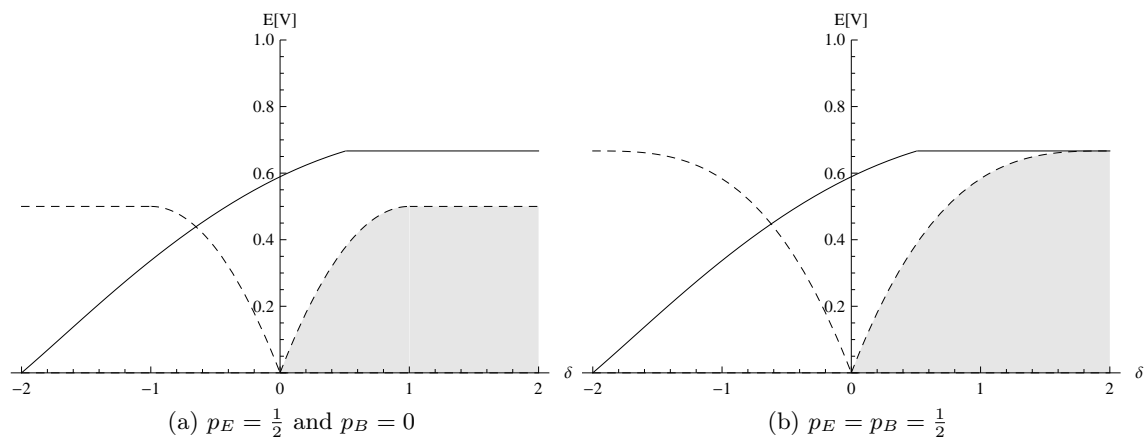


Figure 4: Value of follow on investment as a function of  $\delta$ . The solid line represents entrepreneur control when and the dashed line represents bank control. The shaded area notes that for this region, bank control represents a set of possible values, bounded by the dashed line.

When the bank's signal is informative, an increase in  $p_B$  has the effect of increasing the value of bank control in low cash flow states. As demonstrated in Figure 4b, when the bank is similarly informed, the threshold value of  $\delta$  for which bank control dominates entrepreneur control shifts to the right relative to the uninformed case. This also has the effect of increasing the value of the control transfer provision, since the bank's investment policy dominates the entrepreneur's over a greater range of cash flows.

### 3.1.1 The Value of Covenants With Informative Signals

We now consider the implications of the model with information for the choice of debt covenants. Investment restrictions still may play a role in improving value even when the firm learns about the productivity parameter. Such a restriction, however, now generates two costs. First, any investment restriction that adds value must cap investment below  $\frac{4}{3} - \frac{1}{3}\delta$  for at least one cash flow

realization. Otherwise, the restriction is not effective in mitigating the overinvestment problem for the entrepreneur. But, when  $\beta > \frac{4}{3} - \frac{1}{3}\delta$ , such a restriction prevents the entrepreneur from choosing the socially efficient level of investment  $\beta$ , which, from Lemma 3, he would do if unrestricted when  $\beta > \beta^*$ . Furthermore, investment restrictions are chosen before cash flows are realized, while the severity of the overinvestment problem depends on the realized cash flow. Thus, the optimal ex ante investment restriction will be sub-optimal for at least one realized cash flow.

In the proposition below, we establish conditions under which investment restrictions are inferior to contingent control implemented by an optimally chosen cash flow covenant. We consider the case with an very well informed entrepreneur:

**Proposition 2.** *As  $p_E$  approaches one, ex-ante investment restrictions are value destroying for all  $\delta > -\frac{4}{5}$ . The threshold  $\delta$  for which ex-ante investment restrictions are value creating decreases with the informativeness of the bank signal  $p_B$ . For  $p_B > \frac{1}{2}$ , ex-ante investment restrictions are never optimal.*

*Proof.* See Appendix. □

Thus, in contrast to the case where no information about productivity arrives, we now have cases where cash flow covenants dominate investment covenants. When the entrepreneur's non-contractable signal is sufficiently informative, ex-ante investment restrictions are value destroying for high cash flow realizations. When the bank's non-contractable signal is sufficiently informative, ex-ante investment restrictions are never optimal. This is true even when the intermediate cash flows do not vary much at all, and would thus hold even if investment covenants could be written to be conditional on realized cash flows.

Figure 5 presents this result graphically. When  $p_E$  is close to 1, the entrepreneur's overinvestment region is  $-2 < \delta < 0$ . The black line represents firm value under the best possible investment restriction for all known values of  $\delta$ , possible only if  $c_H \approx c_L$  or if investment restrictions can be made contingent on realizations of  $c$ . Firm value is lower under an investment restriction for all realizations of  $\delta > -\frac{4}{5}$ . By extension, investment covenants are valuable only when all potential

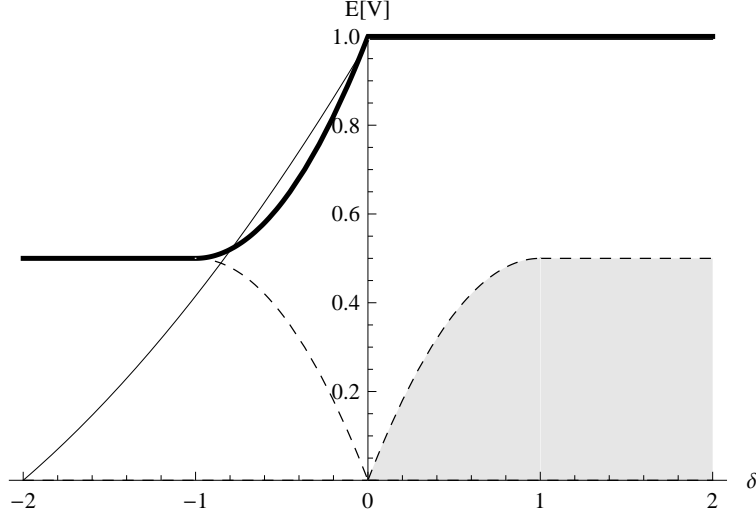


Figure 5: Value of follow on investment as a function of  $\delta$ . The solid line represents entrepreneur control as  $p_E \rightarrow 1$  and the dashed line represents bank control when  $p_B = 0$ . The thick line represents entrepreneur control under the optimal investment restriction. The shaded area notes that for this region, bank control represents a set of possible values, bounded by the dashed line.

cash flow realizations are low relative to the face value of debt and the entrepreneur has a high likelihood of default. Note also that a contingent control provision based on cash flow realizations is value enhancing for  $c_L < F - \frac{6}{7}$ , regardless of  $c_H$ .

Having shown that cash flow covenants may be optimal, we conclude the analysis of the model by comparing the value of cash flow covenants against unrestricted debt, and seeing how this changes as the bank's signal changes:

**Proposition 3.** *The threshold realization of  $c_L$ , such that transfer of control to the bank is value increasing, is decreasing in  $p_E$  for all  $\frac{1}{2} < p_E < 1$ . The threshold realization of  $c_L$ , such that transfer of control to the bank is value increasing, is increasing in  $p_B$  for all  $\frac{1}{2} < p_B < 1$ .*

*Proof.* See Appendix. □

**Proposition 4.** *As the bank's signal becomes more informative relative to the entrepreneur's signal, the value of cash flow contingent control increases.*

*Proof.* From equation (17), the value of the follow on investment is increasing in  $\delta$  from  $-2 < \delta <$

$\delta^* < 1$ , from 0 to 1. From equation (10), the value under bank control is decreasing in  $\delta$  from  $2 < \delta < 0$  from  $\frac{1}{3}(1 + 2p)$  to 0.

Since  $p_B \leq p_E$ , the value of control transfer is decreasing in  $p_E - p_B$ . Thus cash flow covenants are more valuable when the entrepreneur and bank have similar high levels of private information.  $\square$

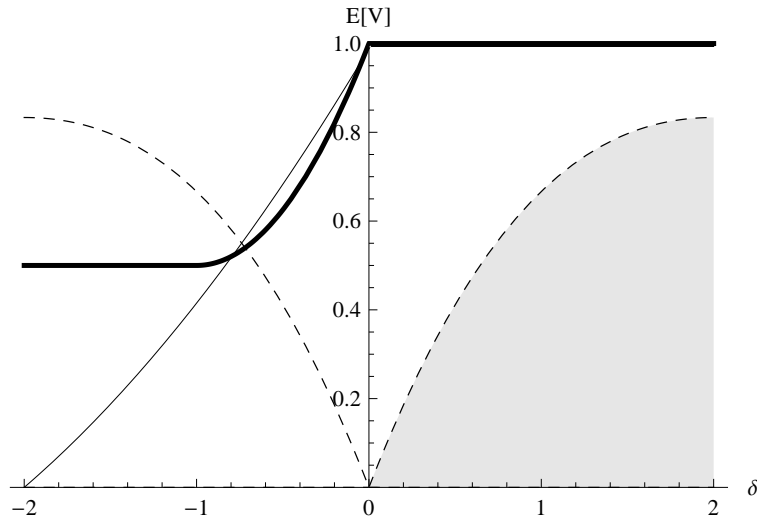


Figure 6: Follow on value of firm as a function of  $\delta$ . The solid line represents entrepreneur control as  $p_E \rightarrow 1$  and the dashed line represents bank control when  $p_B = \frac{2}{3}$ . The thick line represents entrepreneur control under the optimal investment restriction. The shaded area notes that for this region, bank control represents a set of possible values, bounded by the dashed line.

The basic results are illustrated in Figure 6. When  $p_B$  increases, the crossing point of value creation by the entrepreneur and value creation by the bank shifts to the right relative to the uninformed case in Figure 5. This increases the optimal threshold for a change in control such that the unrestricted value created by either party is always greater than the restricted value created under any ex-ante investment restriction. The total value created for any cash flow realization under contingent control also increases. This implies that the value of investment covenants decreases and the value of cash flow covenants increases when banks discover more information over the course of the loan. Because of this, we should expect to see fewer investment covenants among firms with close, repeated banking relationships. Conversely, we should also expect to see more cash flow covenants for these firms.

## 4 Empirical Tests

Our theoretical results predict a monotonic relationship between investment covenants and default risk. Firms more likely to default and those with low expected short term cash flows relative to the size of investment will be more likely to face investment covenants since the value of allowing investment discretion by the firm disappears. Specifically, the firm will almost always choose to risk shift, and as such there is no value in leaving discretion to the firm even when its signal is reasonably precise.

For cash flow covenants, the relationship is more complex. When the risk of default is low, there is little value in restricting the entrepreneur's actions after low cash flow realizations. However, when the risk of default is high, the bank should restrict the investment decision of the entrepreneur regardless of the cash flow realization. The cash flow covenant is superfluous or value destroying since it places control in the hands of the bank, which is both less informed and may have an incentive to underinvest. Consequently, there should be a non-monotonic relationship between expected default and the adoption of cash flow covenants where the likelihood of adoption increases in firm quality initially then decreases.

In addition to these predictions on firm quality, the model also offers predictions on how the information transmitted through a banking relationship will affect the selection of covenants. When a banking relationship is informative, i.e. a bank knows more about the firm they are lending to, the value of cash flow covenants increases. Conversely, ex-ante investment restrictions become less valuable. Thus the model offers the unique prediction that stronger bank relationships should lead to a greater inclusion of cash flow covenants.

We proxy for firm quality by examining private loans to firms with an existing credit rating. Credit ratings offer a long horizon measure of the default risk and recovery rates for public companies based on both hard and soft information. Moreover, they provide a natural sorting with which to examine the monotonicity of the relationship between expected losses and covenant selection.

To test how the quality of the bank's information affects covenant inclusion, we examine whether the banking relationship is a repeat relationship. If the firm is borrowing from a bank for the first



time, the bank is likely to have less information and have less confidence about the information it gathers through monitoring. If the firm has an ongoing borrowing relationship with the bank, the bank is likely to have more accurate information and be more informed in the event of a technical default where it has to make a continuation decision.

## 4.1 Data and Variable Construction

The data on loan contracts come from the Dealscan loan database, provided by the Loan Pricing Corporation. Our data set contains detailed information on the terms of commercial bank loans made to corporations from 1988 to 2007. We restrict our sample to the subset of deals which have information about financial covenants. Since covenant information is not widely available until 1993, we restrict our sample to loans made on or after that year. We obtain firm financial information from Compustat and CRSP, which is matched to each loan for the period in which the loan was initiated.

We focus on financial covenants which deal with investment restrictions and maintenance cash flows as a function of outstanding debt. Debt-to-cash-flow covenants require cash flow maintenance relative to the total debt amount. In addition to analyzing these covenants, we also examine interest coverage covenants, which mandate that the firm maintain cash flows at some threshold ratio relative to the periodic interest due on the loan. These are similar in spirit, except that both the numerator and denominator are flows. Investment restrictions, usually presented in the form of pre-specified caps on capital investment, place some explicit limitation on the maximum amount of investment by the firm.

Our independent variables are the credit ratings of the borrowing firms, broken out into five bins based on credit quality. These bins are ratings of A or better, BBB, BB, B, and CCC or worse. As further controls, we include the ratio of PPE to assets as a measure of asset tangibility, the ratio of R&D to assets, and the log of total firm assets as firm size. We also include loan specific characteristics with the log total amount of the loan, and longest maturity of the facilities included the loan. We also include dummy variables indicating if the loan contains a revolving line of credit,

if the loan is secured, and whether the primary purpose of the loan was designated as funding an acquisition. We also include a default probability measure, calculated from the accounting and stock market data of the firm. Our default probability measure is calculated following Campbell et al. (2008).

Lastly, we include a dummy which takes on a value of 1 if the firm has borrowed from the same lead bank at least once in the past five years. This captures whether the firm is a repeat borrower and the informationally intensiveness of the banking relationship. If greater information makes cash flow covenants more valuable, we would expect a repeat relationship to increase the probability that these covenants are included.

Summary statistics are reported in Table 1. Interest coverage and debt to cash flow covenants are the most common provisions, followed by investment restrictions. The firms in the sample are fairly large on average, with a median loan maturity of 5 years. Additionally, about half of the loan packages in the sample are secured, and the majority of them contain a revolving line of credit.

Table 2 presents the unconditional correlation of the contract details and firm specific controls. Debt to cash flow covenants and interest coverage covenants are fairly highly correlated, suggesting that they may be complementary. Investment covenants appear to be unconditionally correlated with secured debt, suggesting a role for additional protection from expropriation. Debt to cash flow covenants also appear correlated with longer maturities.

## 4.2 Test Setup and Results

Our model predicts that investment restrictions will be most common in loans to low cash flow companies with high default probabilities, while cash flow related covenants will be more common for companies with moderate cash flows and less common for those with very high and very low default probabilities. Table 3 presents the occurrence of specific debt covenants within each rating category. The fraction of firms with any type of covenant is significantly lower for firms rated A or better. Investment restrictions are progressively more common at each lower credit rating. Debt

to cash flow and interest coverage covenants on the other hand are more prevalent for firms rated BBB and BB, but much less prevalent for lower ratings.

To formally test our covenant selection hypothesis, we estimate a probit model for the inclusion of an investment covenant and the inclusion of a debt to cash flow covenant. We first estimate the choice equations separately. Later we will estimate them jointly to model the joint decision of selecting one or more covenants. The single model results, presented in Table 4 show the marginal effect of a change in the prediction variables on the unconditional probability of covenant inclusion. After controlling for a variety of firm and loan characteristics, having both the highest and lowest quality debt ratings significantly decrease the likelihood of a debt-to-cash flow covenant. Firms which have a lower probability of default, but still retain somewhat substantial downside risk are most likely to incorporate a debt to cash flow covenant. Similar results apply to the application of interest coverage covenants. Conversely, the application of an investment covenant appears to be almost completely monotonic in default risk.

In line with our hypothesis, the likelihood of taking on a debt to cash flow covenant increases for repeat borrowers. This contrasts with Bharath et al. (2011) and other studies which show that repeat borrowing leads to an overall relaxing of contract terms. While there is a marginally significant negative relationship between investment restrictions and repeat lending, cash flow based covenants become more common. This suggests that cash flow covenants serve a distinct role in shaping the value of banking relationships. Thus while repeat lending may lead to an overall relaxation of contracting terms, it also leads to a shift in the nature of those terms.

Since covenants are selected simultaneously, we now estimate a joint multivariate probit model where the firm selects one or both types of covenants. The marginal effects of each determinate are reported in Tables 5, and the marginal effect of each debt rating category is reported separately for comparison in Table 6. The marginal probability of selecting each class of covenant is calculated from the joint model and reported in the first two columns. The joint estimation of the model also allows us to report the joint probability of selecting neither class of covenant. These marginal effects are reported in the last column. The marginal probability of selecting each covenant is similar to

the single model case. The probability of including neither an investment nor a debt to cash flow covenant is predictably largest for high rated, investment grade firms.

Table 6 further tests the significance of the difference in the coefficients. For the investment regressions, the marginal probability of inclusion is significantly higher than the next highest rating group at at least the 10% level for four of the five categories. The trend for debt to cash flow covenants is significantly increasing and then decreasing for all rating groups at or above the 10 % level. Taken together, these results imply that significant non-monotonicity exists in the value and application of these covenants.

## 5 Conclusion

In this paper, we analyze the effectiveness of different types of debt covenants in mitigating the investment distortions caused by the agency problems associated with debt. By explicitly modeling these distortions in the context of firm control rights, we help to explain why bank debt contains both explicit investment restrictions and so called maintenance covenants which allow for bank intervention upon violation. Importantly, we demonstrate that the inclusion of covenants is not necessarily a monotonic function of firm financial risk and provide theoretical motivation for why this non-monotonicity exists.

By modeling the way in which stakeholders process information, we also shed light on how bank debt and bank relationships create value through debt covenants. We demonstrate how bank monitoring mitigates the agency costs of debt by increasing the value of contingent control. Since firm value is increased by the existence of these control provisions, closer monitoring paradoxically leads to greater use of cash flow covenants.

The non-price terms of debt contracting are an often neglected aspect of the cost of capital. In many respects, the overall cost of debt is influenced as much by its contractual restrictions and control provisions as its stated interest rate. These contractual details can tell us much about the costs and benefits of capital structure decisions and the wide variation in the choices made

by firms. This paper demonstrates an important channel through which these costs are shaped through efficient contracting. Future research in this area should provide insights into how financing decisions are made to shape the capital structure of firms.

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# A Appendix

## A.1 Proof of existence

In this appendix, we show that there is some  $k_0$  corresponding to each face value of debt such that  $c_L - F > -\frac{5}{4}$ . Since the lowest range for  $c_L - F$  that we generically consider in any of the analysis is  $c - F < -1$ , this confirms that each region we consider has a feasible face value of debt.

**Proposition 5.** *For every  $\delta \in [-\frac{5}{4}, \infty)$ , there exists a triple  $\{k_0, c_L, c_H\}$  such that, for at least one of the two cash flow realizations,  $c - F = \delta$  for the contract with no debt covenants.*

*Proof.* We can consider only the case where  $c_H = c_L$ , which is sufficient to establish the result. For  $c_H = c_L$ , the value of the debt claim is given by:

$$\frac{1}{9} (-2 - 2c_L^2 + (5 - 2F)F + 4c_L(1 + F)).$$

Setting this value equal to  $k_0$ , this gives a face value of debt of:

$$\frac{1}{9} (-2 - 2c_L^2 + (5 - 2F)F + 4c_L(1 + F)).$$

Thus, for  $c_L - 2 < k_0 \leq v_L + \frac{1}{8}$ , the debt contract is feasible in the sense that a real, positive face value of debt makes the debt claim equal to  $k_0$ . If  $k_0$  is too large, debt cannot be raised, while if  $k_0$  is sufficiently low the debt is safe and  $F = k_0$ . Evaluating the expression for the face value of debt at  $k_0 = c_L + \frac{1}{8}$ , we obtain  $c_L - F = -\frac{5}{4}$ . As  $c_L$  increases and  $k_0$  decreases this expression increases without bound.

□

## A.2 Proof of Proposition 1

*Proof.* We first solve for the simplest case, where  $c_H = c_L + \epsilon$  where  $\epsilon$  is vanishingly small. In this case  $c_H \approx c_L$ , but the realization of  $c_L$  is contractually distinguishable from  $c_H$ . For  $k_0 < c_L - 1$ ,



the face value of debt is exactly  $k_0$  and the debt is therefore always safe. Equity holders always make the first best investment decision.

For  $k_0 > c_L - 1$ , the debt is risky. First conjecture a  $k_0$  such that  $-1 < F - c < 0$ . The face value of debt under equity control, ( $k = \frac{4}{3} - \frac{1}{3}(c_L - F)$ ), is given by

$$\begin{aligned} \frac{1}{9} (-2 - 2c_L^2 + (5 - 2F)F + 4c_L(1 + F)) &= k_0 \\ \Leftrightarrow F &= \frac{1}{4} \left( 5 + 4c_L - 3\sqrt{1 + 8c_L - 8k_0} \right) \end{aligned}$$

This gives an expected value of the follow-on investment of

$$\frac{1}{16} \left( 3 - 4c_L + 3\sqrt{1 + 8c_L - 8k_0} + 4k_0 \right) \quad (11)$$

If control over the follow-on investment is given to the bank upon the realizing  $c_L$ , the investment  $k(c_L) = F - c_L$ . The face value of debt when control switches to the bank at  $c_L$  is given by:

$$\begin{aligned} \frac{1}{36} (-4 - 13c_L^2 + 28F - 13F^2 + c_L(8 + 26F)) &= k_0 \\ \Leftrightarrow F &= \frac{1}{13} \left( 14 + 13c_L - 6\sqrt{4 + 13c_L - 13k_0} \right) \end{aligned}$$

This gives an expected value of the follow-on investment of

$$\frac{2}{169} \left( -65c_L + 6 \left( 2 + \sqrt{4 + 13c_L - 13k_0} \right) + 65k_0 \right) \quad (12)$$

The inequality implied by equation (11) and equation (12), gives a threshold cash flow value of  $c_L = \frac{1}{9} (10 + 9k_0) - \frac{68\sqrt{2}}{81}$ . For cash flows above this value, the loss due to over-investment by the

entrepreneur when he is in control outweighs the loss due under-investment when the bank is in control.

□

### A.3 Proof of Lemma 3

*Proof.* The entrepreneur can capture no more than the full value of the firm. Therefore, the maximum possible threshold  $p_E$  below which the entrepreneur will prefer to mix is  $p_E = \frac{1}{2}$ , given by the solution to the socially optimal value in equation (7). Thus for any signal  $\beta$ , the entrepreneur's claim is maximized either by investing  $\beta$  or investing at the ignorant risk-shifting optimum of  $\frac{4}{3} - \frac{1}{3}\delta$ .

If the entrepreneur invests  $\beta$ , the expected value of his payoff will be as follows:

$$E[V_E] = \begin{cases} p_E (\max[\beta + \delta, 0]) + (1 - p_E)(\beta - \frac{1}{2}\beta^2 + \delta) & \text{if } \beta < \delta \\ p_E (\max[\beta + \delta, 0]) + (1 - p_E)\frac{1}{8}(8 + \delta - 3\beta)(\delta + \beta) & \text{if } \beta > \delta \end{cases}$$

If the entrepreneur invests  $\frac{4}{3} - \frac{1}{3}\delta$ , the expected value of his payoff will be:

$$E[V_E] = p_E \left( \max[2\beta - \frac{4}{3}(1 - \delta), 0] \right) + (1 - p_E)\frac{1}{6}(2 + \delta)^2$$

For all  $\beta < -\delta$ ,  $\max[\beta + \delta, 0] = \max[2\beta - \frac{4}{3}(1 - \delta), 0] = 0$ . Because  $(\beta - \frac{1}{2}\beta^2 + \delta) \leq \frac{1}{8}(8 + \delta - 3\beta)(\delta + \beta)$ , the following inequality must be satisfied for the entrepreneur to prefer investing  $\beta$ :

$$\frac{1}{8}(8 + \delta - 3\beta)(\delta + \beta) > \frac{1}{6}(2 + \delta)^2$$

This inequality can never be satisfied for  $\beta < -\delta \leq \beta^*$  so the entrepreneur will always invest the ignorant optimum.

For  $\beta > \frac{2}{3}(1 - \delta)$ ,  $\max[\beta + \delta, 0] > 0$  and  $\max[2\beta - \frac{4}{3}(1 - \delta), 0] > 0$ . For the entrepreneur to prefer an investment of  $\frac{4}{3} - \frac{1}{3}\delta$  the following inequality must be satisfied when  $\beta < \frac{4}{3} - \frac{1}{3}\delta$ :

$$p_E(\beta + \delta) + (1 - p_E)(\beta - \frac{1}{2}\beta^2 + \delta) < p_E(2\beta - \frac{4}{3}(1 - \delta)) + (1 - p_E)\frac{1}{6}(2 + \delta)^2$$

When  $\beta > \frac{4}{3} - \frac{1}{3}\beta$ , the following inequality must be satisfied:

$$p_E(\beta + \delta) + (1 - p_E)(\beta - \frac{1}{2}\beta^2 + \delta) < p_E(\frac{4}{3}(1 + \delta)) + (1 - p_E)\frac{1}{6}(2 + \delta)^2$$

Neither inequality can be satisfied for  $\beta > \frac{2}{3}(1 - \delta) \geq \beta^*$ , so the entrepreneur will always invest  $\beta$ .

For the remaining case  $-\delta < \beta < \frac{2}{3}(1 - \delta)$ , the following inequality must hold for the entrepreneur to invest  $\beta$ .

$$p_E(\beta + \delta) + (1 - p_E)\frac{1}{8}(8 + \delta - 3\beta)(\delta + \beta) \geq (1 - p_E)\frac{1}{6}(2 + \delta)^2$$

This is satisfied when  $\beta \geq \beta^* = \frac{4 - \delta + p\delta - 4\sqrt{-p(-2 + p - \delta + p\delta)}}{3 - 3p}$ , which simplifies to the expression in the lemma. □

#### A.4 Proof of Lemma 4

*Proof.* The payoff to the bank for any investment  $k$  is given by the following equation:

$$p_B(\min[\beta - |\beta - k| + c, F]) + (1 - p_B)(E[V_{Bu}]) \tag{13}$$

$$\text{where } E[V_{Bu}] = \begin{cases} F & k < c - F \text{ and } c - F > 0 \\ c + k - \frac{k^2}{2} & k < F - c \text{ and } c - F < 0 \\ F - \frac{1}{8}(k - c + F)^2 & k > F - c \text{ and } c - F < 0 \end{cases}$$

which is the unconditional value of the bank's claim when the signal is uniform noise.

If  $c - F > 0$ , the bank can realize the maximum payoff  $F$ , for sure, with any investment  $k < c - F$ .

If  $c - F < 0$  the bank's optimization problem reduces to

$$p_B(\min[\beta - |\beta - k| + c, F]) + \begin{cases} (1 - p_B) \left( c + k - \frac{k^2}{2} \right) & k < F - c \\ (1 - p_B) \left( F - \frac{1}{8}(k - c + F)^2 \right) & k > F - c \end{cases} \quad (14)$$

When  $\beta > F - c$ , equation (14) reduces to:

- $p_B(F) + 1 - p_B) \left( c + k - \frac{k^2}{2} \right)$  for all  $k \leq F - c \leq \beta$
- $p_B(\beta + k + c) + (1 - p_B) \left( F - \frac{1}{8}(k - c + F)^2 \right)$  for all  $F - c < k \leq \beta$
- and  $p_B(2\beta - k + c) + (1 - p_B) \left( F - \frac{1}{8}(k - c + F)^2 \right)$  for all  $\beta < k$

and the bank's claim is maximized at  $k = F - c$ . Alternatively, when  $\beta < F - c$ , equation (14) reduces to:

- $p_B(\beta + k + c) + (1 - p_B) \left( c + k - \frac{k^2}{2} \right)$  for all  $k \leq \beta$
- $p_B(2\beta - k + c) + (1 - p_B) \left( c + k - \frac{k^2}{2} \right)$  for all  $\beta < k \leq F - c$
- and  $p_B(2\beta - k + c) + (1 - p_B) \left( F - \frac{1}{8}(k - c + F)^2 \right)$  for all  $F - c < k$

The bank's claim in this case is maximized at  $k = \beta$ . □

## A.5 Proof of Proposition 2

*Proof.* For any  $p$  strictly less than one, the entrepreneur continues to discard signals of  $\beta$  which imply default at  $t = 3$ , but will place full weight on all signals which imply a positive profit. Thus, as  $p \rightarrow 1$ , the entrepreneur will invest  $\frac{4}{3} - \frac{1}{3}\delta$  for all  $\beta < -\delta$  and  $\beta$  otherwise. In this case, the value of the follow-on project at the socially optimal level of investment is 1 and the expected value under equity control is  $\frac{1}{12} (12 + 8\delta + \delta^2)$ .

In order for an ex-ante investment restriction to be valuable, the investment must be restricted to less than  $k = \frac{4}{3} - \frac{1}{3}\delta$  for any given cash flow outcome  $-2 < \delta < 0$ , since all investments above this

level imply the entrepreneur is investing the optimal level of investment  $\beta$ . The restriction must also be weakly greater than the unconditional optimum,  $k = 1$  since this is the best that can be achieved in the no-information case under the optimal investment covenant.

The value of the follow on project with the investment restriction  $k_{\max}$  is thus given by:

$$\begin{aligned} \int_0^{-\delta} (2\beta - k_{\max}) \frac{1}{2} d\beta + \int_{-\delta}^{k_{\max}} (\beta) \frac{1}{2} d\beta + \int_{k_{\max}}^2 (k_{\max}) \frac{1}{2} d\beta \\ = \frac{1}{4} (2k_{\max}\delta + \delta^2 + 4k_{\max} - k_{\max}^2) \end{aligned}$$

The investment restriction which maximizes the value of the firm is  $k_{\max} = 2 + \delta$  for  $-1 < \delta < 0$  and  $k_{\max} = 1$  for  $\delta \leq -1$ . This gives a firm value of  $1 + \delta + \frac{1}{2}\delta^2$  for  $-1 < \delta < 0$ ,  $\frac{1}{2}$  for  $\delta \leq -1$ , and 1 for  $\delta \geq 0$ .

The difference between the maximum restricted and unrestricted value of the follow on investment is given by

$$1 + \delta + \frac{\delta^2}{2} - \frac{1}{12} (12 + 8\delta + \delta^2) \tag{15}$$

and is negative for  $\delta > -\frac{4}{5}$ .

If the bank is uninformed, the optimal transfer of control occurs when  $\frac{1}{12} (12 + 8\delta + \delta^2) = -\delta - \frac{1}{2}(-\delta)^2$  implying a  $\delta_{cf} = \frac{6}{7}$ . Thus, in the presence of cash flow covenants, investment covenants may be value increasing only for  $-\frac{6}{7} < \delta < -\frac{4}{5}$ .

From Lemma 4, the value of investment is increasing in the informativeness of the bank's signal. As the bank's signal increases the threshold  $\delta$  for which transfer is optimal also increases. For  $p_b = \frac{1}{2}$ , the cash flow threshold  $\delta_{cf} > -\frac{4}{5}$  and thus an investment covenant is never optimal.  $\square$

## A.6 Proof of Proposition 3

*Proof.* We first prove that the threshold value of  $c_L$  is decreasing in  $p_E$ .

From Lemma 3, the investment decision of the firm is determined by the threshold  $\beta^* = \frac{4-\delta+p\delta-4\sqrt{-p(-2+p-\delta+p\delta)}}{3-3p}$ . For all possible signals  $\beta^* < \beta < 2$  the expected value of the follow on project will be  $p_E(\beta) + (1-p_E)(\beta - \frac{1}{2}\beta^2)$ . For all possible signals  $0 < \beta < \beta^*$ , the expected value of the follow on project will be  $p_E(2\beta - (\frac{4}{3} - \frac{1}{3}\delta)) + (1-p_E)(\frac{1}{18}(4-\delta)(2+\delta))$ , where  $\delta$  is evaluated at  $c_L$ .

This gives an unconditional expectation for the value of the follow on project, prior to the realization of the signal, as follows:

$$E(V) = \begin{cases} \frac{1}{3}(1+2p) & \text{for } \delta \geq \delta^* = \frac{4+8p-\sqrt{48p(2+p)}}{1-p} \\ \frac{1}{324(p-1)^2} [124 + 24\delta - 15\delta^2 + 2\delta^3 - \\ \quad 6(16 + 8\delta + 2\delta^2 + \delta^3)p + \\ \quad 3(196 + 88\delta + 23\delta^2 + 2\delta^3)p^2 - \\ \quad 2(36 + 120\delta + 21\delta^2 + \delta^3)p^3 + \\ \quad 32(-7 + \delta)p^{3/2}\sqrt{2 + \delta - (1 + \delta)p} - \\ \quad 32(10 + \delta)p^{5/2}\sqrt{2 + \delta - (1 + \delta)p}] & \text{for } \delta < \delta^* \end{cases} \quad (16)$$

From equation (17), the value of the investment is 0 when  $\delta = -2$  and is increasing in  $\delta$  up to  $\delta^* > 0$ .

From Lemma 4, the value of the follow on investment under bank control for  $-2 < \delta < 0$  is given as:

$$-\delta \left( \delta^2 \frac{1}{6}(1-p) + \delta \left( \frac{1}{2}p - \frac{3}{4} \right) - 1 \right) \quad (18)$$

The value of the investment is 0 when  $\delta = 0$  and is decreasing in  $\delta$ . This establishes a crossing condition for the two values. Since the value under equity control is increasing in  $p_E$  for all  $\delta$  and

the value under bank control is decreasing in  $\delta$ , the threshold realization of  $c = F + \delta$  must also be decreasing in  $p_E$ .

By extension, since the value under bank control is increasing in  $p_B$  and the value under firm control is increasing in  $\delta$ , the threshold realization of  $c$  must be increasing in  $p_B$ .

□

Table 1: Summary Stats

This table reports summary statistics for covenant provisions in our loan contract sample and the financial ratios of the firm at the time of the initiation of the loan. Loan covenant variables take on a value of one if the loan contract has at least one covenant in the category and zero otherwise. The probability of default is calculated from a logit model as a function of eight firm specific factors. Asset tangibility is the net property, plant, and equipment divided by total assets. R&D expense ratio is the value of research and development expense divided by assets. Total firm assets and total deal amount are reported in millions of dollars. Maturity is maturity, in months, of the longest maturity loan in each deal. Revolver takes on a value of one if a revolving line of credit is present in the deal. Acquisition takes on a value of one if the deal's primary purpose is stated as funding an acquisition. Secured takes on a value of one if the loan is secured.

	Mean	Median	Std. Dev.	Min	Max
Investment Restriction	0.17	0.00	0.38	0.00	1.00
Debt to Cash Flow Covenant	0.47	0.00	0.50	0.00	1.00
Interest Coverage Covenant	0.66	1.00	0.47	0.00	1.00
Pr(Default)	0.0010	0.0000	0.0057	0.0000	0.1065
Tangibility	0.38	0.34	0.26	0.00	0.96
R&D Ratio	0.01	0.00	0.02	0.00	0.28
Assets - Total	5883	1958	13040	69	242223
Total Deal Amount	756	400	1417	4	30000
Maturity	49	60	24	2	120
Revolver	0.78	1.00	0.41	0.00	1.00
Acquisition	0.17	0.00	0.38	0.00	1.00
Secured	0.53	1.00	0.50	0.00	1.00



Table 2: Correlation Table

Pairwise correlations for the inclusion of each covenant and the control variables.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
(1) Investment Restriction	1.00											
(2) Debt to Cash Flow Covenant	0.23	1.00										
(3) Interest Coverage Covenant	0.20	0.45	1.00									
(4) Pr(Default)	0.14	-0.05	-0.08	1.00								
(5) Tangibility	-0.10	-0.14	-0.11	0.01	1.00							
(6) R&D Ratio	-0.01	0.01	-0.07	-0.03	-0.23	1.00						
(7) Assets - Total	-0.13	-0.10	-0.18	-0.02	-0.04	0.01	1.00					
(8) Total Deal Amount	-0.08	-0.01	-0.11	-0.05	-0.00	0.01	0.47	1.00				
(9) Maturity	0.12	0.25	0.16	-0.14	-0.03	-0.04	-0.13	0.06	1.00			
(10) Revolver	0.08	0.09	0.14	0.03	-0.00	-0.03	-0.15	-0.05	0.39	1.00		
(11) Acquisition	0.03	0.10	0.05	-0.07	-0.00	0.00	-0.08	0.16	0.12	-0.05	1.00	
(12) Secured	0.40	0.24	0.23	0.15	-0.02	-0.08	-0.25	-0.15	0.21	0.15	0.09	1.00

Table 3: Covenants and Debt Ratings

This table breaks loans into groups based on the S&P debt rating of the firm at the time the loan was initiated. Each cell represents the fraction of loans in each group which include at least one debt covenant in the category.

	Investment Restriction	Debt to Cash Flow Covenant	Interest Coverage Covenant
A or better	0.002	0.143	0.354
BBB	0.054	0.408	0.622
BB	0.257	0.672	0.821
B	0.341	0.507	0.718
CCC or worse	0.491	0.283	0.528
Total	0.173	0.467	0.660

Table 4: Probit Model - Single Model Results

The results of a probit model estimating the probability that a loan will include an investment restriction, a debt to cash flow covenant, an interest coverage covenant, or either a debt to cash flow or interest covenant. Marginal effects at the mean of each continuous variable are reported. Standard errors are Huber-White corrected for heteroscedasticity and clustered at the firm level.

	Investment	Debt to CF	Coverage	DtCF or Coverage
BBB (d)	0.248** (0.086)	0.315*** (0.044)	0.207*** (0.035)	0.202*** (0.029)
BB (d)	0.317*** (0.093)	0.460*** (0.044)	0.292*** (0.037)	0.280*** (0.031)
B (d)	0.409*** (0.120)	0.327*** (0.056)	0.175*** (0.043)	0.171*** (0.036)
CCC or worse (d)	0.604*** (0.152)	0.220* (0.091)	0.155* (0.064)	0.133* (0.055)
Tangibility	-0.0934*** (0.026)	-0.289*** (0.061)	-0.257*** (0.055)	-0.230*** (0.053)
R&D Ratio	0.152 (0.212)	0.305 (0.506)	-1.423** (0.461)	-0.859* (0.415)
Log(Assets)	-0.00407 (0.007)	-0.0854*** (0.018)	-0.0818*** (0.014)	-0.0744*** (0.013)
Revolver (d)	0.00580 (0.014)	-0.0751* (0.031)	0.0458 (0.027)	0.0311 (0.025)
Log(Loan Amount)	0.00452 (0.007)	0.0905*** (0.017)	0.0380** (0.015)	0.0506*** (0.014)
Acquisition (d)	-0.0133 (0.012)	0.0204 (0.030)	-0.00779 (0.030)	0.00392 (0.028)
Maturity	0.000385 (0.000)	0.00282*** (0.001)	0.000490 (0.001)	0.000352 (0.001)
Secured (d)	0.189*** (0.022)	0.0757* (0.035)	0.0699* (0.031)	0.0321 (0.030)
Pr(Default)	1.733* (0.748)	-2.582 (2.270)	-7.995*** (2.113)	-5.747** (1.863)
>1 loan in last 5 years (d)	-0.0132 (0.011)	0.0957*** (0.022)	0.0809*** (0.022)	0.0844*** (0.020)
Observations	2947	2947	2947	2947

Marginal effects; Standard errors in parentheses

(d) for discrete change of dummy variable from 0 to 1

\*  $p < 0.05$ , \*\*  $p < 0.01$ , \*\*\*  $p < 0.001$

Table 5: Multivariate Probit Model

The results of a bivariate probit model estimating the probability that a loan will include either a capex restriction or a debt to cash flow covenant. Marginal effects at the mean of each continuous variable are reported. Column (1) reports the marginal probability of inclusion of an investment restriction. Column (2) reports the marginal probability of a debt to cash flow covenant. Column (3) reports the joint probability that neither covenant type is included. Standard errors are Huber-White corrected for heteroscedasticity and clustered at the firm level.

	(1)	(2)	(3)
	Investment	Debt to Cash Flow	Neither
BBB (d)	0.248** (0.082)	0.316*** (0.044)	-0.357*** (0.045)
BB (d)	0.318*** (0.089)	0.460*** (0.044)	-0.493*** (0.043)
B (d)	0.408*** (0.115)	0.326*** (0.056)	-0.394*** (0.053)
CCC or worse (d)	0.607*** (0.146)	0.222* (0.090)	-0.374*** (0.066)
Tangibility	-0.0960*** (0.025)	-0.286*** (0.061)	0.300*** (0.060)
R&D Ratio	0.181 (0.214)	0.329 (0.510)	-0.369 (0.510)
Log(Assets)	-0.00558 (0.007)	-0.0850*** (0.018)	0.0814*** (0.017)
Revolver (d)	0.00439 (0.014)	-0.0766* (0.031)	0.0706* (0.030)
Log(Loan Amount)	0.00510 (0.007)	0.0902*** (0.017)	-0.0862*** (0.016)
Acquisition (d)	-0.0138 (0.012)	0.0212 (0.030)	-0.0154 (0.029)
Maturity	0.000268 (0.000)	0.00283*** (0.001)	-0.00274*** (0.001)
Secured (d)	0.189*** (0.021)	0.0761* (0.035)	-0.137*** (0.035)
Pr(Default)	1.656* (0.729)	-2.592 (2.285)	1.868 (2.173)
>1 loan in last 5 years (d)	-0.0120 (0.010)	0.0948*** (0.022)	-0.0842*** (0.022)
Observations	2947	2947	2947

Marginal effects; Standard errors in parentheses

(d) for discrete change of dummy variable from 0 to 1

\*  $p < 0.05$ , \*\*  $p < 0.01$ , \*\*\*  $p < 0.001$

Table 6: Multivariate Probit Model - Group Marginal Effects

This table reports the marginal probability of each rating group taking on a given covenant. The effects are reported as distinct estimates for each group rather than relative to a group mean. The model contains all control variables, whose output is suppressed. As such, each category represent the marginal probability of selection for each group after controlling for the other existing determinants of covenant choice. Also reported are the results of a Wald test on the significance of the difference of each of the marginal coefficients. The table reports the Chi-squared significance level rejecting that the difference of the two coefficients is zero.

	(1) Investment	(2) Debt to Cash Flow	(3) Neither
A or better	0.0120 (0.010)	0.210*** (0.031)	0.784*** (0.031)
BBB	0.132*** (0.021)	0.473*** (0.025)	0.488*** (0.024)
BB	0.182*** (0.014)	0.619*** (0.024)	0.347*** (0.023)
B	0.207*** (0.018)	0.467*** (0.032)	0.465*** (0.031)
CCC or worse	0.327*** (0.059)	0.347*** (0.065)	0.491*** (0.057)
p(A-BBB = 0)	0.000	0.000	0.000
p(BBB-BB = 0)	0.060	0.000	0.000
p(BB-B = 0)	0.226	0.000	0.000
p(B-CCC = 0)	0.037	0.065	0.644

Standard errors in parentheses

p(X-Y) reports the significance level of a Wald test on the difference of the coefficients on X and Y, either X-Y if X>Y or Y-X if Y>X

\*  $p < 0.05$ , \*\*  $p < 0.01$ , \*\*\*  $p < 0.001$