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Uncertainty and debt covenants

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Abstract I examine the use of financial covenants when contracting for debt under uncertainty. Uncertainty, in the context of this study, is a lack of information about future economic events and their consequences for the borrower's creditworthiness. I examine the implications of ex ante uncertainty that is resolved by information received following loan initiation but prior to maturity. I argue that financial covenants, by transferring control rights ex post, provide a trigger for creditor-initiated renegotiation when the borrower is revealed to be of low credit quality. Using a large sample of private loans, I predict and find that financial covenant intensity is associated with greater uncertainty. I also revisit the agency-based explanation for covenant use and find that this uncertainty explanation is robust to various controls for agency conflicts.

Keywords Debt covenants · Uncertainty · Debt contracting · Agency theory

JEL Classification D86 · G300 · G320 · M41

1 Introduction

In debt contracting, many questions remain unanswered upon loan initiation. Will the borrower adopt the optimal investment policy? Will the operating choices that the borrower makes maximize the return on these investments? Will the contractually stipulated payments of principal and interest be made? In addressing these questions, the literature has typically followed the agency paradigm and focused on how debt contract design addresses moral hazard problems (Jensen and Meckling 1976). The

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lender may have other concerns, however, about the borrower (beyond the borrower's actions) that are likely to be important when entering the loan contract. For example, the borrower's future performance, which determines creditworthiness and ability to repay the loan, is a function of both the borrower's actions and the future state of nature. Thus, as part of due diligence when considering a prospective borrower, the creditor will seek information about the possible future states of nature and how these will affect the borrower's creditworthiness.

When screening the borrower during initial contracting, the creditor will draw upon a variety of sources, including information from any past negotiations with the borrower, examination of the borrower's historical data, private information received directly from the borrower, and the creditor's own proprietary knowledge of industry and macroeconomic trends. Some information, however, is unknown and unknowable, even by the most skilled and informed creditor. This information can include unpredictable economic events, unexpected changes in industry demand, or the consequences of geopolitical upheaval. These events, which are likely to affect the borrower's creditworthiness, defy prediction in any conventional sense: perhaps the likelihood of the event is too remote, there is no discernible historical pattern, or the implications of the event (should it happen) on the borrower are too difficult to project.[1] If this information affects the borrower's ability to repay the loan, its absence is relevant for contracting. Thus, in this study, I develop and test theory on how the lack of ex ante information, which I term uncertainty, motivates the use of financial covenants in private loans agreements. This uncertainty explanation is a departure from the action-focused, agency-based perspective typically used in debt contracting to explain covenant use.

I develop a stylized analytic framework that highlights the contracting issue related to uncertainty. An entrepreneur (the borrower) has a risky investment project but lacks funds to make the investment. An investor (the creditor) has sufficient funds but lacks the expertise to manage the project and so lends funds to the borrower. The creditor gathers information to determine the ultimate payout of the project; because the project is risky, in some cases, the borrower will be able to repay the loan but, in others, the borrower will default. The creditor's central challenge is to determine the appropriate contract to offer. As a benchmark case, I consider an informationally complete debt contract for which the creditor knows the possible amount and timing of the project's cash flows with certainty. In this case, an objectively determined distribution of the investment project returns leads to a contract on which the borrower and creditor will agree. Moreover, this contract provides no scope for renegotiation, as both parties understand and agree on the full set of possible future outcomes of the borrower.

A more realistic setting is an informationally incomplete contract for which some information about the investment project's cash flows is unknown during initial contracting. Expanding the analytic framework, I assume that whatever information is not known ex ante may be revealed through an information signal after loan initiation (but prior to maturity); in other words, the information signal potentially resolves the

[1] Gleick (1987), referring to analytical attempts to predict future economic events, notes, "In practice, econometric models proved dismally blind to what the future would bring" (pg. 20).

uncertainty. In addition, I assume that the creditor and borrower know that the signal may be coming, though neither knows what information it will reveal. Having incomplete information during initial contracting makes it difficult to determine the most efficient contract terms. Furthermore, if both parties know that the information signal could be coming, they will be hesitant to contract before the signal's receipt, out of concern that the information will reveal the contract to favor the other party. This comprises the central contracting issue related to uncertainty: how can the borrower and creditor agree to a contract ex ante knowing that new, contract-relevant information might be revealed?

The solution to this conflict is to explicitly allow for renegotiation in the initial contract. Although the borrower has the implicit ability to renegotiate at any time, the creditor needs an explicit contractual provision to be able to force renegotiation.[2] Specifically, the contract must include a provision that shifts control rights when the creditor has incentive to change the contract terms, that is, in those cases when the information received after contract initiation reveals the borrower to be of low creditworthiness, relative to the level upon which the contract was originally written. I contend that financial covenants serve this purpose.

Financial covenants require the borrower to maintain a threshold level of an accounting-based metric, such as interest coverage or net worth. If the borrower fails to maintain the threshold, the loan enters technical default, and the creditor receives control rights. By their structure, financial covenants facilitate creditor-initiated renegotiation. When contracting under uncertainty, the borrower and creditor agree to initial contract terms based on the available (but incomplete) information. Subsequently, the covenant accounting metric reveals whether the borrower has had good or poor performance. Good performance allows the borrower to remain in compliance with the covenant and the loan to continue with the initial terms. Poor performance triggers the financial covenant, granting the creditor control rights and providing the option to force renegotiation and to adjust the terms to reflect the borrower's revealed creditworthiness. Because greater uncertainty exacerbates this conflict, I predict financial covenant use increases with uncertainty about the borrower.

I test this prediction empirically using a large sample of loans from the LPC/Dealscan database. I measure uncertainty about the borrower with a variety of metrics from the literature (Bloom 2009), including those measured at the borrower-level (stock trading volume, whether the borrower has an S&P rating, and analyst forecast dispersion), industry-level (cross-sectional variability in stock returns and profitability growth), and economy-level (variability of GDP forecasts and multi-factor productivity and the VIX, as described later). I measure financial covenant intensity as the number of financial covenants used in each loan package. Loan-level regressions show a significant association between financial covenant use and the borrower- and industry-level uncertainty measures but not those measured at the economy-level. These results are robust to a variety of alternative measurements and specifications.

I also contrast the predictions based on uncertainty with a common prediction in the literature: agency theory (Smith and Warner 1979). I identify a setting—

[2] I discuss the differences in borrower- and creditor-initiated renegotiations in Section 3.3.

the Sept. 11, 2001, attacks—whereby uncertainty exogenously increased without a clear corresponding increase in agency conflicts. I find that financial covenant use subsequently increased. In contrast, inclusion of dividend restrictions and collateral requirements, two contract provisions that directly address agency conflicts, did not change. These results suggest that the uncertainty explanation advanced in this paper differs from the agency arguments commonly made in the literature and provides a complementary explanation for these commonly used provisions.

This study expands the literature on the the role of financial covenants in private debt contracts. It complements recent studies that consider covenants trip wires triggered by poor borrower performance (Dichev and Skinner 2002), examine the association between accounting information and credit downgrades (Ball et al. 2008), and measure the ability of accounting information to capture borrower performance (Christensen and Nikolaev 2012). This study formalizes the intuition of these studies—that accounting provides information about the borrower's financial condition—and illustrates how financial covenants address uncertainty. Moreover, the results suggest an alternative role for financial covenants that differs from the agency cost explanation (Smith and Warner 1979) typically cited in the literature. My study presents a new perspective, whereby the conflict is not over the borrower's action but rather the lack of contract-relevant information during initial loan contracting. This departure from agency represents an innovation from past research and contributes to the growing literature on incomplete contracts and accounting information (Christensen et al. 2016). This study is, to the best of my knowledge, the first to examine how borrowers and creditors address uncertainty in contract design. I expect that the uncertainty predictions of this study, coupled with the predictions of agency, provide a more comprehensive perspective on debt contracting.

2 Background

2.1 Relation to existing literature

Many studies on debt covenants derive their predictions from agency theory (Jensen and Meckling 1976; Smith and Warner 1979). Specifically, when a borrower assumes risky debt from a creditor, there is incentive to take actions that transfer wealth to shareholders at the expense of the creditor. These transfers are possible because the operating and investing choices of the borrower are unobservable and hence cannot be included in the contract. Much of the early research on covenants is based on the findings of Smith and Warner (1979), who examine negative (restrictive) covenants. More recent work by Garleanu and Zwiebel (2009) uses an agency framework to explain financial covenant use and design. They argue that the contingent transfer of control rights limits the costs to the creditor when there are agency conflicts of the type described by Smith and Warner (1979).

My explanation for the use of financial covenants differs from agency-based explanations in several important ways. First, the predictions of agency are driven by moral hazard, whereby the borrower takes some adverse action; in the model of Smith and Warner (1979), the borrower pays a dividend, incurs additional debt, or alters investment policy. My study does not rely on moral hazard, as the borrower is not assumed to take an adverse action (nor are covenants needed to prevent these actions ex ante.) Second, the agency literature is based on asymmetric information between the borrower and creditor, with the borrower having an information advantage over the creditor. This information advantage is theorized to provide opportunity and incentive for the borrower to make transfers (Garleanu and Zwiebel 2009) or lead to adverse selection (Demiroglu and James 2010). I do not assume that the borrower has an information advantage. Rather, I assume that the borrower and creditor can costlessly and credibly share information, so that during initial contracting both parties have identical (although potentially incomplete) information sets. Put another way, I conjecture that the borrower and creditor are *equally ignorant* of future shocks and their implications on borrower creditworthiness.

The theory that I present relates closely to incomplete contracting theory (Roberts and Sufi 2009a; Christensen et al. 2016). In the incomplete contracting setting, there is information that is relevant to the contract but, for a variety of reasons, cannot be included in the contract. For example, Aghion and Bolton (1992) model a setting in which an entrepreneur (that is, the borrower) has the expertise to exploit an investment opportunity but lacks capital to invest. The investor (that is, the creditor) has the capital and, to earn a monetary return, is willing to lend to the borrower. The optimal future action by the borrower is state contingent. However, the parties cannot contract on the future state of nature ex ante because either the future state is too difficult to predict or it is prohibitively costly to specify a slate of actions tied to all possible future states. As such, the contract is incomplete, and the contracting parties must agree to conditional allocations of control rights to force the borrower to take the correct action.

I apply an incomplete contracting framework to a simple debt setting. Similar to the case modeled by Aghion and Bolton (1992), the contractual incompleteness is due to a lack of knowledge about the future state of nature; specifically, the borrower and creditor do not know and cannot predict the implications of future shocks on the value of the borrower's investment (which correspondingly dictates the borrower's capacity to service his debt). Here, my theory deviates from that of Aghion and Bolton (1992) and related studies in that I model the value of the borrower's investment as *state contingent* but not *action contingent*. In the setting I describe, the contracting tension is the lack of information itself due to uncertainty about the value of the borrower's investment. This issue is distinct from the agency cost of debt as traditionally formulated (for example, Jensen and Meckling (1976)), in which the conflict is due to moral hazard (or sometimes adverse selection, as by Demiroglu and James (2010)). That is, I describe a new debt contracting conflict based on the unavailability of information ex ante. In Section 3, I provide an analytical framework that describes how contractual incompleteness of this type would affect the initial loan contracting as well as renegotiation. Before doing so, I provide a formal definition of uncertainty, the key construct of this study.

2.2 Uncertainty

Knight (1921) defines uncertainty as outcomes that are both unknown and unknowable. If a future outcome is uncertain, history is no guide to prediction, and the person who is trying to make the prediction is simply guessing. Alchian (1950) defines uncertainty as lack of foresight coupled with human beings' inability to process and solve problems with many variables. He argues that uncertainty threatens the idea of optimization that guides much of economic thought because it is impossible to optimize when the best outcome is not known and cannot be measured.

A more recent line of empirical research examines how uncertainty affects a variety of outcomes, including economic productivity and stock returns. Epstein and Wang (1994) argue that uncertainty leads to indeterminate prices, resulting in greater volatility. Bloom (2009) tests the link between uncertainty shocks and various measures of economic output and finds that these shocks lead to a temporary decline in firm investment and hiring. Jiang et al. (2005) finds that uncertainty leads to lower expected returns, while Zhang (2006) shows that uncertainty exacerbates price drift.

A related line of literature examines *ambiguity*, which is conceptually similar to Knightian uncertainty, as ambiguity refers to unknown parameters in an outcome distribution. Many of these studies focus on the equity investment context. Epstein and Schneider (2008) show that, under ambiguity, investors will assume the worst about prices. Caskey (2009) shows that ambiguity-averse investors may prefer aggregate information signals. Hou (2015) applies theory on ambiguity to accounting. This study shows that discretionary accruals quality is priced by investors, and, furthermore, the effect cannot be mitigated through diversification due to the ambiguous nature of discretionary accruals.

Although many of these papers do not provide a rigorous conceptual definition of uncertainty, their empirical measurements typically capture uncertainty as the second moment of some set of measures, for example, cross-sectional variance in GDP forecasts by professional forecasters. The idea of uncertainty (as defined by Knight (1921)) as leading to a wider range of outcomes is suggested by Bernanke (1983), who notes, "A natural specification of increased uncertainty is a 'spread' of the [future] outcomes" (pg. 92). So although these literatures have evolved separately, their conceptual underpinnings are similar.

I adopt a view of uncertainty similar to that of Knight (1921) and related papers. In the context of debt contracting, uncertainty refers to future events that affect the borrower's creditworthiness, that is, capacity to make payments of principal and interest. These events are either impossible to predict or their value implications are too difficult to assess ex ante. As such, uncertainty is a key source of contractual incompleteness, and the degree of uncertainty will dictate the extent to which the contract is incomplete.

Any discussion of uncertainty also must consider its conceptual counterpart, risk. There are two ways to distinguish uncertainty from risk, each based on the work of Knight (1921). First, under risk, probabilities are known, while, under uncertainty, probabilities are unknown. In the context of debt contracting, a borrower's investment project has stochastic outcomes: the value of the investment will vary based on the future state of nature. If the distribution of the project's value is known, the payoff is purely risky. If the distribution is unknown, the payoff is uncertain. Second, risk lends itself to objective measurement, while uncertainty does not. Following Savage

(1954), any attempt to quantify probabilities under uncertainty cannot be objective because no objective measure exists.[3]

I differentiate risk and uncertainty in the manner described above, whereby risk implies known, objectively measured distributions, and uncertainty indicates unknown distributions that cannot be objectively measured. This distinction is important because new information and renegotiation have a role under uncertainty but not under risk. In empirical tests, I control for risk with a variety of control variables, thus allowing me to isolate the effects of uncertainty proxies.

3 Hypothesis development

I develop the following analytic framework to analyze the role of uncertainty in debt contracting. At time $t = 0$, an entrepreneur with no internal financial resources (the borrower) has an investment opportunity that costs I. The borrower approaches an investor (the creditor), who lacks the ability to exploit the investment opportunity but has I to lend. The borrower is risk-neutral and solely interested in the financial return of the project; that is, there are no nonmonetary inputs to the borrower's utility. The creditor is also risk-neutral and motivated solely by financial return.

Assume the borrower gets I from the creditor and invests in the project. At a future period m, the project will mature and yield a final cash flow V. For simplicity, I assume that V follows a simple Bernoulli distribution: V is V_H (the high-state outcome) with probability p, and V_L (the low-state outcome) with probability $1 - p$. Finally, I include the periodic discount rate τ_m, which captures the time value of money; the expected value will be lower the longer it takes for the final cash flow to be realized. This leads to an expected value $E[V] = \frac{1}{1+\tau_m}[pV_H + (1 - p)V_L]$.

I make three assumptions about the distribution of V. First, I assume that $E[V]$ is greater than I and sufficiently high that the borrower will always make the investment (that is, no underinvestment (Smith and Warner 1979)). Second, I assume that $V_H > I > V_L$. In other words, the higher value outcome is greater than the initial investment, implying full repayment when V_H is realized. Similarly, the lower value outcome is less than the initial investment, so that, in some cases, the borrower defaults. In short, the loan is risky. Finally and importantly, I assume that the outcome of the project is state contingent but not borrower action contingent. This means that the cash flow V realized at maturity is not a function of the borrower's action but, rather, due to other forces outside of the borrower's control.[4] As such, the problem I

[3]This perspective on Knightian uncertainty is pervasive in the literature; however, there is disagreement as to whether it is consistent with Knight's original intent (LeRoy and Singell 1987).

[4]This assumption is not meant to suggest that moral hazard problems (the main agency conflict to which covenant use is attributed) do not exist or are not important in contracts; rather, in my analysis, agency conflicts related to moral hazard are not the focus. I expect that moral hazard problems are relevant in debt contracts but are addressed through some means other than financial covenants (for example, negative covenants, such as dividend restrictions, or some other aspect of contract design or capital structure). More broadly, the different provisions in debt contracts are likely in place to address different types of contracting conflicts.

describe is different from the moral hazard-based, action-driven agency cost of debt that is often used to describe the use of financial covenants (Smith and Warner 1979).

3.1 Contracting under certainty

To analyze contract design under different information assumptions, consider the case in which the distribution of V is common knowledge; that is, during initial contracting, the borrower and lender know and agree on the values of p, V_H, and V_L as well as the payoff period m and discount rate τ_m. I term this case certainty. Note that certainty in this case does not imply that the outcome (that is, the realized value of V) is known ex ante. Rather, it means that the parameters of V's distribution are known. Therefore, even though the distribution of V is known with certainty, the borrower's outcome is still risky. The certainty case serves as a benchmark to evaluate cases where some of these parameters are not known.

The contract that the creditor will offer is a function of the expected payoff from making the loan. This differs from the expected value of the borrower's investment (noted above) due to asymmetric payoffs to creditors. The creditor expects to receive V_L when the low state (that is, the liquidation value of the borrower) is realized. In the high state, the creditor expects to receive full repayment of the loan principal I plus interest. Defining r as 1 plus the interest rate, the creditor's expected payoff can be written: E[payoff] = $\frac{1}{1+\tau_m}[pIr + (1-p)V_L]$. As long as $V_H > I$, the actual value of V_H does not affect the creditor's expected payoff.

The risk-neutral creditor prices the loan by equating the loan principal I to the discounted expected payoff, leading to the pricing expression:

$$r = \frac{1}{pI}[(1+\tau_m)I - (1-p)V_L]. \tag{1}$$

This pricing expression has certain expected properties: the interest rate decreases with p and V_L and increases with I and τ_m. When the creditor knows the loan parameters with certainty, that is, the loan is *informationally complete*, r can be objectively calculated. Due to the common knowledge assumption, the borrower should agree to this objective r. Furthermore, in this case, there is no subsequent scope for renegotiation. This is because all information is priced; only *unexpected* information should motivate renegotiation. Thus, although V is stochastic (that is, risky), both the creditor and borrower agree on the likelihood of future outcomes, the value of these outcomes, and their timing. No future event can change this assessment, so the ex ante interest rate of the loan will be satisfactory to both parties over the term of the loan.

3.2 Contracting under uncertainty

In reality, it is unlikely that the contracting parties know the parameters of the pricing expression with certainty; there are many events that are hard to predict, and their impact on different aspects of the loan are prohibitively difficult to determine. Going forward, I examine the implications of contracting under *uncertainty*, for which some information about the future value of the investment project is unknown.

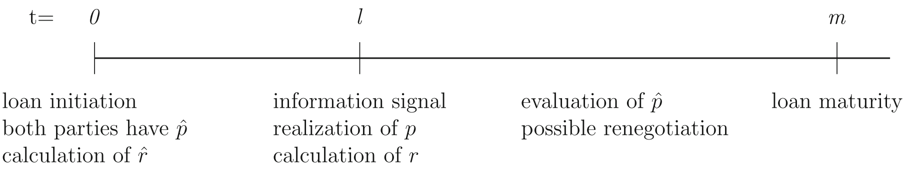

Fig. 1 Timeline

Recall the distinction between risk and uncertainty and their implications for contracting. Risk, as described above, implies stochastic outcomes but known distributional parameters. This means that a risky distribution can be fully described and contracted on ex ante. Uncertainty, in contrast, refers to stochastic outcomes in which some relevant parameter of the distribution of outcomes is not known ex ante. In terms of debt contracting, uncertainty results from economic shocks and other impossible-to-predict future events. To examine the uncertainty case, I expand the analytic framework from above. The borrower still receives funds totaling I from the creditor to invest in the project. Under uncertainty, some information about the investment project (and thus future realizations of V) is missing ex ante. In other words, this contract is *informationally incomplete*.

I make several assumptions about uncertainty and how it affects debt contracting. First, I assume that the borrower and creditor have the same initial information set, so that any information that is missing ex ante is missing to both the creditor and the borrower; that is, there is no information asymmetry.[5] Second, I assume that the information, were it available, could affect loan contract terms. Specifically, I assume that the information informs the contracting parties about the parameters of the distribution of V but not about the specific value of V that will be realized.[6] Third, I assume that this contract-relevant information may be revealed to the contracting parties after loan initiation but before maturity. Specifically, I assume there may be an information signal in period l, where $m > l > 0$. Fourth, any information revealed in the signal is unambiguous, in the sense that the borrower and creditor will interpret its implications for the value of the investment in the same way. Finally, during initial contracting the borrower and lender both know that a signal could arrive in period l. In short, the contracting parties agree that the contract is incomplete ex ante and agree that contract-relevant information could be received, but they cannot contract on that information because its implications are not known. I present a timeline of contracting in Fig. 1.

How does this anticipated ex post information signal affect loan contracting? As an example, consider loan pricing where V_L, V_H, and τ_m are all known, the amount

[5] Asymmetric information between the borrower and lender plays a clear role in contracting theory (Demiroglu and James 2010). To focus on symmetric uncertainty between the borrower and creditor, I assume that their information endowment is similar.

[6] As an example, consider a scenario in which there are two possible ranges for an outcome but which range the outcome belongs to is uncertain ex ante: Range 1 is [10, 20], and Range 2 is [25, 35]. If a signal reveals a low outcome, it will be clear that the outcome will draw from Range 1, but the signal will not provide information on where the outcome will be in Range 1.

and timing of I are fixed, but p is uncertain. In other words, the true value of p is not known at $t = 0$, but both the borrower and creditor know that this value could be revealed by an information signal in period l. One way to address this uncertainty would be to delay loan initiation until period l, when any additional information would be revealed. If we assume that the investment opportunity is available only at $t = 0$, however, this is not a sufficient solution.

As an alternative to not executing the contract (and forgoing the expected rents that it would generate), the contracting parties must agree to contract on an estimated value $\hat{p}$. $\hat{p}$ is a negotiated value of p. As such, it reflects the relative negotiating power of borrower and creditor. Under the assumption of a competitive lending market with multiple borrowers and creditors, I assume that the negotiated $\hat{p}$ is fair, in that neither contracting party will feel ex ante that the other party is at a significant advantage in the contract. This estimate $\hat{p}$ will be used in Eq. 1 to generate a contracted interest rate $\hat{r}$ for the loan. Because the borrower and creditor negotiate and agree about the value of $\hat{p}$ (and all other parameters are assumed to be known), they also will agree on $\hat{r}$. If, in period l, information reveals p to be equal to $\hat{p}$, both parties should be satisfied with the contract.[7] If, however, the revealed p differs enough from $\hat{p}$, either the creditor or the borrower will be unsatisfied with the contracted rate $\hat{r}$ ex post. For example, if $p > \hat{p}$, then the borrower is revealed to be more creditworthy than the original loan terms indicate and will want a different contract ex post. Similarly, if $p < \hat{p}$, then the creditor is undercompensated for the revealed creditworthiness of the borrower and will be unsatisfied with the original contract.

Because the true p is not revealed until period l, neither the borrower nor the lender will know whether the negotiated loan will be satisfactory; they will know only that the loan terms *could* be unsatisfactory. This knowledge will make both the borrower and lender hesitant to enter into the contract, as each will be concerned that the negotiated terms will turn out to be more favorable to the other contracting party based on the information revealed in period l. This effect will be increasing in the severity of uncertainty.[8]

3.3 Renegotiation

One solution to the above-described problem is to allow the contracting parties to change loan terms contingent on the signal received in period l. Stated another way, ex post differences between r and $\hat{r}$ provide the scope for renegotiation in the loan (Nikolaev 2016). Similarly, Roberts (2015) shows that uncertainty is associated with a higher frequency of renegotiations of private loans. The nature of the information revealed in period l will determine the incentive to renegotiate and whether uncertainty needs to be addressed contractually.

If $\hat{p} < p$, the borrower is revealed to be of higher credit quality than the initial loan terms suggest; from the example above, $\hat{r}$ is higher than r would have been

[7] More precisely, p must be sufficiently close to $\hat{p}$ that the cost of changing the contract is higher than the benefit to either party of changing it.

[8] Uncertainty is more severe when there are more unknown parameters or when there is relatively little information available about a parameter (or parameters.)

had the ex post information been contractible. In this case, the borrower will want to renegotiate the loan ex post. The creditor, however, will not: the high $\hat{r}$ (relative to r) provides the creditor with extra interest income without additional risk. Because prepayment restrictions are seldom used in private loans (Roberts and Sufi 2009b), the borrower can plausibly threaten to exit the loan when the information is received and the borrower's type is revealed. Specifically, the borrower can find financing at the more favorable rate r from a different creditor and use the proceeds to repay his old loan. The original creditor has no recourse in this case and will agree to renegotiate the loan at period l, incorporating the new information, to retain the borrower's business. This means that the creditor should consent to the borrower's desire to renegotiate, and thus there is no need to address uncertainty contractually in this case. Moving back toward contract initiation, the borrower will feel comfortable contracting under uncertainty even without contractual provisions to address it, knowing that action can be taken if needed.

If $\hat{p} > p$, the borrower is revealed to be of lower credit quality than the value embedded in the original loan terms. In this case, the creditor will be unsatisfied with $\hat{r}$ because this rate is too low based on the borrower's true creditworthiness.[9] The borrower, however, will favor the loan terms: the contracted rate is lower than it would have been had the ex post information been known, meaning the borrower benefits while the creditor bears the cost of the excess riskiness. This situation is recognized by Roberts and Sufi (2009b), who note, "An ex post reduction in cash flow leads to a situation where the borrower is better off under the initial terms of the contract and therefore has little incentive to restructure the contract in a manner reflecting the ex post deteriorating of credit quality" (pg. 161). Whereas the borrower could prepay the loan with new funds, the creditor cannot force the borrower to repay the outstanding loan absent a contractual provision. As a result, the creditor will demand a contractual provision that allows renegotiation of loan terms conditional on the information received in period l, specifically when p is revealed to be lower than $\hat{p}$. Absent such a provision, the creditor will be hesitant to enter a loan contract under uncertainty.

Financial covenants, such as interest coverage, net worth, or leverage, require the borrower to maintain a threshold level of an accounting measure. If the borrower fails to maintain the threshold, the loan enters technical default. In technical default, the creditor receives controls rights, which provide the option to attempt action against the borrower. To avoid such actions, the borrower can agree to renegotiate the loan, yielding concessions that favor the creditor. Consistent with this, Beneish and Press (1993) find that covenant violations are commonly associated with creditor-favorable renegotiated outcomes (for example, increase in interest spread or decrease in loan amount). In fact, borrowers renegotiate loans in anticipation of financial covenant violations, also leading to creditor-favorable outcomes (Roberts and Sufi 2009b).

[9] In this study's framework, the primary lever for the creditor in setting loan terms is the interest rate; this is due to the assumption of a single investment project with a single cash flow. In reality, the creditor will be pricing the borrower as a set of investments. These investments will have multiple cash flows, and the amount and the timing of these flows will be uncertain. As such, the creditor could vary multiple loan terms, such as maturity, collateral, and restrictive provisions, when setting the contract.

In structuring a covenant to facilitate creditor-initiated renegotiation, the initial interest rate of the loan is set to $\hat{r}$, reflecting the negotiated estimate $\hat{p}$. The covenant is indexed to some accounting-based measure that correlates with the borrower's financial condition. The covenant threshold is tested periodically; the covenant accounting measure provides information about the borrower's creditworthiness. The covenant threshold is set to be triggered when borrower performance is poor and the borrower is revealed to be less creditworthy than the original interest rate implies. If the borrower fails to maintain this threshold, the loan enters technical default: the creditor receives control rights and can attempt to renegotiate the loan to an interest rate consistent with the borrower's revealed creditworthiness.[10] If the covenant is not triggered, the borrower maintains control rights and the initial interest rate stays in place. In sum, financial covenants, through technical default, facilitate the transfer of control rights to the creditor when the borrower is revealed to have low creditworthiness, relative to the ex ante contract terms. This contingent transfer is more valuable when the contract is informationally incomplete and uncertainty is more severe. This study's hypothesis, stated in alternative form, is:

> H1: Greater uncertainty about the future value of the borrower will lead to greater use of financial covenants.

4 Sample and data

4.1 Sample

I draw the sample from the LPC/Dealscan database, collecting private loan agreements initiated between January 1995 and December 2013. Sample agreements must be U.S. dollar-denominated loans to U.S.-domiciled borrowers. I require each loan-observation to have covenant data available from Dealscan, from the dataset "FinancialCovenant" or "NetWorthCovenant." This sample selection yields a total of 22,123 observations.[11]

I collect accounting data from Compustat (quarterly), stock trading and returns data from CRSP (daily), and analyst data from I/B/E/S. I match the Dealscan data to

[10] A more general interpretation is that the creditor wants a covenant that is triggered when some parameter of the loan (for example, interest rate, loan amount, or maturity) is revealed to be suboptimal. The creditor will attempt to renegotiate these terms following (or in anticipation of) technical default. This illustrates an important difference between a pre-negotiated loan parameter changes (for example, performance pricing) and the more general transfer of control rights; if it is unknown which parameter(s) will be revealed as suboptimal, it is difficult to specify a menu of changes ex ante. I examine performance pricing in greater detail in Section 6.2.1.

[11] Drucker and Puri (2009) find that some Dealscan loan-observations that report no financial covenants are data errors and that covenants are in fact included in these loans. To include these cov-lite loans, but avoid data errors, I collect a subsample of loans that have SEC filings available but no covenants reported on Dealscan. I hand-collect loan agreements from SEC filings (from 10-K, 10-Q, and 8-K filings) to verify which have no covenants; I include 429 cov-lite loans in the sample. The results from the analysis are not sensitive to inclusion of these observations.

these data, using the matching table from Chava and Roberts (2008).[12] Dealscan is organized on the facility- and package-level. Facilities are individual loans, such as term loans and revolving lines of credit. Packages are groups of facilities issued under the same loan agreement, generally at the same time and by the same lead lender. All the facilities in a package are governed by the same set of covenants, and thus the analysis in this study is at the package-level. The final sample, after matching to other data, consists of 17,768 loan package-observations.

4.2 Variable measurement

This study's hypothesis links uncertainty to the use of financial covenants. One way to measure covenant use is to separate borrowers with no financial covenants from those with at least one. There are few loan packages with zero covenants, however, resulting in insufficient variation. Therefore, instead of using a dichotomous variable, I use a count of covenants in each loan package, *Financial Covenant Intensity*, as the dependent variable.[13]

Because uncertainty is a multi-dimensional construct, I use a wide range of proxies in empirical tests. I start with three borrower-level variables to measure uncertainty specific to the individual borrowers. *Volume* is the average trading volume of the borrower's equity for the 25 days preceding loan initiation. Uncertainty can lead to disagreement among investors, which can spur increased equity trading (Karpoff 1987). *Unrated* is an indicator variable with a value of 1 if the borrower has no S&P senior unsecured debt rating. *Forecast Dispersion* is the standard deviation of analysts earnings forecasts scaled by the average forecast value. Uncertainty can lead to disagreement in the estimates of analysts, leading to greater dispersion (Zhang 2006). These proxies capture uncertainty about the borrower from the perspective of investors, rating agencies, and equity analysts, respectively; I predict each to be positively associated with financial covenant use.

The second set of proxies measures uncertainty at the industry-level. Following (Bloom 2009), I use two measures. I measure quarterly profit growth as the quarterly change in operating income scaled by the average total assets. I then calculate *Profit Growth Uncertainty* as the cross-sectional standard deviation of quarterly profit growth for each quarter and two-digit NAICS industry. This proxy is matched to loans by industry, year, and quarter. *Stock Return Uncertainty* is the cross-sectional standard deviation of stock returns, measured for each month and two-digit NAICS

[12] I thank Michael Roberts for making these data public. I use the link file available in November 2014, which includes links for packages up to August 2012. For loans with an active date after August 2012, I hand-match loans to Compustat by borrower name.

[13] Murfin (2012) notes that financial covenant intensity captures only one dimension of the package's covenant portfolio; three other aspects—the covenants' initial slack (initial value less threshold value of the covenant accounting measure), the variance of the underlying accounting measure, and the correlation between accounting measures—also contribute to the frequency of technical default. To the extent that initial slack and correlation vary between borrowers and packages, this confounds covenant intensity as a proxy for overall covenant protection. However, covenant intensity is commonly used in the literature (Bradley and Roberts 2004; Billett et al. 2007; Christensen and Nikolaev 2012). I examine alternative measures of covenant use, incorporating slack and correlation between measures, in a robustness test.

industry. This proxy is matched to loans by industry, year, and month. These proxies capture uncertainty within an industry related to accounting and equity market performance. Because uncertainty increases with each of these metrics, I predict a positive association between each and financial covenant use.

The third set of proxies measures economy-wide uncertainty. Two of these measures follow (Bloom 2009). *MFP Growth Uncertainty* is the across-industry standard deviation of the year-on-year change in multifactor productivity (MFP). I collect MFP data from the Bureau of Labor Statistics (BLS), which measures productivity based on five input factors (capital, labor, energy, materials, and purchased services: the KLEMS measure). The BLS measures MFP by industry based on NAICS codes.[14] The standard deviation is calculated on an annual basis across the BLS industry groupings. The second measure from Bloom (2009) is *GDP Forecast Uncertainty*. This measure is based on the Livingston Survey of GDP reported by the Philadelphia Federal Reserve Bank.[15] The survey collects GDP forecasts from a set of economists; forecast uncertainty is the standard deviation of the estimates, calculated semi-annually. The third and final measure of uncertainty is the *VIX*. The *VIX* is the CBOE's traded market volatility index and captures expectations of future stock market volatility (Drechsler 2010). I predict a positive association between each of these metrics and financial covenant use. These proxies are matched to loans by year (*MFP Growth Uncertainty*), half-year (*GDP Forecast Uncertainty*), and quarter (*VIX*). I provide precise definitions of each variable in the Appendix.

The number of observations available for each variable depends on the unit of observation and data availability. The borrower-level metrics have between 16,908 and 17,768 observations. Industry-level variables are measured at specific time intervals, either quarterly or monthly. This leads to 1,312 observations for *Profit Growth Uncertainty* and 2,467 observations for *Stock Return Uncertainty*. Economy-wide variables are measured by time, leading to relatively few observations: 79 for *VIX* (monthly), 40 for *GDP Forecast Uncertainty* (semi-annually), and 20 for *MFP Growth Uncertainty* (annually). Since the dataset is constructed on the loan level, I also present the descriptive statistics in Table 2, Panel A, at the loan level.

Some of the empirical tests include borrower-level control variables, each potentially associated with financial covenant use. *Leverage* is the ratio of total debt to total assets. *EBITDA* is the ratio of earnings before interest, taxes, depreciation, and amortization to average total assets. This controls for operating performance, which indicates the sufficiency of cash flows to cover debt payments. *Size* is the natural logarithm of the market value of the firm (the market value of equity plus the book value of debt). *Market-to-Book* is the ratio of the market value of the firm to the book value of the firm and is a common proxy for growth opportunities and agency conflicts. *EDF*, the distance to default (based on Merton (1974)), measures default risk based on the borrower's leverage and asset volatility.

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[14] The BLS sorts firms by sectors based on two-, three-, and four-digit NAICS codes; the classification can be found at http://www.bls.gov/mfp/mprdload.htm.

[15] https://www.philadelphiafed.org/research-and-data/real-time-center/livingston-survey

4.3 Descriptive statistics

I present descriptive data on the sample and variables in Tables 1 and 2. In Table 1, Panel A, I present statistics on *Financial Covenant Intensity*. This table shows that financial

Table 1 Financial covenant & loan data

Panel A: Financial Covenants

Financial Covenant Intensity	**Frequency**	**Percent**
0	429	2.4%
1	3,519	19.8%
2	6,321	35.6%
3	5,019	28.3%
4	2,004	11.3%
5	416	2.3%
6	59	0.3%
7	1	0.0%
Total	17,768	

Panel B: Loans and Financial Covenant Intensity by Year

Year	**Loans**	**Percent**	**Financial Covenant Intensity**
1995	595	3.4%	2.69
1996	1,336	7.5%	2.71
1997	1,574	8.9%	2.64
1998	1,299	7.3%	2.69
1999	1,039	5.9%	2.64
2000	944	5.3%	2.50
2001	1,000	5.6%	2.40
2002	1,111	6.3%	2.43
2003	1,080	6.1%	2.46
2004	1,204	6.8%	2.32
2005	1,160	6.5%	2.21
2006	1,033	5.8%	2.12
2007	863	4.9%	1.97
2008	617	3.5%	2.00
2009	425	2.4%	1.97
2010	554	3.1%	1.96
2011	698	3.9%	1.92
2012	613	3.5%	1.82
2013	623	3.5%	1.76

Panel A shows the number of financial covenants per package for the sample period. Panel B shows the number of loan packages per year, the percentage of the sample that year comprises, and the average number of financial covenants in loans for that year

Table 2 Descriptive statistics

Variable	Obs.	Mean	Standard Deviation	Min.	1st Quartile	Median	3rd Quartile	Max.
Panel A: Uncertainty Variables								
Volume	16,908	6.918	6.862	0.092	2.485	4.899	8.786	48.784
Unrated	17,768	0.581	0.493	0.000	0.000	1.000	1.000	1.000
Forecast Dispersion	17,768	0.057	0.250	0.000	0.000	0.007	0.029	4.998
Profit Growth Uncertainty	17,335	0.075	0.093	0.006	0.028	0.049	0.079	0.933
Stock Return Uncertainty	17,624	0.151	0.060	0.041	0.112	0.145	0.182	0.782
MFP Growth Uncertainty	17,768	0.051	0.011	0.028	0.044	0.045	0.060	0.071
GDP Forecast Uncertainty	17,768	0.010	0.004	0.004	0.008	0.010	0.013	0.031
VIX	17,768	20.773	7.235	10.420	15.450	19.710	24.420	59.890
Panel B: Control Variables								
Leverage	15,916	0.284	0.208	0.000	0.119	0.265	0.407	1.111
EBITDA	13,872	0.133	0.111	−0.610	0.082	0.130	0.187	0.608
Size	15,445	6.768	1.930	−0.171	5.407	6.801	8.104	12.693
Market-to-Book	17,019	1.713	1.077	0.514	1.105	1.382	1.913	14.804
EDF	10,531	3.964	4.420	−48.897	1.265	3.038	5.555	77.486

This table presents descriptive statistics on the proxy measures for uncertainty and other control variables. VOLUME is the 25-day average number of shares traded, scaled by total shares outstanding. UNRATED is an indicator variable with a value of one if the firm has no S&P debt rating and zero otherwise. FORECAST DISPERSION is the standard deviation of analysts' estimates of the borrower's earnings, measured in the quarter preceding loan initiation. PROFIT GROWTH UNCERTAINTY is the cross-sectional standard deviation in profit growth, measured by quarter and industry (based on the two-digit NAICS code). STOCK RETURN UNCERTAINTY is the cross-sectional standard deviation of stock returns, measured by month and industry. MFP GROWTH UNCERTAINTY is the cross-sectional standard deviation in multi-factor productivity growth, measured on an annual basis. GDP FORECAST UNCERTAINTY is the cross-sectional standard deviation of GDP forecast estimates in the Livingston Survey (reported by the Philadelphia Federal Reserve Bank), measured on a semi-annual basis. VIX is the 30-day average value of the CBOE Market Volatility Index. LEVERAGE is the ratio of total long-term debt to total assets. EBITDA is the ratio of earnings before interest, taxes, depreciation, and amortization scaled by average total assets. SIZE is the natural logarithm of the market value of the firm (market value of equity plus the book value of debt). MARKET-TO-BOOK is the ratio of the market value of the firm to total assets. EDF is the distance-to-default, based on the Merton (1974) model and calculated following (Hillegeist et al. 2004). All continuous variables are winsorized at the top and bottom 1%

covenant use is pervasive, with only 2.4% of loans not having financial covenants. Across the entire distribution, the index ranges from 0 to 7, with an average of 2.35 financial covenants per loan package. In Table 1, Panel B, I present annual statistics on loans and financial covenants. The two columns show the number of loans per year and percentage share of the entire sample. The pattern suggests that loan issuance is pro-cyclical; new loan issuance declined around the recession in the early 2000s, and even more dramatically during the Great Recession of 2007–2009 (with only a slight recovery in volume through the end of this study's sample period.) The third column shows the average number of financial covenants per year. Although there is some variability, the trend is largely downward. This is consistent with evidence in Demerjian (2011), who shows a declining trend in financial covenant use over time. I present descriptive statistics for the study variables in Table 2, with uncertainty variables in Panel A and control variables in Panel B.

5 Empirical tests and results

5.1 Descriptive analysis

To start analyzing the relation between financial covenant use and uncertainty, I present correlations in Table 3. The table includes *Financial Covenant Intensity* and the eight uncertainty proxies described in the prior section. The table shows that *Financial Covenant Intensity* has relatively strong ($> 5\%$) positive correlations with *Volume*, *Unrated*, and *Stock Return Uncertainty*, and more muted correlations ($< 5\%$) with *Forecast Dispersion*, *MFP Growth Uncertainty*, *GDP Forecast Uncertainty*, and *VIX*. The only strong negative correlation is between *Financial Covenant Intensity* and *Profit Growth Uncertainty*. The table also presents the correlations between the eight uncertainty metrics. Although many of the correlations are statistically significant, in economic terms the associations are relatively low; the average absolute correlation is just 0.076 (0.120 for the rank correlations). This suggests that the measures are capturing distinct aspects of uncertainty.

To better understand the relationship between different types of uncertainty and covenant use, I rank uncertainty measures into quintiles by uncertainty category (borrower, industry, and economy) and measure the average level of financial covenant use. For the quintile sorting, I start by ranking each uncertainty variable and scaling by the total observations (yielding a scaled rank from 0 to 1).[16] Then, I add these scaled ranks together to get a sum-rank for observations in each uncertainty category. I sort these sum-ranks into quintiles and measure the average of *Financial Covenant Intensity*.

I present the results of this descriptive analysis in Fig. 2. The first panel shows results for borrower-level uncertainty. The figure shows a monotonic increase in *Financial Covenant Intensity* across the quintiles, with pronounced jumps between the first and second and again between the fourth and fifth. The second panel shows results for industry-level uncertainty. There is again an upward trend from the first through third quintiles and then a slight decline in the fourth quintile. The pattern still broadly indicates increasing financial covenant use in higher quintiles. I present the results for economy-level uncertainty in the third panel. This figure reveals a different pattern from the prior two; specifically, rather than increasing financial covenant use over the quintiles, the pattern is more an inverted-U shape, with the highest value in the third quintile. In total, this descriptive analysis suggests that firm- and industry-level uncertainty metrics have a positive association with financial covenant use but that economy-level measures do not.

[16] Because *Unrated* is an indicator variable, this gets a score of 0 or 1, with no ranking or scaling necessary.

Table 3 Correlations

		Firm-Specific			Industry-Level		Economy-Level		
	[1] Financial Covenant Intensity	[2] Volume	[3] Unrated	[4] Forecast Dispersion	[5] Profit Growth Uncertainty	[6] Stock Return Uncertainty	[7] MFP Growth Uncertainty	[8] GDP Forecast Uncertainty	[9] VIX
[1]		0.06	0.20	0.00	−0.05	0.12	−0.02	0.04	0.03
[2]	0.09		−0.09	0.07	0.12	−0.01	0.04	0.05	0.02
[3]	0.21	−0.18		−0.04	−0.06	0.15	−0.01	0.05	0.05
[4]	0.10	0.30	−0.28		0.10	−0.01	0.00	0.00	0.02
[5]	−0.04	0.17	−0.02	0.09		0.03	−0.04	−0.06	−0.04
[6]	0.15	−0.07	0.17	−0.11	0.28		0.19	0.14	0.25
[7]	−0.02	0.01	−0.02	−0.02	0.11	0.20		0.13	0.35
[8]	0.05	−0.02	0.06	−0.04	−0.08	0.12	0.07		0.03
[9]	0.06	−0.06	0.07	−0.08	0.00	0.36	0.38	0.02	

This table presents correlations between the uncertainty variables. VOLUME is the 25-day average number of shares traded, scaled by total shares outstanding. UNRATED is an indicator variable with a value of one if the firm has no S&P debt rating and zero otherwise. FORECAST DISPERSION is the standard deviation of analysts' estimates of the borrower's earnings, measured in the quarter preceding loan initiation. PROFIT GROWTH UNCERTAINTY is the cross-sectional standard deviation in profit growth, measured by quarter and industry (based on the two-digit NAICS code). STOCK RETURN UNCERTAINTY is the cross-sectional standard deviation of stock returns, measured by month and industry. MFP GROWTH UNCERTAINTY is the cross-sectional standard deviation in multi-factor productivity growth, measured on an annual basis. GDP FORECAST UNCERTAINTY is the cross-sectional standard deviation of GDP forecast estimates in the Livingston Survey (reported by the Philadelphia Federal Reserve Bank), measured on a semi-annual basis. VIX is the 30-day average value of the CBOE Market Volatility Index. The number of observations in each cell ranges from 16,908 to 17,768 depending on the availability of the underlying variables

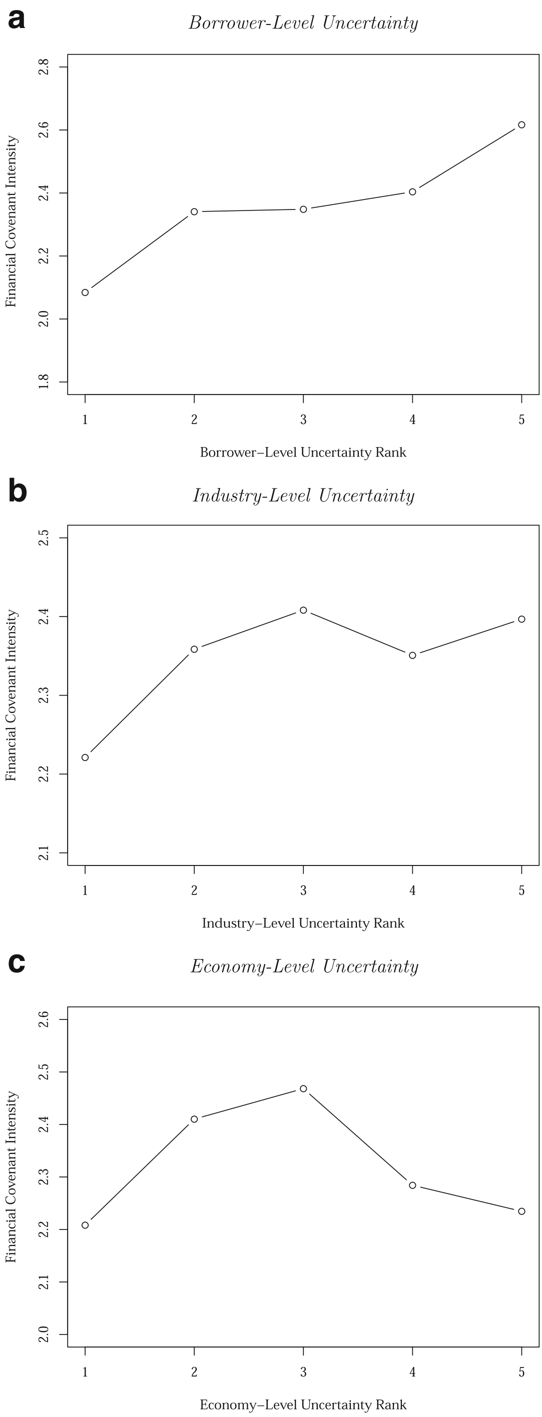

Fig. 2 Financial covenant intensity and uncertainty measures (quintile sorts). This figure illustrates the relation between financial covenant intensity and uncertainty. Panel A presents the relation between financial covenant intensity and firm-level uncertainty measures (Volume, Unrated, and Forecast Dispersion). I start by ranking each variable and scaling by the number of observations, yielding a value between zero and one. I take the sum of all three variables and get a sum-rank, which I sort into quintiles. Finally, I measure the average number of financial covenants included in each quintile and present this data in the figure. Panel B presents the relation between financial covenant intensity and industry-level uncertainty measures (Profit Growth Uncertainty and Stock Return Uncertainty), and Panel C presents the relation between financial covenant intensity and economy-level uncertainty measures (MFP Growth Uncertainty, GDP Growth Uncertainty, and VIX)

5.2 Regression analysis

I start the formal tests with loan-level analysis, examining all eight uncertainty measures and financial covenant use in individual loans. I test H1 using the following panel regression:

$$FinancialCovenantIntensity_j = f(\alpha + \boldsymbol{\beta} Uncertainty_j + \boldsymbol{\Gamma} Controls_j + \tau_t + \iota_i + \varepsilon). \quad (2)$$

Because *Financial Covenant Intensity* is a count variable, the regression uses a negative binomial function. I test three specifications of Eq. 2. The first includes the three borrower-level uncertainty measures (*Volume*, *Unrated*, and *Forecast Dispersion*) and the controls. Because the uncertainty measures are calculated on the borrower-level, I include fixed effects for industry (two-digit NAICS) and time (year). In the second specification, I include the two industry-level uncertainty measures (*Profit Growth Uncertainty* and *Stock Return Uncertainty*) and the controls. Because the uncertainty measures are industry-level, I include only time fixed effects. In the third specification, I include the three economy-level uncertainty measures (*MFP Growth Uncertainty*, *GDP Forecast Uncertainty*, and *VIX*) and the controls. I include industry but not time fixed effects, as the uncertainty proxies are measured periodically.

I present the regression results in Table 4, Panel A. The table shows coefficient estimates and Z-statistics (clustered by borrower and year to address cross-sectional and intertemporal correlation). The first column shows results for the borrower-level uncertainty variables. Each of the coefficients is positive and significant at the 1% level, consistent with the prediction that uncertainty is associated with use of financial covenants. The control variables show that borrowers who have high leverage and strong financial performance have more financial covenants, on average, while large borrowers and borrowers with a high market-to-book ratio on average have fewer.

The second column shows regression results for the industry-level uncertainty variables. Like the borrower-level variables, both are positively and significantly associated with the number of financial covenants, further supporting the link between financial covenant use and uncertainty. The third column presents results using the economy-level variables. In contrast to the prior sets of measures, these variables do not have a significant association with uncertainty. This suggests that uncertainty due to borrower and industry features is associated with financial covenant use but that there is no association between economy-wide uncertainty and financial covenant use. The nonresult for economy-wide uncertainty metrics is consistent with the literature. Roberts (2015) examines renegotiations of private loan contracts and finds that borrower-level uncertainty is positively associated with renegotiation likelihood, while economy-level uncertainty has no association. Thus the nonresult is consistent with my contention that financial covenants serve as a trigger for renegotiation.

I assess the economic significance of these results in two ways. First, I multiply the marginal effect of each explanatory variable by its standard deviation (except for *Unrated*, which is not continuous); this captures how much a one standard deviation shift in the value of that variable affects the number of financial covenants. I report the results in the fourth column of Table 4, Panel A. *Volume* has an economic effect of 0.073; that is, if the level of *Volume* shifts up one standard deviation, the average firm will have 0.073 more financial covenants. Given an average of 2.346 financial covenants per loan package, this corresponds to an increase of 3.1%. For the other significant variables, the significance ranges from 1.3% to 2.4%. The economic significance of *Unrated* is 0.176; this means that firms with no rating have, on average, 0.176 more financial covenants. Not surprisingly, the economic effects

Table 4 Regressions of uncertainty measures on financial covenant intensity

Panel A: Regression Results

Variable	**Pred. Sign**	**(1)**	**(2)**	**(3)**	**(4)**
Volume	+	**0.033***** **(4.36)**			**0.073**
Unrated	+	**0.078***** **(4.27)**			**0.176**
Forecast Dispersion	+	**0.055***** **(3.83)**			**0.030**
Profit Growth Uncertainty	+		**0.193***** **(3.50)**		**0.035**
Stock Return Uncertainty	+		**0.428***** **(3.67)**		**0.057**
MFP Growth Uncertainty	+			**0.435** **(0.25)**	**0.010**
GDP Growth Uncertainty	+			**0.075** **(0.03)**	**0.002**
VIX	+			**0.000** **(0.15)**	**0.006**
Leverage		0.165*** (4.13)	0.100** (2.55)	0.149*** (3.62)	
EBITDA		0.604*** (8.77)	0.773*** (10.28)	0.726*** (10.16)	
Size		−0.062*** (−9.68)	−0.077*** (−13.22)	−0.085*** (−13.48)	
Market-to-Book		−0.020 ∗ ∗ (−2.36)	−0.014 (−1.62)	−0.013 (−1.19)	
EDF		0.003** (2.57)	0.002** (2.23)	0.003** (2.21)	
Constant		1.178*** (13.07)	1.134*** (23.59)	1.340*** (10.12)	
Year-Quarter Fixed Effects		Yes	Yes	No	
Industry Fixed Effects		Yes	No	Yes	
Observations		7,989	7,846	8,063	

Table 4 (continued)

Panel B: Model Fit Analysis

	(1)	**(2)**	**(3)**
Full Model	0.219	0.181	0.180
Controls & Fixed Effects	0.208	0.178	0.181
Difference	0.011	0.003	−0.001
Percentage	5.3%	1.7%	−0.6%

This table presents the main regression results. Panel A presents multivariate regression results. The response variable in each regression is FINANCIAL COVENANT INTENSITY, the number of financial covenants used in the loan package. Since the response is a count variable, I use negative binomial regression. VOLUME is the 25-day average number of shares traded, scaled by total shares outstanding. UNRATED is an indicator variable with a value of one if the firm has no S&P debt rating and zero otherwise. FORECAST DISPERSION is the standard deviation of analysts' estimates of the borrower's earnings, measured in the quarter preceding loan initiation. PROFIT GROWTH UNCERTAINTY is the cross-sectional standard deviation in profit growth, measured by quarter and industry (based on the two-digit NAICS code). STOCK RETURN UNCERTAINTY is the cross-sectional standard deviation of stock returns, measured by month and industry. MFP GROWTH UNCERTAINTY is the cross-sectional standard deviation in multi-factor productivity growth, measured on an annual basis. GDP FORECAST UNCERTAINTY is the cross-sectional standard deviation of GDP forecast estimates in the Livingston Survey (reported by the Philadelphia Federal Reserve Bank), measured on a semi-annual basis. VIX is the 30-day average value of the CBOE Market Volatility Index. LEVERAGE is the ratio of total long-term debt to total assets. EBITDA is the ratio of earnings before interest, taxes, depreciation, and amortization scaled by average total assets. SIZE is the natural logarithm of the market value of the firm (market value of equity plus the book value of debt). MARKET-TO-BOOK is the ratio of the market value of the firm to total assets. EDF is the distance-to-default, based on the Merton (1974) model and calculated following (Hillegeist et al. 2004). All continuous variables are winsorized at the top and bottom 1%. Column (4) presents the economic effects of the uncertainty variables, calculated as the change in FINANCIAL COVENANT INTENSITY for a one standard deviation change in the uncertainty metric. Panel B includes comparisons in adjusted R^2 from ordinary least squares regressions for the full model (including all explanatory variables, controls, and fixed effects) and a model with only controls and fixed effects. The table also reports the differences between the adjusted R^2s for the models and the percentage difference. The columns reflect the different specifications as reported in Panel A. *** and ** indicate statistical significance at the 1% and 5% levels, respectively (two-tailed tests)

of the economy-level variables are low, ranging from 0.08% to 0.4%. As a benchmark, the economic effect of the control variables (untabulated) ranges from 1.2% (*Distance to Default*) to 11.1% (*Size*).

As a second test of economic significance, I compare the adjusted R^2s from regressions for the full model (uncertainty variables, controls, and fixed effects) and from a model with just the controls and fixed effects. The differences in the adjusted R^2s capture the incremental explanatory power of the uncertainty variables. I report these results in Table 4, Panel B. For the first specification (firm-level uncertainty metrics), the adjusted R^2 of the model with just controls and fixed effects is 0.208. The full model has an adjusted R^2 of 0.219, an improvement of 0.011 or 5.3%. For the second specification, the improvement is 0.003 or 1.7%. In the third specification, the adjusted R^2 actually declines by 0.001. These findings suggest that firm- and industry-level uncertainty measures have an economically meaningful effect on financial covenant use.

For robustness, I test three variants of the main regression specification. In the first, I include five loan-level controls in addition to the borrower-level controls.[17] I do not include them in the main regression because loan terms are jointly determined, potentially leading to measurement error due to endogeneity. Second, I run the main regression specification excluding *EDF*. Although *EDF* has been shown to be a superior measure of default risk (Hillegeist et al. 2004; Bharath and Shumway 2008), its calculation is data intensive; including *EDF* drops the sample size for the main regressions by approximately 40%. Therefore I exclude it to ensure that the results are not driven by sample selection related to availability of *EDF*. Third, I replace *Financial Covenant Intensity* with *PViolate*. *PViolate* is a measure of aggregate covenant strictness developed by Demerjian and Owens (2016). This measure uses all 15 Dealscan covenants and incorporates their slack, measurement variance, and the covariance between different measures to estimate a single metric that captures the expected likelihood of covenant violation on the loan package-level. In untabulated analysis, I find that inferences are essentially unchanged; the only differences are that the sign on *Forecast Dispersion* is positive but insignificant, and the coefficient on *VIX* is positive and significant (p-value: 0.052) when *PViolate* is the response variable.

An additional concern in the main empirical tests is matching loan-level variables (for example, covenant data and controls) to variables with different units of measurement (for example, industry- and economy-level variables.) To ensure that the results are robust to these measurement differences, I run aggregate-level analysis using separate regressions for each industry or economy uncertainty variable. For example, I measure *GDP Forecast Uncertainty* semi-annually; thus I calculate the average *Financial Covenant Intensity* (and the average controls) for each semi-annual period. I run the regression for each semi-annual period (a total of 40 in this example). I run similar regressions for each time and industry-time grouping. The untabulated results show similar patterns as those reported in Table 4, Panel A; the industry-level uncertainty metrics have positive, significant coefficients, while the economy-level metrics have insignificant signs.

The regressions in Table 4, Panel A, include *EDF* as a control for risk. Risk and uncertainty, however, are related concepts; both are based on the idea of stochastic outcomes, with a wider range of outcomes indicating both greater risk and greater uncertainty. This makes differentiating risk and uncertainty with empirical measures difficult. It is unlikely that including control variables for risk in multivariate regression fully controls for this issue. To address the influence of risk more directly, I use regression to create a set of uncertainty measures orthogonalized to risk. Specifically, I run each of the uncertainty measures through the following ordinary least square (OLS) regression:

$$\begin{aligned} UncertaintyMeasure_j = {} & \alpha + \beta_1 EDF + \beta_2 Rating + \gamma_1 Leverage + \gamma_2 Size \\ & + \gamma_3 \textit{Market-to-Book} + \tau_t + \iota_i + \epsilon. \end{aligned} \tag{3}$$

[17]The controls include the number of lenders in the loan's syndicate, an indicator for whether the loan has a covenant that restricts capital expenditures, an indicator for performance pricing, an indicator for collateral, and the loan's maturity.

I run a regression for each of the uncertainty measures to extract risk. *EDF* and *Rating* are the two main proxies for risk; *Rating* is defined as the firm's S&P senior unsecured debt rating, on a scale from 1 (AAA) to 22 (D).[18] Other variables also have possible associations with risk; thus I include them. Year and industry indicators capture time-varying aspects of risk that are not captured by the other variables and are included based on the measurement of the uncertainty variable. The regressions (untabulated) vary in explanatory power, with R^2s that range from 0.8% (*GDP Forecast Uncertainty*) to 48.6% (*Volume*), suggesting variation in the degree to which these measures capture risk. In addition, *EDF* is significant in each regression but *Forecast Dispersion* and *GDP Forecast Uncertainty*, and *Rating* is significant for all but *GDP Forecast Uncertainty* and *MFP Growth Uncertainty*. The residual from each of these regressions is the orthogonalized uncertainty proxy. I use these new residual uncertainty measures to reproduce the regression from Eq. 2. I present these results in Table 5. Each variable has the predicted sign and is statistically significant, comparable to the results reported in Table 4, Panel A.

The empirical tests to this point have concerned an index of all financial covenants, implicitly assuming that each type of financial covenant serves the same purpose. Recent evidence suggests that different types of covenants serve different roles. Christensen and Nikolaev (2012) classify financial covenants in performance and capital categories. They show that earnings-based performance covenants (for example, interest coverage and debt-to-EBITDA) typically monitor the ongoing performance of the firm by allocating control rights ex post. Capital covenants, which include net worth and leverage covenants, protect creditors by requiring the borrower to maintain a protective capital cushion within the firm, thus aligning borrower and creditor incentives ex ante. Following (Christensen and Nikolaev 2012), I consider whether and how performance and capital covenants resolve uncertainty and facilitate transfer of control rights to the creditor. As discussed in the analytic framework in Section 3, financial covenants are useful when they provide information about the performance of the borrower. Although earnings are a useful signal for creditors in this context, it is less clear that capital measures provide the same information; because borrowers can, for example, change net worth through various financing activities, capital covenants will not necessarily provide information about the borrower's true performance. This suggests that performance covenants might have a more prominent role in resolving uncertainty about the borrower.[19]

To test this, I create two new financial covenant indices, one for performance covenants and one for capital covenants. I use this as the response variable in the original regression specification in Eq. 2. In Table 6, Panel A, I present results for

[18] I exclude *Rating* from the regression for *Unrated*, as they are highly correlated.

[19] Consistent with this idea, Nikolaev (2016) finds that performance covenants are associated with debt contract renegotiation, while capital covenants are not (although the paper does not distinguish between borrower- and creditor-initiated renegotiations).

performance covenants. The results are substantively similar to those reported in Table 4, Panel A, for all financial covenants: the coefficients on the borrower- and industry-level uncertainty measures are positive and significant. I present results for capital covenants in Table 6, Panel B. These results differ considerably from Table 4, Panel A: although the coefficient on *Unrated* is positive and significant, all others are either insignificant or significantly negative. This suggests that performance covenants drive the main results.

Table 5 Regressions of uncertainty measures on financial covenant intensity controlling for risk

Variable	Pred. Sign	(1)	(2)	(3)
Volume*	+	**0.065***** **(3.36)**		
Unrated*	+	**0.155***** **(3.94)**		
Forecast Dispersion*	+	**0.112***** **(3.34)**		
Profit Growth Uncertainty*	+		**0.367***** **(3.09)**	
Stock Return Uncertainty*	+		**0.940***** **(3.51)**	
MFP Growth Uncertainty*	+			**0.887** **(0.24)**
GDP Growth Uncertainty*	+			**0.404** **(0.07)**
VIX*	+			**0.001** **(0.25)**
Leverage		0.258*** (2.71)	0.213** (2.36)	0.322*** (3.26)
EBITDA		1.382*** (8.36)	1.730*** (9.58)	1.624*** (9.93)
Size		−0.155*** (−13.87)	−0.175*** (−14.86)	−0.188*** (−15.06)
Market-to-Book		−0.028 (−1.48)	−0.027 (−1.37)	−0.031 (−1.30)
EDF		0.005* (1.83)	0.004 (1.51)	0.006 (1.43)
Constant		3.178*** (18.66)	3.172*** (40.56)	3.506*** (18.81)
Year-Quarter Fixed Effects		Yes	Yes	No

Table 5 (continued)

Variable	Pred. Sign	(1)	(2)	(3)
Industry Fixed Effects		Yes	No	Yes
Observations		7,989	7,846	8,063

This table reports presents multivariate regression results controlling for risk. The response variable in each regression is FINANCIAL COVENANT INTENSITY, the number of financial covenants used in the loan package. Since the response is a count variable, I use negative binomial regression. To control for the effects of risk, the seven uncertainty proxies (VOLUME, UNRATED, FORECAST DISPERSION, PROFIT GROWTH UNCERTAINTY, STOCK RETURN UNCERTAINTY, MFP GROWTH UNCERTAINTY, GDP GROWTH UNCERTAINTY, VIX) are orthogonalized against two proxies for risk, EDF and RATING, as well as controls; the measure used in the regression is residual from the regression: $Uncertainty\_Measure_j = \alpha + \beta_1 EDF + \beta_2 RATING + \gamma_1 LEVERAGE + \gamma_2 SIZE + \gamma_3 MARKET - TO - BOOK + \Theta Year Indicators + \Lambda Industry Indicators + \epsilon$. (The regression for UNRATED does not including RATING.) The orthogonalized variables are denoted with an asterisk (*). VOLUME is the 25-day average number of shares traded, scaled by total shares outstanding. UNRATED is an indicator variable with a value of one if the firm has no S&P debt rating and zero otherwise. FORECAST DISPERSION is the standard deviation of analysts' estimates of the borrower's earnings, measured in the quarter preceding loan initiation. PROFIT GROWTH UNCERTAINTY is the cross-sectional standard deviation in profit growth, measured by quarter and industry (based on two-digit NAICS code). STOCK RETURN UNCERTAINTY is the cross-sectional standard deviation of stock returns, measured by month and industry. MFP GROWTH UNCERTAINTY is the cross-sectional standard deviation in multi-factor productivity growth, measured on an annual basis. GDP FORECAST UNCERTAINTY is the cross-sectional standard deviation of GDP forecast estimates in the Livingston Survey (reported by the Philadelphia Federal Reserve Bank), measured on a semi-annual basis. VIX is the 30-day average value of the CBOE Market Volatility Index. LEVERAGE is the ratio of total long-term debt to total assets. EBITDA is the ratio of earnings before interest, taxes, depreciation, and amortization scaled by average total assets. SIZE is the natural logarithm of the market value of the firm (market value of equity plus the book value of debt). MARKET-TO-BOOK is the ratio of the market value of the firm to total assets. EDF is the distance-to-default, based on the Merton (1974) model and calculated following (Hillegeist et al. 2004). All continuous variables are winsorized at the top and bottom 1%. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively (two-tailed tests)

6 Additional analysis

In this section, I provide additional tests meant to better separate my uncertainty explanation for financial covenants from explanations based on agency theory. I follow this with tests that examine the association between uncertainty and other contract provisions.

6.1 Agency theory

Whether explicitly or implicitly, agency theory is the most commonly invoked explanation for the use of financial covenants in debt contracts. Agency theory, as it relates to debt, predicts that the borrower has incentive to take adverse actions against the creditor to avoid repaying the debt, thus expropriating wealth from the creditor and enriching equity holders. The creditor anticipates this incentive and prices the cost of these transfers into the interest rate. Pioneering research by Jensen and Meckling (1976) shows how limiting the borrower's ability to make agency transfers increases

Table 6 Regressions of uncertainty measures on financial covenant intensity sorted by covenant type

Variable	Pred. Sign	(1)	(2)	(3)
Panel A: Performance Covenants				
Volume	+	**0.059*****		
		(4.63)		
Unrated	+	**0.117*****		
		(2.97)		
Forecast Dispersion	+	**0.129*****		
		(5.00)		
Profit Growth Uncertainty	+		**0.356***	
			(1.93)	
Stock Return Uncertainty	+		**2.291*****	
			(7.19)	
MFP Growth Uncertainty	+			**3.451**
				(1.63)
GDP Growth Uncertainty	+			**−11.250***
				(−1.68)
VIX	+			**−0.003**
				(−0.86)
Leverage		0.668***	0.603**	0.512***
		(7.67)	(7.51)	(6.24)
EBITDA		1.504***	1.728***	1.474***
		(10.59)	(11.10)	(9.52)
Size		−0.084***	−0.123***	−0.064***
		(−5.18)	(−8.14)	(−4.31)
Market-to-Book		−0.045***	0.001	−0.041***
		(−2.85)	(0.08)	(−2.61)
EDF		0.007**	0.003	0.006
		(2.05)	(0.88)	(1.84)
Constant		1.365***	0.955***	1.876***
		(5.28)	(8.74)	(5.64)
Year-Quarter Fixed Effects		Yes	Yes	No
Industry Fixed Effects		Yes	No	Yes
Observations		7,848	7,669	7,882
Panel B: Capital Covenants				
Volume	+	**0.006**		
		(0.41)		
Unrated	+	**0.097*****		
		(3.22)		
Forecast Dispersion	+	**−0.043***		
		(−1.71)		

Table 6 (continued)

Variable	Pred. Sign	(1)	(2)	(3)
Profit Growth Uncertainty	+		**−0.123**	
			(−0.73)	
Stock Return Uncertainty	+		**−1.468*****	
			(−4.25)	
MFP Growth Uncertainty	+			**−2.531**
				(−0.49)
GDP Growth Uncertainty	+			**11.847**
				(1.06)
VIX	+			**0.004**
				(0.79)
Leverage		−0.472***	−0.544***	−0.326***
		(−7.92)	(−9.27)	(−4.59)
EBITDA		−0.361***	−0.416***	−0.262
		(−2.58)	(−2.64)	(−1.59)
Size		−0.033**	−0.036***	−0.118***
		(−2.15)	(−2.22)	(−6.11)
Market-to-Book		0.004	−0.015	0.40**
		(0.29)	(−0.79)	(2.00)
EDF		−0.006*	−0.003	−0.004
		(−1.88)	(−0.74)	(−1.12)
Constant		1.683***	2.082***	1.620***
		(9.14)	(20.07)	(4.46)
Year-Quarter Fixed Effects		Yes	Yes	No
Industry Fixed Effects		Yes	No	Yes
Observations		7,848	7,669	7,882

This table reports presents multivariate regression results by covenant type. The response variable in Panel A is an index of PERFORMANCE COVENANTS, including interest coverage, cash interest coverage, debt-to-EBITDA, senior debt-to-EBITDA, debt service coverage, fixed charge coverage, and EBITDA (all defined on Dealscan). The response variable in Panel B is an index of CAPITAL COVENANTS, including leverage, debt-to-equity, debt-to-tangible net worth, senior leverage, net worth, tangible net worth, current ratio, and quick ratio. Since the responses are count variables, I use negative binomial regression. VOLUME is the 25-day average number of shares traded, scaled by total shares outstanding. UNRATED is an indicator variable with a value of one if the firm has no S&P debt rating and zero otherwise. FORECAST DISPERSION is the standard deviation of analysts' estimates of the borrower's earnings, measured in the quarter preceding loan initiation. PROFIT GROWTH UNCERTAINTY is the cross-sectional standard deviation in profit growth, measured by quarter and industry (based on two-digit NAICS code). STOCK RETURN UNCERTAINTY is the cross-sectional standard deviation of stock returns, measured by month and industry. MFP GROWTH UNCERTAINTY is the cross-sectional standard deviation in multi-factor productivity growth, measured on an annual basis. GDP FORECAST UNCERTAINTY is the cross-sectional standard deviation of GDP forecast estimates in the Livingston Survey (reported by the Philadelphia Federal Reserve Bank), measured on a semi-annual basis. VIX is the 30-day average value of the CBOE Market Volatility Index. LEVERAGE is the ratio of total long-term debt to total assets. EBITDA is the ratio of earnings before interest, taxes, depreciation, and amortization scaled by average total assets. SIZE is the natural logarithm of the market value of the firm (market value of equity plus the book value of debt). MARKET-TO-BOOK is the ratio of the market value of the firm to total assets. EDF is the distance-to-default, based on the Merton (1974) model and calculated following (Hillegeist et al. 2004). All continuous variables are winsorized at the top and bottom 1%. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively (two-tailed tests) the borrower's value. Smith and Warner (1979) show how restrictive, or negative, covenants directly restrict agency transfers, controlling agency conflicts related to debt.

There are several ways that the theory and predictions in this study differ from agency theory. First, agency theory is based on the borrower's taking some hidden, adverse action (that is, moral hazard). The framework of this study does not rely on moral hazard problems; rather the contracting problem is a lack of contract-relevant information, regardless of borrower action. Second, Smith and Warner (1979) draw links between a covenants from a specific group—negative covenants—and agency conflicts. They show that covenants that restrict specific actions, such as paying dividends or selling assets, limit common manifestations of the agency conflict, such as underinvestment or asset substitution. Their theory and evidence have been applied broadly to all covenants in debt contracts, including financial covenants (Billett et al. 2007; Bradley and Roberts 2004; Nash et al. 2003). However, there are reasons that the analysis in Smith and Warner (1979) may not be applicable to financial covenants. Unlike negative covenants, which require the borrower to take an action to be violated, financial covenants can be violated in the absence of any adverse action. This suggests that financial covenants may be imprecise in controlling agency conflicts. In addition, the evidence by Smith and Warner (1979) is based on the bond market. The private debt market, where financial covenants are used extensively, is more informationally opaque than is the bond market (Bharath et al. 2008; Denis and Mihov 2003), leading to a greater demand for contracting provisions that address uncertainty.

Despite certain conceptual differences, it is not easy to separate agency from uncertainty on a theoretical basis. Although the theory that I present here does not feature moral hazard problems, this does not mean that I can dismiss moral hazard and agency as a possible explanation for my results. In fact, uncertainty of the type that I describe likely facilitates moral hazard transfers by obscuring the true value of the borrower; in a sense, agency conflicts can be thought of as a subset of the broader set of contracting problems associated with uncertainty. Empirical separation of agency and uncertainty is also difficult. In the empirical tests, I use a variety of proxies to measure uncertainty; however, some of these could be interpreted as proxies for agency conflicts.[20] To sharpen the identification of uncertainty versus agency, I identify a specific setting where an event increased uncertainty (an uncertainty shock) but had a lesser effect on agency incentives.

Shocks to uncertainty, as defined by Bloom (2009), are spikes in the level of uncertainty that accompany major economic crises (for example, the Asian Financial Crisis, the Russian Default and Long-Term Capital Management collapse, and

[20] I include the *Market-to-Book* ratio as a control variable in the main tests. This ratio has been used as a proxy for growth opportunities and thus agency conflicts (Skinner 1993; Smith and Watts 1992). The negative coefficient in the main tests is inconsistent with the predictions of agency (wherein higher levels of the ratio mean greater agency conflicts.) There are, however, a variety of alternative interpretations of the market-to-book ratio, including accounting conservatism (Roychowdhury and Watts 2007) and deficiencies in GAAP (Lev and Sougiannis 1999); thus I do not focus on this result as providing evidence related to agency conflicts.

the Worldcom and Enron scandals, the Subprime Crisis) and significant political events (for example, the Sept. 11, 2001, attacks and the Second Gulf War). Bloom (2009) shows that uncertainty is abnormally high for three to six months following a shock. In selecting a shock, I need to isolate changes in uncertainty that leave agency conflicts unaffected; in other words, to find a shock where uncertainty increases regardless of the characteristics of firms in the market. For this reason, I do not consider any of the financial crises, for which the events themselves are endogenous to the market. The shock that I select is the Sept. 11 attacks. This event is political rather than economic, so the spike in uncertainty is not related to any underlying features of firms in the market. In addition, the level of the VIX was stable in the period that preceded the shock; thus the tests would not be confounded by another uncertainty triggering event. I illustrate the level of uncertainty in the period around the Sept. 11 attacks in Fig. 3.

The shock allows me to avoid using potentially endogenous measures of borrower-, industry-, and economy-level uncertainty in regression analysis. The empirical test takes the form:

$$FinancialCovenantIntensity_i = f(\alpha + \boldsymbol{\beta}\, Post + \boldsymbol{\Gamma} Controls_i + \epsilon). \quad (4)$$

I run the regression for loans initiated from September 12, 2000 (one year prior to the shock), to March 12, 2002 (six months after the shock).[21] The variable *Post* is an indicator with a value of 1 if the observations fall after September 16, 2001, and 0 otherwise. The subsample consists of 1,550 packages, with 1,030 prior to the shock and 520 following it (although there are fewer observations in the reported results due to missing control variables). I employ a one-year prior-period to benchmark normal uncertainty. The six-month post-period is the upper bound suggested in Bloom (2009).[22] Because I expect covenant use to increase following the shock, the predicted coefficient on *Post* is positive. Finally, because the test subsample involves a relatively short period, I exclude year indicators from the set of control variables.

My interpretation of the evidence relies on this economic shock's affecting uncertainty but not altering agency conflicts. Although it is clear that uncertainty shifts (Bloom 2009), it is less clear whether agency conflicts are affected. On the one hand,

[21] After the attacks, the NYSE and NASDAQ did not reopen until September 17. Although the private loan market was not directly affected, I exclude loan packages initiated from September 11 through 16, due to overall disruption in the financial markets. There are only six packages recorded for this period, and their inclusion in the test subsample does not affect inferences.

[22] There are two threats to the validity of the Sept. 11 attacks as an exogenous shock to uncertainty. First, the Enron accounting scandal was revealed in October 2001, which falls within the six month post-period. However, the VIX did not reflect any increase in uncertainty when the scandal was initially disclosed. Specifically, from a high in the mid 40s immediately following Sept. 11, the VIX trended downward and into the low 20s and high teens through May 2002. Uncertainty only increased again in June 2002, coinciding with revelations about accounting problems at Worldcom. It is likely that the market viewed Enron as idiosyncratic at the time that the scandal was made public, and only when another major scandal broke, did concern grow that accounting issues were widespread. As such, I do not expect that the Enron scandal contaminates the post-shock period. Second, the U.S. economy was in recession from March to November 2001. If a recession influences the use of financial covenants, for example, with increased macroeconomic risk leading to greater demand for covenants, this could limit the inferences that can be drawn from this sample. This recession, however, was short and shallow and, more importantly, spanned both the pre- and post-periods. As such, it should not damage inferences from this test.

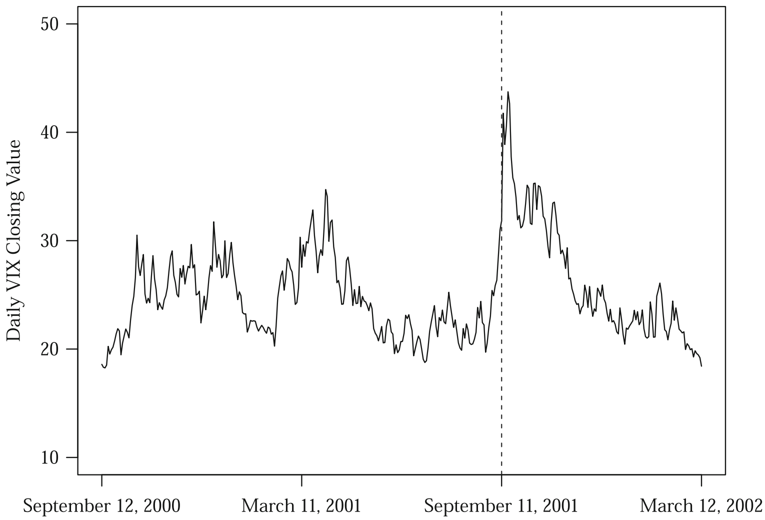

Fig. 3 VIX closing value around the 9/11 attacks. This figure presents the daily level of the VIX index from September 12, 2000, to March 12, 2002. The VIX is the Chicago Board of Exchange's Market Volatility Index, which measures the market's forward-looking expectations of volatility for the next 30 days

agency conflicts are often linked to the asset composition of the firm (that is, the investment opportunity set) and adjust relatively slowly to shocks. On the other hand, the *incentives* for agency transfers could shift rapidly in response to a shock. As this is an empirical question, and one on which the inferences from this test rest, I present further evidence to validate that agency conflicts did not change following this shock.

First, I examine whether the use of other contract provisions changed in the *Post* period. The first provisions I examine are covenants that restrict dividends. As noted by Smith and Warner (1979) and Kalay (1982), covenants that restrict dividend payments directly address the agency cost of debt. Therefore, if agency problems increased following the shock, the use of these covenants also should increase. Second, I examine whether more loans require collateral following the shock. Berger and Udell (1990) find that collateral is associated with greater agency conflicts between the borrower and creditor. If inclusion of dividend restrictions or collateral requirements increases in the *Post* period, this serves as a benchmark to understand changes in financial covenant use. I reproduce the regression from Eq. 4, using dividend restrictions and collateral requirements as the dependent variable. Because each of these provisions is dichotomous, I use logit regressions.

I present the regression results in Table 7, Panel A. The first column shows the results for financial covenant use. The coefficient on *Post* is positive and significant, indicating that loans include more financial covenants following this shock. The results for *Dividend Restrictions* and *Collateral* are presented in the second and third columns. In each, the coefficient on *Post* is positive but insignificant. If dividend restrictions and collateral requirements are in place to address agency conflicts, this suggests that agency did not shift following the *Post* period and something else must be driving the change in financial covenant use.[23]

I run additional tests to complement the results in Table 7, Panel A. First, I rerun the regressions for indices of performance and capital covenants. In unreported analysis, I find that performance covenant use increases significantly after the shock but that capital covenant use does not change. These findings are consistent with the results in Table 6 and the results of Christensen and Nikolaev (2012). Second, I run the regressions for a subsample of borrowers who have loans in both the pre- and post-crisis periods. Although this restriction greatly attenuates the sample size (for example, from 639 to 127 for *Financial Covenant Intensity*), the results (untabulated) for this constant borrower subsample are consistent with those reported in Table 7, Panel A; the coefficient on *Post* is positive and significant for *Financial Covenant Intensity*, insignificant for *Collateral*, and significantly negative for *Dividend Restrictions*.

To further isolate the effects of uncertainty from agency, I examine how the Sept. 11 shock had different effects on borrowers in different industries. In addition to increased uncertainty, some industries, such as airlines and tourism, experienced a reduction in expected cash flows following the shock. As theory suggests, poor operating performance exacerbates agency conflicts (Berlin and Mester 1992), and it is difficult to separate the affects of agency from uncertainty in the presence of a shock that erodes expected future operating performance. As an additional identification test, I separate observations based on their ex post earnings performance. The logic behind this partition is that realized performance proxies for expected performance. Sorting firms by two-digit NAICS codes, I measure the change in annual earnings from 2000 to 2002. If an industry had a decline in earnings over this measurement period, I set the value of an indicator variable *Shock Industry* to 1, which identifies industries whose future cash flows were directly affected by the shock. In total, 31 of 60 industries experienced earnings declines and thus are more susceptible to increased agency conflicts. Although borrowers in a *Shock Industry* may have experienced a concurrent increase in agency and uncertainty, those borrowers in better performing-industries were likely affected just by the uncertainty.

To enhance identification and further isolate the effects of uncertainty from agency, I supplement the regressions run in Table 7, Panel A, with two additional variables: *Shock Industry* and *Shock Industry* * *Post*. The main effect captures whether the decline in expected earnings affected the design of contracts. The interaction term, the variable of interest, identifies whether there is a differential effect in the *Post* period between borrowers with strong and weak expected future earnings performance. If the change in use of a provision can be explained by agency, then the effect should be concentrated in industries where earnings declined; that is, the coefficient on the interaction term will be positive. A nonpositive interaction suggests that agency is not the likely explanation for the provision.

[23] It is also notable that *Market-to-Book* is positive and significant in regressions for *Dividends* and *Collateral*. To the extent this variable captures some aspects of agency conflicts, this supports the idea that dividend restrictions and collateral requirements are associated with agency conflicts.

Table 7 Exogenous shock to uncertainty - regressions testing financial covenant intensity before and after the 9/11 attacks

Variable	Predicted Sign	Financial Covenant Intensity	Dividend Restriction	Collateral Requirements
Panel A: Main Regression				
Post	+ / ? / ?	**0.137***** **(3.95)**	**0.015** **(0.07)**	**0.229** **(0.88)**
Leverage		0.075 (0.71)	1.768** (1.98)	4.754*** (5.71)
EBITDA		1.002*** (6.21)	−1.926 (−1.46)	−3.080** (−2.27)
Size		−0.067*** (−6.74)	−0.796*** (−7.93)	−1.058*** (−9.62)
Market-to-Book		−0.047*** (−2.71)	0.495*** (2.93)	0.181* (1.88)
EDF		−0.004 (−0.71)	0.052 (1.52)	−0.059 (−1.58)
Constant		1.200*** (18.49)	5.592*** (6.87)	6.870*** (9.10)
Year Fixed Effects		No	No	No
Industry Fixed Effects		Yes	Yes	Yes
Regression Function		Negative Binomial	Logit	Logit
Observations		639	592	541
Panel B: Industry Interaction Tests				
Post	+ / ? / ?	**0.118**** **(2.09)**	**−0.412** **(−1.26)**	**−0.364** **(−0.98)**
Shock Industry		−0.052 (−1.04)	−0.134 (−0.48)	−0.131 (−0.43)
Post × Shock Industry	? / + / +	**0.034** **(0.48)**	**0.814*** **(1.87)**	**1.041**** **(2.01)**
Leverage		0.069 (0.66)	1.737* (1.95)	4.827*** (5.70)
EBITDA		1.019*** (6.32)	−1.898 (−1.46)	−3.108** (−2.26)
Size		−0.068*** (−6.76)	−0.800*** (−7.92)	−1.077*** (−9.66)
Market-to-Book		−0.047*** (−2.71)	0.487*** (2.90)	0.180* (1.80)
EDF		−0.005 (−0.85)	0.057* (1.68)	−0.059 (−1.55)
Constant		1.233*** (15.81)	5.703*** (7.65)	7.068*** (8.98)

Table 7 (continued)

Variable	Predicted Sign	Financial Covenant Intensity	Dividend Restriction	Collateral Requirements
Year Fixed Effects		No	No	No
Industry Fixed Effects		Yes	Yes	Yes
Regression Function		Negative Binomial	Logit	Logit
Observations		639	592	541

This table reports regression results of the use of financial covenants before and after the Sept. 11, 2001 Attacks. The test sample includes packages initiated between Sept. 12, 2000, and March 12, 2002, and excludes packages from Sept. 11 through 16, 2001. The variable POST is an indicator with a value of one for packages starting after September 16, 2001, and zero otherwise. The variable SHOCK INDUSTRY is an indicator with a value of one for packages in industries that saw a decline in earnings performance from 2000 to 2002. The response variable in the first specification is FINANCIAL COVENANT INTENSITY, the number of financial covenants used in the package. Since this response is a count variable, I use negative binomial regression. The response variable in the second specification is DIVIDEND RESTRICTION, an indicator with a value of one when the loan contract restricts dividend payments and zero otherwise. The response in the third column is COLLATERAL REQUIREMENTS, an indicator with a value of one when the loan contract requires collateral. Since these responses are dichotomous, I run logit regressions. LEVERAGE is the ratio of total long-term debt to total assets. EBITDA is the ratio of earnings before interest, taxes, depreciation, and amortization scaled by average total assets. SIZE is the natural logarithm of the market value of the firm (market value of equity plus the book value of debt). MARKET-TO-BOOK is the ratio of the market value of the firm to total assets. EDF is the distance-to-default, based on the Merton (1974) model and calculated following (Hillegeist et al. 2004). Each regression includes indicator variables for industry (based on the two-digit NAICS code). All continuous variables are winsorized at the top and bottom 1%. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively (two-tailed tests)

I present the regression results in Table 7, Panel B. The first column shows results for *Financial Covenant Intensity*. The coefficient on *Post* is positive and significant, consistent with Panel A. The coefficient on *Shock Industry* is insignificant, suggesting no difference in financial covenant use based on future industry earnings performance. More importantly, the coefficient on the interaction term is insignificant, suggesting that agency does not explain the number of financial covenants. Turning to the second and third columns, the coefficient on the interaction term in each case is positive and significant. This suggests that dividend restrictions and collateral requirements increased in the *Post* period but only for borrowers for whom agency conflicts were predicted to increase most acutely.

6.2 Other contract provisions

6.2.1 Performance pricing

An alternative to ex post renegotiation of a loan contract is to set conditional changes in contract terms ex ante; that is, the contract can be written so that satisfaction of specific performance thresholds will automatically trigger changes in the contract without costly renegotiation. A common example of this is performance pricing. This provision, examined by Asquith et al. (2005), sets a pricing grid, linking realizations of accounting metrics (such as debt-to-EBITDA) or agency credit ratings to changes in the loan interest spread. The pricing grid represents a set of pre-negotiated interest rate changes based on the borrower's financial performance or credit risk.

Performance pricing would seem like an ideal provision in the setting described in this paper (Armstrong et al. 2010); in fact, pre-negotiated contract changes are almost certainly less costly than than are formal renegotiations triggered by financial covenants. As such, installing pre-determined interest rate changes linked to realized outcomes would be an efficient way to integrate the ex post resolution of uncertainty into contracts. There are ways, however, that performance pricing may not be sufficient to address uncertainty. First, setting performance pricing provisions requires the contracting parties to define a set of performance conditions ex ante and to link these to the appropriate interest rates. Depending on the degree of uncertainty, it may be challenging to specify the set of possible future states and the appropriate interest rates.

Second, even when future states can be reasonably predicted, it is not clear that adjusting the interest rate is the optimal response. Given the large set of additional provisions open to contracting parties (for example, collateral, maturity, and covenants), the optimal contractual adjustment to ex post information may be the adjustment of a nonpricing term (Beneish and Press 1995). Renegotiation means that the contracting parties could change any contract provision, while performance pricing allows changes only in interest rate. To the extent that lenders want the option to make nonpricing changes to the contract ex post, performance pricing may not be associated with ex ante uncertainty.

Using a similar regression specification as in Eq. 2, I test the association between performance pricing provisions and uncertainty. The dependent variable in the regression is an indicator with a value of 1 if the loan has performance pricing; as such, I use logit regression. I present the results in Table 8, Panel A. The regressions show that neither borrower-level nor industry-level uncertainty proxies are associated with performance pricing and, among the industry-level proxies, only *MFP Growth Uncertainty* has a significant coefficient. These results suggest, on the whole, that performance pricing is not associated with uncertainty, but rather is used to address some other contracting problem.[24]

6.2.2 Maturity

Another alternative to ex post renegotiation is for the creditor to offer shorter loan terms and negotiate new terms as the shorter loans expire. This suggests that greater uncertainty should be associated with shorter loans, other things being equal. Having a shorter loan, however, introduces certain costs, with the potential for hold-up based on what the ex post information reveals. Therefore a longer contract with the possibility of renegotiation may be preferable to a series of shorter contracts.

[24] Asquith et al. (2005) present evidence that performance pricing addresses adverse selection costs.

Table 8 Regression of uncertainty measures on other contract provisions

Variable	Pred. Sign	(1)	(2)	(3)
Panel A: Performance Pricing				
Volume	+	−0.062		
		(−0.64)		
Unrated	+	**−0.314*****		
		(−3.06)		
Forecast Dispersion	+	**−0.043**		
		(−0.97)		
Profit Growth Uncertainty	+		**0.867**	
			(1.06)	
Stock Return Uncertainty	+		**0.134**	
			(0.31)	
MFP Growth Uncertainty	+			**26.558*****
				(3.38)
GDP Growth Uncertainty	+			**−4.127**
				(−0.37)
VIX	+			**−0.016**
				(−1.57)
Leverage		−0.841***	−0.573**	−0.635***
		(−3.83)	(−3.03)	(−2.82)
EBITDA		3.911***	2.449***	4.024***
		(8.36)	(8.87)	(8.84)
Size		0.299***	0.332***	0.295***
		(7.04)	(9.15)	(6.83)
Market-to-Book		−0.267***	−0.312***	−0.265***
		(−5.39)	(−5.89)	(−5.29)
EDF		0.030***	0.025**	0.030***
		(2.68)	(2.19)	(2.69)
Constant		−1.331**	−1.999***	−2.117***
		(−2.40)	(−7.35)	(−3.17)
Year-Quarter Fixed Effects		Yes	Yes	No
Industry Fixed Effects		Yes	No	Yes
Observations		7,989	7,846	8,063
Panel B: Maturity				
Volume	–	**0.032**		
		(1.57)		
Unrated	–	**−0.017**		
		(−0.75)		
Forecast Dispersion	–	**0.002**		
		(0.18)		
Profit Growth Uncertainty	–		**1.064*****	
			(5.48)	
Stock Return Uncertainty	–		**0.132****	
			(2.05)	
MFP Growth Uncertainty	–			**−6.576*****
				(−9.22)

Table 8 (continued)

Variable	Pred. Sign	(1)	(2)	(3)
GDP Growth Uncertainty	–			**0.373**
				(0.22)
VIX	–			**−0.013*****
				(−11.99)
Leverage		0.251***	0.265**	0.144***
		(5.39)	(5.78)	(3.11)
EBITDA		0.951***	1.054***	0.956***
		(10.16)	(11.33)	(10.36)
Size		−0.019**	−0.023***	0.012**
		(−2.51)	(−3.99)	(2.04)
Market-to-Book		−0.074***	−0.070***	−0.078***
		(−7.45)	(−7.29)	(−8.36)
EDF		0.010***	0.009**	0.010***
		(5.07)	(4.10)	(4.94)
Constant		7.469***	7.035***	7.714***
		(85.06)	(110.44)	(86.62)
Year-Quarter Fixed Effects		Yes	Yes	No
Industry Fixed Effects		Yes	No	Yes
Observations		7,931	7,786	8,003

This table reports regression results on other contractual provisions. In Panel A, the response variable is PERFORMANCE PRICING, an indicator variable with a value of one if the loan package includes a performance pricing provision. Since this response is dichotomous, I use logit regression. In Panel B, the response variable is MATURITY, the natural logarithm of the term to maturity of the loan package. Since this response is continuous, I use ordinary least squares regression. VOLUME is the 25-day average number of shares traded, scaled by total shares outstanding. UNRATED is an indicator variable with a value of one if the firm has no S&P debt rating and zero otherwise. FORECAST DISPERSION is the standard deviation of analysts' estimates of the borrower's earnings, measured in the quarter preceding loan initiation. PROFIT GROWTH UNCERTAINTY is the cross-sectional standard deviation in profit growth, measured by quarter and industry (based on two-digit NAICS code). STOCK RETURN UNCERTAINTY is the cross-sectional standard deviation of stock returns, measured by month and industry. MFP GROWTH UNCERTAINTY is the cross-sectional standard deviation in multi-factor productivity growth, measured on an annual basis. GDP FORECAST UNCERTAINTY is the cross-sectional standard deviation of GDP forecast estimates in the Livingston Survey (reported by the Philadelphia Federal Reserve Bank), measured on a semi-annual basis. VIX is the 30-day average value of the CBOE Market Volatility Index. LEVERAGE is the ratio of total long-term debt to total assets. EBITDA is the ratio of earnings before interest, taxes, depreciation, and amortization scaled by average total assets. SIZE is the natural logarithm of the market value of the firm (market value of equity plus the book value of debt). MARKET-TO-BOOK is the ratio of the market value of the firm to total assets. EDF is the distance-to-default, based on the Merton (1974) model and calculated following (Hillegeist et al. 2004). All continuous variables are winsorized at the top and bottom 1%. *** and ** indicate statistical significance at the 1% and 5% levels, respectively (two-tailed tests)

As with the performance pricing test, I reproduce the main regression results with loan maturity as the dependant variable. Because this is a continuous variable, I use ordinary least squares regression. Moreover, because I expect uncertainty to potentially drive shorter loan maturities, I expect negative signs on the uncertainty proxies. I present the regression results in Table 8, Panel B. The coefficients on each of the borrower-level uncertainty proxies are insignificant. On the industry-level proxies, the coefficients are positive and significant. This suggests that more uncertainty is associated with *longer* loans, contrary to prediction. Finally, two of the three economy-level proxies (*MFP Growth Uncertainty* and *VIX*) have negative, significant coefficients. This suggests that financial covenants and loan maturity may be complements, with the former addressing borrower- and industry-level uncertainty and latter addressing economy-wide uncertainty.

7 Conclusion

I examine financial covenant use in a framework that incorporates uncertainty, information, and renegotiation. I argue that financial covenants, which transfer control rights to the creditor when the borrower performs poorly, facilitate contracting under uncertainty. Using a large sample of private loan contracts, I find that financial covenant use increases with uncertainty, consistent with my prediction.

Uncertainty has received significant attention in the equity market literature; for example, both Jiang et al. (2005) and Zhang (2006) show that uncertainty affects stock returns. The effects of uncertainty on contracting have received relatively less attention. In this paper, I present an analytic framework in the vein of incomplete contracting (Christensen et al. 2016) that shows one way that uncertainty can be addressed via contract design. One innovation of this framework is that the predictions do not rely on moral hazard but rather on ex ante uncertainty about the future. While I focus on financial covenants, the framework is likely applicable to many aspects of debt contract design.

There are some limitations to this study that may constrain the inferences that readers can draw. First, in the analytical framework, I argue that financial covenants serve to facilitate creditor-initiated renegotiations. It is difficult, however, to identify which renegotiations are creditor-initiated. I can observe only that uncertainty is associated with financial covenant use, but I cannot determine whether financial covenant use actually leads to creditor-favorable renegotiation. Second, I attempt to provide an explanation for covenant use that does not rely on agency conflicts. As I describe, it is conceptually and practically difficult to separate the threat of agency conflicts from uncertainty. Although I attempt to separate these two constructs using an exogenous shock to uncertainty, the results should nonetheless be interpreted with caution.

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Appendix

Variable	Definition	Source
Measures of Covenant Use		
Financial Covenant Intensity	Index of financial covenants (sum of coverage, debt-to-earnings, leverage, current ratio, net worth, and EBITDA covenants)	Dealscan
PViolate	Expected likelihood of financial covenant violation, from Demerjian and Owens (2016)	Authors
Performance Covenants	Index of performance covenants (sum of coverage, debt-to-earnings, and EBITDA covenants)	Dealscan
Capital Covenants	Index of capital covenants (sum of leverage, current ratio, and net worth covenants)	Dealscan
Uncertainty Measures		
Volume	25-day average equity trading volume (scaled by total shares outstanding)	CRSP
Unated	Indicator if firm does not have a S&P senior unsecured debt rating (SPLTICRM)	Compustat
Forecast Dispersion	The standard deviation of analysts' earnings forecasts scaled by the average forecast value	I/B/E/S
Profit Growth Uncertainty	The cross-sectional standard deviation of quarterly profit growth by two-digit NAICS code; profit growth is quarterly operating income (OIBDPQ) divided by average total assets (ATQ)	Compustat
Stock Return Uncertainty	The cross-sectional standard deviation of monthly stock returns by two-digit NAICS code	CRSP
MFP Growth Uncertainty	The cross-industry standard deviation of year-on-year changes in multifactor productivity	Bureau of Labor Statistics
GDP Forecast Uncertainty	The standard deviation of semi-annual GDP forecasts in the Livingston Survey	Philadelphia Federal Reserve
VIX	The quarterly average level of the CBOE traded market volatility index	Chicago Board of Exchange
Controls & Other Variables		
Leverage	Long-term debt (DLCQ+DLTTQ) scaled by total assets (ATQ)	Compustat
EBITDA	Operating income (OIBDPQ) scaled by average total assets (ATQ)	Compustat
Size	Natural logarithm of estimated firm market value: market value of equity (CSHOQ*PRCCQ) plus book value of debt (DLCQ+DLTTQ)	Compustat

(continued)

Variable	Definition	Source
Market-to-Book	Firm market value ((CSHOQ*PRCCQ) + (DLCQ+DLTTQ)) scaled by total assets (ATQ)	Compustat
EDF	Distance-to-default based on Merton (1974) and calculated as in Hillegeist et al. (2004)	CRSP & Compustat
Post	Indicator with value of one for packages initiated between September 17, 2001, and March 15, 2002, and zero between September 12, 2000, and September 10, 2001	n/a
Dividend Restriction	Indicator for negative covenant restricting dividends	Dealscan
Collateral	Indicator for collateral requirements	Dealscan
Shock Industry	Indicator with a value of one if an industry had a decline in aggregate earnings from 2000 to 2002, based on two-digit NAICS code	Compustat
Performance Pricing	Indicator for use of a performance pricing provision	Dealscan
Maturity	Term to maturity in days	Dealscan

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