Inside Debt and Agency Conflicts: Evidence from the Financial Crisis[*]

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Abstract

We examine the association of inside debt with debt contract design and investment policy, with a focus on the effects of the Global Financial Crisis. While prior evidence shows that inside debt limits agency conflicts, most of the evidence is from periods of robust economic growth and widely available credit. The crisis resulted in substantial changes to lender and borrower incentives, which we likely affected the usefulness of inside debt in debt contracting, as well as borrowers' incentives from inside debt. We find evidence of a reduced reliance on inside debt in debt contracting during the crisis period, consistent with lenders demanding more protection from agency conflicts during the crisis. We further find a stronger association between inside debt and investment risk during the crisis, consistent with inside debt providing incentives to protect liquidation values. In additional tests, we find that some of these changes persist even when corporate bank lending recovered to pre-crisis levels. In total, the results suggest an evolving role for inside debt.

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1. Introduction

A relatively recent stream of research examines how inside debt—compensation that has debt-like payoffs to executives—mitigates the agency cost of debt. Jensen and Meckling (1976) suggest that borrowers and lenders can alleviate this conflict by compensating the manager of the borrowing firm with debt (instead of cash or equity). Edmans and Liu (2011) examine this idea using a model of how inside debt interacts with equity-based compensation to reduce the agency cost of debt as well as the conflict between inside and outside equity holders. Other studies, such as Wei and Yermack (2011) and Anantharaman et al. (2014), examine the role of inside debt in mitigating the agency cost of debt.

Much of the research on inside debt (e.g., Wei and Yermack 2011; Cassell et al. 2012; Anantharaman et al. 2014; Campbell et al. 2016) examines a relatively short time series of data, generally running from 2006 to 2008. Most evidence is from this time period because of a regulatory change that made disclosure of inside debt compensation mandatory in 2006. The 2006 to 2008 time period was, however, one of relatively strong economic conditions: until the end of this time period, the economy was growing, the stock market was rising, and credit was easy to obtain, with many firms having access to debt capital markets. The research from this time period, therefore, provides evidence from a steady-state economic climate.

The period immediately following the time period of these studies witnessed one of the most dramatic economic upheavals in recent history: The Global Financial Crisis (hereafter, the crisis). The crisis began in 2007 with problems in the subprime mortgage market. After years of issuing and securitizing residential mortgages of increasingly poor quality, increases in realized default rates caused a sharp deterioration of banks' balance sheets. This in turn constrained banks' access to funding, which constricted their commercial lending. In the ensuing broader

financial crisis, commencing in late 2007, commercial firms with no exposure to the residual mortgage market or subprime loans found themselves unable to borrow from cash-strapped banks. Ivashina and Scharfstein (2010) show that commercial bank loan issuance fell by two-thirds from 2007 to 2009. The decrease in credit availability constrained borrowers' investment, leading to decreased economy-wide demand that eventually resulted in poor operating performance and increased bankruptcy risk (Duchin et al. 2010).

Because these of substantial changes in the availability of credit and firms' operating performance, the crisis provides an opportunity for us to expand our understanding of inside debt. We explore two potentially offsetting sources of changes to the role of inside debt during the crisis. On the one hand, financing constraints may have circumscribed the investment opportunity set of firms to relatively less risky projects (Almeida et al. 2011). On the other hand, uncertainty related to the crisis may have made bankruptcy risk (and expected recovery rates given bankruptcy) relatively more salient to borrowers. We develop three hypotheses regarding how these two economy-wide changes affect the usefulness of inside debt in debt contracting, and alter the incentive effects of inside debt on managerial behavior.

We first examine whether the crisis altered the association between inside debt and debt contract design. Anantharaman et al. (2014) find evidence that inside debt and debt covenants are substitutes. This suggests that, during the pre-crisis period, debt covenants and inside debt are substitutes in addressing the agency cost of debt, and that borrowers and lenders chose to rely on one mechanism or the other. During the crisis, however, financial distress and the economic uncertainty increased for both lenders and borrowers. The constriction of credit availability shifted bargaining power in favor of lenders, who could increase the level of protection they demanded when entering a loan contract. If lenders demanded protection in the forms of both

inside debt and debt covenants, then we expect the substitution effect between inside debt and debt covenants to be weaker during the crisis. We examine this substitution effect using three measures of covenant intensity. Similar to prior literature, we find evidence of a substitution effect in the pre-crisis period. The substitution effect is not, however, significant during the crisis period, consistent with lenders requiring both forms of protection during the crisis.

In addition to substituting for covenant use, prior studies (e.g., Anantharaman et al. 2014, Li et al. 2017) find that inside debt decreases the cost of debt. Inside debt is presumed to better align the incentives of the manager with those of lenders, thus lowering the risk that the borrower will take extractive actions. This reduction in agency costs will be reflected in a lower interest rate for the debt, where borrowers and lenders share the surplus generated by reducing deadweight contracting losses. Similar to our findings for the substitution effect, and consistent with an increase in lender bargaining power, we expect lenders will be less willing to share any surplus during the crisis, leading to an attenuation of the negative association between inside debt and the cost of debt. We again find evidence consistent with our prediction. We detect a negative association between incentives from inside debt and the cost of debt prior to the crisis, but, as we predict, this association weakens and is no longer significant during the crisis.

We next consider how the association between inside debt and investment policy changed during the crisis. For firms with access to external financing sources, inside debt curbs the incentive to make risky investments (e.g., Cassell et al. 2012). Almeida et al. (2011) suggest that financing constraints, such as those faced during the crisis, restrict the investment opportunity set of firms to relatively less risky projects. If the crisis led borrowers to select lower risk projects, then the incentives provided by inside debt during periods of strong economic performance will be rendered redundant by credit constraints; that is, the incentives for investment policy that

inside debt provides will already be provided by scarce credit. In this case, we expect the association between inside debt and investment risk, which is typically negative, to be weaker (i.e., closer to zero) during the crisis.

It is likely, however, that the value of inside debt is sensitive not only to the expected *likelihood* of bankruptcy, but also to the expected *recovery rate* given bankruptcy (i.e., the lender's expected payout from reorganization or liquidation of the borrower). As the risk of bankruptcy became more salient during the crisis, managers with inside debt holdings may have incentives to decrease investment risk even further, in an effort to avoid bankruptcy and preserve the firm's liquidation value. If this is the case, then investment risk will be more negatively associated with the amount of inside debt held by managers during the crisis period. Using several proxies for investment risk, we find consistently stronger negative associations between inside debt and investment risk during the crisis period than the pre-crisis period, which suggests that incentives from inside debt more strongly encouraged managers to reduce investment risk during the crisis. Our evidence suggests that firms with more inside debt displayed lower levels of risk-taking via investments during the crisis compared to the pre-crisis period, consistent with heightened managerial incentives to protect liquidation value incremental to any effects of credit constraints on the borrower's investments.

In sum, we find that, even though the incentives provided by inside debt to reduce investment risk were stronger during the crisis than prior to the crisis, substitution and cost of debt associations weakened during the crisis. This evidence is consistent with lenders demanding greater protection during the crisis in the form of inside debt *and* debt covenants, and not sharing the surplus resulting from this greater protection. These findings are broadly consistent with a

shift in bargaining power toward lenders during the crisis, which resulted when lenders reduced credit availability during the crisis (e.g., Cornetta et al. 2011, Ivashina and Scharfstein 2010).

In additional analyses, we investigate whether the changes in the role of inside debt during the crisis period persist into the post-crisis (or recovery) period. Interestingly, we find that inside debt continues to have a stronger negative association with investment riskiness during the recovery period compared to the pre-crisis period, suggesting a continuation of the change from the crisis period that persists even as lending constraints loosened and the economy improved. We do not detect evidence of the substitution effect between inside debt and debt covenants during this recovery period. We do, however, find that the association between inside debt and the cost of debt returns to being significantly negative during the recovery period. This result, coupled with the insignificant finding on the substitution effect, suggests a structural change in how lenders address agency conflicts following the crisis, with inside debt rising in prominence as covenants declined.

This research contributes to the growing literature on inside debt and its role in mitigating agency conflicts. Although existing research provides theory and evidence on inside debt and the agency cost of debt (Jensen and Meckling 1976; Edmans and Liu 2011; Wei and Yermack 2011; Anantharaman et al. 2014; Pawlicek 2016), most evidence is restricted to a relatively short time period featuring robust credit markets and strong economy-wide performance that may not reflect the efficacy of inside debt in less favorable conditions. Our study extends this research into a period where credit was constrained, economy-wide economic performance was poor, and incentives related to investment policy were affected by a variety of forces. Our evidence, showing predictable changes in the role of inside debt during the crisis period, furthers our understanding of its effectiveness in limiting agency problems, and is particularly interesting as

the incentives inside debt provides are more likely to be relevant in periods of poor economic performance and financial constraints. We also provide additional evidence on how the constriction of credit during the crisis affected firms' investment policies. While several studies examine the effect of the crisis on firm investment (e.g., Campello, Graham and Harvey 2010; Duchin et al. 2010), none relate to the potentially mitigating role of inside debt. By examining covenant intensity and investment policies concurrently, our study documents that inside debt was still effective during the crisis in reducing risky investments, but this value was not reflected in debt contract design due to concurrent changes in the debt market.

2. Hypothesis development

2.1. Inside debt

Jensen and Meckling (1976) describe the conflict between equity holders (investors) and debt holders (lenders). This conflict, typically termed the *agency cost of debt*, arises when a firm's capital structure includes risky debt. The manager of the borrowing firm, acting on behalf of investors, has incentives to take actions that transfer wealth from lenders to investors. These types of transfers, such as paying out liquidating dividends and altering investment policies, reduce lenders' expected payoffs. Jensen and Meckling argue that the lender rationally anticipates the borrower's incentive to take such harmful actions and price protects, forcing the borrower to bear the cost of the conflict. Unless the borrower can convincingly commit to not taking such extractive actions, he bears the contracting costs. Theory suggests several methods by which borrowers can reduce the agency cost of debt. Considerable literature on debt contract design focuses on how various provisions limit agency conflicts, including restrictive covenants

(Smith and Warner 1979; Kalay 1982) and financial covenants (Gârleanu and Zwiebel 2009; Christensen and Nikolaev 2012).[1]

Another line of literature suggests that compensation that gives managers debt-like claims on the assets of the firm—*inside debt*—aligns the interests of managers with those of lenders to alleviate the cost of debt (Jensen and Meckling 1976; Edmans and Liu 2011). Lenders have asymmetric payoffs to debt, where they bear the downside risk of poor borrower performance, but do not enjoy the benefits of strong performance. Given this asymmetric payoff, lenders prefer lower risk projects to higher risk projects (Smith and Warner 1979). This preference will conflict with that of firm managers who are compensated with equity (e.g., options or common stock grants), which leads them to prefer riskier projects. Granting inside debt as part of compensation is one potential way to alleviate this conflict between borrowers and lenders; if the manager of the borrowing firms has some compensation that does not vary with equity price but is sensitive to the bankruptcy risk of the firm, it will reduce the manager's incentives to take on higher risk projects.

In order to align interests of managers with lenders, inside debt must be designed to mimic the payoff features of lenders: payoffs must be fixed in solvency and proportional to the firm's liquidation value in the case of insolvency. The literature describes two components of compensation that serve as inside debt: defined benefit pension plans and other deferred compensation (ODC). Defined benefit pension plans include rank-and-file (RAF) pension plans and supplemental employee retirement plans (SERPs). Both RAF and SERP plans provide fixed payments to executives at or following retirement. RAF plans are available to a wide range of employees, and are typically funded and secured. SERPs, which are available to top executives

[1] Restrictive, or negative, covenants are provisions which limit or prohibit specific actions of the borrower. Financial, or maintenance, covenants, are provisions which stipulate threshold levels of financial ratios that the borrower must maintain to be in compliance with the contract.

once they exceed the benefit limits of RAF plans ($215,000 per year in 2017), are unfunded and unsecured. Other deferred compensation reflects voluntary deferment of compensation to be withdrawn on a specified schedule. Although most ODC payments are made after retirement, the schedule for withdrawal may start before the executive retires. Additionally, these plans can often be settled in equity; as such, payments from these plans are not necessarily fixed. Of these forms of deferred compensation, SERPs most closely mimic "outside" debt. These plans are not secured in the case of bankruptcy, cannot be settled in equity, and cannot be distributed prior to retirement. Anantharaman et al. (2014) find evidence that the debt-like incentives provided by inside debt are largely driven by SERP values.

Prior literature documents that inside debt is a pervasive and substantial portion of compensation. Using limited data prior to the 2006 compensation disclosure changes, Sundaram and Yermack (2007) find 78% of observations in their Fortune 500 sample include a pension component. Wei and Yermack (2011) show that at least 84% of firms in their 2006 sample include some form of inside debt in their CEO compensation plans. In addition, they report an average inside debt value of $10 million, while noting that the value exceeds $100 million for some top managers.

While boards have flexibility in structuring deferred compensation, empirical evidence is consistent with the notion that inside debt mitigates the agency cost of debt. Two studies demonstrate the effect of inside debt on agency transfers directly. Wei and Yermack (2011) find that bond prices rose and equity prices fell for firms with large amounts of inside debt when inside debt values were first reported following the 2006 change in U.S. Securities and Exchange Commission (SEC) disclosure regulations. Pawliczek (2016) find that firms whose CEOs hold

more inside debt recover more unsecured debt during bankruptcy and take steps to protect lenders as they approach bankruptcy.

2.2. The financial crisis

The period leading up to the Global Financial Crisis was characterized by easy availability of credit (both for consumers and companies) and relatively strong economic growth. A variety of related factors, including low interest rates, increased securitization of loans, the government-backed mandate of the Federal National Mortgage Association (Fannie Mae or FNMA) and Federal Home Loan Mortgage Corporation (Freddie Mac or FHLMC), and a fee-for-origination model in mortgage underwriting, led available credit into the consumer mortgage market (Temin 2010; Isaac 2012; The Economist 2013). As lending standards loosened, banks issued and securitized increasingly low-quality loans. Over time, the residual portions of these loans built up on bank balance sheets, leaving large balances of toxic assets with little value. The situation reached its breaking point in mid-2007, when default rates on consumer mortgages spiked and banks began to acknowledge the low quality of loans on their balance sheets.

Although the crisis began with consumers, the integration of consumer and commercial lending markets soon led to systemic issues, particularly for those banks with large exposure to consumer mortgage-backed securities. In March 2008 Bear Stearns collapsed; the demise of Lehman Brothers and Washington Mutual (both failing in September 2008) soon followed. At this point, the crisis had spread beyond consumer finance to envelop the entire financial sector.

The subprime and subsequent broader financial crises led to both a deep recession (from December 2007 to June 2009) and a bear market where the S&P 500 lost roughly 50% of its value (from October 2007 to March 2009). The recovery from the crisis in the credit market commenced in 2011: Syndicated loan volume increased from a low of $0.6T in 2009 to $1.6T in

2012, $2.3T in 2013, and $2.3T in 2014, achieving higher levels than prior to the crisis. The broader economy recovered somewhat more slowly. Unemployment, which was under 5% in the pre-crisis period, peaked at 10% in late 2009. From this apex unemployment declined, although it was not until 2016 that it fell below its pre-crisis level. The stock market similarly began a recovery after reaching a nadir in early 2009, surpassing its pre-crisis high in early 2013 and continuing to rise subsequently.

The crisis had important (and related) consequences on the availability of external financing and investment policy. Ivashina and Scharfstein (2010) find that, during the crisis period, loan volume to large borrowers fell 47% from its pre-crisis peak. For non-financial firms reliant on external financing, this credit restriction affected investment policy. In particular, Almeida et al. (2011) suggest that financing constraints such as those experienced by non-financial firms during the crisis circumscribe the investment opportunity set of firms to relatively less risky projects.

The reduced access to credit persisted long enough to have effects on the real economy: Financing constraints eventually constricted economy-wide demand, leading non-financial firms to limit investment due to poor performance (Duchin et al., 2010). Thus, beyond the investment effects of financing constraints, financial crises can ultimately affect the operations of non-financial firms. Both the uncertainty related to the crisis and firms' weaker operating performance may have made bankruptcy risk (and expected recovery rates given bankruptcy) more salient than in non-crisis periods.

In the next section we develop three hypotheses regarding how these two economy-wide changes – reduced risk in borrowers' investment opportunity sets, and increased uncertainty and

bankruptcy risk – affected the association of inside debt and debt contract design, and altered the incentive effects of inside debt on managerial behavior.

2.3. Hypothesis development

2.3.1. The substitution effect between inside debt and other contracting features

Prior literature provides evidence that inside debt substitutes for other loan contracting features, notably covenants. Smith and Warner (1979) suggest that covenants serve as a commitment mechanism for borrowers. Subsequent studies examine the role of financial covenants, provisions that require the borrower to maintain a threshold level of some accounting-based metric, in limiting agency conflicts. If the borrower fails to maintain the threshold, then the loan enters technical default and control rights revert to the lender. Research shows that financial covenants are effective in mitigating agency conflicts (Gârleanu and Zwiebel 2009; Christensen and Nikolaev 2012). Because both inside debt and financial covenants have been shown to mitigate the agency cost of debt, researchers have investigated whether these two contracting features are substitutes. Anantharaman et al. (2014) examine a set of firms with both inside debt and private debt contracts (i.e., bank loans) and find that inside debt is associated with fewer loan covenants. Chava et al. (2010) also provide evidence that restrictive covenants, including dividend and subsequent financing restrictions, are negatively associated with the percentage of compensation granted as pensions, also consistent with a substitution effect. This evidence, however, is from the pre-crisis period, during which time firm performance was strong and credit was readily available.

The crisis led to dramatic economic changes that may be associated with the incentives provided by inside debt. One is the level of protection that lenders would demand in order to make loans. Evidence in Ivashina and Scharfstein (2010) indicates a significant constriction of

credit in the crisis period. To the extent that lenders were still willing to lend money, it is likely that the economic conditions (and the corresponding strengthening of lenders' bargaining power relative to borrowers) would dictate more stringent conditions attached to lending arrangements. As a result, lenders were likely to demand a greater level of protection in aggregate because borrowers faced higher risk of financial distress and bankruptcy. With lenders demanding both inside debt *and* covenants to increase aggregate protection, the substitution effect should diminish. This leads to our first hypothesis:

H1: The substitution effect between inside debt and other debt contracting features was weaker during the financial crisis than in the pre-crisis time period.

In addition to substituting for covenant use, prior literature (e.g., Anantharaman et al. 2014, Li et al. 2017) finds that inside debt decreases the cost of debt. They contend that inside debt better aligns the incentives of managers with lender, thus lowering the risk of agency conflicts. The surplus generated by reducing deadweight debt contracting costs is shared by the lender and borrower, allowing the lender to offer a lower interest spread. Similar to our expectation that the substitution effect between inside debt and financial covenants weakened during the crisis, we expect that lenders leveraged their relatively stronger bargaining power during the crisis to share less of the surplus with borrowers. This means that, even if inside debt was effective during the crisis in lowering the agency cost of debt, the lender would be unwilling to reduce to cost of debt. As such, we predict that the negative association between inside debt and the cost of debt was weaker during the crisis. This leads to our second hypothesis:

H2: The sensitivity of the cost of debt to inside debt was weaker during the financial crisis than in the pre-crisis time period.

2.3.2. Inside debt and investment policy

Empirical evidence shows that the level of inside debt is associated with firm investment policy, with inside debt being associated with less risky investments. For example, Cassell et al. (2012) find a negative association between the level of inside debt and a variety of measures of borrower-level riskiness, such as stock return volatility, R&D intensity, and leverage. Liu et al. (2014) find a positive association between inside debt and cash holding, and show that this relation is stronger in firms with higher leverage and more financial constraints. Phan (2014) demonstrates that CEOs with high levels of inside debt are less likely to engage in mergers and acquisitions, and that deal characteristics reflect less risky preferences. This evidence is consistent with inside debt tempering the risk-taking incentives induced by equity-based compensation, thus providing greater alignment between borrowers and their lenders.

As we discuss in Section 2.2, the crisis constrained firms' access to external capital, which in turn shifted firms' investment opportunity sets to lower risk investments (Almeida et al., 2011). This shift means inside debt became less necessary to curb investment risk during the crisis. By this reasoning, inside debt will have a weaker (i.e., less negative) association with investment risk during the crisis compared to the pre-crisis period. However, as the risk of bankruptcy became more salient during the crisis, managers with inside debt holdings may have decreased investment risk incrementally further (relative to firms with no inside debt) in an effort to avoid bankruptcy and preserve the firm's liquidation value in the case of bankruptcy. This line of reasoning suggests that the association between inside debt and investment policy will be stronger (i.e., more negative) during the crisis than in the pre-crisis period.

Given both the tighter credit constraints and higher financial distress brought on by the crisis, it is not clear whether the association between inside debt and investment policy

diminished or strengthened during the crisis compared to the pre-crisis period. Therefore, we state our third hypotheses in the null form:

H3: The sensitivity of investment policy to inside debt is not different between the pre-crisis and financial crisis time periods.

3. Measurement of inside debt, sample selection, and crisis time-periods

3.1. Measurement of incentives provided by inside debt

Jensen and Meckling (1976), Sundaram and Yermack (2007), and Edmans and Liu (2011) propose that CEOs' incentive alignment between equity and debt holders should be measured relative to firms' incentive alignment between equity and debtholders.[2] Wei and Yermack (2011) propose several reasons that the best measure of CEOs' incentives provided by inside debt is measured in changes in the values of debt and equity. First, inside debt likely has different duration than firm securities. Second, payoffs to CEOs from equity are both finite and convex with respect to firm value, whereas firm equity payoffs are infinite and linear with respect to firm value. As such, our measure of inside debt, *RelativeIncentive*, follows Wei and Yermack (2011) in evaluating marginal changes in CEO's inside debt to equity ratio per unit associated with unit changes in firm's debt and equity. We calculate *RelativeIncentive* as:

$$RelativeIncentive = \frac{\Delta InsideDebt/\Delta CEOEquity}{\Delta FirmDebt/\Delta FirmEquity} \quad (1)$$

Consistent with Wei and Yermack (2011) and Cassell et al. (2012), we make the simplifying assumptions that the change in CEO inside debt and the change in firm debt are equal to the levels of inside debt and firm debt, respectively.[3] The CEO's inside debt is the sum of actuarial

[2] Jensen and Meckling (1976) argue that insiders should hold debt and equity in the same proportion as the firm to avoid risk-shifting problems (i.e., they argue for a *relative leverage ratio* of one). Edmans and Liu (2011) and Campbell et al. (2016) suggest that CEOs' inside debt ratios need not equal one to be optimal. Whichever case represents the optimal measurement, in our study we are not interested in just the level of CEO inside debt, but rather in the proportion of debt and equity in CEOs' holdings relative to firm holdings.

[3] Wei and Yermack (2011) justify this assumption on pages 14 and 15.

present value of pension balances and non-tax-qualified deferred compensation balances. Firm leverage is the sum of long-term debt and debt in current liabilities divided by market value of equity. We calculate CEO and firm equity delta following Core and Guay (1999).

3.2. Sample selection

Our main sample includes observations of CEO compensation and debt contracts from 2006 through 2011. The SEC requires filings for fiscal years ending after December 15, 2006 to include details of compensation plans, including the present value of pension benefits accrued under pension and other deferred compensation plans (SEC Final Rule 33-8732a, Item 402(b)(1)(iv)). As such, our sample begins once these disclosures were required. Our analysis requires data from Execucomp, Compustat, and the Center for Research on Security Prices (CRSP). Following related research (e.g., Bradley and Roberts 2004, Chava and Roberts 2008, Anantharaman et al. 2014), we exclude financial firms (firms in Standard Industrial Classification (SIC) codes 6000-6999) because these firms are highly regulated with significantly different debt contracting environments and are uniquely affected by financial crises. We require that each observation have the information necessary to calculate *RelativeIncentive* to be included in our primary sample. We collect debt contract provisions, including the use of covenants, from Dealscan, a database which contains information on private loans. These data restrictions lead to a main sample of 8,076 firm-years. We report the descriptive statistics in Table 1.

We use two different samples in our analyses. For analyses focused on covenants, we limit our sample to only include firms that initiate a loan reported in Dealscan. For these analyses, we allow the sample size to vary based on the data availability of each proxy for debt covenants in order to maximize the number of observations. We do not require firms to initiate

loans in both the pre-crisis and crisis periods because doing so would significantly limit our sample size, and negatively impact the external validity of our results. Such a restriction would limit our sample to firms with sufficiently high operating performance during the crisis that they would be able to obtain additional credit. Variables used in the debt covenant analyses are measured at the package level because covenants are usually contracted at the level of a package.[4] For tests of investment risk, we require firms to be present throughout the time period to avoid confounding inferences due to changes in the population of firms over time.[5]

3.3. Crisis time periods

We perform our main tests in two separate time periods: (i) 2006-2008, which we label the pre-crisis period, (ii) 2009-2011, which we label the crisis period. To create the pre-crisis/crisis split we follow Duchin et al. (2010) who show that the financial crisis first affected financing in August 2007, but that firms' operating performance was not affected until late 2008. We include firm-years through 2011 in the crisis period because we note that commercial and industrial lending levels returned to pre-crisis levels at the end of 2011. We plot these values using data from the St. Louis Federal Reserve Economic Research Division in Figure 1. The dashed horizontal line approximates the pre-crisis level of loan volume.

4. Analyses

4.1. Changes in incentives from inside debt and levels of firm leverage

To document changes in the firm financing and compensation policy, and to better ground the context for our formal hypothesis tests, we begin with a descriptive investigation of changes in firm leverage and CEO incentives from inside debt during our sample period 2006 through 2011. We do not have directional predictions for any changes in the level of inside debt.

[4] Loan packages are groups of loans (termed *facilities*) issued to the same borrower by the same lead lender and with the same initiation date.

[5] We find similar results and inferences with the full sample without this restriction.

If, on average, borrowers reduce the riskiness of expected investments due to credit constraints, the demand for inside debt will be lower during the crisis. Conversely, if the probability of default increased due to increased financial distress across the economy and shifted negotiating power in favor of lenders, then lenders may have demanded more protection, and borrowers may have increased levels of inside debt accordingly.

In addition to these conflicting predictions about the direction of the change in inside debt (whose effects might, on average, cancel out) we may not observe changes in inside debt levels because inside debt is a comparatively persistent mechanism with which to address agency costs. Once issued by firms, borrowers cannot simply "un-issue" inside debt, which is comprised of promises to pay pensions or other forms of deferred compensation upon a CEO's retirement. As the length of the crisis was unknown when it was taking place, firms may not have undertaken the task of adjusting inside debt levels to optimize agency costs in their current economic conditions. Similarly, because inside debt is sticky, lenders and borrowers may have chosen to address changes in the agency cost of debt utilizing more flexible, more specific debt contract provisions, such as covenant use.

We provide descriptive evidence on the use of inside debt and covenants during our time period in Figures 2 and 3. In Figure 2 we present both the mean level of firm leverage and the mean value of the relative incentive ratio for each year. We highlight the crisis period in grey. Presumably due to financing constraints, firm leverage is lower during the crisis period (2009 through 2011) and begins to recover by 2012 (not tabulated). CEOs' incentives from inside debt, while not consistent, appear to follow a general upward trend, including a large increase at the beginning of the crisis. We present the means of the number of financial covenants and the strictness of covenants, as proxied by the probability of covenant violation following Demerjian

and Owens (2016), in Figure 3. We again highlight the crisis period in grey. Figure 3 shows that the average number of financial covenants remained reasonably constant throughout our sample period, though it exhibits a slight downward trend. An alternative measure of the level of protection provided by covenants is their strictness, i.e., how likely borrowers are to violate covenant thresholds. We observe that the strictness of covenants increased sharply in 2008 and 2009, before reverting back to approximately pre-crisis levels in 2010 and 2011. Coupled with the increase in incentives from inside debt shown in Figure 1, the increase in covenant strictness during the crisis provides descriptive evidence that the substitution effect between inside debt and covenant use was weaker during the crisis.

4.2. Tests of changes in the association between inside debt and loan contracting features

To test our first hypothesis of a diminished substitution effect between inside debt and debt covenants we estimate the following equation separately for the pre-crisis and crisis periods using OLS regression. We use seemingly unrelated estimation method to address correlated errors across the two time periods (Zellner 1962; Srivastava and Giles 1987).[6] All regressions include industry (two-digit SIC) and year fixed effects, and we cluster standard errors by firm.

$$\begin{aligned} Covenants_{it} = {} & \alpha_0 + \beta_1 RelativeIncentive_{it} + \beta_2 Tenure_{it} + \beta_3 Salary \\ & + \beta_4 Bonus_{it} + \beta_5 Delta + \beta_6 Vega_{it} + \beta_7 FacilityAmount_{it} \\ & + \beta_8 FacilityMaturity_{it} + \beta_9 Lenders_{it} + \beta_{10} MVE_{it} + \beta_{11} ROA_{it} \\ & + \beta_{12} MTB_{it} + \beta_{13} Leverage_{it} + \beta_{14} Tangibility_{it} + \beta_{15} \sigma OCF_{it} \\ & + \beta_{16} AtlmanZ_{it} + Fixed\ industry\ effects + Fixed\ year\ effects \\ & + \varepsilon_{it} \end{aligned} \quad (2)$$

[6] Estimating the equations separately (rather than using estimating them in a single equation and using and indicator and interactions for the crisis period) allows the coefficients on the control variables to vary based on the time period. Given the upheaval the crisis caused, we expect it is likely that the relation between various firm variables and contract design will be different before and during the crisis.

We measure *Covenants* in three ways. First, we consider the number of financial covenants in place on newly initiated loans (*FinCov*).[7] Second, we consider whether newly initiated loans include dividend covenants (*DivCov*), a provision limiting the amount of dividends that the borrower can pay. This variable is set to one if a dividend covenant is present, and zero otherwise. These measures are intended to capture the strength of monitoring that covenants provide. However, as noted in Murfin (2012), the degree of monitoring is a function of not only the number of covenants, but also how tightly those covenants are set. When we refer to the strictness of covenants, we refer to the level of the accounting metric used in the covenant relative to the contractually stipulated threshold. If the covenant metric can move substantially before reaching the threshold, the covenant is considered *loose*. In contrast, if relatively little movement is possible, the covenant is considered *tight*. As noted previously, we measure the strictness of debt covenants using the probability of covenant violation (*PViolate*) following Demerjian and Owens (2016). *PViolate* is a measure of the probability that at least one covenant included in a loan will be violated, and is meant to provide a comprehensive, aggregated measure of the protection provided by the entire covenant package of the loan (as opposed to a particular covenant or the tightest covenant attached to the loan). We include controls for the level of monitoring in debt contracts following Anantharaman et al. (2014).

We report the results of these analyses in Table 2. We find consistent evidence across all three proxies for debt covenants that the substitution effect between inside debt and debt covenants was weaker during the crisis than in the pre-crisis period. Panel A presents the results of estimating Equation 2 when *Covenants* is measured as the number of financial covenants in

[7] Financial covenants are contract provisions that require the borrower to maintain a threshold level of an accounting-based metric. These include interest coverage, cash interest coverage, debt service coverage, fixed charge coverage, debt to EBITDA, senior debt to EBITDA, leverage, debt to total assets, debt to equity, senior debt to total assets, net worth, tangible net worth, current ratio, and quick ratio.

the loan contract (*FinCov*). Consistent with Anantharaman et al. (2014), we observe a substitution effect between incentives from inside debt and the number of financial covenants in the pre-crisis period; the association between *RelativeIncentive* and *FinCov* is significantly negative (-0.067, p<0.01). In contrast, we find no evidence of a substitution effect during the crisis time period (β_1 is not significantly different from zero). A Wald test indicates that the coefficients for *RelativeIncentive* are statistically different between the two periods (p<0.01), supporting our prediction. Panels B and C present the results of estimating the monitoring intensity of loan contracts using *DivCov* and *PViolate*, respectively. In both cases, we find that, consistent with prior literature, monitoring strength of covenants and incentives from inside debt were substitutes in the pre-crisis period, and we again find that that the substitution effect diminished during the crisis. Overall, our results from these analyses provide robust evidence that the substitution effect between debt covenants and incentives for inside debt diminished as the risk of bankruptcy increased during the crisis.

To test our second hypothesis, that the association between inside debt and the cost of debt was weaker during the crisis than prior to the crisis, we estimate the following equation separately for the pre-crisis and crisis periods using OLS regression. We again use seemingly unrelated estimation to address correlated errors across the two time periods, include industry (two-digit SIC) and year fixed effects, and cluster standard errors by firm.

$$\begin{aligned} Spread_i = \alpha_0 &+ \beta_1 RelativeIncentive_{it} + \beta_2 PViolate_{it} + \beta_3 Tenure_{it} + \beta_4 Salary \\ &+ \beta_5 Bonus_{it} + \beta_6 Delta + \beta_7 Vega_{it} + \beta_8 FacilityAmount_{it} \\ &+ \beta_9 FacilityMaturity_{it} + \beta_{10} Lenders_{it} + \beta_{11} MVE_{it} + \beta_{12} ROA_{it} \\ &+ \beta_{13} MTB_{it} + \beta_{14} Leverage_{it} + \beta_{15} Tangibility_{it} + \beta_{16} \sigma OCF_{it} \\ &+ \beta_{17} AtlmanZ_{it} + Fixed\ industry\ effects + Fixed\ year\ effects \\ &+ \varepsilon_{it} \end{aligned} \quad (3)$$

We collect *Spread*, our measure of the cost of debt, from the Dealscan database. Bank loans are generally floating rate, and spread is the increment above an index rate (typically LIBOR) charged. Thus, spread captures the default risk of the borrower independent of prevailing interest rates. Consistent with prior literature, we define *Spread* as the all-in drawn spread from Dealscan; this metric includes the interest spread charged on the loan as well as related fees and charges on any drawn portion of the credit.[8] We define all control variables as in the discussion of Equation 2, and all variables are defined in the appendix.

We report the results of estimating Equation 3 in Table 3. As we predict, the main effect on *RelativeIncentive* is negative during both the pre-crisis and crisis periods, though it is only significantly different from zero in the pre-crisis period. This is consistent with incentives from inside debt reducing the cost of debt for borrowers, as previously documented in prior literature (e.g., Anantharaman et al. 2014). Consistent with our expectation, we find that the effect of inside debt on loan spread is weaker during the crisis period; the Wald test statistic is significant at conventional levels ($p<0.05$).

The results of tests of our first two hypotheses provide consistent evidence that lenders demanded additional protection during the crisis; inside debt and covenants are less likely to be substitutes, and lenders place less emphasis on a single contract feature – inside debt – when determining the cost of debt. These results collectively are consistent with an increase in lender relative negotiating power during the crisis.

4.3. Tests of changes in the association between inside debt and investment policies

To test our third hypothesis, whether the association between inside debt and investment policies differs during the crisis period from the pre-crisis period, we estimate Equation 4

[8] Private loan facilities, particularly revolving lines of credit, can also have an *undrawn spread*, which is a charge for having access to a credit line even when the borrower does not draw on that line.

separately for the pre-crisis and crisis periods using OLS regression. We perform seemingly unrelated estimation on the set of regressions to address correlated errors across the two time periods while allowing the coefficients for the covariates to differ. All regressions include industry (two-digit SIC) and year fixed effects, and we cluster standard errors by firm.

$$
\begin{aligned}
InvestmentRisk_{it+1} &= \alpha_0 + \beta_1 RelativeIncentive_{it} + \beta_2 Vega/Delta_{it} \\
&+ \beta_3 TotalComp_{it} + \beta_4 FirmAge_{it} + \beta_5 TotalAssets + \beta_6 MTB_{it} \\
&+ \beta_7 SalesGrowth_{it} + \beta_8 Ret_{it} + \beta_9 Debt/Equity_{it} \\
&+ \beta_{10} CashSurplus_{it} + Fixed\ industry\ effects \\
&+ Fixed\ year\ effects + \varepsilon_{it}
\end{aligned} \tag{4}
$$

We measure firm investment policy (*InvestmentRisk*) using several proxies. First, we use the volatility of future firm performance calculated as the natural logarithm of the variance of daily stock returns in year t+1 ($LogTotalRisk_{t+1}$). This measure is intended to capture the effect of high risk investments on cash flows and, correspondingly, stock returns (Coles et al. 2006). Because stock return volatility likely reflects both firm-specific and common risks, we use a second volatility measure, $LogIdioRisk_{t+1}$, which captures the idiosyncratic volatility of future firm performance by accounting for market-wide fluctuations. Similar to Cassell et al. (2012), we estimate the market model using daily returns over 36 months for years t-2 to t. We then construct the expected daily returns for each firm using the estimated parameters and subtract these from the realized returns to calculate the residual daily returns for year t+1. $LogIdioRisk_{t+1}$ is the natural logarithm of the variance of the residual daily returns. Our third measure for *InvestmentRisk* is the value of R&D expenditures, scaled by sales ($R\&D_{t+1}$). This measure is intended to capture the riskiness of firm investment policy (Nam et al. 2003; Coles et al. 2006; Cassell et al. 2012). Finally, we use working capital ($WorkingCapital_{t+1}$) to proxy for asset liquidity, which reduces risk exposure (Ohlson 1980; Begley et al. 1996). We calculate

WorkingCapital$_{t+1}$ as current assets minus current liabilities, with the difference scaled by total assets. If incentives from inside debt have less impact on investment policies during the crisis, we expect the absolute value of β_1 to be smaller during the crisis period than during the pre-crisis periods. If incentives to reduce risk are stronger during the crisis, we expect the absolute value of β_1 to be larger. Panel B of Table 1 shows that the univariate correlations between *RelativeIncentive* and *LogTotalRisk* and *R&D* are negative, consistent with incentives from inside debt reducing the risk in firm investments, on average. The correlation between *RelativeIncentive* and *WorkingCapital* is negative but insignificant.

We present the results of estimating Equation 4 in Table 4. In Panel A, the dependent variable is the volatility of future stock returns (*LogTotalRisk*$_{t+1}$). We note that the relation between incentives from inside debt and total firm risk is negative and significant for the pre-crisis (-0.061, $p<0.10$) consistent with Cassell et al. (2012), and remains negative in the crisis period (-0.127, $p<0.01$). The results of a Wald test for differences in coefficients show that the association between *RelativeIncentive* and *LogTotalRisk* is significantly stronger in the crisis period (i.e. more negative) than in the pre-crisis period (the difference in coefficients of 0.066 is significantly different from zero at the 1% level).

In Panel B of Table 4, we report the results of estimating Equation 4 using the volatility of future stock returns after removing market-wide fluctuations (*LogIdioRisk*$_{t+1}$) as the dependent variable. Similar to the above results, we find negative and significant coefficients for *RelativeIncentive* in both the pre-crisis and crisis periods (-0.047, $p<0.01$; -0.098, $p<0.01$), and the difference in coefficients of -0.049 is statistically significant at the 1% level. Together, the results for the volatility proxies suggest that the association of inside debt and investment risk was stronger during the crisis compared to the proceeding time period.

Panel C of Table 4 presents the results of estimating Equation 4 when *InvestmentRisk* is measured as investments in R&D. The relation between incentives from inside debt and research and development remains negative in both the pre-crisis and crisis periods ($\beta_1<0$ in Columns 1 and 2). However, the results of a Wald test for differences in coefficients indicate that the association between *RelativeIncentive* and R&D was not different between the two time periods. Thus, this analysis does not provide evidence that investments in R&D were differentially sensitive to inside debt during the crisis.

In Panel D of Table 4 we present results using *WorkingCapital* as our measure of investment risk. For pre-crisis period (Column 1), the coefficient on *RelativeIncentive* is positive but insignificant, which is inconsistent with Cassell et al. (2012). We find a positive and significant coefficient on *RelativeIncentive* in the crisis period (0.016, $p<0.10$) reported in Column 2. This suggests that the positive association between working capital and inside debt strengthened between the pre-crisis and crisis periods.

The results from this set of tests provide some evidence that, as uncertainty increased during the crisis, firms with more inside debt generally displayed lower levels of risk-taking in investments. This finding is consistent with the that inside debt provided these firms with stronger incentives to protect liquidation value during the crisis, and with prior literature demonstrating that inside debt incentivizes managers to protect lenders as they approach bankruptcy (e.g., Pawliczek 2016). The results of our first two analyses suggest that lenders demanded additional protection during the crisis. The results of this analysis suggest that lenders' requirements for additional protection were quite strong; even though inside debt provided stronger incentives to borrowers, lenders no longer priced this in the debt contract's interest spread. These results suggest a shift in bargaining power toward lenders during the financial

crisis, which is consistent with lenders reducing credit availability during the crisis (e.g., Cornetta et al. 2011, Ivashina and Scharfstein 2010).

4.4. Additional analysis: post-crisis period

We extend our main analyses to the post-crisis, or recovery, period (2012–2014) to understand whether the changes we document in our main tests represent a temporary shift in the role of inside debt in mitigating the agency cost of debt during the crisis, or a more persistent change. We use the years 2012 through 2014 as the recovery period: firm leverage was lower during between 2009 through 2011, consistent with financing constraints, but began to rise by 2012. In addition, using data from the St. Louis Federal Reserve Economic Research Division, we find that commercial and industrial lending levels recovered to pre-crisis levels in 2012 (Figure 1).

We first extend our analysis of changes in the association between inside debt and loan contract features to 2012-2014. Table 5 reports the results for re-estimating Equation 2 for this new time period. Overall, we do not find that the substitution effect returns in the recovery period; the coefficient for *RelativeIncentive* remains insignificantly different from zero. In addition, Wald tests indicate that the coefficients for our variable of interest are statistically different between the time periods when the dependent variable is the number of financial covenants or covenant strictness. We cannot reject the null for the Wald test when the dependent variable is the inclusion of a dividend covenant (p=0.08), but we note that the coefficient for *RelativeIncentive* in either period is not statistically different from zero. Taken together, our results suggest that the substitution effect shown in prior studies diminished during the crisis and did not re-emerge in the recovery period.

We next test whether the weaker effect of inside debt on loan spreads persisted during the recovery period. We report the results of estimating Equation 3 for the recovery period in Table 6. Unlike the substitution effect between inside debt and covenant use, we find that the association between inside debt and loan spreads reveals an association consistent with the pre-crisis period. The association between inside debt levels and loan spreads is negative and significantly different from zero in the recovery period. This level of significance is statistically indistinguishable from the pre-crisis period (p=0.71), and significantly more negative than the crisis period (p=0.05). These results, coupled with the lack of a significant substitution effect between covenant intensity and inside debt, suggests a structural change that occurred during the recovery period. The lack of a substitution effect implies that lenders continued to demand both covenants and inside debt concurrently.[9] The significant coefficient on inside debt in the cost of debt regressions spread suggest that inside debt was valuable to lenders during the recovery period. In contrast, covenants appear to be less valued by lenders in this period; the coefficient on *PViolate* is insignificant.

Finally, we examine the effect of inside debt on investment policy by re-estimating Equation 4 for the recovery period. Similar to our prior tests for investment policy, we restrict our recovery sample to firms that are present in both the pre-crisis and crisis periods to avoid confounding inferences due to changes in the population of firms over time. We also use seemingly unrelated estimation as before to account for possible correlated errors between the crisis and recovery periods. Table 7 presents the results comparing the crisis (results already reported in main tests) and the recovery time periods. We present the results of estimating Equation 4 using $LogTotalRisk_{t+1}$ as the measure of $InvestmentRisk_{t+1}$ in Panel A. The coefficient

[9] Or alternatively, that lenders required neither; the substitution relies only on consistent use or non-use between covenants and inside debt.

for *RelativeIncentive* remains negative and significant (-0.176, p<0.01) in the recovery period, which is 0.049 less than in the crisis period. A Wald test indicates that the coefficients are not statistically different between the crisis and recovery periods. We find similar results in our idiosyncratic risk tests in Panel B. Together, these results suggest that inside debt continued to have a stronger effect in reducing investment risk following the crisis compared to the pre-crisis period.

Panels C and D of Table 7 present results for tests of the association between inside debt and the riskiness of firms' investments in the recovery period. We find a negative and significant coefficient for *RelativeIncentive* in the recovery period when the dependent variable is future R&D (-0.014, p<0.01), and a positive and significant coefficient when the dependent variable is future working capital (0.018, p < 0.05). The differences in coefficients between the crisis and recovery periods are not statistically significant using Wald tests.[10] Thus, we do not find evidence that investments in R&D were differentially sensitive to inside debt following the crisis. However, our findings for working capital suggest that the stronger positive association of inside debt and future working capital noted in the crisis persists in the post-crisis period.

Taken together, the results of tests of the association between inside debt and firm investment policy provide evidence that the stronger association between inside debt and firm investment policy persisted following the crisis. This suggests there was a fundamental shift, a persistent increase, in the efficacy of inside debt in influencing firm investment policies.

5. Conclusion

We examine the role of inside debt in limiting agency conflicts, with a focus on the Global Financial Crisis. Past research has shown that inside debt is associated with fewer protective covenants in debt contracts, suggesting these provisions are substitutes, with lower

[10] In untabulated analyses, we find similar results in Wald tests when comparing pre- and post-crisis periods.

cost of debt, and with lower level of riskiness in investment, consistent with limiting agency conflicts related to asset substitution. However, this evidence was largely documented during the period 2006 to 2008, when credit was freely available and the economy was strong. By focusing on the period around the crisis, we are able to examine how the role of inside debt changed when credit was constrained and economic performance deteriorated.

We find that the negative relation between inside debt and debt covenants documented in the literature attenuates during the crisis, and that inside debt does not reduce the cost of debt during the crisis period. We interpret these changes as consistent with an increase lenders' demand for protection, and a shift in bargaining power from borrowers to lenders during the crisis period. We also find that the relation between inside debt and borrower investment risk is strengthened during the crisis. Firms with more inside debt generally displayed lower levels of risk-taking in investments during the crisis compared to the pre-crisis period, consistent with incentives to protect liquidation value. Additional analyses indicate that the lack of substitution between inside debt and covenants, and the increased efficacy of inside debt in reducing investment risk persist in subsequent periods.

Our results complement the extant research on inside debt and how it helps address agency problems related to having debt. We show that the role of inside debt changed in the period of the crisis and subsequent recovery, and that this change is likely due to increased credit constraints and risk aversion. Further, we build on research examining how investment policy changes in the face of financial crises.

Appendix: Variable definitions

Variable	Definition
AltmanZ	Altman's Z-score calculated following Hillegeist et al. (2004) for manufacturing firms (0.08 × working capital/total assets – 0.04 × retained earnings/total assets + 0.10 × EBIT/total assets + 0.22 × market value of equity/total liabilities – 0.06 × sales/total assets + 4.34) and Altman (2000) for nonmanufacturing firms (6.56 × working capital/total assets + 3.26 × retained earnings/total assets + 6.72 × EBIT/total assets + 1.05 × book value of equity/ total liabilities)
Bonus	Natural logarithm of (CEO's bonus + 1)
CashSurplus	Sum of cash flow from operations and R&D expenditures less depreciation expense, scaled by total assets
CEOTenure	CEO tenure
Debt/Equity	Sum of long-term debt and debt in current liabilities divided by the market value of equity
Delta	Change in CEO's stock and option value for a 1% change in stock price scaled by annual total compensation
DivCov	Equal to one when the package includes a covenant with dividend restrictions
FacilityAmount	Natural logarithm of the facility's amount. We retain the largest facility in each package similar to Anantharaman et al. (2014)
FacilityMaturity	Natural logarithm of the facility's maturity in months. We retain the largest facility in each package similar to Anantharaman et al. (2014)
FinCov	Number of financial covenants included in the package
FirmAge	Natural log of the number of years since the firm first appeared in Compustat with valid assets data
Lenders	Number of lenders for a facility
Leverage	Sum of long-term debt and debt in current liabilities divided by total assets
$LogIdioRisk_{t+1}$	Natural logarithm of the variance of (daily returns less expected daily returns) over year t+1. Follow Cassell et al. (2012), we estimate the market model using daily returns over 36 months for years t-2 to t. We then construct the expected daily returns for each firm using the estimated parameters and subtract these from the realized returns to calculate the residual daily returns for year t+1. $LogIdioRisk_{t+1}$ is the natural logarithm of the variance of the residual daily returns
$LogTotalRisk_{t+1}$	Natural logarithm of the variance of daily returns measured over year t+1

Variable	Definition
MTB	Market value of equity divided by book value of equity
MVE	Natural logarithm of market value of equity
PViolate	Probability of violating a covenant during the fiscal year, excluding fixed charge coverage covenants. We calculate the probability of violating covenants following Demerjian and Owens (2016). PViolate is based on the 15 most common covenants included in Dealscan, which capture about 99.3% of all financial covenants used in loans in that database. For each of these 15 covenants, Demerjian and Owens (2016) calculate covenant slack, which is the difference between the threshold value of a covenant and actual value of the corresponding covenant metric at loan initiation. PViolate incorporates two other dimensions of strictness. First, the slack of each covenant is scaled by the standard deviation of the covenant metric. When a covenant is written on a more volatile measure, it is more likely to be violated ceteris paribus. Second, PViolate incorporates the covariance structure among covenant measures. By incorporating the covariance between covenants, the similarity and overlap between measures does not inflate the expected likelihood of default. Using the slack, variance, and covariance across all covenant measures, Demerjian and Owens (2016) use simulation to calculate an expected likelihood that at least one financial covenant within the loan package will be violated. Using the realizations of the simulation across multiple runs, they calculate PViolate. This metric has a range between zero and one, with zero indicating technical default is not expected (there were no instances of technical default in any of the simulation runs) and one indicating a high likelihood of default (at least one covenant was violated in every simulation run)
R&D	R&D expenditures scaled by sales
RelativeIncentive	$\frac{InsideDebt/\Delta CEOEquity}{FirmDebt/\Delta FirmEquity}$ The CEO's inside debt is the sum of actuarial present value of pension balances and non-tax-qualified deferred compensation balances. Firm leverage is the sum of long-term debt and debt in current liabilities divided by market value of equity. We calculate CEO and firm equity delta following Core and Guay (1999)
Return	Stock return over year t
ROA	Return on assets calculated as income before extraordinary items divided by lagged total assets
Salary	Natural logarithm of (CEO's salary + 1)

Variable	Definition
SalesGrowth	Percentage change in sales between years t-1 and t
Spread	The all-in-drawn spread of the loan
Tangibility	Asset tangibility calculated as net property, plant and equipment divided by total assets
TotalAssets	Natural logarithm of total assets
TotalComp	Natural logarithm of (CEO's salary + bonus + 1)
Vega	Change in CEO's option value for a 1% change in volatility
Vega/Delta	Ratio of vega and delta
$WorkingCapital_{t+1}$	Current assets minus current liabilities scaled by total assets measured in year t+1. We follow Cassell et al. (2012) in calculating an alternative measure
σOCF	Standard deviation of operating income before depreciation scaled by total assets, measured over years t-4 to t

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Table 1: Descriptive statistics for selected regression variables

This table presents the descriptive statistics of selected variables used in subsequent regression analyses. Panel A reports the distributions of the variables. Panel B reports the Pearson correlations (lower left triangle) and Spearman correlations (upper right triangle). * indicates a statistically significant correlation of 5%. Variables are defined in the appendix.

Panel A: Distributions of selected regression variables

Variable	N	Mean	SD	p25	Median	p75
LogTotalRisk$_{t+1}$	8,076	-7.258	0.909	-7.893	-7.274	-6.654
LogIdioRisk$_{t+1}$	8,076	-3.869	0.494	-4.216	-3.879	-3.548
R&D$_{t+1}$	8,076	0.044	0.083	0.000	0.000	0.048
WorkingCapital$_{t+1}$	8,076	0.220	0.208	0.064	0.197	0.346
FinCov	1,806	1.879	0.720	1	2	2
DivCov	1,830	0.696	0.460	0	1	1
PViolate	1,136	0.233	0.369	0.000	0.019	0.269
Spread	1,136	1.725	1.208	0.750	1.500	2.250
RelativeIncentive	8,076	1.693	6.918	0.000	0.047	0.741
Vega/Delta	8,076	0.391	0.360	0.078	0.318	0.608
TotalComp ($ thousands)	8,076	954.889	736.761	553.303	800.000	1,068.773
Salary ($ thousands)	8,076	768.481	353.004	510.000	723.115	981.826
Bonus ($ thousands)	8,076	179.946	557.033	0.000	0.000	0.000
FirmAge	8,076	27.291	17.435	13.000	21.000	42.000
TotalAssets	8,076	7.511	1.616	6.348	7.422	8.574
MTB	8,076	2.781	3.355	1.355	2.082	3.330
Leverage	1,806	0.268	0.166	0.150	0.258	0.362
Tangibility	1,806	0.318	0.248	0.111	0.228	0.504
SalesGrowth	8,076	0.092	0.221	-0.017	0.075	0.175
Ret	8,076	0.110	0.543	-0.215	0.048	0.302
Debt/Equity	8,076	0.247	0.557	0.000	0.016	0.231
CashSurplus	8,076	0.093	0.092	0.036	0.080	0.139

Table 1: Descriptive statistics for selected regression variables (continued)

Panel B: Correlations among selected regression variables

	(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*	*(8)*
(1) LogTotalRisk$_{t+1}$		0.94*	0.01	0.21*	0.16*	0.23*	0.31*	-0.17*
(2) LogIdioRisk$_{t+1}$	0.95*		-0.02	0.20*	0.16*	0.26*	0.34*	-0.24*
(3) R&D$_{t+1}$	0.10*	0.13*		0.29*	0.00	-0.04	-0.09	-0.01
(4) WorkingCapital$_{t+1}$	0.20*	0.20*	0.35*		0.16*	0.11*	0.09*	-0.06
(5) FinCov	0.16*	0.17*	0.02	0.16*		0.25*	0.36*	-0.20*
(6) DivCov	0.24*	0.27*	-0.01	0.10*	0.23*		0.27*	-0.21*
(7) PViolate	0.29*	0.33*	-0.04	0.06	0.20*	0.18*		-0.27*
(8) Log of RelativeIncentive	-0.15*	-0.19*	-0.11*	-0.02	-0.13*	-0.10*	-0.13	

Table 2: Substitution effect between inside debt and debt contracting features

This table reports the regression results of debt contracting features as a function of inside debt (Equation 2). The dependent variables are the number of financial covenants (Panel A), inclusion of dividend covenant (Panel B), and strictness of debt covenants (Panel C). All regressions include fixed two-digit SIC industry and year effects. Robust standard errors, adjusted with clustering by firm, are reported in parentheses. Variables are defined in the appendix. ***, **, and * indicate p<1%, 5%, and 10% (two-tailed), respectively.

Panel A: Number of financial covenants (FinCov)

	Pre-Crisis (1)	Crisis (2)	*Wald Test of* $\beta_{Pre\text{-}crisis} = \beta_{Crisis}$
Log of RelativeIncentive	-0.067***	0.012	*p < 0.01*
	(0.021)	(0.020)	
CEOTenure	0.013***	0.011**	
	(0.004)	(0.005)	
Salary	-0.112	-0.144*	
	(0.085)	(0.079)	
Bonus	-0.004	0.006	
	(0.009)	(0.010)	
Delta	-0.000	0.000	
	(0.000)	(0.000)	
Vega	-0.000*	-0.000	
	(0.000)	(0.000)	
FacilityAmount	-0.064*	0.043	
	(0.036)	(0.038)	
FacilityMaturity	0.065	0.051	
	(0.056)	(0.066)	
Lenders	0.000	0.001	
	(0.004)	(0.004)	
MVE	-0.048	-0.154***	
	(0.033)	(0.035)	
ROA	-0.045	1.446***	
	(0.374)	(0.453)	
MTB	0.002	0.005	
	(0.006)	(0.008)	
Leverage	0.356*	0.608***	
	(0.211)	(0.218)	
Tangibility	-0.313	0.099	
	(0.200)	(0.209)	
σOCF	-1.326	-1.459*	
	(0.877)	(0.852)	
AltmanZ	0.033**	0.064***	
	(0.016)	(0.017)	
Constant	4.861***	3.659***	
	(0.812)	(0.820)	
Observations	1,034	772	
R-squared	0.26	0.31	

Table 2: Substitution effect between inside debt and debt contracting features (continued)

Panel B: Inclusion of dividend covenant (DivCov)

	Pre-Crisis (1)	Crisis (2)	*Wald Test of* $\beta_{Pre\text{-}crisis} = \beta_{Crisis}$
Log of RelativeIncentive	-0.160**	0.078	*p < 0.05*
	(0.082)	(0.070)	
CEOTenure	0.009	0.022	
	(0.017)	(0.018)	
Salary	0.061	-0.209	
	(0.329)	(0.281)	
Bonus	0.048	0.009	
	(0.034)	(0.042)	
Delta	0.000*	-0.000	
	(0.000)	(0.000)	
Vega	-0.000	-0.000	
	(0.001)	(0.001)	
FacilityAmount	-0.337**	0.281*	
	(0.144)	(0.164)	
FacilityMaturity	0.325**	0.530*	
	(0.153)	(0.275)	
Lenders	0.016	-0.007	
	(0.014)	(0.016)	
MVE	-0.619***	-0.681***	
	(0.133)	(0.148)	
ROA	1.891	-1.180	
	(1.743)	(1.865)	
MTB	-0.053*	0.010	
	(0.029)	(0.033)	
Leverage	-0.493	0.908	
	(0.755)	(0.743)	
Tangibility	-0.985*	-0.241	
	(0.566)	(0.495)	
σOCF	-0.221	0.206	
	(3.244)	(3.466)	
AltmanZ	-0.195***	-0.015	
	(0.066)	(0.064)	
Constant	11.586***	-0.149	
	(2.830)	(3.268)	
Observations	1,082	748	
Pseudo R-squared	0.25	0.18	

Table 2: Substitution effect between inside debt and debt contracting features (continued)

Panel C: Strictness of debt covenants (PViolate)

	Pre-Crisis (1)	Crisis (2)	*Wald Test of* $\beta_{Pre\text{-}crisis} = \beta_{Crisis}$
Log of RelativeIncentive	-0.026**	0.003	*p < 0.10*
	(0.013)	(0.011)	
CEOTenure	0.002	0.001	
	(0.003)	(0.003)	
Salary	0.054	0.068	
	(0.056)	(0.053)	
Bonus	-0.005	0.007	
	(0.005)	(0.006)	
Delta	0.000	-0.000	
	(0.000)	(0.000)	
Vega	-0.000	0.000	
	(0.000)	(0.000)	
FacilityAmount	-0.013	-0.022	
	(0.024)	(0.024)	
FacilityMaturity	-0.011	-0.033	
	(0.023)	(0.037)	
Lenders	-0.002	-0.004	
	(0.003)	(0.002)	
MVE	-0.080***	-0.040*	
	(0.022)	(0.024)	
ROA	-0.604*	-1.227***	
	(0.313)	(0.291)	
MTB	-0.001	0.006	
	(0.004)	(0.005)	
Leverage	0.077	0.484***	
	(0.104)	(0.125)	
Tangibility	-0.030	-0.012	
	(0.111)	(0.102)	
σOCF	0.058	1.157**	
	(0.490)	(0.477)	
AltmanZ	-0.032***	-0.007	
	(0.012)	(0.010)	
Constant	0.527	0.423	
	(0.495)	(0.471)	
Observations	632	504	
R-squared	0.35	0.46	

Table 3: Association between inside debt and loan spread

This table reports the regression results of loan spread as a function of inside debt (Equation 3). The dependent variable is the loan spread. All regressions include fixed two-digit SIC industry and year effects. Robust standard errors, adjusted with clustering by firm, are reported in parentheses. Variables are defined in the appendix. ***, **, and * indicate p<1%, 5%, and 10% (two-tailed), respectively.

	Pre-Crisis (1)	Crisis (2)	*Wald Test of* $\beta_{Pre\text{-}crisis} = \beta_{Crisis}$
Log of RelativeIncentive	-0.098***	-0.016	*p < 0.05*
	(0.025)	(0.033)	
PViolate	0.362***	0.569***	
	(0.118)	(0.129)	
Tenure	0.002	-0.015**	
	(0.007)	(0.006)	
Salary	-0.026	0.240*	
	(0.133)	(0.135)	
Bonus	0.003	0.016	
	(0.011)	(0.017)	
Delta	-0.000	0.000	
	(0.000)	(0.000)	
Vega	-0.000**	-0.001***	
	(0.000)	(0.000)	
FacilityAmount	-0.058	0.101	
	(0.060)	(0.069)	
FacilityMaturity	0.024	0.131	
	(0.063)	(0.111)	
Lenders	-0.013**	-0.014*	
	(0.006)	(0.008)	
MVE	-0.101**	-0.187***	
	(0.042)	(0.060)	
ROA	-1.937**	-1.276*	
	(0.778)	(0.772)	
MTB	-0.019*	0.012	
	(0.010)	(0.014)	
Leverage	1.160***	0.477	
	(0.310)	(0.318)	
Tangibility	-0.173	-0.570**	
	(0.268)	(0.255)	
σOCF	1.312	1.168	
	(1.025)	(1.271)	
AltmanZ	-0.084***	-0.056**	
	(0.027)	(0.023)	
Constant	4.871***	0.404	
	(1.141)	(1.337)	
Observations	632	504	
R-squared	0.56	0.58	

Table 4: Association between investment risk and inside debt

This table reports the OLS regression results of investment risk as a function of inside debt (Equation 4). We proxy for investment risk using total firm risk ($LogTotalRisk_{t+1}$) in Panel A, idiosyncratic risk ($LogIdioRisk_{t+1}$) in Panel B, R&D expenditures scaled by sales ($R\&D_{t+1}$) in Panel C, and working capital ($WorkingCapital_{t+1}$) in Panel D. All regressions include fixed two-digit SIC industry and year effects. Robust standard errors, adjusted with clustering by firm, are reported in parentheses. Variables are defined in the appendix. ***, **, and * indicate p<1%, 5%, and 10% (two-tailed), respectively.

Panel A: Total firm risk ($LogTotalRisk_{t+1}$)

	Pre-Crisis (1)	Crisis (2)	*Wald Test of* $\beta_{Pre\text{-}crisis} = \beta_{Crisis}$
Log of RelativeIncentive	-0.061*	-0.127***	*p < 0.01*
	(0.035)	(0.029)	
Vega/Delta	0.200***	-0.069	
	(0.049)	(0.049)	
TotalComp	-0.123***	0.063*	
	(0.034)	(0.033)	
FirmAge	-0.121***	-0.084**	
	(0.033)	(0.035)	
TotalAssets	-0.140***	-0.227***	
	(0.014)	(0.013)	
MTB	0.001	-0.010*	
	(0.005)	(0.006)	
SalesGrowth	-0.124	0.113*	
	(0.110)	(0.063)	
Return	-0.417***	0.228***	
	(0.052)	(0.025)	
Debt/Equity	0.128***	0.008	
	(0.040)	(0.046)	
CashSurplus	-1.643***	-1.983***	
	(0.212)	(0.223)	
Constant	-5.230***	-6.442***	
	(0.224)	(0.219)	
Observations	2,382	2,382	
R-squared	0.29	0.51	

Table 4: Association between investment risk and inside debt (continued)

Panel B: Idiosyncratic risk (LogIdioRisk$_{t+1}$)

	Pre-Crisis (1)	Crisis (2)	*Wald Test of* $\beta_{Pre\text{-}crisis} = \beta_{Crisis}$
Log of RelativeIncentive	-0.047***	-0.098***	*p < 0.01*
	(0.018)	(0.018)	
Vega/Delta	0.106***	-0.023	
	(0.024)	(0.027)	
TotalComp	-0.066***	0.011	
	(0.017)	(0.019)	
FirmAge	-0.088***	-0.084***	
	(0.018)	(0.021)	
TotalAssets	-0.095***	-0.125***	
	(0.007)	(0.008)	
MTB	0.000	-0.006**	
	(0.003)	(0.003)	
SalesGrowth	-0.003	0.092***	
	(0.053)	(0.033)	
Return	-0.139***	0.069***	
	(0.024)	(0.015)	
Debt/Equity	0.071***	0.040	
	(0.022)	(0.027)	
CashSurplus	-0.955***	-0.954***	
	(0.116)	(0.127)	
Constant	-1.958***	-2.561***	
	(0.109)	(0.126)	
Observations	2,382	2,382	
R-squared	0.29	0.51	

Table 4: Association between investment risk and inside debt (continued)

Panel C: R&D expenditures scaled by sales ($R\&D_{t+1}$)

	Pre-Crisis (1)	Crisis (2)	*Wald Test of* $\beta_{Pre\text{-}crisis} = \beta_{Crisis}$
Log of RelativeIncentive	-0.010***	-0.010***	*p > 0.10*
	(0.003)	(0.003)	
Vega/Delta	0.038***	0.027***	
	(0.006)	(0.006)	
TotalComp	-0.004	-0.008**	
	(0.003)	(0.004)	
FirmAge	-0.004	-0.005	
	(0.003)	(0.003)	
TotalAssets	-0.005**	-0.003	
	(0.002)	(0.002)	
MTB	-0.002**	-0.001	
	(0.001)	(0.001)	
SalesGrowth	0.023*	0.029***	
	(0.012)	(0.008)	
Return	0.001	-0.000	
	(0.003)	(0.003)	
Debt/Equity	-0.003	0.002	
	(0.003)	(0.002)	
CashSurplus	0.308***	0.301***	
	(0.031)	(0.037)	
Constant	-0.010***	-0.010***	
	(0.003)	(0.003)	
Observations	2,382	2,382	
R-squared	0.36	0.35	

Table 4: Association between investment risk and inside debt (continued)

Panel D: Working Capital (WorkingCapital$_{t+1}$)

	Pre-Crisis (1)	Crisis (2)	*Wald Test of* $\beta_{Pre\text{-}crisis} = \beta_{Crisis}$
Log of RelativeIncentive	0.002	0.016*	*p < 0.10*
	(0.008)	(0.008)	
Vega/Delta	0.009	0.006	
	(0.012)	(0.013)	
TotalComp	-0.018*	-0.029***	
	(0.010)	(0.011)	
FirmAge	-0.011	-0.017*	
	(0.009)	(0.010)	
TotalAssets	-0.039***	-0.031***	
	(0.005)	(0.005)	
MTB	-0.003*	-0.001	
	(0.001)	(0.001)	
SalesGrowth	0.039	0.052***	
	(0.024)	(0.013)	
Return	-0.003	0.017***	
	(0.008)	(0.005)	
Debt/Equity	-0.002	-0.018**	
	(0.007)	(0.008)	
CashSurplus	0.241***	0.286***	
	(0.063)	(0.062)	
Constant	0.680***	0.728***	
	(0.060)	(0.068)	
Observations	2,382	2,382	
R-squared	0.55	0.57	

Table 5: Substitution effect between inside debt and debt contracting features following the financial crisis

This table reports the regression results of debt contracting features as a function of inside debt (Equation 2). The dependent variables are the number of financial covenants (Panel A), inclusion of dividend covenant (Panel B), and strictness of debt covenants (Panel C). All regressions include fixed two-digit SIC industry and year effects. Robust standard errors, adjusted with clustering by firm, are reported in parentheses. Variables are defined in the appendix. ***, **, and * indicate p<1%, 5%, and 10% (two-tailed), respectively.

Panel A: Number of financial covenants (FinCov)

	Crisis (1)	Recovery (2)	*Wald Test of* $\beta_{Crisis} = \beta_{Recovery}$
Log of RelativeIncentive	0.012	-0.014	*p > 0.10*
	(0.020)	(0.016)	
CEOTenure	0.011**	0.000	
	(0.005)	(0.003)	
Salary	-0.144*	-0.254***	
	(0.079)	(0.080)	
Bonus	0.006	-0.005	
	(0.010)	(0.009)	
Delta	0.000	0.000	
	(0.000)	(0.000)	
Vega	-0.000	-0.001***	
	(0.000)	(0.000)	
FacilityAmount	0.043	-0.010	
	(0.038)	(0.032)	
FacilityMaturity	0.051	0.092**	
	(0.066)	(0.041)	
Lenders	0.001	0.009***	
	(0.004)	(0.003)	
MVE	-0.154***	-0.077***	
	(0.035)	(0.028)	
ROA	1.446***	0.020	
	(0.453)	(0.428)	
MTB	0.005	-0.002	
	(0.008)	(0.006)	
Leverage	0.608***	-0.095	
	(0.218)	(0.184)	
Tangibility	0.099	-0.098	
	(0.209)	(0.170)	
σOCF	-1.459*	-0.308	
	(0.852)	(0.924)	
AltmanZ	0.064***	0.025	
	(0.017)	(0.016)	
Constant	3.659***	3.051***	
	(0.820)	(0.720)	
Observations	772	899	
R-squared	0.31	0.35	

Table 5: Substitution effect between inside debt and debt contracting features following financial crisis (continued)

Panel B: Inclusion of dividend covenant (DivCov)

	Crisis (1)	Recovery (2)	*Wald Test of* $\beta_{Crisis} = \beta_{Recovery}$
Log of RelativeIncentive	0.078	-0.077	*p < 0.10*
	(0.070)	(0.075)	
CEOTenure	0.022	0.024	
	(0.018)	(0.017)	
Salary	-0.209	-0.333	
	(0.281)	(0.338)	
Bonus	0.009	-0.046	
	(0.042)	(0.043)	
Delta	-0.000	0.000	
	(0.000)	(0.000)	
Vega	-0.000	-0.002**	
	(0.001)	(0.001)	
FacilityAmount	0.281*	0.315*	
	(0.164)	(0.165)	
FacilityMaturity	0.530*	0.830***	
	(0.275)	(0.279)	
Lenders	-0.007	-0.001	
	(0.016)	(0.019)	
MVE	-0.681***	-0.829***	
	(0.148)	(0.147)	
ROA	-1.180	0.702	
	(1.865)	(1.829)	
MTB	0.010	0.003	
	(0.033)	(0.030)	
Leverage	0.908	-0.135	
	(0.743)	(0.721)	
Tangibility	-0.241	-0.396	
	(0.495)	(0.561)	
σOCF	0.206	4.190	
	(3.466)	(4.600)	
AltmanZ	-0.015	-0.155***	
	(0.064)	(0.058)	
Constant	-0.149	-1.213	
	(3.268)	(3.084)	
Observations	748	910	
Pseudo R-squared	0.18	0.29	

Table 5: Substitution effect between inside debt and debt contracting features following financial crisis (continued)

Panel C: Strictness of debt covenants (PViolate)

	Crisis (1)	Recovery (2)	*Wald Test of* $\beta_{Crisis} = \beta_{Recovery}$
Log of RelativeIncentive	0.003	-0.006	*p > 0.10*
	(0.011)	(0.011)	
CEOTenure	0.001	0.001	
	(0.003)	(0.003)	
Salary	0.068	0.114*	
	(0.053)	(0.061)	
Bonus	0.007	0.012	
	(0.006)	(0.008)	
Delta	-0.000	0.000	
	(0.000)	(0.000)	
Vega	0.000	-0.000	
	(0.000)	(0.000)	
FacilityAmount	-0.022	0.001	
	(0.024)	(0.024)	
FacilityMaturity	-0.033	0.033	
	(0.037)	(0.028)	
Lenders	-0.004	0.001	
	(0.002)	(0.003)	
MVE	-0.040*	-0.056**	
	(0.024)	(0.022)	
ROA	-1.227***	-1.621***	
	(0.291)	(0.428)	
MTB	0.006	0.010*	
	(0.005)	(0.005)	
Leverage	0.484***	0.381**	
	(0.125)	(0.154)	
Tangibility	-0.012	0.046	
	(0.102)	(0.109)	
σOCF	1.157**	1.255*	
	(0.477)	(0.717)	
AltmanZ	-0.007	-0.009	
	(0.010)	(0.012)	
Constant	0.423	-0.450	
	(0.471)	(0.567)	
Observations	504	400	
R-squared	0.46	0.41	

Table 6: Association between inside debt and loan spread following the financial crisis

This table reports the regression results of loan spread as a function of inside debt (Equation 3). The dependent variable is the loan spread. All regressions include fixed two-digit SIC industry and year effects. Robust standard errors, adjusted with clustering by firm, are reported in parentheses. Variables are defined in the appendix. ***, **, and * indicate p<1%, 5%, and 10% (two-tailed), respectively.

	Crisis (1)	Recovery (2)	*Wald Test of* $\beta_{Crisis} = \beta_{Recovery}$
Log of RelativeIncentive	-0.016	-0.086***	*p < 0.10*
	(0.033)	(0.021)	
PViolate	0.569***	0.122	
	(0.129)	(0.141)	
Tenure	-0.015**	-0.007	
	(0.006)	(0.006)	
Salary	0.240*	0.182	
	(0.135)	(0.136)	
Bonus	0.016	-0.028*	
	(0.017)	(0.015)	
Delta	0.000	-0.000	
	(0.000)	(0.000)	
Vega	-0.001***	-0.000**	
	(0.000)	(0.000)	
FacilityAmount	0.101	0.084	
	(0.069)	(0.059)	
FacilityMaturity	0.131	0.095	
	(0.111)	(0.096)	
Lenders	-0.014*	-0.013*	
	(0.008)	(0.007)	
MVE	-0.187***	-0.232***	
	(0.060)	(0.058)	
ROA	-1.276*	-1.698**	
	(0.772)	(0.782)	
MTB	0.012	0.004	
	(0.014)	(0.008)	
Leverage	0.477	0.638**	
	(0.318)	(0.303)	
Tangibility	-0.570**	0.141	
	(0.255)	(0.327)	
σOCF	1.168	3.608**	
	(1.271)	(1.819)	
AltmanZ	-0.056**	-0.134***	
	(0.023)	(0.023)	
Constant	0.404	-0.460	
	(1.337)	(1.316)	
Observations	504	400	
R-squared	0.58	0.57	

Table 7: Association between investment risk and inside debt following the financial crisis

This table reports the OLS regression results of investment risk as a function of inside debt (Equation 4) for the crisis (2009-2011) and recovery periods (2012-2014). We proxy for investment risk using total firm risk ($LogTotalRisk_{t+1}$) in Panel A, R&D expenditures scaled by sales ($R\&D_{t+1}$) in Panel B, and working capital ($WorkingCapital_{t+1}$) in Panel C. All regressions include fixed two-digit SIC industry and year effects. Robust standard errors, adjusted with clustering by firm, are reported in parentheses. Variables are defined in the appendix. ***, **, and * indicate p<1%, 5%, and 10% (two-tailed), respectively.

Panel A: Total firm risk ($LogTotalRisk_{t+1}$)

	Crisis (1)	Recovery (2)	*Wald Test of* $\beta_{Crisis} = \beta_{Recovery}$
Log of RelativeIncentive	-0.127***	-0.169***	*p > 0.10*
	(0.029)	(0.030)	
Vega/Delta	-0.069	-0.198***	
	(0.049)	(0.014)	
TotalComp	0.063*	-0.004	
	(0.033)	(0.005)	
FirmAge	-0.084**	0.146	
	(0.035)	(0.115)	
TotalAssets	-0.227***	-0.014	
	(0.013)	(0.040)	
MTB	-0.010*	0.074*	
	(0.006)	(0.043)	
SalesGrowth	0.113*	-1.857***	
	(0.063)	(0.282)	
Return	0.228***	-5.785***	
	(0.025)	(0.261)	
Debt/Equity	0.008	-0.169***	
	(0.046)	(0.030)	
CashSurplus	-1.983***	0.053	
	(0.223)	(0.047)	
Constant	-6.442***	-0.005	
	(0.219)	(0.040)	
Observations	2,382	2,382	
R-squared	0.51	0.42	

Table 7: Association between investment risk and inside debt following the financial crisis (continued)

Panel B: Idiosyncratic risk (LogIdioRisk$_{t+1}$)

	Crisis (1)	Recovery (2)	*Wald Test of* $\beta_{Crisis} = \beta_{Recovery}$
Log of RelativeIncentive	-0.098***	-0.105***	*p > 0.10*
	(0.018)	(0.018)	
Vega/Delta	-0.023	0.049*	
	(0.027)	(0.027)	
TotalComp	0.011	-0.009	
	(0.019)	(0.022)	
FirmAge	-0.084***	-0.115***	
	(0.021)	(0.024)	
TotalAssets	-0.125***	-0.116***	
	(0.008)	(0.008)	
MTB	-0.006**	-0.003	
	(0.003)	(0.003)	
SalesGrowth	0.092***	0.084	
	(0.033)	(0.064)	
Return	0.069***	-0.014	
	(0.015)	(0.022)	
Debt/Equity	0.040	0.055**	
	(0.027)	(0.025)	
CashSurplus	-0.954***	-0.978***	
	(0.127)	(0.163)	
Constant	-2.561***	-2.758***	
	(0.126)	(0.149)	
Observations	2,382	2,382	
R-squared	0.51	0.42	

Table 7: Association between investment risk and inside debt following the financial crisis (continued)

Panel C: R&D expenditures scaled by sales ($R\&D_{t+1}$)

	Crisis (1)	Recovery (2)	*Wald Test of* $\beta_{Crisis} = \beta_{Recovery}$
Log of RelativeIncentive	-0.010***	-0.014***	*p > 0.10*
	(0.003)	(0.004)	
Vega/Delta	0.027***	0.016***	
	(0.006)	(0.005)	
TotalComp	-0.008**	-0.011**	
	(0.004)	(0.004)	
FirmAge	-0.005	-0.006	
	(0.003)	(0.004)	
TotalAssets	-0.003	-0.003	
	(0.002)	(0.002)	
MTB	-0.001	-0.001	
	(0.001)	(0.001)	
SalesGrowth	0.029***	-0.036*	
	(0.008)	(0.019)	
Return	-0.000	0.008	
	(0.003)	(0.006)	
Debt/Equity	0.002	0.006	
	(0.002)	(0.004)	
CashSurplus	0.301***	0.361***	
	(0.037)	(0.048)	
Constant	-0.010***	-0.014***	
	(0.003)	(0.004)	
Observations	2,382	2,382	
R-squared	0.35	0.37	

Table 7: Association between investment risk and inside debt following the financial crisis (continued)

Panel D: Working Capital (WorkingCapital$_{t+1}$)

	Crisis (1)	Recovery (2)	*Wald Test of* $\beta_{Crisis} = \beta_{Recovery}$
Log of RelativeIncentive	0.016*	0.018**	*p > 0.10*
	(0.008)	(0.009)	
Vega/Delta	0.006	-0.004	
	(0.013)	(0.011)	
TotalComp	-0.029***	-0.034***	
	(0.011)	(0.011)	
FirmAge	-0.017*	-0.024**	
	(0.010)	(0.011)	
TotalAssets	-0.031***	-0.029***	
	(0.005)	(0.005)	
MTB	-0.001	-0.003**	
	(0.001)	(0.001)	
SalesGrowth	0.052***	-0.046*	
	(0.013)	(0.026)	
Return	0.017***	0.002	
	(0.005)	(0.007)	
Debt/Equity	-0.018**	-0.023**	
	(0.008)	(0.010)	
CashSurplus	0.286***	0.306***	
	(0.062)	(0.073)	
Constant	0.728***	0.794***	
	(0.068)	(0.071)	
Observations	2,382	2,382	
R-squared	0.57	0.54	

Figure 1: Commercial and industrial lending levels, 2002 through 2014

This figure reports the commerical and industrial lending levels per year for 2002 – 2014 using data from the St. Louis Federal Reserve Economic Research Division. The dashed line approximates pre-crisis loan volume levels.

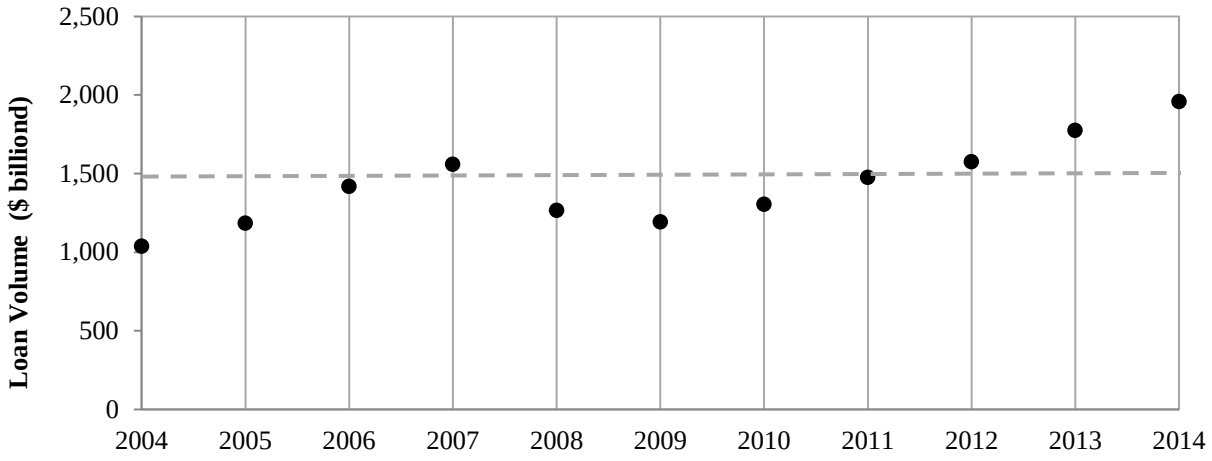

Figure 2: Leverage and inside debt incentives, 2006 through 2011

This figure presents mean levels of firm leverage and inside debt (relative incentive ratio) per year over our sample period. We define the Pre-crisis period as 2006-2008 and crisis period (in grey) as 2009-2011 based on Duchin et al. (2010) who show that the crisis first affected financing in August 2007, but that firms' operating performance was not affected until late 2008. Variables are defined in the appendix.

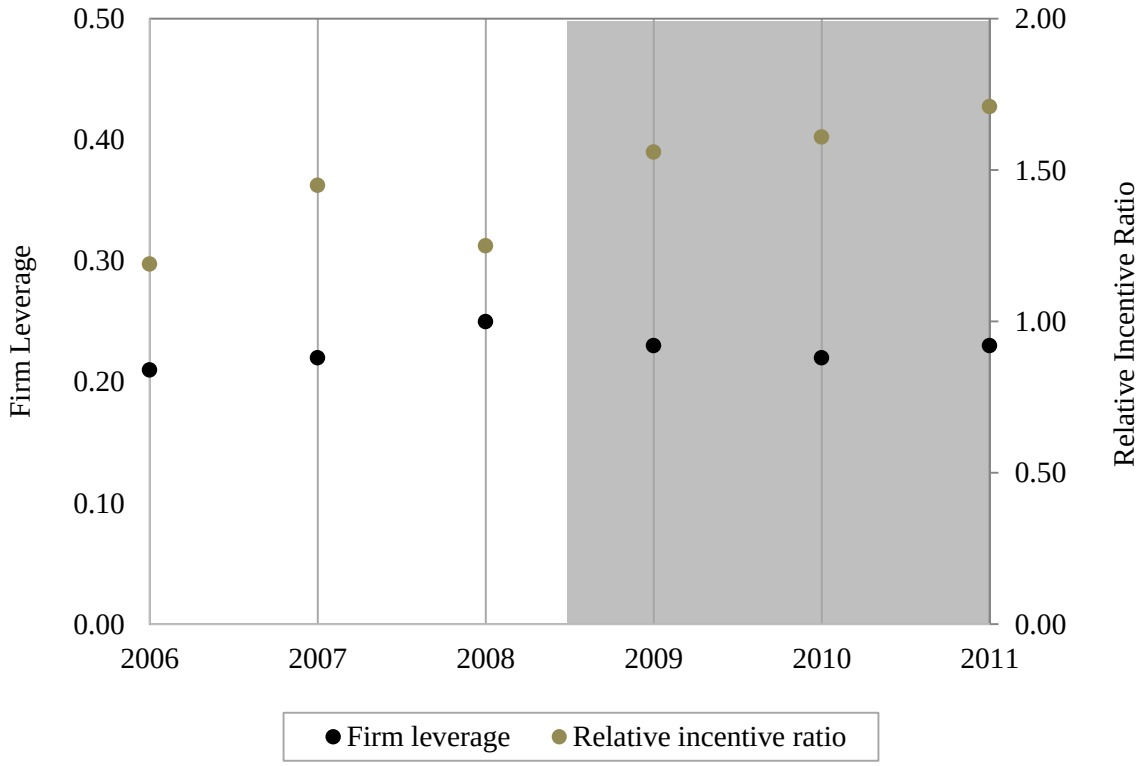

Figure 3: Financial covenant frequency and covenant strictness over time

This figure presents mean levels of financial covenants and covenant strictness (*PViolate*) per year over our sample period. We define the Pre-crisis period as 2006-2008 and crisis period (in grey) as 2009-2011 based on Duchin et al. (2010) who show that the crisis first affected financing in August 2007, but that firms' operating performance was not affected until late 2008. Variables are defined in the appendix.