Comments welcome

Inside Debt and Corporate Investment

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Abstract

Prior literature examines the role of debt-like compensation in dampening CEO risk-taking incentives, and several recent studies document a negative association between CEO "inside debt" holdings and measures of firm risk. A separate line of research suggests that inside debt, by providing greater alignment of CEOs' incentives with debtholders', can reduce the cost of debt financing. We examine whether and under what conditions the alignment-with-debtholders role of inside debt can lead to *increased* investment levels. In contrast to the monotonic negative relationship predicted in prior research, we hypothesize and find that the relationship between inside debt and investment depends on whether firms require external debt to fund investments. In particular, we find that the investment is *negatively* related to inside debt for firms with sufficient internal resources to fund investment projects, but *positively* related to inside debt for firms facing cash constraints. Our findings contribute to the literature on CEO incentives and corporate investment policy, and provide a richer understanding of the role of debt-like compensation in reducing agency costs.

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Inside Debt and Corporate Investment

by Joonil Lee, Kevin J. Murphy, Peter SH. Oh, Marshall D. Vance

1. Introduction

Over the past several decades, a large literature has explored how corporate investment decisions are influenced by top-management incentives. The early literature documented a positive relation between investment and equity-based (as opposed to cash-based) compensation, concluding that equity-based compensation mitigates short-term investment horizons by better aligning the interests of managers and shareholders. In addition, researchers have argued (and sometimes found) that asymmetric payoffs from stock options (and equity claims in levered firms) promote risk taking, including investment in relatively risky projects.[1] More recently, researchers have explored the relation between investment activity and "inside debt," defined as unsecured long-term fixed claims (primarily defined-benefit pensions and deferred compensation) held by managers.[2] In contrast to equity-based incentives, which are characterized by large upside potential with limited downside losses, the value of inside debt is particularly sensitive to downside risk and helps align the interest of managers and debtholders, who will typically prefer less risky investments relative to those preferred by shareholders. Indeed, inside debt has been proposed as a key control mechanism for reducing managers' overall risk-taking incentives.

Existing evidence on the relation between inside debt and investment behavior is limited, but suggests a negative association between management inside debt and research and development (R&D) expenditures. In this paper, we argue that while inside debt can dampen managerial risk-taking incentives, the overall effect of inside debt on the level of investment activity is unclear. Inside debt aligns the interests of managers with those of debtholders, reducing agency costs that arise due to the conflicts of interest between shareholders and debtholders (Jensen and Meckling, 1976). Therefore, to the extent that

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1 See, for sample, DeFusco, Johnson, and Zorn 1990; Agrawal and Mandelker, 1987; Coles et al., 2006; Gormley et al., 2013

2 Key papers discussed in more detail below include Sundaram and Yermack, 2007; Wei and Yermack, 2011; Cassell et al. 2012; and Choy et al., 2014.

lenders take inside debt into account when structuring debt-contracting terms (as suggested by Anantharaman et al., 2014), inside debt will reduce the cost of debt financing which in turn will *increase* the level of investments for firms that rely on external debt to fund investments.

We explore the relation between inside debt and corporate investment, taking into account the effect of inside debt on both the demand side (i.e., inside debt reduces the managerial demand for risky investments) and the supply side (i.e., inside debt reduces the cost of external debt financing). We exploit the fact that the "supply side" is only relevant for firms that require external debt financing to fund investments, and hypothesize that the relationship between inside debt and investment levels depends on the degree of cash (or liquidity) constraints facing the firm.[3] In particular, for firms with sufficient internal funds to finance investments (i.e., low cash constraints), we predict a negative relation between inside debt and investment. However, we expect the negative relation between inside debt and investment to be reduced or reversed for firms requiring external funding.

Our empirical results largely support our hypotheses. We use R&D and capital expenditures (CapEx) as proxies for investment activity. We find no relation between inside and investment before controlling for cash constraints (but after including firm fixed effects). We find the expected negative association between inside debt and both R&D and CapEx spending when cash constraints are low, but find that this relation is reduced or reversed for firms with high cash constraints. Moreover, we find that the positive association between inside debt and investment for cash-constrained firms is strongest for firms with a greater risk of default (based on Altman's Z-scores) where shareholder-debtholder conflicts are expected to be particularly high. Our findings are robust to instrumental variables regressions (using rank-and-file pension-benefit obligations as an instrument for CEO inside debt) and also to a number of alternative specifications, including alternative measures of cash constraints as proxies for reliance on external funding: low cash holdings, high leverage, and high Hoberg-Maksimovic (2015) Debt-Delay Scores.

[3] Our concept of "cash constraints" is related to, but distinct from, the more-familiar concept of "financial constraints." In particular, while financially constrained firms are typically those with limited access to external capital markets, our cash-constrained firms are precisely those requiring external capital to fund investments.

In supplemental tests, we directly assess the relationship between inside debt and changes in debt financing. For cash-constrained firms, we find a significant positive association between inside debt and changes in levels of debt financing. However, we do not find a significant association for unconstrained firms. In addition, we re-examine Wei and Yermack's (2011) finding that equity prices fell when high levels of inside debt were first disclosed following a 2006 SEC disclosure reform. In particular, we show that the stock-price reaction to high disclosed levels of inside debt are negative for firms facing few cash constraints, but positive for firms facing high cash constraints.

This study contributes to the literature examining the relation between management incentives and firm risk-taking, and in particular contributes to the literature on the impact of incentives on corporate investment decisions. While much of the prior literature has focused primarily on equity-based incentives, we extend a growing literature examining the incentive effects of inside debt. Prior research has predicted a simple negative relation between inside debt and R&D spending. However, we show that the relationship between inside debt and the level of investment is more nuanced, and depends on firms' need for accessing outside capital. Understanding the contextual factors determining how managerial incentives impact firm policies is important for practitioners in setting optimal compensation and incentive targets, and is important for academics trying to understand observed compensation arrangements observed in practice.

We also contribute to the literature on the underinvestment problem in firms (Stein, 2003; Franzoni, 2009). Lenders protect themselves from shareholder-debtholder conflicts by charging higher interest rates, by imposing restrictive covenants or collateral requirements, and through costly monitoring (Jensen and Meckling, 1976). These "protections" increase the cost of capital for firms requiring external debt financing; this increased cost of capital is interpreted as the agency cost of debt. However, Jensen and Meckling (1976) note that agency costs also include the opportunity cost of the investments which would have increased firm value but are forgone due to the increased cost of capital. Firms facing cash constraints are particularly susceptible to inefficiencies due to underinvestment. Our results suggest that inside debt, by providing greater alignment of management incentives with those of debtholders, can reduce the cost of debt financing for firms facing cash constraints and therefore increase investment levels in such firms, mitigating the underinvestment problem.

We proceed as follows. Section 2 develops our central hypotheses and provides a literature review. Section 3 discusses our research design, and Section 4 describes our data and presents our primary findings. Section 5 describes our supplemental analyses, and Section 6 concludes.

2. Literature Review and Hypothesis Development

There is a conflict of interest between a firm's "residual claimants" (e.g., owners of common equity) and "fixed claimants" (e.g., owners of unsecured debt) over the level of acceptable risk associated with firm investment. In particular, since shareholders in a levered firm receive a disproportionately large share of the positive cash flows associated with successful risky investments, but bear a disproportionately smaller share of failures (since shareholder losses are limited by the value of their equity), shareholders will typically prefer riskier investments relative to those preferred by fixed claimants. CEOs with wealth tied primarily to equity prices (through, for example, stock ownership, stock options, restricted shares, or other equity-based compensation) have incentives to pursue investments that have positive NPV from the standpoint of shareholders, regardless of whether those projects are valuable for fixed claimants or, indeed, the firm as a whole.[4] Excessive risk-taking (from the perspective of debtholders) after initiating debt financing is commonly referred to as "asset substitution" or "risk-shifting." Fixed claimants, of course, understand these incentives and will protect themselves by charging higher interest rates, by imposing restrictive covenants or collateral requirements, and through costly monitoring.

Jensen and Meckling (1976) termed the costs arising from the conflict of interest between residual and fixed claimants the "Agency Cost of Debt," and defined these costs as including not only the loss from suboptimal (risky) investments, but also the costs of monitoring and writing and enforcing debt covenants, and the opportunity cost of forgone

[4] Several studies document an association between managerial equity incentives and risk taking (e.g., Guay, 1999; Coles et al., 2006).

investments that would increase the value of the firm as a whole but are either precluded by the covenants or are unprofitable to shareholders when evaluated at the inflated cost of capital charged by appropriately suspicious fixed claimants.

Jensen and Meckling (1976) conjecture that the agency cost of debt can be mitigated by contractually obligating the CEO to hold equity and debt securities in proportion to the residual and fixed claims held by outside investors. They note that requirements for CEOs to hold firm debt are not commonly observed in practice, and subsequent research attempts to explain why CEOs' wealth is tied to the value of equity and not to the value of the firm as a whole (e.g., Hirshleifer and Thakor, 1992; John and John, 1993). However, more recent research demonstrates that pensions and deferred compensation represent a substantial component of executives' firm-related wealth,[5] and argues these forms of compensation are debt-like because the manager receives a fixed unsecured claim with value that, in the event of bankruptcy, depends on the liquidating value of the firm (e.g., Sundaram and Yermack, 2007; Wei and Yermack, 2011).

Following the intuition from Jensen and Meckling (1976), several recent papers document empirical support for the role of debt-like compensation, termed "inside debt," in aligning managers' risk-taking preferences with debt holders compared to equity holders. Sundaram and Yermack (2007) find that the ratio of inside debt to inside equity (i.e., the value of managers' stock and option holdings) is negatively associated with default risk, which they interpret as evidence for inside debt motivating managers to reduce firm risk, e.g., by accepting fewer risky investments. Similarly, Cassell et al. (2012) find a negative association between CEO inside debt holdings and the volatility of future firm stock returns. Wei and Yermack (2011) examine equity and debt prices immediately following initial disclosures of CEO inside debt holdings, and find that when inside debt is revealed to be large, equity prices fall and debt prices rise. These results are consistent with capital markets adjusting prices to reflect CEOs' incentives being relatively more aligned with debt holders than equity holders.

[5]In both our paper and the prior literature, firm-related wealth is defined as the sum of the value of the executive's equity holdings (including stock, restricted shares, and stock options), the actuarial present value of the executive's pension, and the nominal value of the executive's deferred compensation accounts.

While the literature has largely established a between inside debt and firm risk, direct evidence for the role of inside debt influencing investment policy is limited. Cassell et al. (2012) show that inside debt is associated with lower R&D expenditures, but only when inside debt is large. Somewhat analogously, Choy et al. (2014) find that R&D spending increases when firms switch from defined-benefit to defined-contribution pension plans (with the benefits under the existing defined-benefit plan "frozen" as of the date of the switch). Collectively, these studies provide evidence suggesting that the effect of CEO debt compensation is to reduce firm risk taking, and reduce investment in R&D in particular.

Although the literature to this point has emphasized the role of debt-like compensation in reducing managers' incentives to engage in risk shifting, agency conflicts can manifest in other forms of investment distortions, including underinvestment. Under traditional finance theory, in the absence of market frictions firms maximize value by pursuing all positive NPV investment opportunities. However, a large theoretical and empirical literature has examined reasons why firms invest below efficient levels.[6] A standard result from this literature is that investment distortions depend not only on managers' incentives, but also on the availability of financing. That is, when sufficient internal financing is available, firms can pursue all available positive NPV projects. However, in the absence of readily available internal financing, whether the firm can undertake a given project will depend on its ability to access external capital and on the cost of that capital. While in a frictionless capital market firms should be able to fund all positive NPV projects, under more realistic circumstances financing may be too costly or even unavailable even for an otherwise positive NPV project.

Inside debt can mitigate the agency cost of debt and therefore may improve a firm's ability to obtain debt financing to pursue positive NPV projects. As the ratio of inside debt to inside equity increases, the CEO's incentives are increasingly aligned with those of the outside debtholders. Lenders, in turn, offer more favorable debt contracting terms for firms that use inside debt to compensate their chief executives, including lower interest rates (Anantharaman et al., 2014), reduced use of covenants (Chava et al., 2010; Anantharaman et al., 2014), and lower collateral requirements (Wang et al., 2011). To the extent inside debt

[6] See Hubbard (1998) and Stein (2003) for reviews of this literature.

reduces the perceived cost of debt financing (e.g., from lower interest rates and fewer costly covenants), inside debt can *increase* investment for firms that depend on debt financing to fund investments.

Prior research has generally assumed that firm investment in risky projects will be negatively related to inside debt, because inside debt reduces the CEO's benefit from risk-taking activities. We argue that, since inside debt reduces the cost of external debt financing, the relation between inside debt and investment depends on whether firms have sufficient cash holdings or cash flows to fund promising investments. In particular, for firms with sufficient capital to finance all projects using internal funds, the relation between inside debt and investment will be unambiguously negative since the reduction in the cost of external debt financing associated with inside debt is irrelevant. But, for cash-constrained firms requiring external financing, inside debt lowers the cost of external debt capital, which, ceteris paribus, increases the equilibrium level of investment.

Based on the above discussion, we hypothesize that the relationship between CEO inside debt holdings and investment levels depends on cash constraints. Following the conventional wisdom, inside debt reduces CEO's incentives to take risks, and therefore we expect that in the absence of cash constraints inside debt will be negatively associated with risky investment levels. However, when firms are cash constrained, inside debt reduces the cost of external debt financing which, in turn, will increase investment levels. Thus, the overall effect of inside debt for cash-constrained firms can be either positive or negative, depending on whether the offsetting effects of reducing risk-taking incentives or increasing ability to borrow funds prevails.

3. Research Design

To test the relation between inside debt and the level of investment conditional on cash constraints, we regress investment on prior-year values for CEO debt-like incentives, cash constraints facing the firm, and an interaction between the two. Specifically, our primary model is the following:

$$Investment_{i,t+1} = \alpha_i + \beta_1(Inside\ Debt\ Ratio)_{i,t} + \beta_2(Inside\ Debt\ Ratio)_{i,t} \bullet Constrained_{i,t}$$

$$+ \beta_3 Constrained_{i,t} + \gamma_t + \Sigma\Gamma_j Control\ Variables_{j,i,t} + \varepsilon_{i,t} \quad (1)$$

where *Investment* is either research and development ("R&D") expense or capital expenditures ("CapEx") depending on the test, *Inside Debt Ratio* is our measure of CEO debt-based incentives, *Constrained* is a proxy for cash constraints, α_i represents firm fixed effects (to control for firm-specific time-invariant omitted factors affecting investment) and γ_t represents year fixed-effects, and *Control* represents a vector of firm-and-year variant control variables. Following prior literature (e.g., Biddle et al., 2009), we scale R&D by lagged total assets and CapEx by lagged property, plant, and equipment ("PP&E").

As discussed above, management incentives to adopt investment policies that favor debt holders over equity holders increase with the portion of debt-like claims in the CEO's overall firm-related wealth portfolio. We operationalize CEO debt incentives using the amount of inside debt divided by CEO's firm-related wealth as follows:

$$Inside\ Debt\ Ratio = Inside\ debt\ /\ (Inside\ debt + Inside\ equity), \quad (2)$$

where Inside Debt is the sum of the actuarial present value of accumulated benefits under defined-benefit pension plans and the total balance in the deferred compensation plans at fiscal year-end (Wei and Yermack, 2011; Cassell et al., 2012; He, 2015). Inside Equity is defined as the sum of stock holdings (obtained by multiplying the number of shares, including restricted shares, by the stock price) and the year-end fair value of stock options based on the Black–Scholes formula.[7] *Inside Debt Ratio,* which ranges from 0 (no inside debt) to 1 (only inside debt), is intended to capture the relative alignment of CEO incentives with outside debt holders compared to equity holders.

Jensen and Meckling (1976) observed that CEO incentives to favor one group of financial claimants over others are mitigated by requiring the CEO to hold strips of residual and fixed claims in exact proportion to the firm's capital structure. Based on this observation, many empirical studies of inside debt have measured inside debt as the ratio of the CEO's

[7] Option values for the portfolio of option held at the end of the fiscal year are computed assuming a risk-free rate equal to yield on 7-year U.S. treasuries, volatilities based on monthly stock returns over the prior 48 months, and dividend yields based on three-year rolling averages. The expected term for options is assumed to be 70% of the full term.

debt-equity ratio (i.e., inside debt divided by inside equity) to the firm's debt-equity ratio, which measures the alignment between the CEO's risk-shifting incentives and the risk-shifting policy that would optimize the value of the firm as a whole.[8] We depart from this "ratio of ratios" approach for three primary reasons. First, the ratio-of-ratios makes sense only if the firm's fixed claims are composed entirely of unsecured claims with payoff characteristics similar to the CEO's deferred compensation and defined-benefit pension plans (which would be highly unusual).[9] Second, our focus is on whether the CEO's incentives are aligned with debtholders relative to shareholders, and not whether incentives are aligned to the overall capital structure. Third, since we use the firm's debt-equity ratio in constructing our proxy for cash constraints, the ratio-of-ratios would be mechanically related to this proxy. In untabulated results, we show that our results are largely driven by differences between CEOs holding inside debt and those not holding inside debt, and not to the level of inside debt conditional on holding inside debt.

We construct a measure of cash constraints, *Constrained,* as a proxy for firms with insufficient internal resources to finance investments. Our primary measure is constructed from cash holdings (since firms with low cash holdings are expected to require external financing) and leverage (since firms with high leverage have a contractual obligation to devote a large portion of their cash flow – and cash holdings, if necessary – to service the debt). Following recent studies in accounting (e.g., Biddle et al 2009; Cheng et al, 2013; Balakrishnan et al., 2013) we construct the decile rank of each firm for cash holdings and leverage, and scale the average of both ranks to obtain values between zero and one. Since high values of cash and leverage have opposite implications for firms' ability to fund potential investment opportunities using internal funds, we multiply cash by negative one prior to generating decile ranks. Thus, higher values of *Constrained* are interpreted as indicating a higher *ex-ante* tendency towards requiring external financing to fund

8 Wei and Yermack (2011) define the "CEO relative incentive ratio" using the "total delta" of CEO or firm equity rather than market values; the total delta measures the change in the CEO's equity holdings for a $1 change in the stock price. Cassell et al. (2012) exclude observations for CEOs without CEO debt (which account for about a third of our sample) and use both the logarithm of the "ratio-of-ratios" and a dummy variable equal to one if the ratio-of-ratios exceeds one (that is, the CEO is more levered than the firm).

9 For example, the ratio-of-ratios is irrelevant if the CEO's inside debt consists of unsecured claims while the firm's debt is secured or collateralized.

investments. The coefficient on the interaction of *Inside Debt Ratio* and *Constrained* is interpreted as the incremental effect of cash constraints on the relation between investment and inside debt. Thus, the overall relationship between inside debt and investment levels when constraints are highest (i.e., *Constrained*=1) is captured by the sum of the main effect of inside debt (β_1) and the interactive effect (β_2). Including *Constrained* and the interaction term in the model allows us to examine separately the effect of inside debt holdings when constraints are lowest (β_1 for *Constrained*=0) from the effect when constraints are highest ($\beta_1 + \beta_2$).

We include a number of traditional control variables to account for determinants of firm investment policy that are also likely to be correlated with CEO debt-based compensation. Consistent with prior research on corporate investment levels, we include proxies for firm size, asset growth, and Tobin's Q to control for the investment opportunity set available to the firm. We control for annual stock returns and operating cash flow to account for past firm performance, and also control for the average leverage of firms within the same industry. We control for operating environment volatility and Altman's Z-score as proxies for firm risk. In addition, since shareholder-debtholder conflicts are expected to be more salient in firms with a greater risk of default, we present separate tests for subsamples with high and low Altman Z-scores. All variables are defined in the Appendix.

4. Primary Results

4.1. Data composition and sample description

While theoretical interest in the impact of inside debt on investment decisions is not new (Jensen and Meckling, 1976; Sundaram and Yermack, 2007), changes in disclosure laws in 2006 substantially improved researchers' ability to examine this topic empirically. Beginning in 2006, the Securities and Exchange Commission (SEC) adopted expanded executive compensation disclosure requirements that require firms to provide detailed information on executive pension benefits, deferred compensation, and year-end option holdings. Information from these augmented disclosures is available in proxy statements (and in Computstat's Execucomp database) for firms with a fiscal year-end following December

15, 2006, which we adopt as the starting period for our sample selection. We combine these data on executive equity and debt-based compensation with financial statement data from Compustat and stock price data from CRSP to form the primary basis of our sample.[10] We exclude financial firms (SIC codes from 6000-6999) because they do not report research and development expenses, which is our primary proxy for investment. Our full sample is comprised of 1,623 firms and 10,195 firm-year observations over the years 2006 to 2013. Our sample selection procedure is detailed in Panel A of Table 1.

Table 1, Panel B presents descriptive statistics for executive debt and equity holdings, as well as other variables used in our models. Inside debt comprises a non-trivial portion of a CEO's overall incentive package; the average CEO's inside debt holdings is $5,045,000 (with a median of $519,900). By comparison, the average CEO's equity holding is $116,058,000 (median of $15,610,000). For the average CEO in our sample, inside debt makes up approximately 13% of total firm related wealth. However, we document large variation in the proportion of CEO wealth comprised of inside debt. While *Inside Debt Ratio* is zero for 33% of our sample (i.e., CEOs without deferred compensation or defined-benefit pensions), CEOs in the third quartile hold inside debt representing nearly one-fourth of total firm-related wealth. We expect this variation in debt-like holdings to manifest in differential incentives to favor the interests of debtholders vs. equityholders. On average, firms' annual investment in Capital Expenditures and R&D amounts to 25.5% and 5.4% of their PP&E and total assets, respectively.[11] Pairwise correlations among selected variables are reported in Table 2. Our measure of debt-based incentives, *Inside Debt Ratio*, is negatively associated with R&D, consistent with the effect of inside debt being to reduce CEO incentives to take risks. Also, we find a negative correlation between *Constrained* and both measures of investment, consistent with cash constraints reducing firms' ability to pursue investment opportunities.

[10] We limit our sample to Execucomp firms, which include firms in the S&P 500, the S&P MidCap 400, the S&P SmallCap 600, and a small number of other firms tracked by Standard and Poors.

[11] The R&D statistics, and our subsequent tests using R&D as the dependent variable, are based on the sample of firm-years with non-missing R&D data.

4.2. The relation between inside debt, cash constraints, and investment

Before turning to our primary multivariate results, we first discuss analyses of differences in investment levels for firms with and without inside debt, and we compare these differences for firms facing low or high cash constraints. Table 3 presents a 2x2 matrix for average investment levels based on inside debt and cash constraints. As seen in the top row of Panel A, which reports results using the ratio of R&D to assets, unconstrained firms with no inside debt on average invest significantly more in R&D than firms with inside debt. This is consistent inside debt reducing executives' demand for risky investment. However, as shown in the bottom row of Panel A, in the presence of high cash constraints, firms with inside debt invest *more* in R&D compared to firms without inside debt. This is consistent with inside debt reducing agency costs of debt, leading to an increased ability to obtain the necessary financing to pursue investment projects. This pattern is similar for Panel B, which shows investment based on CapEx. These averages are suggestive that the relation between inside debt and investment levels depends on the presence of cash constraints. Specifically, inside debt is associated with lower investment levels when cash constraints are low (and only demand-side considerations are relevant), but higher investment levels when cash constraints are high (and both supply-side and demand-side considerations are relevant).

Table 4 reports coefficients from ordinary least-squares regressions showing the relation between investment, inside debt, and cash constraints. The dependent variable in columns (1), (3) and (5) is the following year's investment in *R&D* scaled by assets while the dependent variable in columns (2), (4) and (6) is the following year's investment in *CapEx* scaled by PP&E. Columns (1) and (2) include year and industry fixed effects but not firm fixed effects; all other columns include firm fixed effects. Observations with missing *R&D* data are excluded from the regressions in columns (1) and (3), which accounts for the different sample sizes across our tests.[12]

[12] Managers exercise discretion in reporting R&D expense and thus not all firms choose to separately report R&D. Prior studies have commonly replaced missing R&D values with zero (i.e., interpret missing to mean there is no significant R&D activity). Koh and Reeb (2015) examine innovation activities of missing R&D firms, as well as changes in R&D reporting following auditor changes, and conclude that treating missing R&D as zero can lead to substantial bias in tests. Therefore, we do not replace missing R&D with zero, and instead drop firms with missing R&D from our sample. However, we note that our results are not sensitive to replacing missing R&D observations with zero.

As shown in columns (1) and (2) of Table 4, we find a negative and significant association between *Inside Debt Ratio* and both *R&D* and *CapEx* before controlling for firm fixed effects, suggesting that CEO inside debt is associated with lower levels of investment. However, as shown in columns (3) and (4), the coefficients on *Inside Debt Ratio* are negative but insignificant after controlling for firm fixed effects. As noted earlier, we expect the direction of the relationship between inside debt and firm investment to vary based on the level of cash constraints facing the firm, because the effect of inside debt on the supply of debt financing (i.e., due to its effect of reducing the cost of debt capital) is predicted to only apply to firms requiring external financing to fund investments. Thus, confounding these opposite effects may be the cause of an insignificant overall relation. In columns (5) and (6) of Table 4, we include *Constrained* as an additional independent variable, as well as an interaction between *Inside Debt Ratio* and *Constrained*. Of note, the coefficient on *Constrained* is significantly negative in both columns (5) and (6), suggesting that our measure of cash constraints does indeed reflect firms' underlying ability to fund investments. The coefficient on *Inside Debt Ratio* in columns (5) and (6) – which measures the effect of inside debt on investment for cash un-constrained firms – is significantly negative for both *R&D* and *CapEx*. Therefore, we conclude that, for cash-unconstrained firms, inside debt is associated with reduced investment.[13]

Our primary variable of interest in columns (5) and (6) of Table 4 is the interaction term, *Inside Debt Ratio* × *Constrained*. We find a significant positive coefficient for the interaction of *Inside Debt Ratio* and *Constrained* in the models of both *R&D* and *CapEx*, suggesting that investment increases with inside debt in cash-constrained firms (but not in unconstrained firms). In particular, we find that while for unconstrained firms there is a negative association between inside debt and both *R&D* and *CapEx*, the incremental effect of cash-constraints on this relationship is positive. Moreover, the overall effect (i.e., the main effect plus the interaction) is significantly *positive* (at the 10% level). Thus, the evidence in

[13] Choy, et al. (2014) find that a switch from defined-benefit to defined-contribution company pension plans (where defined-benefits are frozen as of the day of the switch) leads to an increase in R&D and a *reduction* in CapEx. They interpret this result as suggesting that firms substitute risky investment (i.e., R&D) for safer investment (i.e., CapEx) as incentives become less aligned with debtholders. Our finding in column (4) of Table 4 of a negative association with inside debt for both R&D and CapEx investment suggests that the risk-reducing incentives from inside debt do not lead to an overall substitution from R&D to CapEx.

Table 4 suggests that when cash constraints are high (i.e., when the need for outside financing is high), inside debt increases investment. It is particularly notable that we find this *positive* effect of inside debt on investment levels given the expected risk-reducing influence of inside debt on CEO risk-taking preferences (as suggested by prior literature).

4.3. Instrumental Variables Analysis

We recognize that CEO compensation and firm investment are endogenously determined, which raises the possibility that omitted variables correlated with both inside debt and investment policy are driving our results. Two elements of our research design mitigate this concern. First, we estimate the relationship between CEOs' inside debt incentives and *future* firm investment (i.e., *Inside Debt Ratio* is measured at time t and both R&D and *CapEx* are measured at time t+1). Since inside debt and firm investment are not measured contemporaneously, there is reduced likelihood that an omitted variable associated with both is causing our results. Second, in all of our regressions we employ firm fixed effects. As such we hold constant any omitted factor that is constant at the firm level across time. Thus, in order for an omitted variable to affect our results, it must be the case that *changes* in any such variable is associated with time-series variation in both our measures of inside debt and investment, which we view as less likely.

Nonetheless, while the results of the preceding analysis are consistent with inside debt increasing investment for firms facing cash constraints, it is possible that our findings are influenced by endogeneity among investment policies, cash and liquidity constraints, and compensation structure. We attempt to address the endogeneity concern by implementing an instrumental variables approach, using the firm's rank-and-file tax-qualified defined-benefit pension obligations as an instrument for CEO Inside Debt. Indeed, Supplemental Executive Retirement Plans ("SERPs") initially evolved to make up the difference between the executives' formula-based pension (e.g., 2% per year of tenure multiplied by some variant of final compensation) and the maximum allowed under tax-qualified plans.[14] Since the primary

[14] Currently, SERPs refer to any non-qualified retirement plan for key company employees, such as executives, that provides benefits above and beyond those covered in other tax-preferential retirement plans such as IRA, 401(k) or qualified defined-benefit plans.

component of Inside Debt is the actuarial value of the CEO's pension, the firm's tax-qualified pension-benefit obligations are plausibly correlated with CEO inside debt. On the other hand, there is no obvious reason why the firm's pension obligations should be correlated with investment decisions, thus the exclusion restriction for pension obligations as a valid instrument for inside debt is plausibly satisfied.

Given that our main regression uses interaction between *Inside Debt Ratio* and *Constrained*, we run our IV regression using Heckman and Vytlacil (1998)'s 2SLS estimator to create the predicted values for the interaction term as well as *Inside Debt Ratio*. We first estimate the fitted values of *Inside Debt Ratio* in the first stage by running the following OLS regression (Moers, 2006):

$$(\textit{Inside Debt Ratio})_{i,t} = \alpha + \beta_1(\textit{Pension Obligations/Assets})_{i,t} + \varepsilon_{i,t} \quad (3)$$

We then use the fitted values of *Inside Debt Ratio* from this regression to classify observations as exhibiting a high or low exogenous level of *Inside Debt Ratio*. Specifically, we drop observations that have a predicted *Inside Debt Ratio* value in the second and third quartile of our sample to increase the strength of our instruments (Baiocchi et al. 2010, Erkens et al. 2014), and create an indicator variable (*Inside Debt Ratio IV*) that equals 1 when an observation's predicted *Inside Debt Ratio* value is in the top quartile of the sample, and 0 otherwise. The following second-stage regression is run with using the obtained *INDEBT_IV*:

$$\textit{Investment}_{i,t+1} = \alpha_i + \beta_1(\textit{Inside Debt Ratio IV})_{i,t} + \beta_2(\textit{Inside Debt Ratio IV})_{i,t}\bullet\textit{Constrained}_{i,t} + \beta_3\textit{Constrained}_{i,t} + \gamma_t + \Sigma\Gamma_j\textit{Control Variables}_{j,i,t} + \varepsilon_{i,t} \quad (4)$$

where, as before, *Investment* is either R&D or CapEx, depending on the test, α_i represents firm fixed effects, γ_t represents year fixed-effects, and *Control* represents a vector of firm-and-year variant control variables.

Table 5 contains results from the first- and second-stage regressions. The coefficient on *Pension Obligations/Assets* in the first-stage regression in column (1) is positive and statistically significant, suggesting that the CEO's inside debt is, indeed, highly correlated with rank-and-file pension obligations. Columns (2) and (3) report results from the second-stage regression for R&D (scaled by assets) and CapEx (scaled by PP&E), respectively. As in Table 4, we again find that the main effect (i.e., when cash constraints are low) of inside debt for both R&D and CapEx is negative. Moreover, the interaction between *Inside Debt Ratio IV* and *Constrained* is positive and significant in both specifications, suggesting that the observed negative relation between inside debt and investment for unconstrained firms is reduced or reversed for firms facing cash constraints.

Overall, the results in Table 5 are consistent with the results in Table 4, suggesting that our earlier results are not driven by endogeneity or omitted-variable concerns. In untabulated analyses, we conduct 2SLS using instruments identified in prior studies on inside debt (e.g., Anantharaman et al., 2014; Cassell et al., 2012; He, 2015), and continue to find significant results consistent with those in Table 5.[15]

4.4. Alternative measures of cash constraints

As noted above, we measure cash constraints based on firms' ex-ante cash holdings and leverage (Biddle et al., 2009; Cheng et al, 2013). While our measure assumes both cash holdings and leverage have an equal effect on firm's ability to finance investments using internal funds, in this section we repeat our analyses after developing measures of cash (or liquidity) constraints based on cash holdings and leverage separately, and also using Hoberg and Maksimovic's (2015) measure of financial constraints for firms requiring external debt financing to fund investments.

Columns (1) and (2) of Table 6 report the results of tests using the scaled decile rank based on (the negative of) cash holdings for *R&D* and *CapEx*, respectively, while columns (3) and (4) report results based on the scaled decile rank of leverage. While the results using the cash-based measure are very similar to those reported in Table 4, the results using the

[15] Anantharaman et al. (2014) and He (2015) uses state personal tax rates as an instrument for relative leverage, arguing that inside debt allows executives to defer the tax burden associated with current cash compensation. Cassell et al. (2012) use CEO age, firm age, ln(Assets), and indicators for new CEOs, loss carry-forwards, and negative operating cash flow as instruments for inside debt. While our results are robust to using these instruments, we suspect that all of these instruments can have a plausible direct effect on investment decisions, and therefore violate exclusion restrictions. On the other hand, we assert that whether the firm has defined benefit obligations covering current or past employees (often based on human resource decisions made years or decades before) is plausibly uncorrelated with current investment decisions.

leverage-based measure are weaker. In particular, the interaction between *Inside Debt Ratio* and *Constrained* is significant at only the 5% level in the *R&D* model in column (3), and is not significant (though still positive) in the *CapEx* model in column (4). While both sets of results are still broadly consistent with our hypothesis that the relationship between inside debt and firm investment depends on the level of financing constraints, Table 6 suggest that the existence (or lack) of internal cash holdings is particularly important for understanding the effect of inside debt on firm investment choices.

Hoberg and Maksimovic (2015) develop a novel approach to measure what we call cash constraints (which in their context offers an alternative measure of financial constraints) based on textual analysis of the Management Discussion and Analysis (MD&A) section of firms' 10-Ks. As Hoberg and Maksimovic (2015) note, SEC regulations require firms to discuss challenges to their liquidity, and how these challenges impact their investment plans. Specifically, they use text-extraction techniques to identify firms that disclose having to delay investment due to financial-liquidity difficulties. While relatively few firms explicitly state that they face financial constraints, Hoberg and Maksimovic (2015) develop a continuous measure of constraints by calculating the overall verbal similarity of each MD&A to these firms that explicitly state their constraints. To assuage concerns that our primary *Constrained* variable does not adequately capture firms' cash constraints, we repeat our main analyses using a scaled decile rank (to be consistent with our *Constrained* variable) of Hoberg and Maksimovic's (2015) "Debt Focus Delay Investment Score", which measures cash constraints faced by firms with plans to issue debt to finance investment.[16]

Column (5) of Table 6 reports results using this disclosure-based measure of constraints for our model of *R&D*, while column (6) reports results for our model of *CapEx*. We note that *Constrained* is negatively associated with both *R&D* and *CapEx* (as expected), but the relation is statistically insignificant. The coefficient on the interaction between *Inside Debt Ratio* and *Constrained* is significant at only the 10% level in the *R&D* model in column (5), and is not significant in the *CapEx* model in column (6). Overall, both the magnitude and significance of the interaction is weaker using the Hoberg-Maksimovic proxy for

[16] We are grateful to Gerald Hoberg for generously sharing these data.

Constrained than for models using our primary measure of constraints reported in Table 4, reflecting, in part, the reduced sample size with available Hoberg-Maksimovic data.

4.5. Subsample analysis for firms close financial distress

To this point, we have documented evidence consistent with our hypothesis that the relationship between inside debt and investment levels depends on the cash constraints facing the firm. To the extent that inside debt leads to increased investment for cash-constrained firms by reducing agency costs associated with borrowing, and hence reducing the cost of debt capital, we expect this effect to be particularly strong in settings in which the agency cost of debt is likely to be most severe. In particular, the agency cost of debt (and hence the value of inside debt) is relevant only in settings where managers can consider investment projects with downside risk that exceeds the value of the equity-holders' limited-liability-protected claims. Two settings of primary relevance include cases where (a) managers can take very large investment risks, and (b) where even small investment risks can lead to downside losses borne by debtholders.

While there is no obvious way (with available data) to measure the potential downside from large risky investments, we can measure default risks that could be triggered by relatively modest "risky investments." In particular, as firms get nearer to default, the agency conflict between equityholders vs. debtholders becomes more acute because the differential payoffs for positive compared to negative realizations of risky projects for the two groups of claimholders becomes more salient (or conversely, the further a firm is from default, the more closely the payoff function for debtholders and equityholders resemble each other).

Table 7 repeats our primary analyses for subsamples based on "nearness" to financial distress, using Altman's (2012) Z-scores that measure the probability of bankruptcy within two years. To examine whether the interaction between inside debt and cash constraints is more pronounced for firms that are "closer" to default, we classify firms with a Altman Z-Score above 3.00 as financially sound, while firms with Z-scores below 3.00 are considered financially unsound (Begley et al. 1996; Blay et al. 2011). The main effect of *Inside Debt Ratio* (i.e., the effect of inside debt for firms having sufficient cash to fund investments internally) is significantly negative only for firms classified as unsound in columns (1) (*R&D*) and (3) (*CapEx*). Thus, it appears that inside debt has an especially pronounced effect on CEOs' incentives to take risks when firms are nearer to default. Similarly, we find that the magnitude of the interaction term is much greater for both the *R&D* and *CapEx* models for the unsound sample than for the sound sample, consistent with inside debt having more scope for reducing the debt cost of capital when agency costs between shareholders and lenders is greater.

5. Additional Tests

5.1. Inside Debt and Prevalence of Debt Financing

Inside debt can reduce financing frictions caused by the agency conflict between debt and equity holders, and hence reduce the cost of external debt (Anantharaman et al., 2014). Thus, while inside debt may reduce a manager's incentive to take risky investments, our results suggest that the reduced cost of debt for cash-constrained firms (i.e., those requiring external financing) can result in an overall positive effect on investment. In this section we examine the mechanism of debt market access more directly.

Building upon the research design used in prior studies examining debt financing (Bradshaw et al. 2006; Bharath et al. 2008; Balakrishnan et al. 2013), we examine the effect of inside debt on the propensity to obtain debt financing using the following equation:

$$\Delta DEBT_{i,t+1} = \alpha_i + \beta_1 Inside\ Debt\ Ratio_{i,t} + \beta_2 Constrained_{i,t} + \gamma_t + \Sigma\Gamma_j Control_{j,i,t} + \varepsilon_{i,t} \quad (5)$$

where *ΔDEBT* is net debt financing measured as the cash proceeds from the issuance of long-term debt less cash payments for long-term debt reductions less the net changes in current debt. Consistent with our earlier argument that reducing financing frictions is likely to be particularly helpful for firms with ex-ante cash constraints, we partition our sample based on the median value of our *Constrained* measure (Balakrishnan et al. 2013). While we expect inside debt to lower the cost of external debt financing for both constrained and unconstrained firms, we expect the relation between inside debt and subsequent debt financing to be particularly salient for cash-constrained firms (given our maintained assumption that unconstrained firms have sufficient internal resources to fund investments).

Table 8 presents the results for the credit-market accessibility analysis. Columns (1) and (2) report results for subsamples based on top and bottom terciles of cash constraints, while columns (3) and (4) report results for firms with below median and below median cash constraints. While the coefficients on *Inside Debt Ratio* for the cash-constrained sample (columns (1) and (3) are positive and significant, the coefficients on *Inside Debt Ratio* for unconstrained firms (columns (2) and (4)) is not significant. These results suggest that the positive effect of inside debt on net debt financing is concentrated among cash-constrained firms, i.e., firms for which a reduction in the cost of debt financing is expected to have a greater impact on borrowing. Overall, this evidence corroborates the finding in Anantharaman et al. (2014) that inside debt has a favorable effect on debt contracting terms.

5.2. Market-reaction analysis

Beginning in 2006, the SEC adopted new executive compensation disclosure rules that required firms to provide detailed information on actuarial values of executive pension benefit plans and market values for deferred compensation accounts. Wei and Yermack (2011) identify companies that disclosed (for the first time) large actuarial values of executive pension and deferred compensation. They document that bond prices rise while equity prices fall for firms which disclose that their CEOs have particularly large defined benefit pensions or deferred compensation.[17] This evidence is consistent with equity markets recognizing a loss of value due to CEOs taking actions (e.g., adopting "too safe" investment policies) that favor debtholders over equityholders. However, if inside debt reduces the agency costs of debt, which are born by shareholders (Jensen and Meckling, 1976), there may be potential offsetting benefits of inside debt from equityholders' perspective. In particular, to the extent that agency costs of debt increases the cost of debt and prevents firms from pursuing otherwise attractive investment opportunities, we expect that the negative stock-market reaction to disclosure of inside debt should be less pronounced for firms more

[17] Wei and Yermack (2011) define "particularly large" to be when the ratio of the CEO's inside debt to inside equity exceeds the firm's debt-equity ratio.

likely to underinvest because of the inflated cost of external debt financing. As discussed above, firms that require external financing are more likely to underinvest (Hubbard, 1998; Stein, 2003). Therefore, in this section we examine whether there is a difference in stock-market reactions for cash-constrained (i.e., firms more likely to require external financing to fund investment opportunities) and cash-unconstrained firms.

Following Wei and Yermack (2011), we examine stock-market reactions to the initial disclosure of inside debt values in the proxy filings following increased disclosure regulations effective for publicly traded firms with fiscal closing after December 15, 2006. A univariate analysis of cumulative abnormal returns (CAR) is presented in Panel A of Table 9. CAR is calculated using Fama and French's 4 factor model with a window (0,1) around the proxy filing date. The average CAR for constrained firms (firms with above-median values of *Constrained)* reporting non-zero inside debt for the first time is positive, while the average CAR for unconstrained firms reporting non-zero inside debt is negative. The difference between the mean CAR for constrained vs. unconstrained firms reporting non-zero inside debt is positive and significant at the 1% level. In contrast, the difference in CAR is not significant for firms that do not use inside debt.

In Panel B of Table 9, we conduct a multivariate test of the difference in market response to initial disclosures of inside debt for constrained vs. unconstrained firms using the following model:

$$CAR_{i,t+1} = \alpha + \beta_1 (\textit{Inside Debt>0})_{i,t} + \beta_2 (\textit{Inside Debt>0})_{i,t} \bullet \textit{Constrained}_{i,t} + \beta_3 \textit{Constrained}_{i,t} + \Sigma\Gamma_j \textit{Control Variables}_{j,i,t} + \varepsilon_{i,t} \quad (4)$$

For unconstrained firms, we expect a negative or insignificant response to the disclosure of inside debt, as found in Wei and Yermack (2011) (i.e., we expect $\beta_1 < 0$). If the market recognizes the ability of inside debt to mitigate underinvestment for cash-constrained firms, then we expect $\beta_2 > 0$. Since information about the cash constraints facing firms is already known to the market (i.e., revealed in financial disclosures well before the proxy filing), we expect an insignificant coefficient for β_3. Column (1) of Table 9 includes regression results without control variables, while column (2) includes our maintained set of controls: market-to-book ratios, sales growth, prior-year stock return, Altman's z-score, cash flow scaled by sales, and an indicator for whether the firm had negative operating profit in the prior year. Consistent with the findings in Wei and Yermack (2011), we find a negative response to the disclosure of inside debt for unconstrained firms. However, consistent with our expectations, we find a significantly positive interaction between inside debt and cash constraints. Not surprisingly, the (untabulated) control variables in column (2) are all insignificant, since all of the controls were public knowledge at the time of the proxy filing. Overall, these results indicate that the negative market reaction to inside debt is mitigated, and even reversed, for firms facing cash constraints, which we argue is a setting in which inside debt is likely to be particularly beneficial for reducing the agency costs of debt, which is borne by equityholders.

6. Conclusion

In contrast to prior studies that predict a monotonic negative relationship between inside debt and risky investment, we hypothesize that the relationship between inside debt and investment depends on whether firms have sufficient internal cash holdings or cash flows to fund promising investments. For firms with sufficient internal resources to fund investments, we predict and find a negative relation between inside debt and investment. However, we find that the negative relation between inside debt and investment is reversed for firms with high cash constraints (i.e., firms requiring external funding).

We contribute to the literature on the relationship between management incentives and firm investment policies, as well as to studies investigating the underinvestment problem. Given the finding in the prior literature showing a relation between inside debt and measures of corporate risk, our finding of a positive relationship for firms facing cash constraints (and thus being more likely to underinvest) is noteworthy. Our results suggest that inside debt, through aligning management's incentives with those of debtholders, can reduce the agency costs of debt, and therefore increase investment levels in firms facing cash constraints, thus mitigating the underinvestment problem.

References

Agrawal, A. and Mandelker, G. N. 1987. Managerial Incentives and Corporate Investment and Financing Decisions. *The Journal of Finance*, 42: 823–837.

Altman, E. 2012. Predicting Financial Distress of Companies: Revisiting the Z-Score and Zeta Models. *Handbook of Research in Empirical Finance*, edited by C. Brooks, E. Elgar, Cheltenham, UK.

Anantharaman, D., Fang, V., and Gong, G. 2014. Inside Debt and the Design of Corporate Debt Contracts. *Management Science* 60(5): 1260-1280.

Balakrishnan, K., Core, J., and Verdi, R. 2014. The Relation between Reporting Quality and Financing and Investment: Evidence from Changes in Financing Capacity. *Journal of Accounting Research*, 52: 1–36.

Bharat, S., Sunder, J., and Sunder, S. 2008. Accounting Quality and Debt Contracting. *The Accounting Review* 83: 1–28.

Barton, S., Brown, G., and Stulz, R. 2012, Why are U.S. Stock more Volatile? *Journal of Finance*, 67(4), 1329-1370.

Begley, J., Ming, J., and Watts, S., 1996. Bankruptcy Classification Errors in the 1980s: an Empirical Analysis of Altman's and Ohlson's Models. *Review of Accounting Studies* 1(4): 267-284.

Blay, A, D., Geiger, M., and North, D. 2011. The Auditor's Going-Concern Opinion as a Communication of Risk. *AUDITING: A Journal of Practice & Theory* 30(2): 77-102.

Biddle, G., C., Hilary, G., and Verdi, R. 2009. How Does Financial Reporting Quality Relate to Investment Efficiency? *Journal of Accounting and Economics* 48, 112–131.

Bradshaw, M., Richardson, S., and Sloan, R. 2006. The Relation between Corporate Financing Activities, Analysts' Forecasts and Stock Returns. *Journal of Accounting and Economics* 42: 53–85.

Cassell, C., Huang, S., Sanchez, J., and Stuart, M. 2012. Seeking Safety: The Relation between CEO Inside Debt Holdings and the Riskiness of Firm Investment and Financial Policies. *Journal of Financial Economics* 103, 588–610.

Chava, S., Kumar, P., and Warga, A., 2010. Managerial Agency and Bond Covenants. *The Review of Financial Studies* 23(3): 1120–1148.

Cheng, M., D. Dhaliwal, and Y. Zhang. 2013. Does Investment Efficiency Improve after the Disclosure of Material Weaknesses in Internal Control over Financial Reporting? *Journal of*

Accounting and Economics 56(1): 1–18.

Choy, H., Lin, J., and Officer, M., 2014. Does Freezing a Defined Benefit Pension Plan affect Firm Risk? *Journal of Accounting and Economics* 57, 1–21.

Coles, J., Daniel, N., and Naveen, L., 2006. Managerial Incentives and Risk Taking. *Journal of Financial Economics* 79, 431–468.

DeFusco, R., R. Johnson, and T. Zorn. 1990. The Effect of Executive Stock Option Plans on Stockholders and Bondholders. *Journal of Finance* 45(2): 617-627.

Edmans, A., and Liu, Q. 2011. Inside Debt. *Review of Finance* 15, 75–102.

Franzoni, F. 2009. Underinvestment vs. Overinvestment: Evidence from Price Reactions to Pension Contributions. *Journal of Financial Economics* 92, 491-518.

Gormley, T., D. Matsa, and T. Milbourn. 2013. CEO Compensation and Corporate Risk: Evidence from a Natural Experiment. *Journal of Accounting and Economics* 56 (2-3): 79–101.

Guay, W. 1999. The Sensitivity of CEO Wealth to Equity Risk: An Analysis of the Magnitude and Determinants. *Journal of Financial Economics* 53, 43-78.

He, Guanming. 2015. The Effect of CEO Inside Debt Holdings on Financial Reporting Quality. *Review of Accounting Studies* 20(1): 501-536.

Heckman, J. and E. Vytlacil, 1998. Instrumental Variables Methods for the Correlated Random Coefficient Model. *Journal of Human Resources* 33(4): 974-987.

Hirshleifer, D., and Thakor, A. 1992. Managerial Conservatism, Project Choice, and Debt. *Review of Financial Studies* 5(3): 437-470.

Hoberg, G., and Maksimovic, V., 2015. Redefining Financial Constraints: A Text-Based Analysis, *Review of Financial Studies* 28(5): 1312-1352.

Hubbard, G. 1998. Capital-Market Imperfections and Investment. *Journal of Economic Literature* 36, 193-225.

Jensen, M., and Meckling, W. 1976. Theory of the Firm: Managerial Behavior, Agency Costs, and Capital Structure. *Journal of Financial Economics* 3, 305–360.

John, T. A. and John, K. 1993. Top-Management Compensation and Capital Structure. *The Journal of Finance*, 48: 949–974.

Koh, P., and Reeb, D. 2015. Missing R&D. *Journal of Accounting and Economics* 60, 73–94.

Maksimovic, V., and G. Phillips. 2008. The Industry Life-cycle, Acquisitions and Investment: Does firm Organization Matter? *Journal of Finance* 63:673–709.

Stein, J. 2003. Agency, Information, and Corporate Investment. In: Constantinides, G., Harris, M., Stulz, R. (Eds.), Handbook of the Economics of Finance. Elsevier Science B.V. (Chapter 2).

Sundaram, R., and Yermack, D. 2007. Pay Me Later: Inside Debt and its Role in Managerial Compensation. *Journal of Finance* 62, 1551−1588.

Wang, C., Xie, F., and Xin, X., 2010b. Managerial Ownership of Debt and Accounting Conservatism. *unpublished working paper.* Chinese University of Hong Kong and George Mason University.

Wei, C., and Yermack, D. 2011. Investor Reactions to CEOs' Inside Debt Incentives. *Review of Financial Studies* 24, 3813–3840.

Appendix
Variable Definitions

Variable		Definitions	Data Source
Inside Debt	=	Sum of the actuarial present value of accumulated benefits under defined-benefit pension plans and the total balance in the deferred compensation plans by the fiscal year-end	ExecuComp
Inside Equity	=	Sum of the value of CEO stock holdings obtained by multiplying the number of shares (including restricted shares) by the stock price at the firm's fiscal year-end and the value of stock option calculated by following Black-Scholes formula. Option values for the portfolio of option held at the end of the fiscal year are computed assuming a risk-free rate equal to yield on 7-year U.S. treasuries, volatilities based on monthly stock returns over the prior 48 months, and dividend yields based on three-year rolling averages. The expected term for options is assumed to be 70% of the full term.	ExecuComp
Firm-Related Wealth	=	Sum of *Inside Debt* and *Inside Equity*	ExecuComp
Inside Debt Ratio	=	*Inside Debt* scaled by *Firm-Related Wealth*	ExecuComp
Constrained	=	Decile rank of averaged percentile measure of *CASH* and *LEVERAGE* calculated by fiscal year. *CASH* is cash and all other securities readily transferable to cash, scaled by total assets. *LEVERAGE* is the ratio of debt to the market value of equity. *CASH* is multiplied by -1 before ranking so that both variables are increasing in the likelihood of requiring outside funding. This variable is scaled to range between zero to one	Compustat
CAPEX	=	Capital expenditure multiplied by 100 and scaled by lagged *PP&E*	Compustat
R&D	=	R&D expenditure multiplied by 100 and scaled by lagged total assets	Compustat
Control Variables			
Ln(Assets)	=	Natural log of total asset at the end of fiscal year	Compustat
Market-to-Book	=	Ratio of the market value of total assets to the book value of total assets	Compustat
Asset Growth	=	Annual growth in total assets scaled by lagged total assets	Compustat
Return	=	Annual return defined as the stock return over the 12-month period ending three months after the fiscal year-end	CRSP
STD(Sales)	=	Standard deviation of sales scaled by average total assets from years t-5 to t-1	Compustat

STD(Cash Flow)	=	Standard deviation of net cash flow from operating activities scaled by average total assets from years t-5 to t-1	Compustat
Altman's Z-Score	=	Altman's modified bankruptcy score (Altman's (1968, 2010) Z-score)	Compustat
Industry Leverage	=	Mean capital structure measured by long-term debt to market value of equity for firms in the same two-digit SIC industry (with a minimum of ten observations required for an industry to be included in a year)	Compustat
Cash Flow / Sales	=	Net Cash flow from operating activities scaled by total sales	Compustat
Debt Delay Con	=	Hoberg-Maksimovic Debt-Delay Score (Hoberg and Maksimovic 2015)	
ΔDebt	=	Net debt issuances scaled by the lagged total assets (Balakrishnan et al. 2014)	Compustat
PBO_AT	=	Pension Liablility (Compustat PBPRO and PBPRU) scaled by total assets	Compustat
Ln(Market Value of Equity)	=	Natural log of market value of equity at the end of fiscal year.	Compustat
Ln(Firm Age)	=	Natural log of the number of years a firm has a record in CRSP.	CRSP

Table 1. Summary Statistics

Panel A. Sample Refinement Procedure	Number of Firm Years
Total firm-years in ExecuComp Database (2006 to 2013)	15,453
Less: Observations with missing compensation information	(452)
Less: Observations from financial-services firms	(2,786)
Less: Observations without other control variables information	(2,020)
Final Sample	**10,195**

Variable	**Mean**	**Std. Dev.**	**Q1**	**Median**	**Q3**
Inside Debt Ratio	0.132	0.191	0.000	0.031	0.212
Inside Debt ($000)	5,045	12,349	-	520	4,647
Inside Equity	116,058	1,167,740	6,109	15,610	42,496
CapEx = [CapEx/PPE)x100]	25.539	20.896	12.410	19.550	31.275
R&D = [R&D/Assets)x100]	5.441	6.859	0.528	2.696	8.049
Constrained	0.500	0.319	0.222	0.556	0.778
Cash	0.160	0.163	0.036	0.104	0.236
Leverage	0.399	0.768	0.027	0.180	0.453
Ln(Assets)	7.563	1.604	6.419	7.480	8.646
Market-to-Book	1.745	1.032	1.104	1.463	2.082
Asset Growth	0.089	0.234	-0.018	0.054	0.141
Return	0.160	0.577	-0.146	0.099	0.345
STD(Sales)	0.138	0.126	0.058	0.102	0.175
STD(Cash Flow)	0.048	0.059	0.022	0.036	0.058
Z-Score	4.075	3.772	1.943	3.270	5.181
Industry Leverage	0.467	0.423	0.199	0.322	0.617
Cash Flow / Sales	0.134	0.131	0.061	0.113	0.187

Table 2. Pairwise Pearson Correlations for Primary Variables

	Inside Debt Ratio	*R&D / Assets*	*CapEx / PP&E*	*Cash Constrained*	*Ln(Assets)*	*Market-to-Book*	*Asset Growth*
Inside Debt Ratio	1.0000						
R&D / Assets	**-0.2353***	1.0000					
CapEx / PP&E	**-0.2480***	**0.3049***	1.0000				
Cash Constrained	**0.3328***	**-0.4935***	**-0.3675***	1.0000			
Ln(Assets)	**.3045***	**-0.2880***	**-0.2427***	**0.4219***	1.0000		
Market-to-Book	**-0.2248***	**0.2612***	**0.3432***	**-0.4904***	**-0.1615***	1.0000	
Asset Growth	**-0.1179***	0.0112	**-0.2458***	**-0.0353***	**0.0349***	**0.2014***	1.0000
Altman's Z-Score	**-0.1448***	-0.0309	**0.1944***	**0.3940***	**-0.1692***	**0.5521***	**0.1519***

Note: Correlations significant at the 0.01 level are shown in bold. All variables are defined in the Appendix.

Table 3. Sample means for R&D and Capital Expenditures for firm-years grouped by Inside Debt and Cash Constraints

Panel A. $R\&D_{t+1}/Assets_t$

	No Inside Debt (n=2,709)	With Inside Debt (n=3,627)
Low Cash Constraints	6.79%	4.97%
	t = -10.5***	
High Cash Constraints	5.09%	6.04%
	t = +2.5***	

Panel B. $CapEx_{t+1}/PP\&E_t$

	No Inside Debt (n=3,371)	With Inside Debt (n=6,824)
Low Cash Constraints	34.1%	26.0%
	t = -13.7***	
High Cash Constraints	22.6%	30.4%
	t = +5.0***	

Note: "Low Cash Constraints" include firm-years with "Constrained" index below median of our index based on cash holdings and firm leverage; "High Cash Constraints" include firm-years above the median. t-statistics denote the pairwise difference in investment levels between firm-years with and without CEO inside debt; *, ** and *** denote significance at a 0.10, a 0.05 and a 0.01 level.

Table 4 OLS Regressions showing the relation between investment and inside debt, with interactions for cash constraints

Dependent Variables:	$\frac{R\&D_{t+1}}{Assets_t}$ (1)	$\frac{CapEx_{t+1}}{PP\&E_t}$ (2)	$\frac{R\&D_{t+1}}{Assets_t}$ (3)	$\frac{CapEx_{t+1}}{PP\&E_t}$ (4)	$\frac{R\&D_{t+1}}{Assets_t}$ (5)	$\frac{CapEx_{t+1}}{PP\&E_t}$ (6)
Inside Debt Ratio	-3.893*** (0.000)	-6.609*** (0.000)	-0.047 (0.850)	-0.467 (0.697)	-1.308** (0.026)	-6.411** (0.039)
*Inside Debt Ratio *Constrained*					3.162*** (0.001)	11.219*** (0.004)
Constrained					-2.100*** (0.000)	-15.605*** (0.000)
Ln(Assets)	-0.507*** (0.000)	-1.805*** (0.000)	-3.035*** (0.000)	-6.541*** (0.000)	-3.448*** (0.000)	-5.066*** (0.000)
Market-to-Book	1.691*** (0.000)	4.353*** (0.000)	0.581*** (0.002)	3.476*** (0.000)	0.449*** (0.003)	2.938*** (0.000)
Asset Growth	-1.673*** (0.000)	13.307*** (0.000)	-0.710** (0.007)	9.429*** (0.000)	-0.593* (0.061)	9.888*** (0.000)
Return	-0.476*** (0.001)	1.432*** (0.001)	-0.037 (0.594)	0.982*** (0.005)	-0.168** (0.039)	0.886* (0.012)
STD(Sales)	-2.862** (0.021)	6.512*** (0.009)	-1.680** (0.028)	-0.275 (0.929)	-0.977 (0.261)	-0.232 (0.939)
STD(Cash Flow)	24.662*** (0.000)	30.856** (0.010)	2.372 (0.535)	1.978 (0.842)	-4.040 (0.167)	1.592 (0.872)
Altman's Z-Score	-0.173*** (0.000)	-0.047 (0.663)	-0.119*** (0.003)	.657*** (0.001)	-0.093** (0.039)	0.507*** (0.010)
Industry Leverage	0.303* (0.098)	-0.772 (0.226)	0.317*** (0.008)	-0.778 (0.177)	0.727** (0.012)	-0.457 (0.424)
Cash Flow / Sales	-2.966* (0.099)	13.972*** (0.000)	-3.184*** (0.006)	10.110** (0.042)	-4.046*** (0.001)	6.999 (0.164)
Industry FE	Yes	Yes	No	No	No	No
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	No	No	Yes	Yes	Yes	Yes
R^2	0.446	0.136	0.198	0.129	0.205	0.140
Sample size	6,335	10,195	6,335	10,195	6,335	10,195

Note: p-values in parentheses; *, ** and *** denote significance at a 0.10, a 0.05 and a 0.01 level. Robust standard errors are clustered by firm.

Table 5 Two-Stage IV Regressions showing the relation between investment and inside debt, using qualified pension benefit obligations as an instrument for Inside Debt

	First-Stage	Second-Stage Regression	
	Inside Debt Ratio (1)	$R\&D_{t+1}$ (2)	$CapEx_{t+1}$ (3)
Intercept	0.103***		
	(0.000)		
Pension Benefit Obligations / Assets	0.319***		
	(0.000)		
Inside Debt Ratio IV		-1.533**	-15.099***
		(0.025)	(0.001)
*Inside Debt Ratio IV*Constrained*		2.715***	10.129***
		(0.000)	(0.002)
Constrained		-2.698***	-17.180***
		(0.000)	(0.000)
Ln(Assets)		-3.102***	-5.224***
		(0.000)	(0.000)
Market-to-Book		0.514***	2.787***
		(0.000)	(0.000)
Asset Growth		-0.943***	12.363***
		(0.006)	(0.000)
Return		-0.081	1.171***
		(0.296)	(0.006)
STD(Sales)		-1.567*	-1.522
		(0.055)	(0.681)
STD(Cash Flow)		2.157	5.685
		(0.601)	(0.626)
Altman's Z-Score		-0.148***	0.517**
		(0.001)	(0.014)
Industry Leverage		0.398***	-0.158
		(0.006)	(0.827)
Cash Flow / Sales		-3.377**	10.185*
		(0.011)	(0.095)
Year and Firm Fixed Effects?	No	Yes	Yes
R^2	0.099	0.225	0.141
Sample size	10,195	4,957	7,496

Note: p-values in parentheses; *, ** and *** denote significance at a 0.10, a 0.05 and a 0.01 level. Robust standard errors in columns (2) and (3) are clustered by firm.

Table 6 OLS Regressions showing the relation between investment and inside debt, using alternative measures of cash constraints

	Constrained defined by Index of Cash Holdings		Constrained defined by Index of Leverage		Constrained defined by Hoberg-Maksimovic's Debt-Delay Score	
Dependent Variables:	$R\&D_{t+1}$ / $Assets_t$ (1)	$CapEx_{t+1}$ / $PP\&E_t$ (2)	$R\&D_{t+1}$ / $Assets_t$ (3)	$CapEx_{t+1}$ / $PP\&E_t$ (4)	$R\&D_{t+1}$ / $Assets_t$ (5)	$CapEx_{t+1}$ / $PP\&E_t$ (6)
Inside Debt Ratio	-1.333**	-5.983**	-0.716	-3.216	-0.784*	-0.496
	(0.016)	(0.038)	(0.158)	(0.297)	(0.103)	(0.830)
*Inside Debt Ratio *Constrained*	2.450***	9.968***	1.384**	5.681	1.187*	0.536
	(0.002)	(0.008)	(0.045)	(0.153)	(0.070)	(0.882)
Constrained	-0.902**	-10.540***	-1.882***	-10.50***	-0.274	-0.775
	(0.013)	(0.000)	(0.001)	(0.000)	(0.188)	(0.503)
Ln(Assets)	-2.989***	-5.850***	-2.840***	-5.503***	-3.304***	-7.025***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Market-to-Book	0.568***	3.326***	0.511***	2.992***	0.627***	3.637***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Asset Growth	-0.707***	9.462***	-0.588**	9.994***	-0.716**	9.640***
	(0.007)	(0.007)	(0.000)	(0.000)	(0.021)	(0.000)
Return	-0.046*	0.946***	-0.046*	0.914***	-0.002	0.805**
	(0.495)	(0.007)	(0.495)	(0.010)	(0.979)	(0.039)
STD(Sales)	-1.716**	-0.629	-1.708**	-0.051	-1.770**	-1.537
	(0.025)	(0.834)	(0.027)	(0.987)	(0.038)	(0.704)
STD(Cash Flow)	-2,253	1.775	-2,441	1.913	-3.499	0.751
	(0.554)	(0.855)	(0.522)	(0.847)	(0.394)	(0.949)
Altman's Z-Score	-0.122***	0.613***	-0.144***	0.505**	-0.137***	0.806***
	(0.002)	(0.001)	(0.000)	(0.011)	(0.001)	(0.001)
Industry Leverage	0.315***	-0.701	0.369***	-0.506	0.242*	-0.810
	(0.010)	(0.220)	(0.003)	(0.381)	(0.077)	(0.236)
Cash Flow / Sales	-3.354***	7.968	-3.478***	8.295	-4.101***	6.012
	(0.004)	(0.114)	(0.003)	(0.095)	(0.001)	(0.340)
Year and Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.201	0.136	0.208	0.135	0.223	0.137
Sample size	6,335	10,195	6,335	10,195	4,595	7,350

Note: p-values in parentheses; *, ** and *** denote significance at a 0.10, a 0.05 and a 0.01 level. Robust standard errors are clustered by firm.

Table 7 OLS Regressions showing the relation between investment and inside debt, for sub-samples based on Altman Z-Score default probabilities

Dependent Variables:	$R\&D_{t+1}/Assets_t$		$CapEx_{t+1}/PP\&E_t$	
Subsamples based on Altman's Z-Scores:	Unsound (Z < 3.0) (1)	Sound (Z > 3.0) (2)	Unsound (Z < 3.0) (3)	Sound (Z > 3.0) (4)
Inside Debt Ratio	-2.841***	-0.345	-9.027**	-6.047
	(0.010)	(0.597)	(0.038)	(0.174)
*Inside Debt Ratio*Constrained*	3.752***	1.522	14.346***	11.900*
	(0.008)	(0.141)	(0.005)	(0.093)
Constrained	-2.777***	-0.160	-16.109***	-13.910***
	(0.001)	(0.653)	(0.000)	(0.000)
Ln(Assets)	-3.212***	-2.254***	-4.586***	-6.629***
	(0.000)	(0.000)	(0.000)	(0.001)
Market-to-Book	0.349	0.436***	2.712**	3.286***
	(0.102)	(0.001)	(0.020)	(0.000)
Asset Growth	-0.030	-1.065***	5.652***	15.248***
	(0.933)	(0.000)	(0.000)	(0.000)
Return	-0.052	-0.032	0.917**	0.249
	(0.566)	(0.706)	(0.023)	(0.748)
STD(Sales)	0.125	-2.356***	-4.872	-0.936
	(0.901)	(0.005)	(0.305)	(0.839)
STD(Cash Flow)	1.578	0.736	4.999	-6.114
	(0.783)	(0.786)	(0.687)	(0.765)
Altman's Z-Score	-0.326***	-0.027	0.383	0.298
	(0.000)	(0.242)	(0.173)	(0.142)
Industry Leverage	0.313*	0.366*	-0.836	-0.617
	(0.074)	(0.072)	(0.190)	(0.639)
Cash Flow / Sales	-3.286**	-1.830*	8.490	7.163
	(0.045)	(0.096)	(0.171)	(0.341)
Year and Firm Fixed Effects?	Yes	Yes	Yes	Yes
R^2	0.263	0.136	0.106	0.131
Sample size	2,545	3,790	4,809	5,386

Note: p-values in parentheses; *, ** and *** denote significance at a 0.10, a 0.05 and a 0.01 level. Robust standard errors are clustered by firm.

Table 8 OLS Regressions showing the relation between inside debt and propensity to obtain debt financing

	Dependent Variable is $\Delta Debt_{i,t+1}$			
	Subsamples based on top and bottom terciles of Cash Constraints		Subsamples based on Above and Below Median of Cash Constraints	
	More Constrained (1)	Less Constrained (2)	More Constrained (3)	Less Constrained (4)
Inside Debt Ratio	0.028**	0.024	0.026**	0.022
	(0.046)	(0.142)	(0.049)	(0.127)
Constrained	-0.160***	0.028	-0.170***	-0.048*
	(0.000)	(0.484)	(0.000)	(0.056)
Ln(Market Value of Equity)	-0.023***	-0.008	-0.033***	-0.012*
	(0.004)	(0.193)	(0.000)	(0.050)
Ln(Firm Age)	0.028**	0.022	0.023*	-0.017
	(0.047)	(0.468)	(0.095)	(0.552)
Market-to-Book	0.041***	0.002	0.051***	0.006*
	(0.000)	(0.667)	(0.000)	(0.060)
STD(Cash Flow)	0.078**	0.044	0.059**	0.017
	(0.016)	(0.177)	(0.044)	(0.557)
Leverage	-0.016***	-0.690***	-0.020***	-0.272***
	(0.000)	(0.000)	(0.000)	(0.000)
Year and Firm Fixed Effects?	Yes	Yes	Yes	Yes
R^2	0.102	0.102	0.126	0.096
Sample size	3,052	3,061	3,052	3,045

Note: p-values in parentheses; *, ** and *** denote significance at a 0.10, a 0.05 and a 0.01 level. Robust standard errors are clustered by firm. Control variables are those used in Balakrishnan et al. (2013). ΔDEBT is net debt financing measured as the cash proceeds from the issuance of long-term debt less cash payments for long-term debt reductions less the net changes in current debt.

Table 9 Stock-price reactions to initial disclosures of inside debt

Panel A: Univariate Test

Inside Debt Ratio	Cash-Constrained Sample (upper 50% Constrained)		Cash-Unconstrained Sample (lower 50% Constrained)			
	n	(1) CAR	n	(2) CAR	(1) - (2)	t-value
Inside Debt Ratio >0	319	0.00301 (0.0011)	359	-0.00062 (0.0010)	0.00363***	2.41
Inside Debt Ratio = 0	165	-0.00176 (0.0019)	176	0.00194 (0.0021)	-0.00371	-1.33

Panel B: Multivariate Test

	Dependent Variable is Cumulative Abnormal Return around Proxy Filing Date	
Independent Variables	(1)	(2)
Inside Debt Dummy	-0.004*	-0.005*
	(0.092)	(0.059)
(Inside Debt Dummy) x Constrained	0.012**	0.012**
	(0.012)	(0.012)
Constrained	-0.007*	-0.006
	(0.071)	(0.109)
Observations	1,019	1,019
R-squared	0.007	0.009
Controls	NO	YES
Industry FE	NO	NO

Note: Robust standard errors in parentheses. Significance levels denoted by: *** p<0.01, ** p<0.05, * p<0.1